A Winemaking Beginner's Factfile

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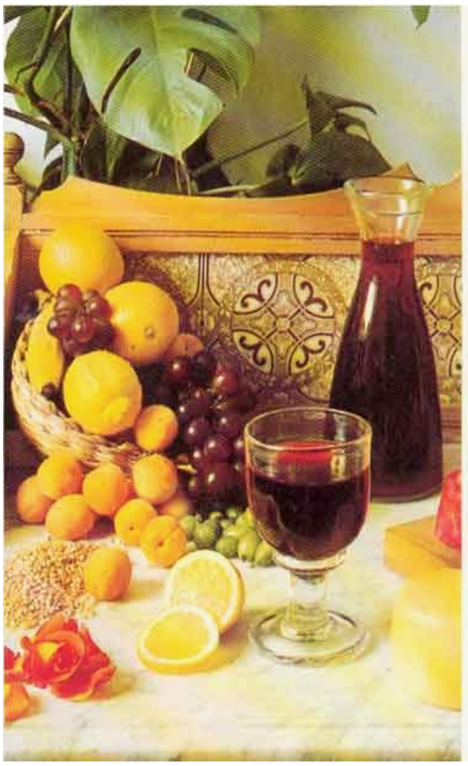
Many books have been written about winemaking, domestic or otherwise, and there are now detailed websites, (see **References)**, so the following file is not about rewriting them all. It is, rather, from hands-on experience, a short compendium of priorities, hints, imperatives, reflections, and memory-joggers that may help bolster prospective beginner confidence at that time when the books are laid down, and the first **table** wine must is being planned. Similar principles are involved in beermaking, either traditionally, or with kits. Indeed, beermaking with kits is a useful introduction to winemaking, and there is also a convenient transfer of skills and equipment for the home winemaking hobbyist. Description of the MLF, (malolactic fermentation), process is also included, but fortified and sparkling wines are not discussed in any detail here.

Contents:

To print this file as a booklet, the suggestion is, for single sides only just, to print all, or, for double sides, print Title and Contents pages separately, then pages 2-X, first as odds, then as evens, and then collate. Page Setup L&R 1.5cm, T&B 2cm.



Hargreaves

Some basic principles of winemaking: Never use ingredients not already in published recipes, they may be poisonous, and/or unsuitable for winemaking. There is already a long history of ingredient knowledge in existence, thousands of years, in fact. Grapes are a fruit, a berry, like tomatoes and dates, and all the others you will know so well, so enjoy your own particular wines, perhaps add a proportion of those vine berries for a vinous dimension to your must creations, and to help enhance the must composition.

Understand that winemaking principles, well learnt and applied, are more important than adherence to recipes in any given situation. Especially, ensure, before beginning fermentation, that your must, whatever its principle ingredients, resembles ripe grape juice in sugar, pH, and nutrients, for optimum yeast performance, and ultimate quality of the result. Recipes may act as useful guides to similar combinations, proportions, or ingredient preparation, and for predicting possible results, in given situations when similar ingredients may be utilised.

Use appropriate cultured yeasts for wine types as well, wild yeasts are variable, and have a low alcohol and metabisulphite tolerance, with attendant risks. The wine yeast has a long association with the vine-berry, and specific cultured wine yeasts suit specific wine types, which you can also strive for in cottage wines, using the ingredients at your disposal, and the appropriate vine berry yeast. Make a starter, so that your chosen yeast continues to multiply and colonise the must rapidly.

Use only food grade plastics, glass or (stabilised) stainless steel for all preparation, storage, fermentation, or maturation. Avoid scratching fermenter interiors by dissolving crystal compounds such as sugars, etc., before adding to must or wort. Never leave **fermenting** must or wort in plastic fermenters longer than 5 or 6 days, and do not mature wine in plastic containers. Brewing beer is handy learning preparation for winemaking, and basic equipment is common to both processes. **But**, the bottles differ as wine needs green **glass**, (against specific wavelengths), and also stronger **glass** for sparkling and/or MLF wines. **DO NOT USE PLASTIC BOTTLES, aka PET/Polyethylene Tetrepthalate/polyester, because the alcohol %age of wine, plus required storage time, leaches the PET, and, if you also really care about making quality beer, do not use them for beer bottling either, not least because they are CO2-permeable, and thus unsuited for long-term storage use beyond a couple of months at cellar temperatures.**

Special bottle-washing powders are useful, plus non-fragrant detergents, hot water, synthetic brushes, and firm decision-making about discarding of doubtful containers, bottles, or utensils! Always clean up immediately after a process is complete, (this applies to beermaking also), never allow equipment or work areas to dry out before attending to this important chore, and the job will also be made easier

Take care with using chlorine, which can cause taint, as well as reacting with stainless steel. Developing a winemaking process without chlorine may be preferable to risk of taint, or where water is not so plentiful for the extensive rinsing required. Chlorine, or chlorinated cleaning products can even pit stainless steel in sufficient concentration, especially with no-rinse applications.

Chlorine and iodine, (also used in cleaning preparations), can taint plastic, and react unfavourably, for taste, with tannins, and with corks, forming trichloranisole. Also, any chlorine containing solids that react with acids, even common household acids such as acetic acid in vinegar, will produce chlorine gas, so beware. **To repeat, better, probably, to develop cleaning procedures for brewing and winemaking that do not require chlorine or iodine compounds, especially when water is not plentiful, and rinsing will be limited. Also, ensure chlorinated water is boiled, or well aerated before using for must or wort preparation.**

Stainless steel should be stabilised before use with an acid rinse of citric or tartaric acid to remove any manganese sulphide that may be present on the surface of the vessel. (**Making Good Wine,** B. Rankine, p. 280, see **References.**) Otherwise, reaction with acids in the wine enables the liberation of hydrogen sulphide, a cause of wine taint.

Use quality ingredients, balanced and compatible, including yeasts, enzymes, additives and supplements, with some working anticipation of the final result. Check preparation procedures for given must staples. Note that **clarified juice**, easier for beginners, nevertheless is low in nutrients, ferments more slowly than unclarified, needs careful must balancing with nutrient supplementation, and also good pre-primary fermentation aeration.

Nitrogen nutritional balance using DAP, diammonium phosphate, is necessary to prevent formation of the byproduct urea which the yeast cannot metabolise. Urea is a byproduct of fermentation, minimised by optimal yeast nutrition, and urea as an additive is unnecessary and pointless as well as potentially toxic.

Urea plus alcohol produces ethyl carbamate, an ester of carbamic acid, being a urethane, and a carcinogen. Also, use only food grade DAP, which has no urea contamination, and add the DAP before fermentation begins for optimum results.

A further tip is to **use plastic film to cover the fermenter**, secure with string or rubber ring, pierce off-centre with a knife **tip,** and CO2 will form an effective air barrier. Beer wort kept at 25ºC should finish fermenting in 6 days, no bubbles should rise, and settling should be advancing. Wine must ferment stage over 6 days is not such an issue, and lift an edge daily to agitate the must and break the cap, **but** strain the must into glass or stainless steel after 6 days to avoid leaching the plastic with the increasing alcohol content as anaerobic secondary fermentation proceeds.

Warmer must means greater extraction, especially of tannins and possibly bitter compounds from skins, seeds/pips, and stalks, as well as loss of fruitier compounds, both of flavour and of taste. Trial musts may prove useful before bulk fermentations of untried ingredients, and a season deferred to taste a young trial wine may prevent further poor results and consequent disappointment.

Use optimum quality water, balanced with appropriate supplements if necessary. Optimum relevant temperatures of must and wine also contribute to ultimate quality of the final product. Do not use chlorinated water, so boil, or leave stand for 12 hours with occasional agitation to remove residual chlorine.

Wines of low alcohol, low tannins, and higher pH and sugar will not age well, and may need stabilizing by chemical means. Dry wines, red or white, of 10%-12% alcohol, are the most stable, will age well, and need less hands-on and deadlines when being made and matured. Tannin content will also influence longevity, clearing, and the time required before optimum maturation. Alcohol itself will inhibit micro-organisms, depending on volume percentage, for this, ideal 10% and above.

Sugar for 9%-12% alcohol, 1.075-1.095 SG, can be added before fermentation to a well balanced must, and using appropriate yeast, without risking a stuck fermentation. Higher alcohol may be obtained by adding more sugar incrementally at successive rackings, until fermentation stops, but this will unbalance a table wine, although will help create a sherry or port base if that is required. There will be no MLF at this level of alcohol**. However, never enable MLF in sweet wines, ie, with residual or added sugar, as off-odours and tastes may result. (**See also the **SG Table** p.16.)

Work in a cool, stable and controlled atmosphere if practicable, ensure adequate ventilation when using metabisulphite. Early morning is ideal, the light is good, you are fresh, and must and culture temperatures are easily controlled. Wear suitable comfortable and clean clothes, and employ optimum sanitation procedures. Dusting, vacuuming, kids, pets, dirty clothes, odours, and general traffic, etc., are all to be avoided in or near the proposed working area, immediately prior to, or during, any winemaking procedure. **NB, Meta solution potentiated by citric acid will not store.**

Isolate raw garbage, as well fruit or vegetables, especially if overripe, all of which may attract undesirable yeasts, other microorganisms, and fruit fly. Boil any leftover must, or gross lees if straining, before disposing in garden or compost, to limit the development of colonies of super-breed yeast which may cause problems for your future winemaking. Preferably work on calm days, and close up the wine-making area, (after preparation when metabisulphite is used), or safeguard with very fine mesh, when preparing must or bottling, especially if the wine is sweet.

Drosophila Melanogaster, the common and very small fruit fly, is attracted to sugar/yeast/fermentation odours, and carries **acetomonas/acetobacter/mycoderma aceti** that causes vinegar formation. This organism is a **thermophile**, so cooler fermentations and/or storage will have an inhibiting effect. Drosophila M. may also enter airlocks if not discouraged by the presence of metabisulphite solution. Note that excess oxygen will also combine with alcohol to produce acetic acid and water, and thus producing a high and unbalancing volatile acidity component. Micro-oxygenation is preferred, and this will occur just with careful transfer handling. **Irreversible spoilage ensues!**

In general, observe optimum ambient temperatures and working conditions at any stage of wine making. Cooler fermentations, usually for white wines, will have less extraction, especially of tannins, and a fruitier taste and bouquet. Warmer temperatures for red, or **darker** wines will effect more colour extraction, and of harsher tannins and/or bitter constituents, if present in the must. Alcohol will increasingly volatilize with higher temperatures, most importantly for controlling secondary fermentation, if projected alcohol levels are to be achieved with minimal testing and adjustment. During maturation, and later aging, wine chemistry will also evolve twice as fast for every 10ºC rise above 10ºC, so maintain a 10ºC-15ºC range if possible.

Maintain an uncluttered and organised working area, using careful handling practices. This includes optimum cellaring and maturation conditions and handling, and cellar air must also be clean and stable at all times, especially if corks and casks are in use. Molecular exchange also occurs within airlocks, so beware of ambient odors during late fermentation, and maturation.

Practice minimum interference or disturbance at any stage of wine production, thus lessening chances of contamination and macro-oxygenation, and/or of inhibiting steady and balanced maturation. Unnecessary racking removes nutrients. Filtering and clarification are only really necessary for show wines, and will otherwise remove molecules beneficial for health, and even for taste. **Time** is the best clarifier of all, if your initial processes were careful. However, **over-aging** will break down beneficial molecules, so do not just bottle and forget, maintain tasting schedules as part of optimum cellaring management techniques, bottling testers to aid with this.

Tirage crown caps using a conventional capper and tirage bell are an easy, undemanding, and very efficient sealing method. Corks, for all their long tradition, have a chequered history, and there are too many failures to justify modern usage. The wine industry is seeking alternatives such as the screw cap for still wines, which may, in turn, become economical for home use. For homewinemaking, any CO2 pressure in wine bottles will be accommodated by the tirage cap, until a replacement is found, if ever.

Allow **Time** to do its part, be patient, and be pleasantly surprised that wine, given a chance, can be quite forgiving of errors, except those of poor sanitation. Any table wine of 10%-12% alcohol should mature in bottle for at least year before drinking. Bottling small tasters, which will mature more quickly, will enable earlier taste checks.

Be also pleasantly surprised how the rough will become smooth, especially if the “right” malolactic bacteria, wild or cultured, have been active, and/or unhurried chemistry evolves during optimum undisturbed maturation time. **In bottle** is a more reductive environment, and MLF, by producing some CO2, will contribute to this. Bouquet, (more winey), is related to the reductive stage of maturation, while aroma, (more fruity), is more a product of the oxidative stage, so a well-made wine will have a balance of both, bouquet becoming more dominant with age. Excess oxygen at bottling will accelerate maturation, to the detriment of bouquet, as will higher temperatures.

Metabisulphite at sufficient strength introduced during rackings, can prevent MLF, if you prefer. Fruit wines may not respond as well as grape wines, but either type, red or white, should respond well to MLF **if full-bodied**, with sufficient acid, tannins, dryness and alcohol. Low-alcohol, low-acid, low tannin wines will thus benefit from sorbate addition at bottling. Keep wine levels high under airlocks, to minimise gas reversal, but never touching stoppers. Use pure strong meta solution in the airlocks,
regularly refreshed to maintain strength and effectiveness to discourage insects.

Key factors in successful winemaking are PLANNING, ORGANISATION, OPTIMISATION, PREFERENTIAL TREATMENT OF CHOSEN YEAST TYPE, OBSERVATION, ORGANOLEPTIC TESTING, RECORD KEEPING, TIME, PATIENCE, and (CALCULATED) OPTIMISM. These principles are also applicable to successful home brewing.

Do develop your own organoleptic skills, and use them throughout the winemaking or brewing processes. Even the youngest must or wort has a message for you, not least as regards comparisons of progress with future fermentations. You will need to know, and balance, the taste (or smell) of any additive that may subsist, in any proportion, to the end of fermentation and maturation, and tartaric/natural acid and tannins are a good examples.

If you are serious enough, even as a Rule-of-Thumb Winemaker, you will also need to build a working knowledge of how original fruits, and possible combinations, will change in taste or smell throughout the entire process, so that more confident outcomes may be predicted. Sufficient working knowledge will, in turn, engender a growing trust in your own organoleptic skills, and how to apply their findings.

Remember Records! Records! Records! However rudimentary, they will prove increasingly valuable as time passes, and this will include **Tasting Notes** compiled at your table. For the best tasting results, after the toil of winemaking and any degree of maturation are completed, appreciation will then depend on treatment and handling of wine before consumption. Rest wine after a journey, and at the correct cellar temperature, if the wine has any value to you at all. Provide appropriate glasses, ambience, conversation, accompanying foods, time of day, and convivial and compatible company.

Decanting, too, is important, although the time elapsed before drinking will depend on the robustness, style, type, and age of the wine. Even a sparkling wine left to settle for a few moments, after being "decanted" into a glass, will benefit as possible unwanted volatiles may be vented before the first sip. Most importantly, if you wish to appreciate the colour of your mature wine, what better than to see a well-filled decanter in good light against a fresh white table cloth?

