The Making of Dry Red Wine

First Publication of the last scientific essay written by the late

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The outstanding difference between dry white and dry red wines is their difference in colour. But this is not all. Red wines will as a rule be more astringent, i.e. they will be richer in tannin than white wines. Where a red and a white wine are made from the same black grapes, the former will as a rule contain more tannin and more dry extract, but less alcohol and less total acidity than the corresponding white wine. Thus *Ventre,* l.c.I, p. 357, quotes the following figures for wines made from the same black grapes:—

	Alcohol.	*Total Acidity.*	*Tannin.*
Total crushed grapes (red wine)	10.0 vol %	4.6	1.60
Total crushed grapes with stalks doubled (red wine)	9.7 vol %	4.4	2.50
Must fermented alone (white wine)	10.4 vol %	5.1	0.12

Dugast, l.c., p. 195, quotes the following results taken from a publication by Prof. Fonseca:—

	Experiment No. 1.			Experiment No. 2.			Experiment No. 3.		
	Red wine.	Vin rosé.	Diff.	Red wine.	Vin rosé.	Diff.	Red wine.	Vin rosé.	Diff.
Alcohol (vol. %)	12·84 12·73	13·18	+0·34 +0·45	13·58	13·86	+0·28	11·97	12·57	+0·60
Total Acidity	5·25 5·68	6·00	+0·75 +0·32	6·22	6·22	nil	6·00	6·25	+0·25
Dry extract	34·87 34·82	28·26	−6·61 −6·56	36·14	29·39	−6·75	32·65	27·11	−5.54
Tannin				4·48	1·10	−3·38	1·95	0·45	−1·50

" Vin rosé " above means a pinkish or rose-coloured wine made from the same grapes as the corresponding red wine but fermented without the husks or removed from the husks after a very slight fermentation had begun and thus made more like a white wine than a red wine.

1. The Colour of Red Wine.*

(1) *Influence of variety of grape.*—Whilst a decent red wine can only be made from a grape that develops a black colour when ripe, the amount of pigment formed varies with the variety. Usually the grains of pigment are deposited in the three or four outer layers of cells of the skin. In such cases the pulp and hence the fresh juice is white or greenish but not red when the grape is fully ripe. This accounts for the possibility of making a white wine out of black grapes, for instance, white Champagne out of the black Pinot grape.

We do sometimes find grape varieties like Teroldigo, Isabella, etc., where the pigment is found in the inner layers of cells of the skin and hence on crushing give a coloured juice. Some varieties have a deep red juice when fully ripe, since the colouring material has diffused into the pulp. Examples of this type of grape are Pontac (" Teinturier ") and its hybrids Alicante-Bouschet and Petit Bouschet, Souzao, direct producers like Seibel 117, etc. Needless to say, these grapes produce a very deep red wine.

Grapes belonging to the normal type will, everything else being equal, produce darker coloured wines as the berries become smaller. Thus Hermitage (" Cinsaut ") will as a rule not produce such a dark wine as Shiraz or Cabernet Sauvignon. The explanation is that the ratio between the content of a sphere and its surface grows with its radius. Hence the bigger the radius (berry) the bigger the ratio between the pulp and the skin and the greater the dilution of the colouring material in the must.

(2) *Influence of degree of ripeness.*—Once the grapes are fully ripe and have been sufficiently exposed to the rays of the sun, they have developed their full complement of pigment. By waiting till the grapes are overripe and more or less wilted, the amount of juice in the berries is reduced and consequently the colour of the wine obtained from such grapes will be darker than if they had been picked when just fully ripe.

(3) *Influence of some other factors.*—A *very heavy crop* and *lack of sunshine* will result in the production of less oenin in the grapes than would otherwise have been the case. *Copious irrigation* can produce the same result, since it makes the berries grow bigger and increases the juice relative to the grape-skins thereby reducing the colour of the wine made from such grapes. *Diseased grapes,* especially when attacked by Botrytis, soon lose a great deal of their pigment and tannin and thus become worthless for the production of a good red

* See Perold, " A Treatise of Viticulture," pp. 57, 134, 135.

wine. The nature of the *soil* and *climate* are also of great importance in this connection. Thus at the Cape our best red wines are made in the Cape, Paarl and Stellenbosch districts where the soils are lacking in lime and general fertility and are usually not irrigated, whilst the Worcester, Robertson and Montagu areas with their generally less acid to sweet and more fertile soils, which are usually irrigated, generally produce only inferior dry red wines. In my opinion the main reason for this is the relative productivity of the respective soils under the governing conditions. I feel all the more convinced of this since the world-famous Burgundies of France are produced on soils rich in lime if anything, so that sweet soils cannot necessarily be unsuitable for the production of good dry red wines.