Oxygen, which may be the enemy during winemaking, will benefit any wine in small amounts during optimum rest after decanting time, and experience will teach you the capabilities of your own style of wines to react favourably to careful decanting. Reds may benefit most of all, whites will need more care. Tannins are most likely to react with oxygen after aeration, and for the better, but do not prolong aeration, or other elements of aroma and/or bouquet may be lost. For these reasons, experience with, and records of decanting relative to both wine types and ages need to be built upon.

How often has that half bottle of red, forgotten in the refrigerator for a few days, surprised you when restored to room temperature again? Any partly consumed bottles should be stored thus, and the whites will be drunk slightly chilled anyway. But, there is much to be read about cellaring tasting elsewhere, and written by some whose whole lives are centered on wine, and as well, you must build your own experiences, so these remarks are only intended as verbal "tastings" in their turn. There is a whole literature of wine appreciation to be assayed!

Preferential treatment for chosen Saccharomyces Cereviseae strains:
Inherent in **all** successful brewing and winemaking is the principle of favouring the survival and thriving of the chosen SC yeast culture, as **Most Favoured Organism** throughout the **fermentation process**. Wine and beer yeast compete with other microorganisms that rely on similar resources to survive, such as water, oxygen, sugar, minerals, nitrogen, etc. Hence the prompt and pre-emptive use of metabisulphite at various stages of winemaking, starting immediately post-harvest favours SC, as does fermentation of sound, good quality fruit.

SC yeasts are developed to be tolerant of **sulphur dioxide, SO2**, the active constituent of metabisulphite, at levels that will kill most common yeast competitors, including wild yeasts. Later, when the proliferated yeast is coerced into facultatively anaerobic function as free oxygen is reduced, any potential competition from unwanted organisms that may have hitherto survived the FP will thus continue to be thwarted.

SC yeast are also tolerant of rising carbon dioxide levels, especially that which is dissolved in the aqueous must after being quickly generated as a byproduct of metabolism in the early oxygen-rich primary fermentation, also adding to the overall acidity of the must. CO2 is, therefore, a useful yeast-generated gas barrier in fermentation vessels and airlocks, thus excluding atmospheric oxygen. CO2 and alcohol will be produced in almost equal amounts **by weight** (alcohol approx. 1% more) in any normal fermentation, from a given sugar quantity. Use a hydrometer for sugar measurement, not least to ensure that dry wines are dry when fermentation is/seems complete, and always stabilise lower alcohol sweet wines before bottling.

Commercial or cultured wine yeasts have these basic characteristics:

will ferment 25%-30% sugar musts to dryness
will tolerate 50-100ppm **free** SO_2
will produce min. acetic acid, hydrogen sulphide, or SO_2
will tolerate cool 50ºF/15ºC to 100ºF/31ºC temperatures
will tolerate low pH musts < 3.0 (From **Winemaking**, Vine et al, Ch.3 p.78, **References**)

Fermentation by the **carbonic maceration process** is undertaken with inoculated whole grapes bunches sealed in vessels which are then filled with CO_2, for the purpose of obtaining high pigmentation, and softer tannins, then pressed, blended an/or matured, and bottled. The outcome is typical of French Beaujolais or Australian CabMac style wines, with a distinct fruity aroma and taste, not meant to be aged.

To emphasise fruity components in their own wines, homewinemakers may wish to withhold a strained portion of original pre-yeast must, and add again after the primary ferment is completed. This is a technique that is useful either for full-bodied or conventional white wines, and a cooler primary and/or secondary fermentation will also help retain desirable volatiles. The **sussreserve** portion thus added will depend on how strong these taste or aroma components are to be, an example of the Winemaker's Art being applied in this case!

More than one yeast strain in a complex fermentation process may be used to achieve a particular result, and all of these may not survive for long after having done their complementary best to help the winemaker, be this for taste, smell, alcohol content or whatever. The higher-alcohol-tolerant strain of S. Cerevisiae will be the great survivor until it, too, can function no longer amidst the products of its own labours. But any or all strains must be enabled to perform for as long as possible in an environment as free as possible of contamination by any other undesirable organism, and any possible byproducts of their metabolisms. (**Ceres**, Roman Goddess of Agriculture)

This is the principle difference between the controlled fermentations of our modern era and the less certain processes of yesteryear, even unto the home wine making processes of you or I! By all accounts, we live in an age of unparalleled quality of winemaking and brewing products, not just the consumer-friendly mass-produced variety, but the sheer diversification possibilities of quality products made possible by optimum use of constituents, in turn guaranteed by successful fermentation and maturation outcomes expedited by modern scientific knowledge and methods. Maker and market both benefit, as does the home hobbyist.

The main physical difference between winemaking, brewing, and baking yeasts is the degree if alcohol tolerance. In the case of baking yeasts, they can be used for low-alcohol beverages, but this is not recommended for reasons of balance and taste, although they do complement citrus wines, according to those who are knowledgeable in this matter. Bakers' yeasts are principally designed to generate CO_2 for proofing dough. This occurs in a normal atmosphere, at a time when yeasts are supposed to proliferate and produce CO_2, but little or no alcohol which is easily lost in the baking process anyway.

Beer yeasts in general do not tolerate alcohol much beyond 6%-8%, and are unsuitable, for this and organoleptic reasons, to use in lieu of wine yeasts. **However**, make no mistake, the type and quality of all wine and beer yeasts used for specific styles is important. Take the trouble to use appropriate yeasts for given ingredients and planned outcomes, and for overall quality of the end product, which will be **your** home wine that you will be proud to proffer for sampling by others.

Successful maturation of particular alcoholic beverages after the principle fermentation also is contingent upon continued control of organisms, including SC yeasts. Unless, of course, there is, as in the case of wine, a prescribed vinous malolactic fermentation episode initiated by the professional winemaker, or, the fortuitous late MLF episode, with the "right" organisms, involving a home vintage.

However, reduction of malic acid, if profound, may mean that particular wine is no longer quite so stable, so keep track of the aging process of MLF wines. Lower alcohol **quaffers** will be especially vulnerable, even if dry. Fuller bodied dry wines, especially red, with higher malic acid respond better to MLF, you could even split a vintage, red or white, stabilizing one control portion with extra SO_2 to make organoleptic and aging comparisons. Sweet wines should not undergo MLF, and whites for MLF need selection.

MLF is subject to the following limits:

pH must be above 3.3,
free SO_2 @10-5ppm, bound 50ppm, nor added before or after fermentation,
alcohol less than 12%
wine temps @ 65º-70ºF/20º-22ºC (From **Winemaking**, Vine et al, Ch3 p.84, **References**.)

Certainly, MLF will not occur in higher alcohol wines, which destroy MLF bacteria **(anaerobes),** which have been surviving along with SC yeasts to the point where higher alcohol levels than they could tolerate have overcome them. Wine yeasts not killed outright by SO_2 or alcohol become dormant, and eventually die of old age, settling to be removed by racking, or final filtering. Time will do a good job, anyway. Stabilising lower alcohol sweet wines will prevent **yeast** from further fermenting them.

Beer is usually bottled much sooner than wine, no problem to the home brewer, but requiring market-driven filtering in most commercial operations. Beer also can be left to mature in suitable cool conditions for weeks or even a couple of months if necessary; the beer will be clear, but will require priming with CO_2 before bottling and/or dispensing from casks. Being of low alcohol, beer does not have good aging prospects, beyond a few years, and given optimum cellaring.

To concentrate on the home winemaking process, at the beginning of the winemaking, when the pulp and juice etc., are prepared, metabisulphite must be added in prescribed amounts to eliminate undesirable organisms, such as wild yeasts, bacteria and other fungii and moulds. **Saccharomyces Cereviseae** is the sugar fungus, (var. **ellipsoideus** the principle variety for winemaking), but sugar is of course beloved of many other forms of life, large and small, hence the biocidal precautions that favour the growth and well-being of the winemaker's yeast. The exception, of course, would be when boiled, pasteurised, or other suitably preserved products may be used for the must.

However, ongoing stability will usually involve SO2 addition at some stage, even if it is just the sanitising residual incorporated at racking or bottling times, which is possible with an optimally developed dry wine, see below. The juice/pulp is sulphited, and after the lag period, when yeast culture inoculation takes place, free SO2 maintains this protection as the more sulphite-tolerant yeast are enabled to go to work in a sugar-rich and slightly warm liquid environment that would support proliferation of many opportunistic organisms, if they were given the chance.

Fermentation temperatures below 15ºC, although slowing the overall process, will inhibit bacteria, and the other wild yeasts, funguses or moulds. However, the higher the pH, the more SC yeasts are inhibited, and also, the lower nutritional levels are, especially that of nitrogen, the more inhibited SC becomes. SC will also be favoured by lower sugar levels as they drop during fermentation, at least in competition with other organisms. SC can, most importantly, tolerate decreasing oxygen levels in the must, because of their ability to be facultatively anaerobic. This faculty is the source of the metabolic byproduct ethanol, by anaerobic fermentation, being one of the main purposes of the initiating controlled fermentation exercise for the winemaker or brewer.

Bacteria, such as acetobacter, are thermophilic, and favour warmer temperatures than are usually employed by the home winemaker, and also do not like a low pH, which in the case of wine yeasts may range from a low 2.8 to 3.5. A finished wine should be 2.8 to 3.8, although the higher pH wine may need stabilising, depending on composition. MLF bacteria favour a pH range of 3.2-3.4 to function optimally. (There are wine yeasts being developed that will also perform the malic acid reduction functions of MLF bacteria, see research of Dr. Ronald Subden of **CCOEVI**, Brock University.)

Encouraging fast proliferation of yeasts by inoculating juice with concentrated cultures further enables early SC yeast domination of musts that still may carry residual undesirables. So-called killer yeasts may also succeed over other less robust varieties. Fortunately, "good" MLF bacteria that favour certain wines, especially reds, can still live with SC yeast throughout its lifecycle until, as previously mentioned, alcohol concentration is too high, or a sufficiently strong increment of metabisulphite is added.

For the home winemaker, sufficient SO2 will control MLF bacteria, but attention would need to be paid to how much malic acid was present in the original juice to maintain taste balance in the final product. Care must be also taken that MLF occurs only in wines that are suited to this, as there may be undesirable gassiness, and the acid may be over-reduced, unbalancing taste. Heuristics and personal taste may rule, OK?

Wine maturation before bottling depends on wine type, anything from 2-3 months to 12 months, and the dry higher acid higher tannin wines will benefit the most. Bottling when (optimally) clear and bright would suit most home-made wines, as a rule of thumb.

Preservation and stabilisation: **To suspend the status of yeast as MFO**, sorbate is added to higher pH and residual sugar wines, (light sweet **summer wine**, young or quaffing types of wines), in tandem with metabisulphite **in carefully controlled doses**, to inhibit yeast budding, after which the extra SO2 prolongs dormancy and/or deals the coup-de-grace to the remaining yeasts, and any other unwanted surviving organisms.

Beyond 12% alcohol, MLF will normally not take place, and anyway, at this alcohol level, a table wine would also be considered unbalanced as to taste and physical effects on humans in relation to quantity imbibed. Flor yeasts, which may or may not be S. Cereviseae, are high-alcohol tolerant, 18% or so, and are encouraged to grow in a skin across the surface of sherry base wines, in conditions of alcohol levels that preclude the survival of other organisms, and help to develop that distinctive sherry taste. A common flor yeast is **saccharomyces beticus.**

In earlier times, before the attainment of potable drinking water by scientific understanding and methods, wine, or indeed distilled spirits when discovered, would be added to water for purification purposes. Resin in wine was for stabilising and preserving purposes, as were other herbs, similarly in beer, before the widespread use of hops. Beer, of course, was usually safe to drink if handled carefully, because of the extensive boiling involved in brewing.

Sulphur dioxide as a preservative has a very long history also, as do wooden casks for storage and transport. Stoppered amphorae served the Ancient World, a technology "lost" to Early Europe, accounting for all that young wine drunk, but reborn again the form of the modern bottle of the C17. Ask Google, re wine or beer history, or consult a book such as **Ancient Wine**. (See **References**, wine history for the sheer pleasure of pursuing it.) Those early beverages would also have been consumed fairly young, and probably would not have had the alcohol content of today's versions, but sufficient then, at least, to aid water quality control. Kidney stones due to inadequate fluid intake were more common in the past than nowadays, so a reliable fluid source was worth the wait in more ways than one, especially when imbibed by all ages as a constituent or additive of a health-giving beverage made by utilising the services of that most favoured of organisms, and traditional friend of Mankind, viz Saccharomyces, the **sugar fungus**, of the Family Cereviseae.

These days, home winemaking, especially, favours the finished 10%-12% alcohol dry table wines, because these are inherently stable, with little or no residual sugar, low pH, balanced with optimum tartaric/natural

acid and tannins, both of which contribute to stability and preservation of table wine, colour, and balance of taste. These are wines that require minimum interference during their making, and look after themselves quite well when left alone to mature.

These are also the types of wines that may need some time to mature before drinking, reds more so than whites, a maturation which may take place in casks, and also be prolonged past the bottling stage as well. These are the so-called keepers, and a quality fuller bodied home wine may just as easily aspire to this description. If the young wine is rather rough after a period of bulk maturation, but in other ways sound, bottle anyway, and let **Time**, and good cellaring, do the rest. A series of small tester bottles opened at intervals will indicate progress, and ahead of the bulk wine maturation rate itself, as smaller bottled quantities mature more quickly.

Increasing lack of oxygen favours yeast during fermentation, especially when the must loses free oxygen as the fermentation progresses, and this then favours the wine itself in reductive stages such as in bottle. Oxygen also is important in carefully controlled doses for maturation of any wine, in bulk or in bottle. White wines require less micro-oxygenation than red. SO2 added during maturation also reduces enzymatic and oxidative chemical reactions, although colour may be temporarily affected. Reds may require less final SO2 because there is more tannin retained, and because there was always more added during the winemaking process itself. There is plenty of literature about on the subject for browsing.

The exception for stabilisation is, of course, when those fortuitously friendly MLF bacteria survive to function in table wines when the SC yeast have finished. Commercial grape winemakers usually encourage controlled MLF at the must stage, immediately after, or even in tandem with, normal yeast fermentation, so the wine is stable during maturation, and definitely so before bottling. Home wines are usually found to have developed a slight fizz in bottle after a spell of warm weather, and this depends on the presence or absence of desirable bacteria in areas ambient when wine is made. Additional SO2 at bottling will prevent this occurring if unwanted.

Thus, there is good news for the no-frills home winemaker, in that a slower, cooler, well-nourished fermentation, with correct yeast, balanced ingredients, optimal sulphite, tannins, and pH, plus careful low oxygen handling and a potentially 10%-12% alcohol dry finish, will result in product that is an easy-to-make-and-keep and **balanced** table wine. Home wines may contain differing proportions of acids, especially of tartaric, if any, but tartaric acid is a preservative; some in addition is worth considering if the must is not a grape blend, but with care.

MLF is optional, at least at the discretion of the home winemaker, given that MLF can definitely be prevented if spontaneous MLF is not always predictable or desirable. The following is an informative passage that explains the use of MLF in relation to conventional grape wines, and would be useful for MLF decision making regarding similar wine styles or musts for home winemakers, so, allowing for the referral to grape wine:

"**Malaolactic fermentation** is a secondary fermentation that converts malic acid to lactic acid with the aid of lactic bacteria, which may be naturally present in the winery, or artificially added. As with alcoholic fermentation, the reaction is accompanied by the release of carbon dioxide, **but** in much smaller quantities. Malolactic fermentation alters the taste of the wine, and is either deliberately encouraged or specifically avoided. It reduces the wine's **acid** content, improves the aromas, and sometimes leads to a slight increase in volatile acids. The wine is made more stable, because there is no longer any danger that this second (MLF) fermentation will take place in the bottle.

The lactic bacteria can also cause a decrease of other components of the wine besides malic acid. If they affect the sugars, for example, the taste may develop a lactic acid edge. Consequently, it is vital that all the sugar is broken down during the alcoholic fermentation. 5ulfur dioxide added after pressing or to the tanks or barrels can render the bacteria inactive, without overly impairing the yeasts.

Most red wines undergo malolactic fermentation. Its use with whites and roses depends on the region and the style of the wine. In regions with a Mediterranean-type climate, where the wines are often lacking in acidity, this second fermentation is avoided. In cooler regions, the wines tend to contain more acid, and so malolactic fermentation is often employed, provided that dry wines are being produced. If a wine contains **residual sugar**, chemical de-acidification is used in preference to malolactic fermentation. In countries where there is no great tradition of producing sweet wines, this tends to be the practice with dry whites as well." (Extract from **WINE**, A. Domine, p.125, see **References**.)

MLF culture may be obtainable commercially if you seek a controlled MLF, add as the yeast fermentation is finishing if you want a still MLF wine, or before bottling if you want a slight sparkle or spritzer effect in the end product. Spontaneous MLF may be difficult to prevent before fermentation, as SO2 concentrations sufficient to kill the bacteria will also kill yeast, although heat treatment would be effective, as long as must properties were not changed by this. (See also **Making Good Wine**, Rankine, pp.175-181, see **References**.) MLF stable means just that, so wine stability in regards to other organisms must be controlled by good sanitization practices and chemical controls such as sorbate or SO2 to the right proportions.

Note that **chemical de-acidification** may be achieved simply by adding **judicious** and discrete amounts of calcium carbonate/precipitated chalk or sodium bicarbonate to a grape must or an unfinished wine sample, (tasting at each step), say a teaspoonful per 4.5 liters maximum at each addition. Remember that acid contributes to stability and aging, and conversely, adding acid in **judicious**, discrete amounts, especially tartaric, being more stable in wine, will increase acidity accordingly.

Tartaric in excess in grape wines will combine with sodium and potassium salts to form tartrates, this also being the principle behind de-acidification. However, chilling of wines will help remove any excess tartrates as any crystals formed can be racked off. **Try this sort of measure with maturing wine samples, and compare with the original, to err on the side of caution**. **Fruit wines** may be unbalanced by the distinctive taste of tartaric and malic acids, so proceed with care, foregoing any addition, or, simply controlling MLF to reduce instability, and thus retain acidity and tartness. Citric acid is also distinctive in taste, so test samples, as is certainly not advised for adding to grape wines, or grape blend wines, nor in wines intended for MLF to finish them, as insipidity and off-tastes will result.

Lower temperatures of fermentation, apart from favouring SC yeast, will also ensure a fruitier, more subtle taste, aroma, and ultimately bouquet, as more volatiles may be conserved to influence the balance of the finished wine. Time will do the rest, and a bright, surprisingly mature and pleasant home wine will ensue after a minimum of 12 months, give or take a couple of quality controlled tester bottles sampled in the interim. **The key to creating a worthwhile or hopefully, a memorable wine, is balance, and this will involve the sum of all the aspects of your winemaking, from ingredients, to style and duration of fermentation, to cellaring and aging.** For interest, you may like to read up on **sourdough culture**, another fortuitous combination of yeast and lactobacillus in our service, making possible sourdough bread, with carbon dioxide as the rising agent. Just enter **sourdough** in any search engine for Web references. Also, the traditional **ginger beer plant** has similar characteristics.

Finally, it is best to say that time, skill, patience and some degree of intelligence and aesthetic sensibility are required for successful and worthwhile home-brewing and winemaking. Unless, that is, you just want immature plonk for quick bulk drinking, because that is what you will get without adequate input of planning, organisation and ongoing learning. Along with just the plonk, there will also, very probably, be some unhealthy by-products, as well as increasingly unhealthy consumption habits.

Certainly, less-than-optimal brewing and winemaking methods may well favour the proliferation of organisms other than Saccharomyces Cereviseae, with predictable consequences. If you must drink in bulk, hopefully with car locked away, then you would be better off, in the long run, to buy a quality-controlled commercial product in bulk to cater for this need, rather than waste time and effort on attempting good- quality do-it-yourself alcoholic beverages.

For others who seek a rewarding, many-faceted hobby, with a long historical, even archaeological pedigree, employing time, intelligence, and patience, while using fruits, plants and flowers of fields, gardens, wild places and grape vines, (not forgetting hop bines), why not take up, and enjoy, home winemaking and brewing, and good luck and good sipping to you!

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COMMON SUGARS FOR WINEMAKING AND BREWING:

SWEETNESS SCALE

		ENZYME
FRUCTOSE	**17**	**-ASE**
SUCROSE	**10**	"
GLUCOSE	**7**	"
GLCERINE	**6**	Byproduct, stable after formation, or as additive
MALTOSE	**5.5**	**-ASE**
LACTOSE	**3**	"

Note that honey, being of mixed sugars, mainly fructose and glucose with some sucrose, will be between 10 and 17 in the sweetness scale, fructose being the main sweetener.

Lactose is non-fermentable by S. Cerevisiae yeast, hence **milk stout**, sweetened with lactose, but beware lactose intolerance. Glycerine is similarly non-fermentable. Truly dry wine is .01% sugar, usually complex residual sugars nonfermentable by the yeast, and enzymes can be obtained to enable optimum dryness if desired. Starch and pectin when present, as more complex sugars need the addition of the enzymes amylase and pectinase to be reduced to more simple sugars that the yeast can ferment.

Fruits, when ripe, usually contain more concentrated sugars than other plant forms, so always crush, soak, blend, etc., to obtain a balanced SG reading before any chaptalisation. Invert sugar is not necessary for chaptalisation, as sucrose will be effectively inverted by yeast enzymes in a must of ideal pH, they adjust their enzyme production accordingly, and more easily if properly nourished. Always ensure added sugar is fully dissolved, the use of sugar syrup made with a minimum of warm water will ensure this. Sucrose is actually a disaccharide, composed of the monosaccharides glucose and fructose, very common in nature, and should be completely fermented in a naturally and completely finished dry wine.

Too much initial sugar in a must may inhibit the yeast, due to the osmotic process being disrupted, some yeasts are more tolerant than others of high sugar concentration. However, incremental addition of sugar, more effective during the anaerobic secondary fermentation, can increase alcohol production, although this concentration of alcohol will eventually kill the yeast. Lack of sugar in a secondary fermentation only leads to yeast dormancy, hence the need for stabilization if the fermentation of added sugars is to be prevented, and other possible organisms in the original must that utilize sugar also need to be eliminated before fermentation begins.

Chaptalisation of white wine must occurs after pressing, while with red wines the unpressed must is chaptalised, so with fruit or vegetable wines, the decision will depend on the produce used, how full-bodied the wine is to be, how much colour, and how much tannin is needed, as the alcohol will leach any tannins present before pressing.

As implied by the chart, sweetness in wines, whether fermentation is stopped by stabilizing, or by natural cessation of yeast activity due to high alcohol content, is a combination of the types of sugars unfermented or added, and their relative amounts. Also, different sugars added may confer their own tastes as well as degree of sweetness depending on the must, eg, raw sugar at 1kg:25 litres complements a finished date wine very well, the result resembles a fine dry sherry.

As a matter of interest, sugars can be increasingly complex, depending on the number of simple monosaccharides that are linked. Apart from their differing tolerance of alcohol concentration, beer and wine yeasts have differing capabilities as regards the range of sugars that they can ferment, and this also may vary within their respective groups. Complementary commercial enzymes aid fermenting of the more complex sugars, apart from starch and pectin, as mentioned.

For Hydrometer parameters, see p. 16

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QUICK WINEMAKING ADDITIVES CHECKLIST as applicable:

MUST INGREDIENTS, OVERALL COMPATIBILITY, WINE STYLE

ACIDS: CITRIC with care, strong taste, not for MLF
TARTARIC with care, as is usually very stable, and is quite bitter,
MALIC with care, unless MLF is projected. Or, reduce acid?
Try some dilute acid samples to gain a taste perspective.

CLEARING, FINING INGREDIENTS, bentonite, gelatine, egg white, etc.

ENZYMES: PECTINASE useful with any amount of fruit proportion in the must; pectin breakdown also reduces methanol by-product proportion.
AMYLASE for starch

NUTRIENTS: DAP
VITAMINS, thiamine, pantothenate, biotin
YEAST HULLS, or even Marmite, 1-2 tsp:4.5l, providing nitrogen and other nutrients and then de-toxifying the must as yeast begin to die.

SANITIZERS/STABILIZERS/ANTIOXIDANTS: METABISULPHITE
SORBATE

SUGARS: SUCROSE, white, raw, brown
DEXTROSE
MALTOSE, liquid, powdered, kit, for brewing
HONEY

TANNIN(S)

GLYCERINE

WATER CONDITIONERS: EPSOM SALTS, useful for winemaking in soft water.
SODIUM CHLORIDE
CALCIUM SULPHATE
CALCIUM CHLORIDE, these last two are more important for brewing,
CALCIUM CARBONATE and a basic water analysis may help with both.
(Kit beers should be self-contained as to ingredients at purchase)

YEAST TYPE, SUITABILITY FOR PARTICULAR MUST, or BREW

OVERALL BALANCE OF MUST, ANY STAGE OF FERMENTATION

Must is any combination of sugars and ingredients, dissolved in or mixed with water, to which yeast has been added, thence becoming fermenting must, through to the end of primary fermentation, until straining and/or or first rack. **Wort** in brewing has a similar definition, albeit with more actual steps involved, such as boiling, resting, straining, and sparging. Kit beers are more simply mixed and the resulting wort fermented. There may be differences of opinion about these definitions, however.

Furthermore, one strains a must, thereafter one racks wine, until the winemaking process is finished, thereafter, one decants from bottle to a decanter, or pours into a glass. One racks wort in beer terms, unless a siphon is used, until finished, then racks or siphons off into casks, which are then drawn from, or, bottles the beer, and the bottles are then poured from.

Just to make things clearer, but again, opinions as to description and nomenclature of processes and constituents may differ, locally, regionally, or internationally, not to mention linguistic differences as well.

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Easy Additives Check ie, rule of thumb cum teaspoon, given that 1tsp = 5ml. Ingredients: prepare as customary for wine type, color, taste, combination, blends.

sugar: white, brown, raw, dextrose, honey, lactose, other

tartaric acid: 1 tsp:4.5l, in grapes, less in other fruits; stabilizer, pH, TASTE

malic acid: 1 tsp:4.5l, common acid, also for pH, TASTE, MLF if required

citric acid: 1 tsp :4.5l, (**not for MLF, grape, root, or veg.) Useful for pH, TASTE**

tannin(s): 1 tsp: 4.5l or to TASTE, pH, stabilizer, preservative

DAP: 1/2 tsp:4.5l, pre-packed **mixed** nitrogen compounds may not suit all wines, or waters, DAP is usually sufficient, independent of water conditioning) **Never Urea!**

enzymes: **pectinase**, 4/5 drops/4.5l, 1ml:20 kg crush or 20l juice
amylase, (for starch**)**, max 1 tsp/4.5l allow 24 hours before adding yeast.

vitamins: one per 4.5l, or in ratio of 1 thiamine:1 pantothenate:1 biotin every 15l. (Biotin not necessary with fresh crushed grape juice). Meta will denature thiamine, so do not overuse meta in must preparation even though yeast are reasonably resistant.

glycerine: 1 tsp 4.5l, or to taste/mouthfeel, **after** fermenting/stabilizing is complete.

yeast: type, starter needed, 24 hour delay for enzymes or meta

starter: **half litre sample** of prepared must/juice, use yeast as per label

stabilizers, antioxidants: *meta .44gms/1 campden/4.5l, (same for **ascorbic acid**, do not use ascorbic in still red wines), **sorbate** same/4.5l, **always** with meta >75 ppm. Plus, **sorbate** is not used for sparkling or red wines, only young, white, sweet, high pH, low tannins only, **not** an antibacterial, yeast inhibitor only. **Potassium sorbate** is just the yeast inhibitor, while **meta** will kill off other organisms, especially the MLF bacteria, which can otherwise cause taste problems (**geranium**), with sorbate. **This is why they must be used in tandem. Ascorbic/erythorbic acids as antioxidants are not advised for beginners, meta is better, plus careful must and wine handling techniques.**

fining/clearing agents: ad hoc, principally **bentonite** (-), **casein** (+), **albumen** (+), **gelatin** (+), **carrageen** (-), **isinglass** (+), **kieselsol** (-), **sparkalloid** (+), plus, re usage, consult experts listed in the **References**. R**emember TIME**, and conserving of **good molecules**. Care with constituent preparation, and use of enzymes, is important. **Nofrillstech** principally relies on must balance, enzymes, rice powder, and **TIME**. So far, OK..?

water conditioners, wine: .5 tsp Epsom Salts:9L, .5 tsp salt:9L or to taste; boil, filter ad hoc, use filtered commercial water? Potassium in the form of potassium phosphate is also useful, if obtainable, but food grade only.

de-acidification: add judicious amounts of **calcium carbonate powder,** $CaCO_3$**, (aka precipitated chalk), or soda bicarbonate**, ($NaHCO_3$), 1 tsp/4.5l, taste/test, and repeat, etc., pre or post fermentation, then chill the wine to rack off resulting crystals, esp the tartrates when treating grape wines or dominant grape blends in fruit wines. See also **Rankine 2004,** p. 172 re ascorbic acid, p. 180 re tartaric acid, also MLF and red wine, and why the geranium smell, bacteria and sorbic acid p. 257 (See **References**.)

Oxygen, via oxygenation, macro and micro, is friend and enemy, affecting yeast growth, fermentation, unwanted organisms, volatiles such as acetic acid, which can form in the absence of organisms, and rates of maturation. Take these facts into account at all stages of must preparation, winemaking, maturation and bottling.

* **1 Campden** =.44 gms .44 gms per L of meta, or 5-6 Campden/1 tsp per 12/13L, which would also be good enough for ascorbic or sorbate as rule of thumb/teaspoon, normal powder form ...agreed? 1 Campden per 4.5 litres =50 ppm, 2 Camden per 4.5 litres =75 ppm, Note that more acidity may be needed for balance depending on sweetness of the must. **CJJ Berry, p. 18,** (see **References**)**,** states that to purify the must, use 1 Campden: 4.5L, each racking also 1 Campden per 4.4 L, and final bottling 2 Campden: 4.5L. However, the longer the wine is matured pre-bottling, and the drier, with lower pH and higher tannins, the more stable and long-lived in bottle.

Pectin is present in the cell walls of fruits, is desirable to set jams, but needs breaking down with the enzyme **pectinase** in musts to prevent pectin haze. More will dissolve in progressively warmer water. Add to the must 24 hours before sugar, which inhibits its action, and the yeast. Pectin can be in liquid or powder form.