The *temperature* of the must whilst fermenting in contact with the husks is of great importance. A proper contact at, say, 30-32° C. (or 86-90° F.) is desirable if a very dark-coloured wine high in extract is aimed at. This is safe if 8 oz. Pot. metabisulphite per ton of grapes is added as the crushed grapes enter the fermenting tank. In this case a contact of 3-4 days between the must and husks will suffice. At a low temperature of say 20° C. or 68° F. the grape pigment will dissolve more slowly and the contact between must and husks may have to be prolonged to get sufficient colour in the wine. This is generally not desirable as the soundness of the wine may thereby be impaired. However, by fermenting at 20° C. the wine will have a more delicate bouquet than when fermented at 32° C.

Acids and alcohol. — *Nessler* (see *Nessler-Windisch*, l.c., pp. 266-267) carried out an experiment to determine the solvent action of the *acids* and *alcohol* on the pigment of the grape. Black Pinot grapes were carefully crushed and the skins were washed free from must with water. Equal weights of these skins were then covered with equal volumes of aqueous solutions of 0.6 per cent. tartaric, malic, succinic and acetic acid and with 10 per cent. alcohol with and without tartaric acid. After four days the liquids were filtered off. Their colours differed in intensity and, beginning with the most deeply coloured and finishing with the least coloured, were as follows:—

1. Tartaric acid and alcohol.
2. Tartaric acid.
3. Alcohol.
4. Malic acid.
5. Succinic acid.
6. Acetic acid.

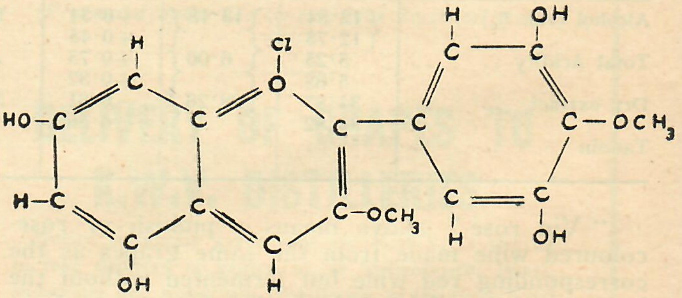
This shows that the solvent action of these acids rose with their electrolytic dissociation and that alcohol is a powerful ally in dissolving the pigment out of the husks.

Loss of colour may result from an *unduly prolonged contact with the husks.* *Nessler* tested this in an experiment with black grapes freed from their stalks which he allowed to ferment in glass flasks. By measuring the colour of the must fermenting at 14-16° C. from time to time, he found that, if the maximum colour of the must be put at 100, then the must

pressed out at the beginning	equalled	8
pressed out after 2 days	equalled	35
pressed out after 4 days	equalled	70
pressed out after 8 days	equalled	100
pressed out after 10 days	equalled	80
pressed out after 12 days	equalled	70
pressed out after 14 days	equalled	65
pressed out after 16 days	equalled	60
pressed out after 18 days	equalled	40

Thus after 18 days the colour had almost gone back to what it was after 2 days. After 3-4 days' contact between the fermenting must and husks the must should be separated from the husks in hot climates. In mild to cold climates 5-8 days will usually be right to get a well-coloured wine. In hot climates the colour is extracted fairly rapidly and one runs the risk of making sour wine when leaving the fermenting must too long in contact with the husks.

(4) *The Nature of the Pigments.*—After a great deal of research had been done by previous workers *Willstätter* (see Von der Heide-Schmitthenner, l.c. pp. 73-74) and his collaborators in 1913, 1914 finally discovered the constitution of the red-wine pigment. According to him it belongs to the great group of the anthocyans. These are vegetable bases which owe their basic properties to tetravalent oxygen in quinoid binding: =o⤺cl. Furthermore they are glucosides. The anthocyan of the grape Willstätter called *Oenin.* It is a monoglucoside of *oenidine,* $C_{17}H_{14}O_7$ or as hydrochloride $C_{17}H_{15}O_7Cl$ with the constitutional formula.



Red wine contains both oenin and oenidine. Willstätter assumes that during fermentation some of the oenin is hydrolysed into glucose and oenidine.

$$\underset{\text{Oenin}}{C_{23}H_{24}O_{12}} + \underset{\text{water}}{H_2O} = \underset{\text{Oenidine}}{C_{17}H_{14}O_7} + \underset{\text{Glucose}}{C_6H_{12}O_6}$$

According to Von der Heide oenin was extracted from black grape skins by means of glacial acetic acid and then precipitated from solution by ether. This raw product forms a sparingly soluble picrate which can easily be converted into the well crystallising hydrochloride. The crystals show a dark red or brownish red colour and when finely powdered the colour becomes a violet red. With soda the acid solution of oenin turns a blue violet until violet blue. On boiling oenin for a short time with hydrochloric acid, it is hydrolysed and oenidine separates out as a greybrown flocculent precipitate. Oenidine hydrochloride is easily soluble in water and in alcohol. In the former case the solution shows a reddish brown colour and in the latter a beautiful violet red. With soda the oenidine solution turns violet and with sodium hydrate it turns blue and soon spoils.

That the continued action of the air throws the colouring substance out of solution has been known to the practical cellar-man for a long time already. In France and Italy the true pigment is extracted from black grape skins and sold as *oenocyanin* which can be used for colouring up red wines lacking in colour. The colour of a red wine will last longer where the total acidity is high than where it is low. Hence the practice of adding tartaric acid to crushed stemmed black grapes. The acid also facilitates the passing into solution of the pigment in the grapeskins. Once fermentation has begun the alcohol thus formed also brings the pigment into solution.

The addition of sulphur dioxide or potassium meta-bisulphite causes a momentary loss of some colour through reduction but nearly all this comes back when the wine is subsequently racked in contact with the air. The presence of some sulphur dioxide in the wine acts as a brake on the action of air when this gets in contact with the wine and so tends to preserve its colour. When a red wine is matured for a number of years in small wood (pipes, hogsheads or barriques) it loses colour and the original red tint becomes reddish brown or tawny and ultimately a brownish yellow. This I saw happening with Pontac. Even bottled wines undergo this process, only more slowly. The oxidised pigment separates out in flakes.

Finally I wish to point out that the colouring matter of the grape is more or less closely related with the grape *tannin*, also called *oenotannin*. Emil Fisher found the latter also to be a glucoside, namely a penta-di-galloyl-glucoside, CH_2OR.-CHOR.CHOR.CHOR.CHOR.CHO, where R stands for $C_6H_2(OH)_3$ COO-$C_6H_2(OH)_2$.CO-(m-digalloyl). Hence oenotannin would have the formula $C_{76}H_{52}O_{46}$.

(5) *Tintometry.*—By this term we mean the measurement not merely of the intensity of the colour of the wine but also of the kind of colour it possesses. The colorimeter measures intensity of colour relative to some standard colour and is most useful in case of certain analytical methods, but the tintometer is the instrument which enables one exactly to measure the colour of a wine for intensity and kind. When a firm sells standardised types of wine where the colour must be kept constant, the tintometer is one's only salvation as it helps one very little to keep check samples of the wine for purposes of reference. A white wine will gradually gain colour and turn yellowish to yellowish brown whilst a red wine will lose colour and the red will gradually become more and more reddish brown or tawny and later a yellowish brown.

In my own work I found the *Lovibond Tintometer* a most excellent instrument for this purpose. It is made by "The Tintometer Ltd.", Salisbury, England. The one we use is "The British Drug Houses Pattern". See Fig. 1. Here m, m are the 60-watt Pearl Osram lamps which illuminate the magnesium

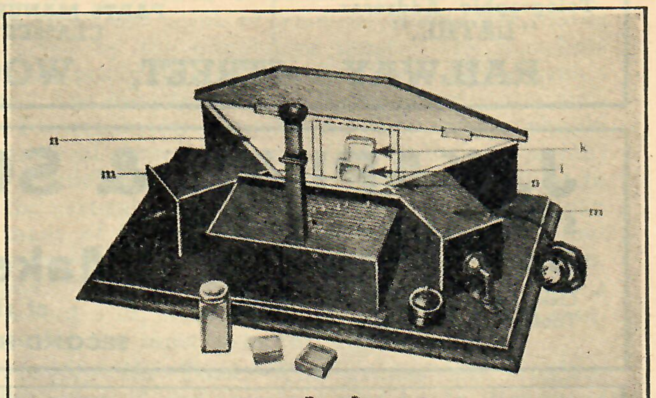


Fig 1

carbonate blocks k and 1 which should be so placed that the white light reflected into the instrument will be of equal intensity in both fields of view as seen through the adjustible eyepiece; n, n are specially constructed blue glass screens which as nearly as possible correct the light from the lamps to daylight. We generally use a 0.5" cell for holding the wine to be examined.

On the left one sees the colour of the wine and on the right the combined colour of the coloured glass discussed. There are for instance blue discs 0.1-0.9, yellow discs 0.1-0.9, 1-9, 10-18, 19-40, and red discs 0.1-0.9, 1-9,10-18,19-70. If the colour is given by 0.9 blue 7.5 yellow 7.5 red, it can be reproduced at will at any later date, and this is the great value of the instrument. Obviously the wine to be examined must be bright.