Starch, (the plant equivalent of animal glycogen), is present as cell stores in cereals, and some vegetables. The enzyme **amylase** will break this down to simpler fermentable sugars, also preventing starch hazes. Add 24 hours before sugar and yeast. Both enzymes will co-exist with meta in a must.

Enzymes work best at about 40C, but 20C-30C is sufficient without adversely affecting the must by over-extraction, or loss of volatiles. Do ensure, however, that the optimum fermenting temperature is reached **before** adding specific wine yeasts.

pH readings of basic juice should be taken before any other additives are included, as meta, DAP, and water conditioners, if any, will affect pH, yet are neutralised by the fermentation process, and do not affect the final pH. Under-acidification may produce off-odours or tastes. Otherwise, try for a thumbnail unsweetened must more bitter than sweet.

Original **sugar** should be tested for in basic must, but extra should not be added until just before fermentation so as not to affect enzyme actions. To obtain the truest hydrometer reading, test a mostly settled sample of the must, avoiding the effects solids in suspension. Final total alcohol will be based on original plus added sugar, consult hydrometer tables for accurate calculations, important if adding sugar incrementally during fermentation. Water is SG 1, and wine should be less than 1.

Tannins are necessary for optimum winemaking, flowers, vegetables, cereals and herbs have none, many fruits have insufficient. Apricots, apples, bananas, black currants, bilberries, damsons, elderberries, peaches, pears, sloes, grapes, have useful amounts, in skins and pips **that will be leached by alcohol, careful!** Check published recipes.
Tannins contribute to preservation, aging, also taste, (astringency), and balance. Extra tannins may be added at any time before bottling, enhances clearing, mellows with aging and, and has **good molecules** present in the form of anti-oxidants.

Acid component contributes to taste and balance, and also to preservation of finished wine, and so requires, with higher tannins, a longer maturation period. Ideal 3-3.4 must pH before fermentation will favour yeast over bacteria and moulds. MLF will lower the malic acid component by conversion to lactic acid, and less maturation time may be needed as a result. NB, pH is the level of acidity, on a relative scale that also measures alkalinity, and titratable acid is the totality of acid(s).

Rules of Thumb and Teaspoon favour a pH reading for simplicity, or just use less fully-ripe fruit in the must; if the unsweetened must tastes slightly tart, as above, then all should be well. **Acids added should reflect the original fruit acids if possible, citric and especially malic. Tartaric acid is predominantly a grape acid,** so add with care for taste or stability purposes, whether using a grape blend must or not. This also influences the need for cold stabilization when/if excess tartaric acid is present. (See the **MVEC Reference**.) **Citric acid should be used with care, and not in wines intended to be finished by MLF,** see elsewhere.

Cereal versions of S. cerevisiae do ferment dextrins and starches, but are not advised for winemaking, due to taste and low alcohol tolerance, but complement citrus wines.
Well-ground/blendered rice, say .5 kg to 15 litres of must with 1 tsp amylase, aids clearing, as does banana syrup from 1 kg of boiled bananas, which also adds body, as do a handful of blended nectarines. Rice flour may used if carefully mixed in also.

Glycerine, sweetness 6, is a stable byproduct of fermentation, and may be added for mouthfeel and sweetness, but care must be made not to unbalance a wine, as pronounced mouthfeel may be offset by undesirable sweetness in a dry wine. A very desirable 'byproduct of process', (**BOP**), and/or additive for inclusion in dessert or fortified wines.

Remember foodgrade DAP, in optimal doses, to prevent formation of ethyl carbamate. An otherwise excellent practical home winemaking book, **Progressive Winemaking,** Acton and Duncan, (see **References)**, even in their 1991 edition, advocated using urea as a yeast nutrient. **NO!** See above, and **CC Notes** below.

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FREEZER FOOD STORAGE GUIDELINES:

The optimum freezer food storage temperature is -18ºC to -20ºC, anything above this will affect quality and keeping properties. For best results initial freezing should proceed evenly and reasonably quickly, so allow produce to be chilled through in a cooler or refrigerator before freezing begins. Wider, flatter trays of produce will freeze more evenly and quickly than rectangular blocks. This method will also help to ensure that the freezer temperature level is not unduly disrupted when unfrozen produce is added.

VEGETABLES	**Most**	**12 months**
	Carrots	**8 months**
	Cauli	**8 months**
	Onions	**3 months**

All vegetables should be blanched and chilled before freezing. For purchased frozen vegetables, follow processors' labels.

FRUIT Fresh & Cooked 12 months

Use only the best quality ingredients, and in the case of fruit, try to combine some not-quite-ripe with ripe, in order to maintain an optimal acid/sugar balance when later constituting the must. Do not freeze over-ripe, damaged, or unwashed raw fruit. Ensure cooked fruit is chilled before freezing.

Concentrating fruit juices by partially freezing grape juice dates back at least to Roman times, using the frosts of winter to help separate some of the frozen water from the rest of the juice, which would remain liquid at the same temperatures because of sugar concentration.

Icewine/Eiswein-making utilizes the juice squeezed from late-picked partially frozen grapes, pressed at an optimum temperature, **(-8ºC/18ºF),** and pressure, that enable ice crystals to be separated and discarded with the pulp. The concentration of flavour would be a combination of long ripening and sugar concentration, as well as partial water removal. An appropriate yeast is matched to the must, and the wine is made in the usual way. Note the temperature required, the operative word is **chilled.**

Home-frosted juices would only require straining through a sieve to separate the crystals, well within the scope of the average home winemaker, and frozen, small, soft, or finely chopped selected frosted fruits could be squeezed with small tabletop press.
Applejack is a conventional fruit-juice equivalent, and other fruits or juices could also be treated in this way, given sufficient initial sweetness. Fermenting this type of must will produce a higher alcohol and very full-bodied wine, the end result depending on whether fermentation is allowed to proceed naturally to completion. Higher acid concentration would enable long-keeping, and the wine itself may be preferred as an aperitif, or consumed later in the meal as a dessert wine.

On the subject of chilling wines, those that have an excess of tartaric acid, either as a result of the original produce used, especially grape, or when added inadvertently, **chilling the wine as above will cause tartrates** to precipitate as crystals that can then be racked off before the wine is returned to normal cellar temperatures. This may be preferable to de-acidification as first resort, as there is less likelihood of taste changes that may occur when using calcium salts, especially if errors are made as to proportions added.

Temperature control of a fermenter is easily achieved using an old bar frig as an incubator, strip out the interior and set your own shelving, install a light socket or baby coffee-warmer, connect to a timer on the wall socket, and then experiment till you get a good working regime for your home, season, etc. Cooling is simple, install a vessel of frozen water as necessary, heating can be done with hot water, too. The main time for cooling, if this is needed, is in usually the first 12-48 hours of primary ferment.

Install a thermostat if you can afford one, or rig up a working frig that incorporates heating as one of its abilities, **but the thermostat must run efficiently from 20ºC-30ºC for an effective range to monitor most beer and wine primary fermentations, between 21ºC and 28ºC. Secondary fermentations of wine should be at 15ºC.** Where there is a will, there is a way, even where there is no electricity..?

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Temperature conversion:

ºCentigrade	ºFahrenheit	ºOptimum
0	32	Lager yeast will work ok almost to zero
1	33	
2	35.6	
3	37.4	
4	39.2	
5	41	
6	42.8	
7	44.6	
8	46.4	
9	48.2	
10	**50**	**Maturation and storage, all, never more than 15ºC**
12	**53.6**	**Sur Lie**
15	**59**	**Wine secondary, min for white primary**
18	64.4	
20	68	
21	**69.8**	**Wine primary (red wine to 30ºC)**
22	71.6	
23	73.4	
24	75.2	
25	**77**	**Beer**
26	78.8	
27	80.6	
28	**82.4**	**Cider and ginger beer**
29	84.2	
30	**86.0**	**Bulk Red Kickstart, esp. color extract**
33	91.4	
34	93.2	
35	**95**	**Rehydrate Kickstart range**
37	98.4	
38	**100.4**	**from 35ºC to 38ºC, then reduce**
39	**102.2**	
40	104	*Yeast begins to die, total death at 50ºC*

Temperature ranges at any stage of winemaking and brewing are important because they influence both biological and chemical activity, and thus the rate and duration of respective stages. For example, thermophile organisms are disadvantaged if temperatures are maintained at levels that favour yeast, micro- or macro-oxygenation reactions are better controlled at appropriate temperatures, and chemical reactions at maturation are more sedate at cooler temperatures. Oxygen is more easily incorporated at lower temperatures, but oxygen reaction within wine is facilitated by higher temperatures, hence the care with temperature and exposure at racking times, compared to earlier must handling.

Maintaining stable temperature ranges is also important lest stages of making or maturation are disrupted. Your beverage may not be spoiled, but also may never reach its full potential if due processes are subject to periodic instabilities of temperature. From primary fermentation onwards, the temperature trend should always be down, in appropriately graduated stages relative to the type of wine or beer under development. Maturation is best undertaken at cellar temperatures to slow the process down and to help maintain stability meanwhile, and this applies to both wine and beer, regardless of the type, or projected consumption date.

Also, sur lie, or leaving wine on lees, contributing extra unique yeasty flavour to the wine, is best undertaken undisturbed at a cooler temperature, although this is not done with gross lees, as putrefaction rather than flavour complementation may be the result. Sur lie is more likely with red wines than white, although mèthode champenoise at the penultimate stage is, of course, a notable exception. Home winemakers will need to experiment sur lie with samples or fractions, this is not an exact science, and some yeasts are more suited than others, as are differing wine types, so consult or research for best results.

More robust wines would perhaps benefit more than delicate or earlier consumption wines, and homemade wines tend to blur the standard distinctions as to type. Homemade beer, primed to ferment in bottle for carbonation, remains **sur lie** until consumed, but maturing on grosser lees/trub may be asking for trouble, and enthusiasts will need to consult re the finer points of appropriate beers sur lie also. But cooler temperatures will ensure better control, and an optimum result, whether wine or beer is being matured sur lie. Some oxygen stabilization is also enabled sur lie due to residual cell enzyme activity acting as an anti-oxidising agent.

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Yeast Fermentation: The main principles are yeast selection and control, through must ingredients and conditions, for the duration of the fermentation cycle, to beginning the final maturation stage.

Principle factors involved:

Hygiene of equipment and work area

Purity of water, no chlorine or other taints, appropriate conditioning as required

Balance of ingredients and additives, and similarity to ripe grape juice

Yeast type, sugar and alcohol tolerance

Sugar, fermentability and total SG concentration

Enzymes, types and fermentation delays

Minerals, water or must conditioning if required, as above

Oxygen, aerobic/anaerobic fermentations and maturation, balance macro to micro

Acids, types, **pH,** balanced

Nutrients, vitamins, minerals, nitrogen, protein supplements

Alcohol concentration and balance

Temperature, all stages

Taste and Smell, all stages, also appearance, and applied organoleptic skills!

Time, and **timing**, all stages

Organised, all stages, incl. **records**

Standard Specific Gravity readings, pre- and post-fermentation, are as follows:

	Pre with total dissolved sugar	**Post-fermentation with total alcohol**	
Dry	1.088-1.095	.850-0.990	Temperature correction for these values may be
Medium	1.110-1.130	.990-1.001	necessary, usually the standard is @ **68ºF/20ºC;**
Sweet	1.135-1.150	1.001-1.005	check your hydrometer specification info?

Note that to achieve the balance of alcohol and residual sugar for medium and sweet wines listed, the fermentation will need to be stopped, and the wine stabilized. Dry wines are a matter of letting the fermentation proceed to the end, when (almost) all sugar should be fermented by the yeast, and the wine will not need any more stabilization as long as there is adequate acid, tannins, and alcohol, (above 8%vol.), and the yeast is sturdy enough to ferment the sugar available.

The dry guideline range given above should ensure this, and higher alcohol levels may be achieved by incremental sugar additions to condition the yeast, although a dry wine of more than 12% will probably be unbalanced, organoleptically speaking. **Dry** could be defined, for Thumbnail Purposes, as having no residual or perceptible sweetness, and acidity will mask sugar somewhat, so ensure keeper wines are above 9% alcohol.

Sweeter wines will tolerate a higher alcohol content, organoleptically speaking, and if there is sufficient alcohol present, may not need stabilization, just optimal maturation and aging to reach their potential. This style can be also achieved by the incremental addition of sugar during fermentation. In both cases, continual observation of fermentation and taste sampling will need to be carried out to ensure the desired end result before the fermentation is concluded.

If sweet wines need stabilization, add sugar after stabilization is carried out, and any organisms present are neutralized, as for yeast, or killed off as for any other type remaining. **For the making of fortified wines**, consult standard texts elsewhere as to process, yeast, must sugar concentration, and constituents etc. This is a major winemaking topic on its own, not covered by this **Winemaking Beginner's Factfile**.

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Tirage caps for sealing wine bottles: These caps are crown caps that fit champagne bottles, being used during mèthode champenoise, (aka sparkling wines), for the penultimate bottling stage. The caps, **and the screw-in tirage bell** that easily replaces the screw-out beer-crown bell on conventional cappers, are available at, or through, any good winemaking supplies.

What is not in the wine before bottling will not be there after maturation, and the old idea of "maturing through the cork" is now misinformed; air in means alcohol out, and damaged wine, and the in-bottle stage is supposed to be a **reductive**/**no oxygen** stage anyway. Furthermore, crowns seal tight, more wine can be added, to 1 or 2 cm from the top, to allow for the actual expansion of the liquid, and also because dissolved CO2 exerts less pressure than gaseous CO2 in any ullage space. Also, there is no more push from compressed gas that can force out a newly inserted wine cork. The bottles can be stored upright, using shelves or cases, and there is no more 10% cork failure rate, or cork taint. Lees settle more effectively in the upright position.

Crown caps should not corrode except in extreme conditions of acidic air and moisture, so, if necessary, a puff of hairspray or similar, or a conventional heat seal, would ensure indefinite failsafe longevity. Any testing or tasting and resealing are easily done, with minimal air exposure, and even the same cap, carefully removed, can be easily replaced with a capper. A fine plastic tube makes an easy wine thief, either suck by mouth, or withdraw sample using a syringe of some kind.

Pouring from a full champagne bottle is achieved without spills by placing the lip of the glass or decanter below the first ring, tip slowly at first.

Screw tops are being experimented with by the industry as an alternate seal, in the face of reluctant and unjustified traditional bias, yet any business with a loss rate as high as cork failure rate, 7%-8%, would be a real financial loser. Crown caps are even more promising, being very sturdy, and almost tamper-proof, which the industry could take notice of, there being some difficulty in carrying around a capper. The crown cap could be hidden beneath a capsule, also, and some work could be done re aesthetics? But crown caps are certainly a practical answer for sparkling wines and general home winemaking.

In the meantime, for the home winemaker, crowns on **champagne bottles** are a quick, economical, and easy solution to capping, using the tirage bell on a conventional capper, **and also ensuring safety** if any residual or malolactic fermentation in bottle may occur, **as the bottles are safe to 8 atmospheres**. Anyway, one cap fits all at bottling, for the sparkling or still wine enthusiast, and bottle choice is made easier.

Do try to obtain champagne bottles with medium punts, if using a bottling wand, so that the spring can be fully compressed as the small rod sits squarely on the rise of the punt, instead of skidding off to one side where full rod travel is not possible.

Note that crown beer bottles may be used, (NOT screw tops as the glass is always thinner) **but are not nearly as strong as a conventional champagne bottle**, (preferably green), which should also have a pronounced dump for strength, as well as being a useful receptacle for any sediment. **Handle inverted bottles carefully when in double-stacked crates, as the rims are easily knocked off if bumped against another upright bottle,** otherwise the bottles are relatively sturdy and easy to handle. Sanitise these bottles in the normal way, but scald the tirage caps **briefly** with hot water before use. **Do not dip tirage caps in meta solution** as this may cause corrosion by attacking the protective layer, or any exposed metal. Pressure on the capping arm is only slightly more than for the smaller diameter crown caps.

For those with an older style capper, the newer tirage bell may be secured using a small countersunk machine screw, and washers as padding. To apply caps without a capper, use a small hardwood billet, say 2x2, with a recess cut in to accommodate the capping bell, and the weight of arms and shoulders acting on a bottle wedged between the feet, or set in a purpose built base, will effect the cap seal with surprising ease, so hammers need not be used. This is especially useful for higher and larger volume bottles, too. Improvise, because tirage caps are definitely worth utilising!

See also **Stoppers**, **Oxford Companion to Wine, Ed.II, p.671,** for a most heartwarming endorsement!

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To a Beginner Browsing the Wine Web: **The Doyen of home winemaking online is Jack Keller,** and also refer to **SARWG,** a page Jack supervises that has many links, especially to scientific winemaking sites that are definitely worth your time. Jack's personal site: **http//www.jackkeller.winemaking.net/**

Cornell University, FS430, Understanding Wine and Beer, is also recommended for good easy chemistry, amongst other things, being précis lecture notes of their wine course**.** **Brock University and University of California (Davis)** are also very useful, and accessible through **SARWG,** as is Lum Eisenman's **The Home Winemaker's Manual, Amateur Winemakers of Ontario,** and many more**.** Try **Vineyard and Vintage View** also**.** **Jack Keller and Spagnol's Wine Cellar** both have useful information on acids and sugars in common fruits, and for well-presented wine chemistry, try **Chemistry in Winemaking.**

AIM, and **The Society of the Medical Friends of Wine,** both have good commonsense information of wine and health, well worth the quest to educate yourself in these matters. **New Scientist** has an Alcohol supplement, also interesting. **Try Robin Garr's Wine Lovers Home Page,** and feast your eyes on the Wallpaper downloads for Desktop inspiration, as well as the masses of good info. For latest, and not so latest winemaking books, go to **Barnes and Noble or Amazon.com** on the Net, great selection, easy to order. Also **alibris.com** and **abebooks.com** et al for access to second-hand books. Otherwise there are real finds to discover in libraries, opp shops and second-hand book emporiums as well. Earlier doyens of home winemaking were **CJJ Berry and Ben Turner. Andre Simon, Hugh Johnson, Jancis Robinson, Bryce Rankine, Maynard Amerine, et al,** are all quite good on those conventional vineberry varieties of winemaking.

Also recommended is finding a simple hobby text, **with photos**, photocopying any relevant sections, (for your own non-profit educational use, of course), interleaving/adding your own notes, and relevant Web data. An excerpts library can be built up from all sorts of sources, and there is so much cutting-edge data available for those interested. **Winemaking is as much Art as Science**, and will vary according to conditions, skills, ingredients, equipment, luck, etc., but the general principles are always the same, especially for learners, as outlined at the beginning of this Factfile. **To quickly summarise:**

> Do not make wine from any ingredient that does not already have a recipe, and/or browse any information you can find on potentially poisonous ingredients.
>
> Be careful of overall sanitation, use food grade plastics, glass, and stainless steel. Beware chlorine and iodine sanitisers.
>
> Start with kit beer making, then fruit juice and/or grape juices from the supermarket, or wherever, easy to use needing minimal processing, as they are already pasteurised, and juices are often usually clarified. Get confident with these basic ingredients, and the common equipment, then move on to greater things.
>
> Adhere to correct temperature ranges, aspire to ingredient quality and balance, practice good sanitation standards, and be patient in waiting for best results.

The dominant general principle, applicable for any wine, (or beer making), is that of giving the appropriate yeast type the best conditions, diet, and temperatures, to go to work for you to produce a desired and appreciated result. Home or country winemaking, as you will have now realised, means initially creating a must that closely resembles, (sugars, acids, tannins, nutrients, etc.), the must resulting from the crushing of optimally grown and ripened vitis vinifera berries, or, **even better if possible**, from the point of view of the yeast which so obligingly does the real work! Art, science, and skill, in equal proportions, are all needed for optimum must development by any good winemaker, however humble. May it also never be forgotten that the first winemakers were home winemakers, however humble their homes may have been, or, whatever their latitude, longitude, and original must ingredients were, for that matter…

Tell the wine snobs that grapes are also a fruit, (a berry), and that many fruits have the potential to make good, aged, and even great wines. Wines from other ingredients may also be made, the common factors are the type or style of wine planned, appropriate yeasts and the necessary must balance common to all wines, yours **or** the professionals. There has never been a law that says real wine can only be made from grapes, even though some may even quote biblically to this effect, and then call anything else merely "fermented beverages". Or, that real wine can only made only with "approved" vineberry products within the conventional winemaking geographical latitudes. That sort of attitude is unjustifiably and regrettably patronizing.

What gustatory, olfactory, and digestive riches there are, and will continue to be, in the encouragement of diverse winemaking **and** blending, using **all** the edible fruits and other produce of the world's gardens, orchards, vineyards, and agriculture, regardless of region or latitude! Indeed, tastes and aromas of grape wines are often likened to fruits and other flavour sources, often very ungrapelike, so why not enjoy wines of the real thing(s), as appropriate to food and occasion, of course, whenever or wherever this is possible, in either blends or original forms? Quality control and truth-in-labeling may still be invoked!

Most importantly, the human race still wrestles with the problems of alcohol consumption, and those who are unable or unwilling to drink alcohol, for health or other reasons, should not be pressured or ridiculed. Winemaking and wine drinking help to create an aesthetic approach to appreciation and consumption of alcoholic beverages that is sorely needed to achieve a mature multicultural attitude to alcohol in general. Not least is the need to gain full respectability of home winemaking as a fine hobby and legitimate cultural pursuit. Remember to show, as a winemaker, an example of moderation in consumption, and sound organoleptic, academic, and practical appreciation of all aspects of winemaking.

There is such a rich diversity of history, geography, botany, horticulture, chemistry, terroir, style, etc., in this field of endeavour, both for the professional, the amateur, and the bon vivant consumers of the final product. There is here a lifetime of study and enjoyment, full or part-time for those seeking a rewarding, many-faceted profession or pastime. **Enjoy yourself, and be proud products of your efforts!**

PS: Do not forget, wine in moderation, and the actual winemaking, are both good for you and yours as well, all things being equal.

Meanwhile, some good wine and beer books worth consulting:

Ancient Wine,* P. McGovern, Princeton UP 2003, ISBN **0691070806**

A Century of Wine, ed. S. Brooks, Octopus 2000, ISBN **840002530**

Concise Wine Companion, J. Robinson, OUP 2001, ISBN **0198662742**, and other works

Encyclopedia of Home Winemaking, Drapeau and Vanasse, Nexus 1999, ISBN **1854861999**

Hugh Johnson's Wine Companion, Colporteur 1983, ISBN **0863990037,** and other works

Dave Miller's Homebrewing Guide, Storey 1995**,** ISBN **088269052,** a great introduction to beer

First Steps in Winemaking, CJJ Berry, Kent 2000, ISBN **0900841834**, the ideal beginner's book

Home Winemaking Chem 101, C. Irion, Xlibris 2000, ISBN **0738828122,** and **Brew Chem 101,** L. Janson, Storey 1996 ISBN **0882669400;** both of these little books are very useful references re the underlying chemical complexity of both home wine and beer making.

Homewinemaking Step by Step, J. Iverson, Ed.3, Shoemark 2000 ISBN **096579363X**

Making Good Wine, B. Rankine, Macmillan 2004, ISBN **140503601**

Modern Winemaking, P. Jackisch, Cornell 1985, ISBN **0801414555**

Polyphenols, Wine & Health, ed. Cheze et al, Kluwer Academic 2001, ISBN **0792367359**

Techniques in Home Winemaking, D. Pambianchi, Véhicule 2002, ISBN **1550651579**

The Art and Science of Wine, J. Halliday & H. Johnson, Beazley 1992, ISBN **0855339462**

The Biotechnology of Malting & Brewing, J. Hough, CUP 1991, ISBN **0521395534**

The Botanist & the Vintner,((C. Campbell, Algonquin 2005, ISBN **15612460**

The Complete Handbook of Winemaking, American Winemaking Society, Kent 1998, ISBN **0961907223**

The Oxford Companion to Wine, ed. II, ed. J. Robinson, OUP 1999, ISBN **019866236X;** sadly, dismissive of homewinemaking

The Production of Grapes and Wine in Cool Climates, Jackson & Schuster, Brasell & Gypsum 2001, ISBN **0909049173**

The Wine Drinker's Handbook, S. Sutcliffe, Pan 1985, ISBN **0330289330**

Understanding Wine Technology, D. Bird, DBQA 2000, ISBN **0953580202**

Vineyard and Vintage View, MVEC Journal, is well worth browsing, (just enter into Google), and Vol. 19(2) has a very useful article, **Wines from Cherries and Soft Fruits**, as an example of content that will be of interest to the home winemaker.

Wine, A. Dominé, Koneman 2001, **3829048564;** a great introduction to wine from the vine-berry!

Wine, M. Sandler & R. Pindler, Princeton UP 2003, ISBN **0415247349**

Winemaking Basics, C. Ough, Food Products Press 1992-, ISBN **1560220058**

Winemaking, ed. II, R. Vine et al, Kluwer Plenum 2002, ISBN **036472724**

As well, these good references have their own bibliographies, so interest and research for the home winemaker and brewer can go as far as you would like them to. **The Botanist and the Vintner**** is a most interesting and well written account of the vine-berry phylloxera era, and **Ancient Wine*** is also an interesting account of scientific method and technology used for determining accurate wine and winemaking history, both ancient and modern. Note also that palaeobotany and DNA techniques are increasingly used to identify both ancient and modern winemaking ingredients, both fresh and preserved. Genetically modified grapes are now planned, and no doubt other fruits and vegetables will be increasingly developed, to ensure better quality and control of growth, including climate tolerance and disease resistance, and, of ultimate processing and vinification. The proof of the many and varied vintages of the future will still be in the drinking, however, no doubt of that!

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Home Bulk Bottling of Wine:

Although strongly defending the identity and validity of winemaking using natural produce other than vitis vinifera vine-berries, beverages of same are nevertheless consumed by this householder, plus friends and their families, for pleasure, for health, and, not least to spin out the homemade product as well. So, the logical next step was to try a bulk home bottling of conventional wine from a local winery as a further Wine Experience. Contact was made through the local brewing and winemaking emporium, a sample was received and appreciated, in this case a very respectable Cabernet, a group order was placed, and the new project was launched.

Although there was all the usual equipment available in house to be used, and the project seemed fairly straightforward enough, there were some differences and changes of procedure worth noting, and consequently of interest to other home bottlers contemplating the same venture. Various ideas came to mind during the toil of the bulk bottling, and as the result of ad hoc steps and decisions. One recommendation is to have flexible tubing near the top of the bottling wand to allow more flexibility and to cushion bumps or jerks. Another wand sacrificed will produce at least 3 suitable sections, one of which is pushed up into the tap, and the flexible tube then connects this to the now longer wand length.

Champagne bottles should have a medium punt if a bottling wand is used, so that the plunger can be easily and fully released, not jamming with the wand in the bottles' base angle. A rigid clear plastic siphoning wand (transversely drilled and with end plug), attached to a flexible hose, is preferable to just using a siphoning hose to transfer wine, if taps cannot be fitted to interim containers. Also, such a wand is still a useful a low-tech alternative to newer, and more expensive, hand-suction siphons. Another useful tip is to try to obtain transportation containers with the bung on the opposite side to the cap to make tapping and running off the wine more easier.

After several years of Nofrillstech brewing and winemaking, and especially since the home bulk bottling, two particular wish-list items have now become evident, viz:

1. Have a dedicated **Preparation Room**, for wine and beermaking, food and preparation such as food bottling or freezing, jam-making, etc., set up with plumbing, storage, benches, incubators, frig and freezer etc., and especially for those with home produce as a financial mainstay, or even as a small home business. Always, of course, kept separate from the rest of the house, and **never** allowed to be cluttered by overflows from elsewhere, an area where stages of preparation may be continued at will without constant setting up and putting away so common to the interrupted use of the family kitchen. Certainly not a cheap utility in the short term, but oh, what a time and logistics boon over the long term.

2. Always purchase bulk bottles and jars, etc., **new** from a wholesaler, all clean, of standard size, and already in standard boxes. There will be repeated use of these, but nothing like the inspection, washing, label removing, sanitising etc., of before. Salvage of containers in small amounts, perhaps cleaned as part of normal kitchen duties, may not mean much in terms of time and hot water, but in-bulk collecting and cleaning of containers over years can be very time, labour, and hot water-consuming. After which, keep those bright clean standard containers, of whatever provenance, close by from then on, extracting promises and even deposits if any containers leave your home!

Apart from which, this particular home bottling went as follows: 140 litres of the very respectable 2001 Cabernet were purchased in seven 20 litre plastic containers, and bottled the following day. A optimum formula had been devised for fair and equitable distribution, those not present got what they paid for, less a small impost, and extras beyond the sum of all orders were divided up between householder and helper.

The principle decision was to call one litre the equivalent of one finished bottle, and because the bottles were tirage sealed, the total volume, to the ring below the seal, was .790 ml. The bottle total in this case was projected as being 140:- .790= 177.2, every participant <u>not present</u> to help was levied an extra half bottle in cost for every dozen bottled for them, the remainder of the cost of the 177 projected bottles was paid for by the householder, any extra after bottling, including the levy, was to be divided up as described.

The order was to the nearest 20 litres, as this was the most convenient container size, so there were bound to be some extras, paid for or otherwise, not least because the containers were filled, most generously at the winery, almost to their limits of capacity.

The .210 liters difference, between a litre purchased and bottle filled and received, meant that the householder gained a proportion of "free" wine, which also helped to cover sundry expenses like containers, caps, hot water, metabisulphite, pre-preparation time, etc., lunch was bring or donate a plate, and petrol for the bulk pick-up was shared. Bottles were variously donated, and pre-prepared by the householder, prior to bottling, and washed once more at bottling, (hence the wish-list item for new standard bottles as above, to reduce the pre-preparation workload...), this extra labour also compensated for by the householder's levy on those not present on the day.

With only two for the job, the 180-odd bottles took a solid 8 hours to be washed, rinsed, dipped, flushed with CO2, filled from the 7 containers, capped, counted, apportioned, and then there was the clean-up and put-away. A couple more hands would have reduced the time dramatically, and the house being split level, (see wish-list items), meant time lost with stair work and carrying. The usual sanitary precautions were carried out at all times. Under those circumstances, not an activity for the faint-hearted, although practice would make perfect, and some small technical glitches had to be overcome which would not be problematic in the future.