2. The Algerian Fermenting Tank.

As the name indicates, this type of tank was first built and made use of in Algeria for the making of red wine. It has many outstanding advantages of which the most important are:

(1) Automatic extraction of colour etc. from the husks by the fermenting must which keeps on circulating through the husks so long as an active fermentation is proceeding. The pressure created inside the tank by the carbon dioxide formed by the fermentation forces the must to circulate. As soon as a certain quantity of must has accumulated in the top tank and the inner pressure is sufficiently reduced, the must will run back into the tank.

(2) The fermenting must is partly cooled on being exposed to the air and the colder must from the bottom of the tank is continually being mixed with the warmer must in the cake of husks.

(3) The husks are not exposed to the air and can thus remain sweet and acetification is avoided.

(4) Once the young wine has been run off, the husks can very easily be removed through the lower opening (door) and taken to the press. From the top manhole make an opening through the cake of husks and allow the carbon dioxide to run out through the opened door, when a man can safely go in and push the husks out with a fork.

(5) The alcohol content of the wine thus made

should be higher and the volatile acidity lower than would have been the case if the fermentation had taken place in an ordinary open fermenting tank.

(6) The wine's colour and dry extract should be higher than from an open fermenting tank, even where the husks had been repeatedly pressed under during fermentation at a considerable expense in labour.

(7) Once the tank has done its duty as a fermenting tank for the season, it can be used as a storage tank for wine until the next vintage arrives, since it is an easy matter to put a proper lid on the man-hole and thus seal the tank hermetically.

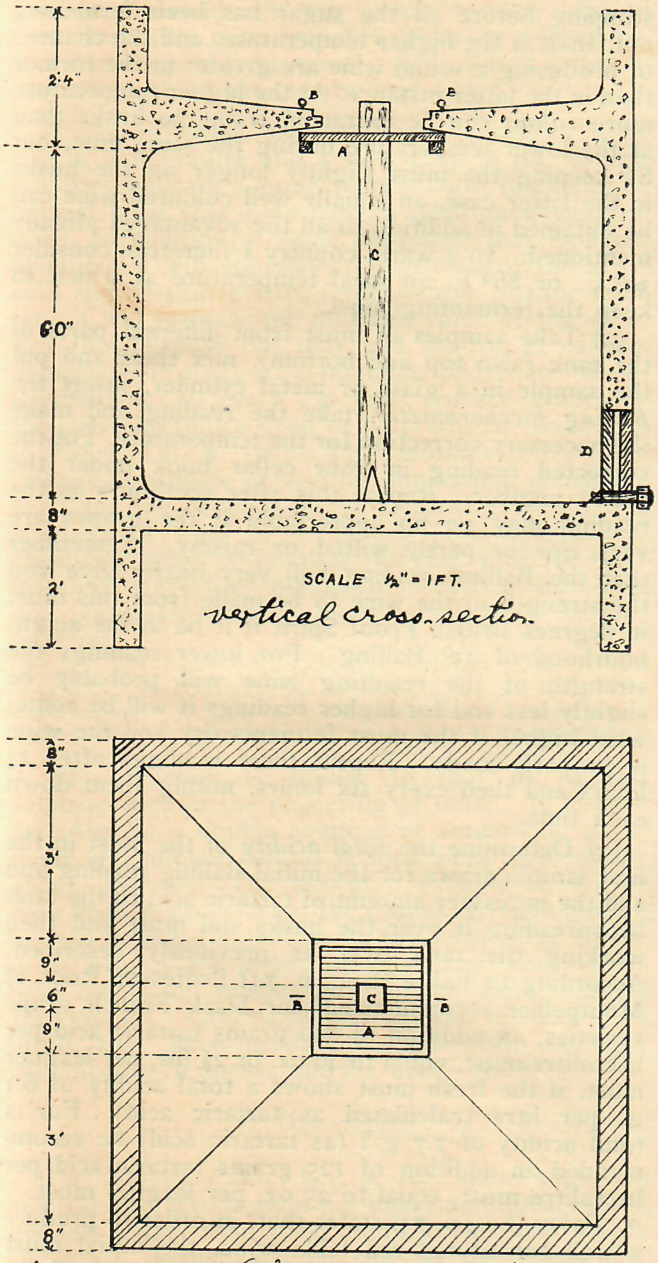


Fig. 2. Top of Algerian Fermenting Tank
A screen, B eyes for tying down C,
C pipe, D door.