The 20 litre containers were carefully flushed with **hot** caustic solution, soap and water, (and brushed), plus soda bicarb solution, before use, to ensure they were neutral as to any possible odours. They were carried on rubber mats in a utility to ensure no worrying of their bases could occur, with resulting leaks. However, the wine should be, and was, transferred to bottles within 24 hours, so as not to leach the plastic which will occur with the alcohol of the wine. Keep cool, 10C-15C at least, before bottling, and after, which means optimal cellaring temperatures.

The CO2 flush was provided by a **SodaStream** canister, removed from its fixture, with trigger attached, a hose extension fitted suitable for venting into bottles and container head-space, and the trigger **gently** pulled when required. After all, the CO2 settling in a generous layer is as good as a full flush. One fill at A$12 per refill was more than enough for the entire task. The local wine and brewing shop also suggested this measure, and **SodaStream** were contacted re a model developed for the needs of the legions of home wine-makers, or anyone else flushing with CO2 on a small scale, who could benefit from such a useful technical addition to their equipment. We are now in wait-and-see mode as to whether the suggestion will be followed up.

Tirage caps meant the bottles were filled to within 2 cm of the top, the bulk fill done with the CO_2 layer, via a bottle filler, and a quick addition of the extra 40 mls required, a short settling period under a loose cap for any bubbles to rise, and then the capping. There would be some residual CO_2 in the wine anyway, so the theory is that even with the slight backwash of air as the bottler is removed, and with the 40 ml top-up following, oxygen contact would be as minimal as possible under the circumstances. Certainly, there is no gap under the cap as would be the case with a cork, whose ingress must force any gases present in the ullage back into the wine below.

Bottling was done, as usual, in daylight, from a kitchen table, against a white background of paper spread below on the floor, so as to see the rise of wine in the bottle, or, an electric light would do the same thing. A conventional screw-in tap and valved bottler wand were used, although siphoning was initially required to lower the generous level inside the containers.

There were 3 cappers involved, of the 2 with tirage bells, one, the “industrial-strength” model was fixed for the most common size of champagne bottle used, the other adjustable for the non-standard bottles. The third capper was for small green beer bottles that serve as half-bottles, or **testers**, to aid in checking the developing state of the wine in the future. The wine could be laid down for as long as 5 years, according to the Winemaker, although up to two years would be optimum, given that oxygen contact was minimised, rather than fully controlled, as the CO_2 was not administered within a sealed delivery system, as would have been the case in the winery.

Costs and necessities to consider, not including labour, would be containers, CO_2 and dispenser, bottles, hot water, rinsing water, metabisulphite, bottle wash powder, crown caps of either size, logistics, work area, time involved, help on the day, fuel, delivery and pickup of bottles, empty and full, pre-preparation, bottling, clean-up and put away, spare parts like taps or extra CO_2 bottle, functioning cappers, (relatively) cool storage or cellaring space. Once started, the task must be completed, and within 24 hours, so some thought and planning, as for all winemaking or brewing activities, is advised before taking on the project.

Finally, at the end of this particular project, as to quality and potability, what of the wine in question? Well, we had, in bottle, a very pleasant, very dark young 2001 Cabernet, not a heavy tannins, would suit many types of food, **and** red wine drinkers, for that matter, which can only get better with time, as above. Indeed, a wine to be proudly and confidently brought forth, in times to come, for guests to enjoy, and the story of its existence recounted. In the end, well worth the labour, including the visit to the winery to see what a modern winery is like, to chat to the Winemaker, to admire the rows of vines just picked, and all under a brilliant sunny autumn sky on the day..! Yes, more bulk vine-berry bottlings are planned.

Thanks are now due, for their patience and goodwill, to Ron Booth, of Highland Brewers, Moss Vale, NSW, for the carbon dioxide dispensing advice, and for contacting Southern Highlands Winery, Sutton Forest, NSW, on our behalf; and of course, to Southern Highlands Winery, and especially Eddie Rossi, being Winemaker of that fine Cabernet, and Carlyle, their most affable salesman, for the decanting job... See you all again very soon. (February 2004)

Southern Highland Wines’ Website is www.southernhighlandwines.com

Highland Brewers’ email is highbrew@bigpond.com

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Recordkeeping in winemaking is absolutely necessary, given the number of vintages, stages, and processes, as well as the time spans involved. **Jack Keller** has an excellent wine-log example on his website, and there are many others to choose from, especially in winemaking text-books. One important tip is to develop a set of records that **you** are comfortable with using, that are **standardised** for easy reference purposes, with spaces or headings included to record extra observances or actions taken.

Nofrillstech uses the following headings for home winemaking, with each vintage record spread across two pages, 30cm x 20cm total area, of a good quality hard-cover notebook. Any smaller size would not be enough for the details and ongoing comments that usually need recording:

Wine No. and Date: The date will refer to the time of original must development.

Wine Type: Still, red, white, rosé, table, etc.

Wine Ingredients: A small précis for easy ingredient identification purposes.

Start of Process: Details may include yeast type; starter type and/or if any; and pre-fermentation waiting periods, such as for metabisulphite action or temperature adjustment.

Temperature Control: Details may include starting temperature of the fermentation, also whether in thermostatically controlled conditions, or by ice, ventilation, hot water cupboard, in situ room ambience, etc.

Progress: Comments may include whether fast, slow, heavy cap, temperature manipulation, taste and smell at various stages, stirring frequency, CO_2 production, etc.

Strained: Including date, must constituent adjustments, sugar, taste and smell, progress, etc.

Rack 1: Including date, comments on progress, taste and smell etc.

Rack 2: Repeated if necessary, similar comments.

Bottled: Including date, final adjustments and/or additions, comments on progress, taste and smell, testers bottled, etc.

On the opposite page:

List of Ingredients: Fully detailed constituent descriptions, type, age, ripeness, all additives etc. for the initial must.

Method(s) of Process, detailed account of steps in materials processing, must development, must and wine adjustments, and at what dates and stages, etc.

Comments: Usually post-bottling, about appearance over time, tester sampling, tastes and smells, comments on mature wine, and also **pre-table cellar tasting notes**, food association suggestions, and references for future vintages or vintage variations.

Tasting Notes templates are also widely available, but once again, you should develop such Notes that suit **your** needs, and then standardise them for easy and consistent reference purposes. **Cellar tasting notes** will be a useful start to more comprehensive table tasting notes, indeed, a copy of table tasting notes should be easily available for reference, with cellar-tasting notes, when future musts are developed, especially if using similar ingredients, or trying must variations. Principles being more important than recipes with any given set of potential must ingredients, so, good records and notes will be a boon to new must development, and also for possible blending of wines, finished or otherwise.

Wine Blending, if carried out, must be under the same controlled conditions as bottling to exclude oxygen, and to ensure ongoing security of storage in glass or stainless steel; plastic wine sacs will be your choice, as well. The exception, of course, is an ad hoc blending shortly before meal-time deployment, when your decanter will take pride of place on the table.

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Common Chemicals and Constituents associated with winemaking and brewing:
acetal, di-ethyl acetal, BOP, miscible in alcohol, sweetish odour
acetaldehyde, ethanal, an aldehyde, BOP, miscible in water and alcohol, strong odour, binds SO2
acetic acid, aka a volatile acid, see also ethyl acetate, BOP, vinegar odour
amylase, enzyme used instead of heat in winemaking to break down starch, cf brewing and boiling
amylum, aka starch, plant equivalent of glycogen
anthocyanins, aka colour and some of the good molecules in wine for humans
anti-oxidants, inhibit, delay, or prevent oxidation
argol, aka winestone, BOP, mainly deposited tartaric acid salts of potassium and sodium
arabinose, a hexose sugar
ascorbic acid, vitamin C, antioxidant, health of connective tissue in animals, water soluble
beerstone, aka beerscale, deposit of calcium oxylate acid, plus protein and sugar
benzoic acid and sodium benzoate, in acid medium, anti-bacterial, anti-fungal
bio-flavinoids, common in plant, good molecule for humans, especially blood for vessel health
biotin, B vitamin, yeast nutrient, B vitamins are water soluble
calcium sulphate, water conditioner, as required, precise presence determined by testing.
calcium carbonate, ditto
calcium chloride, ditto
calcium pantothenate, vitamin, co-enzyme, yeast nutrient
carbon, carbon dioxide, op cit below, Elements Of Life
catechol, plant chemical, a phenol, related to tannin, good molecule for humans
co-enzymes, organic molecules that associates with specific enzymatic actions, eg vitamins
citric acid, common fruit acid, especially citrus, citrus taste
copper, trace element, undesirable in winery in forms that will react to cause copper casse.
di-ammonium phosphate, DAP
diastase of malt, aka amylase
dextrin, int. polycsaccharide, hydrolyis of starch to maltose, cf bubbles in Guiness
diacetyl, dimethyl diketone, BOP, butter aroma and taste, miscible in water and alcohol
ethanol, aka alcohol, BOP
ethyl acetate, aka a volatile acid, BOP
ethyl carbamate, aka urethane, a BOP.
fructose, b/d-fructose, levulose, monosaccharide, sweetest natural sugar
fusel oil, composed of fatty acids, alcohols, and esters, being BOPs
gelatine, water soluble protein derived from collagen, clarifier and tannin remover
glycerine, aka glycerol, BOP, sweetener and conditioner in wine, explosive with some oxidisers
hydrogen, op cit, below
lactic acid, BOP, from MLF conversion of malic acid
lactose, milk sugar, non-fermentable by yeast
linalool, C10H180, a wine fragrance
lupulin, aka hop flour, oilsand resins for taste, smell, also preservative action
malic acid, common fruit acid, especially apples, apple odour, bitter
maltose, malt sugar
magnesium carbonate, water conditioner
magnesium sulphate, Epsom Salts, water conditioner
metabisuphate, op cit
methanol, the simplest of the many alcohols, and a BOP, toxic when concentrated
methyl anthranilate, foxy or bubblegum overtone in vitis labrusca wines and blends
nitrogen, op cit, below
ovalbumin, egg albumin, used in clarification
oxalic acid, aka ethanedoic acid, common plant acid, toxic if concentrated, eg, rhubarb leaves
oxygen, op cit, below

potassium tartrate, BOP

pantothenic acid, a B Vitamin, yeast nutrient

pectin, plant cell component

pectinase, pectic enzyme

pyruvate, intermediate substance in sugar fermentation before alcohol formation

resveratrol winemaking BOP, good molecule

sodium benzoate, plant product, preservative and anti-fungal agent

sodium bicarbonate, de-acidifier

sodium bitartrate, BOP

sodium chloride, water conditioner

sorbate, potassium sorbate, preservative and yeast reproduction inhibiter

sorbic acid, plant chemical, preservative

sorbitol, sweetener and substitute for glycerol

sotolon, adds to the distinctive taste and smell of wines made from botytised grapes

succinic acid aka butanedoic acid

sucrose, cane/beet s., polysach. easily hydrolysed, sucrase/heat/acids, to dextrose and fructose

sulphur, op cit, below

tannin(s), astringent plant chemicals, wine preservative and taste balance

tartaric acid, various forms incl. racemic acid, major grape acid, taste, wine preservative

thiamine, Vitamin B1, yeast nutrient

vanillin, an aromatic aldehyde, taste derived from maturation in or with oak

water, aka oxygen hydride or hydrogen oxide

wine disease is caused by microorganisms**, wine condition** is due more to process and handling, **BOP is byproduct of process**, in this case fermentation; some of the very many are herein noted ...a list ad infinitum, but never ad nauseum, for the quietly sipping home wine connoisseurs drinking their own fine wines!

Selected wine and beer chemicals in detail: The following are more detailed definitions and descriptions of selected winemaking and brewing constituents and/or byproducts. Any feedback to improve or enlarge this data by a better qualified reader would be much appreciated. This minor inventory will grow slowly with time, so watch this space, or ask such questions of your favourite Search Engine, thus accessing what has now become the world's largest library, aka The World Wide Web.

Accounting for the Halogens: This group of non metallic compounds is noteworthy for including iodine and chlorine, elements that in their various forms, and even as residues, may cause tainting of wine and beer. Just put **halogens** into Google, there will be plenty of data resulting, or consult relevant reference texts. In the meantime, with special thanks to Purdue Uni and Yinon Bentor, as you will see for yourself on the Web, here is a precis of the main characteristics of **The Halogens**:

Six elements in VIIA of the Periodic Table, **hydrogen, fluorine, chlorine, bromine, iodine, and astatine**, all form diatomic molecules, and negatively charged ions. They have similar chemistry, are highly reactive, and not found in their pure state **in nature**. Chlorine and hydrogen as the partial exceptions may exist so only transitorily. Hydrogen is the exception as to electrons in the outer and only valence shell, viz one only, but the others all have 7 electrons in their outer valence shell, giving them an oxidation number of minus one, (-1), and **these others are known collectively as the halogens.** Their chemistry is dominated by redox reactions, and chlorine, bromine and iodine can expand their valence shells to 14 electrons. Halogens also form isotopes.

All the halogens are very reactive, (fluorine being the most active element known), their collective name means **salt formers**, from the Greek words **hals**, salt, and **gennan**, to form. At normal temperatures, when in pure form, iodine and astatine are solid, bromine is a liquid, and fluorine and chlorine are gases. Their gaseous forms, and any reactions with other substances, are also characterised by violence, fumes and stench. Astatine is radioactive, and has the most unstable compounds and isotopes. Hydrogen halides are compounds with hydrogen attached to a halogen, and aqueous hydrogen halides form the so-called mineral acids, such as hydrochloric acid. Also, interhalogen compounds are possible.

Halogens with relevance to winemaking in particular are chlorine and iodine.
Both iodine and chlorine are used for disinfectants/sanitisers, and chlorine is used for water purification. Iodine is necessary for thyroid function in human diets, obtained more advisedly from seafood, rather than relying on the more traditional iodised salt. Iodine compounds are also used as catalysts, drugs, dyes, and as silver iodide for photographic use. Chlorine compounds are also used as bleaching and solvent agents. Note that **hydrogen** is beneficial as a component of water, and organic acids; **chlorine,** (trace), **and hydrogen** are essential elements, for both plants and animals.

Chlorine is named for its colour, after the Greek **chloros**, meaning green, (but has no connection with chlorophyll, also green, "which is formed of variously substituted porphyrin rings with magnesium", Chambers Chemical Dictionary). Iodine as a solid is densely colored greyish black, but iodine vapour is an intense violet, named after the Greek word for this colour, **iodes**. Iodine is an essential trace element for humans.

Fluorine compounds are added to drinking water for dental/medical reasons, but apparently do not affect winemaking or brewing in any way. Chlorine in water reacts with OH- ions to form chloride, Cl-, and hypochlorite, OCl-, ions, the latter an example a of halogen oxyacid of chlorine, and both are causes of taint in wine and beer. Both chlorine and iodine compounds react unfavourably, in relation to taste, with tannins, and probably with other constituents in winemaking or brewing.

As noted, chlorine, or chlorinated compounds, will react with, and pit, stainless steel, and chlorinated compounds will react with common household acids to produce chlorine gas, highly reactive and dangerous for any human or animal tissues, and with corks to produce trichloranisole. So, if you **must** use these elements in their various compound forms, beware, and always rinse thoroughly after, if there is sufficient fresh water to do so. Chlorinated drinking water should be stirred regularly while standing over 12 hours, or boiled for 10-15 minutes to remove all traces of the gas. Boiling will, of course, remove oxygen, which will need to be replenished by agitation so that primary fermentation yeast proliferation will be assured.

Alcohol: Aka **ethyl alcohol**, or more specifically **Ethanol**: C2H5OH, product of natural fermentation, for winemakers and brewers, of sugars, principally by Saccharomyces, the sugar fungus. An organic compound with an hydroxyl/aliphatic groups attached directly to carbon atoms. The name derives from the addition of the suffix -ol to the corresponding paraffin hydrocarbon. Miscible with water, alcohol also forms esters with acids, important for aroma/bouquet in fermented beverages.

Not to be confused with **ethanal**, acetaldehyde, **CH3CH**, also a BOP. Or **methanol/methyl alcohol/wood alcohol, CH3OH,** also a **minor** BOP, and a definite toxin and rapid cumulative poison, especially damaging the optic nerve, as well as other brain and nervous tissue. Nor to be confused with **methanal/ormaldehyde**, **HCHO**, or rubbing alcohol, 70% denatured ethanol, or, any of the other higher (tending to be oily or solids), or lower alcohols, (tending to be miscible with water), extant.

Alcohol for humans, anyway, acts as a relaxant, and a depressant, especially in relation to behaviour controls, and this may vary according to individual susceptibility, age, health, gender, etc. Some individuals may become addicted, some racial groups lack the full liver enzyme complement necessary for metabolising alcohol in the liver after transport there by blood circulation, and the hangover of myth and legend will usually strike anyone else who overindulges. The Demon? Or, Nature's Own Best Medicine, along with laughter, of course, as long as one does not exceed the stated dose, and note that alcohol acts synergistically with aspirin and barbiturates.

However, alcohol should really only be consumed on "good" days, or with a meal, **never** habitually as a stress reliever self-medicated, and associations with social or cultural events should be carefully monitored, both for public health and safety, and regarding examples set for children and minors to follow. Human society may owe much of its more complex early development to the necessity for, and the domestication of, systematic cropping of cereals that produced bread and beer, and fruits, particularly the grape, that provided the basis for early wines, and later, the distillation of spirits from these beverages. **We and the sugar fungus go back a long, long way**, and the rituals from that history, as well as many habits and tastes, are still with us, although more sensible consumption seems to be gaining in favour these days.

Alcohol does not undergo digestive changes, is absorbed readily into the blood from the GE tract, especially in the presence of carbon dioxide gas, and rapidly concentrates in the brain. In optimal daily amounts, alcohol has proven medical benefits, especially of a cardiovascular nature, see **AIM, Alchowine, and The Society of the Medical Friends of Wine, and their links, for more information. For bad news, to be fair, try Alpha DeTox. No health measure guards against alcohol damage more effectively than moderation of intake. Fatty liver, from alcohol-induced inhibition of liver function, may be reversed, but cirrhosis never. For wine drinkers, 2-4 standard glasses per day is beneficial, less, and especially, more than 4 standard glasses, are not so.**

Excerpt: ETHANOL, NADH, AND THE LIVER

'The human body can dispose fairly readily of most toxic products of its own manufacture, such as carbon dioxide and nitrogenous wastes. In contrast, most ingested toxic substances, such as ethanol (beverage alcohol), must first be broken down by the liver, which possesses special enzymes not present in other tissues.

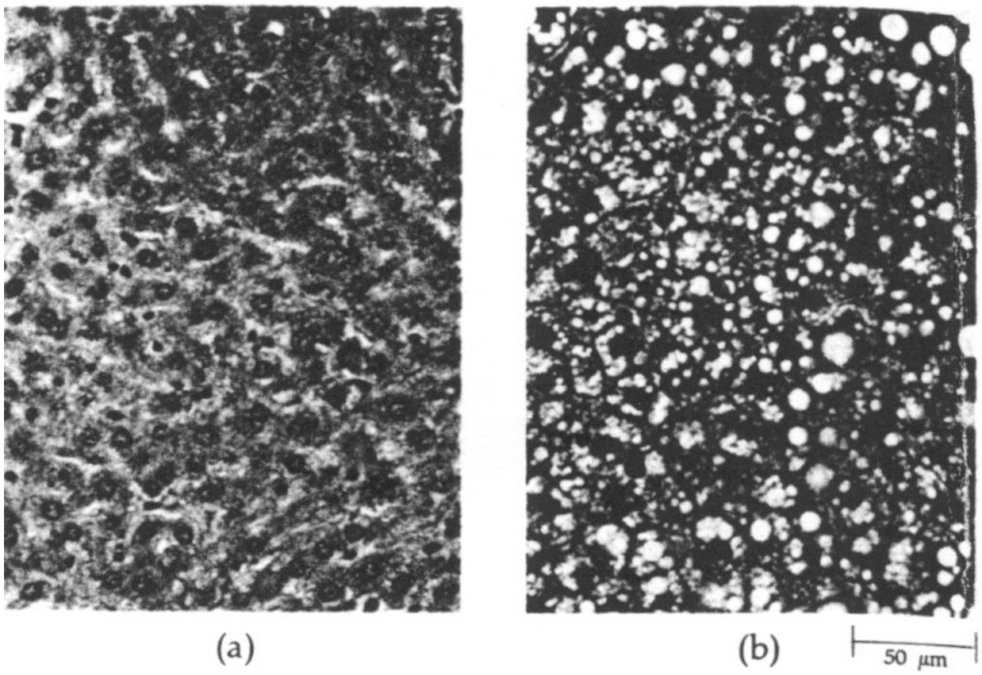
It has been known for many years that heavy drinkers are at great risk for severe, and often fatal, liver disease. Studies conducted by Charles 5. Lieber and his colleagues at the Bronx Veterans Ad ministration Hospital and the Mount Sinai School of Medicine in New York City have demonstrated that the origin of the problem lies in the simple chemical steps involved in the breakdown of ethanol. Enzymes in the liver first oxidize ethanol (CH3CH2OH) to acetaldehyde (CH3CHO), removing two hydrogen atoms and reducing a molecule of NAD+ ; this is the reverse of the second reaction shown in Figure 9-5a on page 193. The acetaldehyde is then oxidized to acetic acid, which is, in turn, oxidized to carbon dioxide and water and eliminated from the body.

The chief culprits in the development of liver disease are the hydrogen atoms, (electrons and protons), removed from ethanol. These "extra" hydrogens, carried by NADH, follow two principal pathways within the cell. Most are fed directly into the electron transport chain, producing water and ATP. Because of the high levels of NADH present in the cell from the oxidation of ethanol, the production of NADH by glycolysis and the Krebs cycle is reduced.

As a result, sugars, amino acids and fatty acids are not broken down but are instead converted to fats. The fats accumulate in the liver. The mitochondria also swell, presumably as a result of the distortion of their normal function, the electron transport chain is doing very heavy duty, while the Krebs cycle is effectively shut down.

Other hydrogen atoms are used in the synthesis of glycero-phosphates and fatty acids from the carbohydrate skeletons that are not being processed in glycolysis and the Krebs cycle. More fats accumulate. It does not take long. In human volunteers fed a good high-protein, low-fat diet, six drinks (about 10 ounces) a day of 80 proof alcohol produced an eightfold increase in fat deposits in the liver in only 18 days. Fortunately, these early effects are completely reversible.

The liver cells work hard to get rid of the excess fats. The fats are not soluble in water (or in blood plasma). Before being released into the bloodstream, they are coated with a thin layer of protein. This coating and secretion process is carried out on the membranes of the endoplasmic reticulum. The liver cells of heavy drinkers show enormous proliferation of the endoplasmic reticulum



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(a) Normal liver tissue from a rat fed a balanced liquid diet for 24 days.
(a) In this liver tissue from another rat fed a liquid diet in which ethanol provided 36 percent of the total calories, many globular fat droplets have accumulated. This rat was also maintained on its special diet for 24 days.

As we noted, the fat deposits are initially reversible, but after a few years, depending on how much alcohol is consumed, liver cells engorged with fat begin to die, triggering the inflammatory process known as alcoholic hepatitis. Liver function becomes impaired. Cirrhosis is the next step; it is the formation of scar tissue which interferes with the function of the individual cells and also with the supply of blood to the liver. This leads to the death of more cells. The liver can no longer carry out its normal activities, such as breaking down nitrogenous wastes, which is why cirrhosis is a cause of death. In fact, cirrhosis of the liver is the seventh leading cause of death in the nation, and the third leading cause of death between the ages of 25 and 65 in New York City.

Not so long ago, it was commonly believed that a good diet was all that was required to protect even a heavy drinker from the deleterious effects of alcohol. In fact, if one were just to add a few vitamins to the alcohol itself some sophisticates maintained, most of the long-term physical damage of alcohol would disappear. This new evidence refutes these comforting notions, and it comes at a time when alcohol is enjoying a resurgence of popularity among persons of high school and college age. (In populations of postgraduate age, as in other human societies the world over, it never lost its status as the drug abuse of choice.)'

Excerpt from **Biology,** H. Curtis, Worth NY 1984, 4th Edition
ISBN 0-87901-186-6, p. 206, Section 2, **Energetics,**

Helena Curtis obviously cared about the health of her students, as well as catering for their knowledge of Biology.

For other information on this theme, see **AIM,** and **The Society of the Medical Friends of Wine,** both have good commonsense information of wine and health, well worth the quest to educate yourself in these matters. **New Scientist** has an **Alcohol Supplement,** also interesting.

Ethyl Carbamate: Op cit, nitrogen nutritional balance **using DAP, diammonium phosphate, is necessary to prevent formation of the BOP urea** which the yeast cannot metabolise. **Urea, (carbamide CH4N2O) plus ethanol, (C2H5OH) produces ethyl carbamate, an ester of carbamic acid, (NH2.COOH), also being both a urethane, and a carcinogen. Thus use only food grade DAP, which has no urea contamination, and add the DAP before fermentation begins for optimum results.**

Ensure that the DAP supplement is not excessive, as excess nitrogen nutrition will lead to EC formation also. Remove pits from stone fruits as they are very likely to contain sugar-bound cyanides, pre-cursors of ethyl carbamate. **All fermented foods and beverages will contain traces of EC, so minimising occurrence of this unwanted BOP is recommended**.

For more detailed information regarding EC and winemaking in general, **see Ethyl Carbamate Preventative Action Manual**, C. Butzke et al; just put this into your Search Engine. The Summary will be of especial interest for any sort of winemaking.

Important Elements of Life and some related compounds are discussed that would be of interest to the home winemaker/brewer. These elements and compounds, in particular occurrences and combinations, manifest properties that all have some bearing on winemaking and brewing.

Water **is composed of 2 elements**:

1) Oxygen: symbol 0, non-metallic element, seldom found as 02 apart from the 19%-21% in atmosphere, also found as the allotrope ozone, O3, in the upper atmosphere, and occasionally at sea level, though mainly as a pollutant due to photochemical effects. The remainder of oxygen is in combination with other elements as an oxide, proportions in the lithosphere 47%, in oceans 89%, and 3 stable isotopes. Oxygen will combine with most elements as an oxide, especially with the addition of heat. **Discovered by Joseph Priestley, 1774**, who derived it in pure form after heating mercuric oxide.

Properties: Colourless, odourless, and tasteless gaseous element, important as an oxidising agent, being an electron donor, and electro-negative, seldom found as O2 because of inherent reactivity, supporter of combustion, and constituent of water. Supporter of respiration for many terrestrial life forms, originating as a by-product of photosynthesis in plant life-forms, which, in turn, utilise carbon dioxide originating from oxygen respiration of other life forms as per **The Carbon Cycle**.

Oxygen is important in winemaking as a constituent of water, for yeast proliferation during primary fermentation, and also for micro-oxygenation, wine aging, etc. Undesirable oxidation of wine may be exacerbated by chemical and/or microbiological means, and thus must be carefully controlled throughout the winemaking process, especially with the making white wines.

2) Hydrogen: symbol H, the lightest element, being a single proton with one electron attached, plus 2 stable isotopes; mostly found in gaseous form as H2. Most abundant element in the Universe, being a constituent of water, minerals and organic compounds on Earth. Hydrogen combines with many elements to form hydrides. **Discovered by Robert Boyle, 1659, and its properties were elucidated by Henry Cavendish, 1766.**

Properties: Colourless, but very reactive, a proton donor, a strong reducing agent, and the active constituent of acids in the H+ or ionic form. The nature of the electrostatically charged portions of contiguous polar molecules produces hydrogen bonds in water molecules responsible for surface tension, the phenomena of latent heat, heat capacity, and heat of vapourisation. The hydrogen part of the molecule is therefore more negative and the oxygen poles are more positive. This type of bonding is also important for the tertiary structure of proteins. Hydrogen is important for winemaking as a constituent of water, amino acids, and of organic acids such as acetic acid, citric, tartaric, benzoic, etc.

Water in general: Symbol H20, hydrogen oxide, oxygen hydride, the covalently bonded, 104°5' chevron-shaped molecule, with a single hydrogen at the apex, and the two oxygen atoms as each leg. Seldom seen in the ionic form, HO^-+ H3O+, as the **pure** liquid form, although often existing with other dissolved salts as an ionic and/or electrolytic solution. Water is also the universal solvent, due to polar properties of the molecule. In pure liquid form, each molecule will be associated with four other water molecules because of polarity, thus water can be considered a continuous compound. Water is also commonly associated in compounds as **water of crystallization**. Water was 'discovered' conclusively by **Henry Cavendish**, (1731-1810), in **1781**, when **inflammable air**, now known as hydrogen, combusted with the atmosphere, ie with the oxygen component thereof, forming water vapour that condensed into droplets on the walls of the experimental vessel he was using, although he did not fully understand the true chemical nature of the reaction.

Properties: COT in pure form. Latent heat and fire-quenching properties, including vapourisation, that will help to exclude, cover, or inhibit other combustible gases or materials. Also capable of extensive range of mechanical activity involving physical association with, and transfer of, materials by means other than by chemical combination. In, brief, pure water is mainly characterised by solvent power, thermal capacity, permittivity, pH neutral, and general abundance, especially in the **biosphere.** Ionic changes in water solutions will depend on the solutes involved, but the measure of acidity, or H+ ions, and alkalinity, OH- ions, are described by the pH scale. As well as the **hydrogen bonding** phenomenon described above, water solutions also manifests weaker **van der Vaals interactions** that are necessary for enzyme reactions.

Ionic/electrovalent bonds and **hydrophobic bonds** are also biologically important. Water is vital for all organic life forms, especially for respiration, plus many inorganic processes, as well as physical transport of material. Osmosis and electrical conduction in cells depend on **ionisation**. **Water potential** refers to the free energy of water in solution in a cell which enables movement by **diffusion, osmosis, or vapour transport.**

BP 100˚C, FP 0˚C, greatest density at 4˚C, the most common form on our planet being as a liquid between these temperature points, also as vapour, or ice. Both boiling and freezing points can be altered depending on solutes or other additives, also air pressure. Water has the highest heat capacity and latent heat of all substances, also characterised by latent heat of evaporation required to allow transition from liquid to vapour. Water also demonstrates the phenomenon of sublimation, whereby ice may transform to vapour, in certain conditions, (gradually), without assuming the intermediate liquid form. Ice is 11% greater in volume than water.