The accompanying illustration (Fig. 2) gives the necessary information to enable one to build such a tank. The size may vary according to circumstances. I suggest a square horizontal cross-section for practical purposes although a cylindrical tank (hence circular cross-section) would be most ideal from the point of view of having the husks extracted by the circulating must. The man-hole must naturally be placed in the centre of the tank's roof. The dimensions recommended are given with the accompanying illustration. The screen should be made of some hard wood (oak or teak or jarrah) and should be constructed with a central opening to let the vertical wooden pipe through. The latter can be made of four boards (same wood as screen) put together to give a cross-section of say 5 x 5 in. square. From the bottom end of each board cut a slit about 2 in. wide finishing in a point about 8 in. up to let the must pass through.

Working the Tank.—The grapes are crushed, stalks removed and the must plus husks is pumped into the tank which is filled up to the man-hole. Now put in the screen and through the opening in its centre the pipe which is pressed down to the floor of the tank when its head will be only slightly higher than the top of the man-hole. A piece of string or a wooden slat tied to two eyes in the adjoining concrete will keep the pipe down.

As fermentation begins the husks form the usual cake over the fermenting must. Once sufficient pressure has been created by the carbon dioxide gas formed by the fermentation, must will pass into the top portion until the pressure has been sufficiently reduced, when the reverse process will take place by the must running down into the bottom tank. This takes place automatically and continues periodically so long as an active fermentation is proceeding.

Add the necessary pot. meta-bisulphite and tartaric acid as the tank is being filled. Cool the fermenting must if necessary and draw it off the husks when it shows about 6 degrees on the Balling saccharometer.

3. Open Fermenting Tanks.

As was described in a previous chapter one can also make use of open cement tanks when making a dry red wine—open wooden tubs or "kuips" are now seldom used in hot countries. In this case the cake of husks can be permanently kept below the fermenting must by means of suitable wooden screens, but this is seldom done. I recommend either the Algerian tank just described or else an open tank when the husks should be pressed under at least every three hours. According to the size of the plant one or more men can be kept permanently on the job. The work can be done either by a more or less naked person tramping down the husks by his feet and legs—this I do not recommend, or better by pushing down a 6-ft. pole having two round pieces of some hard wood, about 18 in. long and 1½ in. in diameter, fixed at right angles to the axis of the pole as well as to one another near its bottom end.

Once the tank has been filled to about 12 in. from the top it is worked over. Six hours later spray it lightly with a 2% solution of meta (1 lb. pot. meta-bisulphite in 5 gls. water) and repeat this twice every day (morning and evening). After a further six hours it is again worked over and thereafter every three hours. If this work is interrupted during the night, the tank should be sprayed with the meta solution after having been worked for the last time in the evening and this should be resumed first thing in the early morning. Thoroughly wash the pole with clean water after the last tank has been worked over and allow it to dry.

If the work is regularly well done, excellent results can be expected as far as this part of the wine-maker's task is concerned. Needless to say the cooler should be used as soon as the temperature in the husks rises beyond 90° F. or 32.2° C. and a further 4 oz. meta per leaguer of must or 20 grams per hectolitre may be added during the stormy fermentation, especially if the temperature goes beyond 90° F. and no cooler is available.

4. Cleanliness in the Cellar.

In wine-making one may truly say that "cleanliness comes next to godliness". Hence enough clean cold water should be available from numerous taps conveniently placed in every cellar. In order to facilitate the cleaning up of the cellar walls, floor, machinery, etc., this water should be under fairly high pressure. No must or crushed grapes or skins should be allowed to remain on the floors. Twice a day at least these should be washed and thereafter sprayed with a 2% meta solution (1% SO_2) to suppress microbes and the vinegar flies (*drosophila celeris*) which easily spread the acetic bacteria. Every evening the grape-crusher, all pumps and hose as well as the receiving bin should be thoroughly washed before ceasing work. This cleaning should also be extended to the baskets, boxes or other receptacles in which the grapes are picked in the vineyards. Where grapes are conveyed to the cellar in tubs or in a flat open wooden or metallic tank, these should likewise be thoroughly cleaned every evening before stopping work for the day.

5. Normal Routine Cellar Work During Fermentation.

In order to keep proper control of what is going on in his cellar the good wine-maker ought to keep a cellar book in which he keeps his records, the various items for each tank being entered on a separate page as each observation is made. From the receiving bin the grapes are fed into the foule-grappe or égrappoir. The husks and must are pumped into the fermenting tank until it is filled up to the desired point. During the filling add the necessary meta: 8 oz. per ton of grapes, equivalent to 200 mg SO_2 per litre, or 4 oz. per ton during filling and 4 oz. during the stormy fermentation. About one hour after the tank has been filled and worked over, the following operations are carried out:

(1) Take the *temperature* of the must by means of a suitable fermentation thermometer and note it down. Repeat this after 24 hours and from then on at least every six hours. During the stormy fermentation this should be done about every 2-3 hours. Every time note down the date, hours and temperature recorded. Do not let the temperature exceed 90° F. or 32.2° C. without immediately cooling down the must or adding 2-4 oz. meta per ton of grapes or 50-100 mg SO_2 per litre must. Professor Fabre (l. c., p. 91) states that it is desirable not to let the temperature exceed 38° C. (100.4° F.), but this I consider unsafe especially when dealing with very sweet grapes—say 24° Balling or more. At a somewhat low temperature, say 25° C. or 77° F., a more delicate, finer and somewhat stronger wine is obtained than at a fairly high temperature (35° C. or 95° F.). At the lower temperature there is less chance of the fermentation getting stuck, i.e., stopping before all the sugar has been fermented out, than at the higher temperature, and the chances of producing a sound wine are greater in the former than in the latter instance. At the higher temperature more colour can be extracted from the husks than at the lower temperature during the same time, but by keeping the must slightly longer on the husks in the latter case, an equally well coloured wine can be obtained in addition to all the advantages already mentioned. In a warm country I therefore consider 30° C. or 86° F. an ideal temperature at which to keep the fermenting must.

(2) Take samples of must from different parts of the tank (also top and bottom), mix them and put the sample in a glass or metal cylinder, insert the *Balling saccharometer*, take the reading and make the necessary correction for the temperature. Put the corrected reading in your cellar book under the tank's number. Repeat this after six hours as the reading may go up appreciably if the grapes are very ripe or partly wilted or raisiny. Remember that the Balling reading will very nearly give you the strength of the wine to be made from this must in degrees British Proof Spirit if it be in the neighbourhood of 23° Balling. For lower readings the strength of the resulting wine will probably be slightly less and for higher readings it will be somewhat higher if the must ferments dry and the wine is properly made. Repeat these readings after 24 hours and then every six hours, noting them down each time.

(3) Determine the *total acidity* of the must in the first sample drawn for the initial Balling reading and add the necessary amount of tartaric acid to the tank by spreading it over the husks and must and then working the tank over as previously described. According to Fabre (l. c., p. 74) Professor Roos of Montpellier recommended, for black French grape varieties, an addition of 200 grams tartaric acid per hectolitre must, equal to 40 oz. or 2½ lbs. per leaguer must, if the fresh must shows a total acidity of 6.1 g. per litre (calculated as tartaric acid). For a total acidity of 7.7 g/l (as tartaric acid) he recommended an addition of 125 grams tartaric acid per hectolitre must, equal to 25 oz. per leaguer must.

Fabre (l.c., p. 73) states that, in order to produce a well constituted red table wine, the initial must should have a total acidity equal to 5-7 g/l (as sulphuric acid), which means 7.6-10.9 grams per litre as tartaric acid. Prof. Roos assumed 8 g/l (as sulphuric acid) as normal in his case. At the Cape our European black wine grape varieties, when fully ripe, usually show a total acidity equal to about 6 g. tartaric acid per litre must. Hence, according to Prof. Roos, we should add about 2½ lbs. tartaric acid to every leaguer of fresh must (or ton of crushed grapes). Under our conditions 1½-2 *lbs. tartaric acid per leaguer of fresh must* should suffice for a good dry red table wine.

It must be remembered that a good deal of the tartaric acid again goes out of solution in the form of pot. bitartrate which separates out in the lees and on the husks. Thus *Fabre* states that, in order to raise the total acidity of the wine by about 1 gram per litre as sulphuric acid or 1.53 g/l as tartaric acid, one should add 190 grams tartaric acid to every hectolitre must (equal to 38 oz. or 2 lbs. 6 oz. to every leaguer fresh must). This shows a loss of 19.5 per cent. of the tartaric acid added.

4. *A lingering fermentation.*—Should a slow rise in temperature and a slow drop in the Balling readings indicate a poor fermentation (assuming a normal must that even had an addition of tartaric acid), an addition of some *phosphate* may be most helpful. It will stimulate the growth of the yeast cells and thus further the fermentation. At the same time it will increase the nutritive value of the wine. For this purpose one may add 100-200 g. calcium phosphate or 10-25 g. ammonium phosphate (di- or tri-ammonic) to every 130 kilos crushed grapes or for every hectolitre wine to be produced (according to *Fabre*, l.c., p. 126). This amounts to 1½-3 lbs. calcium phosphate or 2½-6 oz. ammonium phosphate per Cape ton of 2,000 lbs. of crushed grapes or 1.2 leaguers of wine to be made. This addition of phosphate tends to increase the acidity of the must through converting potassium bitartrate into acid pot. phosphate which is more soluble than the pot. bitartrate.