Hard water, containing mostly calcium and magnesium ions, is considered beneficial to some brewing processes because of taste enhancement. Softer water has more sodium ions, or is attained by replacing Ca and Mg with Na/sodium ions, or is just pure, and thus ion-free water. There may even be combinations of all three ions in some groundwater. Ca, Mg, and Na ions will all and singly affect pH. Ca and Mg ions, better for darker beers, will lower the pH slightly; bicarbonate of soda, NaHCO3, will raise pH, which is better for pale beers. Kit beer concentrate should be self-contained, so clean, untainted water would be the general standard for that process.

However, that sort of detail can only be made relevant with proper water testing. The term water hardness is more related to soap and detergent use in water, but the types of soluble and reactive ions that also affect pH are important here, and there may also be ions present that react unfavourably with brewing and winemaking at different stages, including possible toxicity that may inhibit or even destroy yeasts.

Water for winemaking should be clean, pure and untainted, and **ion-free**, especially for commercial winemaking, because some procedures such as ion exchange require water to be as pure as possible, and therefore ion-neutral in nature. Rainwater or filtered water would be optimum for homewinemakers. Even the water from a clear mountain stream would need scrutiny for **all** brewing and winemaking processes, for mineral content, and especially for wildlife, which boiling, filtering and/or treatment with meta would deal with, although there still would be cleaning procedures to consider. (See also **whisky** and whisky distillation, appropriate water sources are most important!)

Cleaning procedures for both brewing and winemaking can also be affected by water ion content and pH, as cleaning agents may be reduced in efficiency, so their type and efficiency should be related to water quality and content.

The fact that water is so abundant on this planet in liquid form is a happy cosmic accident, as are the carbon-based life forms that have evolved here due, collectively, to the proximity from a local medium-sized star, our Sun, with a sufficient variety of elements present, plus the narrow margin of conditions suitable for life that have produced a suitable atmosphere, and a temperature range that will sustain carbon-based life forms, which, in turn, is also maintained as a balance in large part due to the latent heat/heat capacity properties of water in its various forms. (The **hydrosphere** refers to the water zone of the planet).

Temperature auto-regulation for many life forms is due to the physical properties of water, and water is a major constituent of cells, and of organic processes. Water will absorb significant amounts of heat, but conversely will lose heat relatively slowly, so a body of water, such as in a wine must, will need temperature regulation that ensures an optimum range for the well-being of the yeast. **Bound water**, found within the **hydration** spheres of ions is immobilised, and the more bound water in cell or solution, the lower the potential freezing point, and higher the potential boiling point.

Hydrophobic surfaces lack surface charges and are not wettable, **hydrophilic** surfaces vice versa, which also explains capillarity, as water molecules can be drawn upwards by **electrostatic attraction**. Insoluble substances are electrically negative, with no potential for electrostatic reaction with water, and hydrogen bonds are re-established which exclude the insoluble substance, and water molecules clump together on insoluble or water-repellent surfaces, or vice versa. Hydrophobia is the basis for the spontaneous development of cell membranes which have an exclusive or inclusive function in organisms. A surfactant alters this surface tension-inducing hydrogen bonding, which also explains why detergent residue inhibits the formation of a head on poured beer.

Relevant water-related terms of interest: **absorption, adsorption, dehydrate, deliquescent, electrostatic, emulsion, hard, hydrate, hydrophilia, hydrology, hydrolysis, hydrometer, hydrophobia, hydroxide, soft, solution, suspension..?**

Carbon dioxide: CO2, a COT gaseous covalently-bonded linear molecule with no electrical polarity, carbon molecule in the centre, oxygen molecules at each end, **now (2004), 0.038% of the atmosphere.** Carbon dioxide is the principle source of carbon, which is, in turn, the principal structural element of living tissue.
CO2 dissolves readily in water, a low-energy and easily reversible reaction, forming hydro-carbonic acid, H2CO3. (Also responsible for the bite in your fizz, as well as the fizz itself, and also influenced in nature and behaviour by surface tension)

Uses in winemaking: As a sparging gas, and to protect from atmospheric oxygen and inhibit spoilage bacteria on wine surfaces although more likely to be used for treatment or processing of white wines rather than red. Also important to maintain wine palatability, even still red wines need some dissolved CO2 for this reason, and sparkling wines need extra CO2 for that fizz. See also **nitrogen**, below. **Note that care must be taken to ensure that this colourless and oxygen-displacing gas does not build up in confined spaces, and ensure adequate ventilation when necessary.**

Carbon: Symbol C, non-metallic element plus 2 stable isotopes, occurs in the free state as well as in carbon compounds. Present in all living organisms as part of the **Carbon Cycle** in Nature, which cycles carbon from the atmosphere to plants, animals, dead organisms, and carbon deposits that have provided fossil fuel energy, and back to the atmosphere. Carbon forms stable covalent bonds with other carbon atoms, and with hydrogen, oxygen, nitrogen, sulphur, in various chain or ring configurations.

The Web of Life therefore depends on a particular web of elements, compounds, organic compounds, plus their interactions, especially water, oxygen, hydrogen, and carbon dioxide, nitrogen and sulphur as above. Both **carbon dioxide** and **oxygen** are vital for life processes; CO2 provides carbon for building necessary organic molecules like proteins and carbohydrates, and oxygen is necessary for life forms whose respiration depends on oxygen, which is important as an electron receiver for energy transfer in cell metabolism.
Plants process carbon dioxide by photosynthesis to form oxygen and water, so, without plants, that key aspect of the carbon cycle would be deleted, and the basis of oxygen dependent life forms could not be naturally sustained. A balance of free carbon dioxide in the atmosphere must be maintained at a level that balances plant intake, or increased global warming will ensue. The **Web of Life**, **The Carbon Cycle**, and **The Energy Cycle** should all remain in balance to sustain life on this planet, not least so that horticulture, winemaking, winemakers and brewers, and their helpful yeasts, may continue to thrive!

Oxygen will dissolve in water, and, as well, aquatic plants release some oxygen into water. Plant life, terrestrial and aquatic, is the principal source of atmospheric oxygen that sustains so much other non-flora life forms on Earth. Dissolved oxygen is important for primary fermentation in wine and beer making, micro-oxygenation control is important in remaining stages, and macro-oxygenation is most **un**desirable.

Hydrogen is necessary for the formation and interaction of acids in ionic solutions, especially organic acids, but before any of this occurs, hydrogen is converted, by fusion, to helium in the sun, providing for the release of the light and heat energy so necessary for release of chemical energy for life forms here on Earth. One of these vital chemical energy release reactions concerns the respiration of glucose, so vital to life forms such as humans, and also to the well-being of the yeast that aids the making of our beer and wine.

Note that there is a small minority of organisms that do not use CO2 and O2 for respiration, notably thermphiles that exist around undersea volcanic vets, utilizing hydrogen sulphide for cell respiration. They go back much further than the rest of us, as well!

Nitrogen: Symbol N, colourless, odourless gas, usually occurring atmospherically as N2, or, in chemical combination with other elements, especially as nitrates and nitrites, and as a protein component, some 16%, of plant and animal tissues, including that of the winemaker and brewer, and their chosen yeast.

Uses in Winemaking: As an “inert” sparging gas, or to limit contact with atmospheric oxygen, and inhibit the growth of spoilage yeast on the wine surface, whenever required, during the wine-making or storing processes. Nitrogen is less soluble that CO2, so it is more likely to be used with still red table wines than CO2. Nitrogen may be used alone, or in combination with CO2, in wine treatment or processing, depending on the circumstances, one of which is to limit dissolved CO2 in a given volume of sparging gas when necessary.

Nitrogen gas bubbled through wine will also remove residual oxygen, but it is better to limit oxygen throughout the winemaking process beforehand, as this bubbling will also remove desirable volatile compounds. See also **carbon dioxide** above. **Note that care must be taken to ensure that this colourless and oxygen-displacing gas does not build up in confined spaces, and ensure adequate ventilation when necessary.**

Suphur: Symbol S, yellow non-metallic element, can occur naturally, and has various natural forms, is chemically very reactive, and will combine with most other elements. Sulphur is **essential element** in plant and animal tissue, eg as a component of the **essential amino** acid methionine, and sulphur is also required for amino acid synthesis in plants and animals.

Uses in winemaking are mainly as reducing agent of free oxygen, and an inhibiter and eliminator of undesirable organisms, usually in sodium or potassium metabisulphite forms. Historically sulphur in natural form was burnt for the sanitizing of vats and barrels. Sulphur is also used in vineyard sprays, such as copper sulphate, or as sulphur dust, but becomes undesirable if residues later persist as hydrogen sulphide gas dissolved in finished wine, so care must be used in these applications. Care must also be taken in using metabisulphite in winemaking so that free excess does not taint finished wine.

Amino Acids: Water-soluble organic molecules mainly composed of **carbon, hydrogen**, **oxygen, nitrogen**, including a **basic amino group, NH2**, and a **carboxyl group, COOH,** that combine as peptides, which in turn combine to make up the 20 amino acids, in various proportions, that constitute proteins found in all living organisms, including the brewer/winemaker, and their yeast. Many amino acids are classed as essential, some amino acids do not function as protein building components, but still are important, even essential, for cell growth and function.

Essential Elements for plants and animals: (**Principal elements are in bold.)**
Hydrogen, carbon, nitrogen, oxygen, sodium, magnesium, phosphorus, sulphur, chlorine, **potassium, calcium,** manganese, iron, copper, zinc, selenium. **Potassium** and **chloride ions** are important electrolytes in cells and body fluids, especially for osmosis and electrical potential. **Phosphorus** has its own cycle, too, between plants and animals!
There are other minerals essential to particular species, such as iodine for humans. Other essential trace elements include silicon, vanadium, cobalt, molybdenum, boron, fluorine, chromium, bromine, lithium, aluminium, nickel, strontium, barium, rubidium and tin.

But, information on which of these are required, for optimal nutrition and function of whatever species, is well beyond the scope of this humble Winemaking Beginner's Factfile. This sort of information extrapolation is a matter of how far you personally may wish to push the limits of your brewing and winemaking knowledge, however, even this small sample easily demonstrates the interconnectedness of winemakers, brewers, and their yeasts to just about everything else in our one and only natural biosphere!

Volatile Acidity aka the presence of acetic/ethanoic acid and ethyl acetate/ethyl ethanoate/acetic acid ethyl ester, in finished wine:

Acetic acid: CH3COOH, colourless liquid with a pungent vinegar odour.
Ethyl acetate: CH3CO2C2H5, colourless liquid with a fruity odour, **pear drops,** but with solvent overtones when concentrated.

The three main causes of VA presence, during winemaking, are as BOPs, as byproducts of MLF, and by other bacterial action, especially that of acetic acid bacteria. These compounds are unavoidable as BOPs, **but careful, carefully planned, and otherwise hygienic winemaking procedures will limit their presence**. Small amounts are acceptable, even desirable to some tastes, but there are risks in making wine without regard to limiting volatile acidity, because the taint of unwanted VA cannot be removed once the wine is made.

Apart from BOP origin, (by yeast activity and some **esterification**), and MLF origin, **oxidation of alcohol** will produce VA products, and also oxygen will further aid bacteria in creating more VA. Both products usually occur concurrently, although the vinegar odour is usually dominant.

Respiration which involves fermentation, is in broad terms an energy–producing and transfer process necessary to maintain cell metabolism in humans, saccharomyces cerevisiae yeasts, and many other forms of cellular life, when specifically derived from **glycolosis** and the **pyruvic acid cycle** in cell respiration. There are other forms of cell life that utilize respiration involving similar 'fermentations', which are more likely to be classed as **biochemical reactions**, (apparently about 10 in number), and **malolactic 'fermentation'** is one of these, utilizing, as it does, malic acid in the cellular energy-producing and transfer process, with byproducts of CO2 and lactic acid.

Fermentation, as undertaken by the unicellular moisture-dwelling fungus, saccharomyces cerevisiae, is the similar energy-deriving exergonic catabolic conversion of pyruvate to CO2 and alcohol, primarily in an increasingly oxygen-poor environment, whilst metabolizing pyruvate as a facultative anaerobe, and, **catabolic** meaning the process of breaking down of larger to smaller molecules. (Believe it or not..!)

This last section, pp. 23-31, from **Common Chemicals** to **Volatile Acidity**, plus various other details and comments in this Factfile, (by no means exhaustive in treatment), were compiled with relevant help from:

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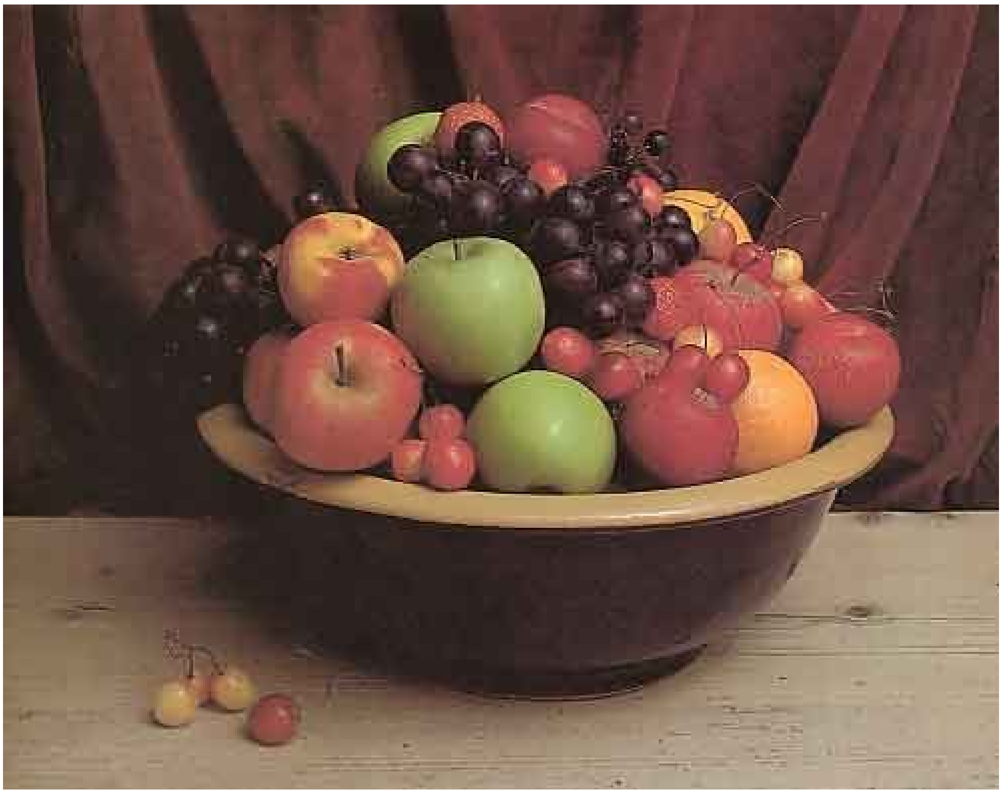
and, not forgetting **David Attenborough, et al, et passim**

Kodak



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