$$\underset{\text{mono-calcium phosphate.}}{CaHPO_4} + \underset{\text{pot. bitartrate.}}{KHC_4H_4O_6} = \underset{\text{Ca-tartrate}}{CaC_4H_4O_6} + \underset{\text{acid pot. phosphate.}}{KH_2PO_4}$$

This reaction is similar to that of calcium sulphate used in the plastering of must. In France and Algeria a double solution of ammonium phosphate and sulphur dioxide is sometimes used for the above purpose. The use of a suitable *starter* or *pure yeast* is necessary if the grapes arrive in a more or less unsound condition at the fermenting house or if grapes are picked shortly after heavy rains have fallen and washed most of the yeast cells off the grapes. Otherwise this is not necessary on farms that have produced good wines through spontaneous fermentation for many years.

6. Devatting.

For Algeria *Fabre*, l.c., p. 127, states that as a rule the contact between the husks and must should not last longer than 50-60 hours, or in other words the must should then be run off the husks, i.e. *devatting* can then take place. His rule is to devat when the mustimètre shows a density of 1025, which is equivalent to 6.3° Balling. At the Cape my experience has been that the period of useful contact between the husks and the must is 72 to 96 hours or 3-4 days. Then the devatting can take place and the must will either be dry or it may still show 4-6° Balling depending upon the initial sweetness of the grapes and the conditions prevailing during fermentation. If 8 oz. meta had been added to every ton of crushed grapes as they entered the fermenting tank, the fermentation may not get active until after 24 hours and devatting will be nearer 4 than 3 days after crushing. Cool weather will favour a good fermentation and not delay same so long as the temperature of the fermenting must does not drop much below 25° C. or 77° F.

7. Completing the Fermentation.

When the fermenting must is run off, it is usually first run into a sump which must beforehand be thoroughly cleaned and should have a screen of tinned wirenetting in a frame fixed in the sump to hold back any grape-skin and pips that might come along with the must. The clean must is pumped into a storage tank or vat until it is almost full—say one foot from the top. Now close the tank with a fermenting bung or, failing this, a clean sandbag. Keep watching the fermentation by measuring the temperature and the density of the must as well as by tasting it. When the fermentation gets feeble and there is still an appreciable amount of sugar present, the lees should be stirred up by blowing in air or by some other mechanical means. By tying a clean heavy chain 4-6 ft. long to a clean rope and letting the chain drop into the lees through the bung-hole and pulling it up and letting it drop again and again for 5-10 minutes a lot of lees will be stirred up into the young wine.

If *fresh, sound* lees are available from wine that has just been drawn off its lees, add say three buckets full of fresh lees to the tank whose wine has difficulty in fermenting dry. This will usually once more start a good fermentation that will decompose the remaining sugar. Lees from an unsound wine must, of course, not be used. In any case, do not let the fermentation get stuck, i.e. stop before the wine is dry, as it is easier to keep the fermentation going than to start it anew. If the temperature of the air in the cellar is not too low, say 25° C. or 77° F., the feebly fermenting must can be run into a sump and thus given air and then again be pumped back into the same or another tank. This must not be done if the temperature in the cellar is only about 20° C. or 68° F. or less, since the must will then lose too much heat and its temperature will fall too far for achieving a complete fermentation. In such a case a liberal dose of an active culture of pure yeast, say, an addition of 5 per cent., might be found most useful.

Had the grapes been picked so ripe that the fresh must showed more than 25° Balling, it may be found impossible to ferment out all the sugar. In this case the *fresh* must might be corrected by adding to it a sufficient quantity of an aqueous solution of tartaric acid (1 lb. tartaric acid to every 16 gallons water) to bring its density down to 23° or 24° Balling. Be it noted that hereby the total acidity of the must will usually be somewhat raised rather than lowered since the acid solution has a total acidity of 6.25 per mil.

8. Racking of the Young Wine.

The First Racking.—Once the fermentation has stopped and the wine is dry, the suspended lees and other materials should be allowed to settle and form the thick lees. Note the date when the fermentation is complete. About 8-10 *days later* rack the young wine off its thick lees. In this operation the wine should be allowed to get freely in contact with air in an open sump and should then be pumped into a lightly sulphured vat or tank. In a warm climate it is dangerous to leave the young wine too long in contact with its thick lees. Especially where pot. meta-bisulphite has been liberally used for properly conducting the fermentation, undue contact with the lees may easily result in the formation of sulphuretted hydrogen and sulphur alcohols or mercaptans (smell of rotten eggs) in the young wine. By racking such a wine into a strongly sulphured container and following it up by a suitable fining a couple of days later, this fault (called "*Böckser*" in German) can be corrected. Yet, also here, prevention is better than cure.

In a cold climate the first racking may be delayed much longer since there is not the same danger of harmful organisms bringing about undesirable results as is the case in a warm climate such as is experienced at the Cape and in Australia and Algeria.

Where a proper filter-press is available (such as that of Daubron et Cie, Paris), the fresh less should immediately be put through it, when the bright filtrate can be just as good as the wine that was run off the lees and the cakes of lees can be forwarded to a factory manufacturing bitartrate of potash or tartaric acid or baking powder.

The container into which the young wine is pumped, should be completely filled and closed with a bung that is put lightly in position and smeared around with some suet or a fairly soft odourless petroleum product to seal the container heremetically. Every week the container should be filled completely with a suitable *topping wine*.

Topping Wine.—For this purpose a very sound wine of suitable quality should be used. It can be kept in well-corked full bottles lying flat or one can use a sound dry red wine that has been fortified to 30-32° P.S. or 17-18 vol. per cent. alcohol and is kept in a cask and which will not turn sour when on *ullage*—i.e. not full. Instead of fortifying the topping wine, it can be kept in a cask or tank which is continually kept under a pressure of carbon dioxide, when the wine will remain sound although on ullage. This wine should naturally be bright and must be examined from time to time.

Don't hammer the bung when topping off, in order that, should a secondary fermentation start in the wine at any time, the pressure might force out the bung instead of bursting the container.

The Second Racking.—This will normally take place about one month after the first. If the wine had still contained some sugar at the first racking, a *secondary fermentation* frequently takes place between the first and the second rackings. The amount of lees will be small compared with the thick lees. At this racking the wine may again come in contact with the air and should be pumped into a well-sulphured container which should be completely filled and kept full as previously described.

The Third Racking.—Towards the end of winter the wine is racked a third time and may then be fined if this is deemed desirable. A wine that is very harsh and astringent for being too rich in tannin may be softened by a gelatine fining whilst at the same time a lot of bacteria is removed that might otherwise have damaged the wine. About fining, see a later chapter. Henceforth just keep the container absolutely full by topping it off regularly every week. The wine may now be sold to a wine merchant or kept for another year in wood. In a warm country hogsheads or the French barriques are unsuitable for the further maturation of the wine on account of the difficulty of keeping them always full. In regions with colder climates like the Médoc barriques are normally used.

9. Pressing the Husks.

About the yield of wine from a certain weight of grapes, *Prof. Ventre*, l.c., pp. 294-296, gives some interesting figures from his own experiments. He says that every one knows that the yield of wine from grapes is about 70 per cent. for Aramon, 64-66 per cent. for Carignan and Alicante Bouschet and 59-60 per cent. for Jacquez. Then he quotes some interesting figures from experiments of his own from which I took the following figures:—

Constitution of the Grape.

	Aramon. 1907.	Aramon. 1908.	Alicante Bouschet. 1907.	Alicante Bouschet. 1908.
Stalks	3·2%	3·5%	2·8%	3·6%
Skins	5·0%	5·25%	8·0%	8·2%
Pips	1·5%	1·8%	2·5%	2·8%
Pulp	90·3%	89·45%	86·7%	85.4%
	100·0%	100·0%	100·0%	100·0%
Density of must	1068	1058	1077	1070
(Equiv. degrees Ball.	16·5	14·2	18·6	17·0)
Wine from pulp	84·55 litres.	84·5 litres.	80·5 litres.	80·0 litres.

Thus 100 kg. Aramon grapes gave at most 84.5 litres wine and 100 kg. Alicante Bouschet gave at most 80 litres wine, which is equal to 169 and 161 gallons wine per ton of 2,000 lbs. grapes, i.e., 1.33 and 1.26 leaguers per ton respectively. At the Cape, probably owing to our sweeter grapes, a ton of grapes yields only about 1.1 to 1.2 leaguers of wine.

In Professor Ventre's experiments above referred to, he obtained the following yields of run-off wine.

	100kg. Aramon grapes. 1907.	100kg. Aramon grapes. 1908.	100 kg. Alicante Bouschet grapes. 1907.	100 kg. Alicante Bouschet grapes. 1908.
Run-off wine	70·2	69·4	65·2	65·9
Husks and pips plus residual wine	24·0	25·6	27·6	28·7
Loss	5·8	5·0	6·8	5·4
	100·0	100·0	100·0	100·0

Thus the yield of run-off wine was 82.6% of the total wine in case of Aramon and 82.5% in case of Alicante Bouschet and the husks plus residual wine contained about 15% of the wine. In case of Aramon the wet husks contained residual wine to the extent of about 60% of their weight whilst in case of Alicante Bouschet this was about 50%.

This makes it clear that an effort should be made to extract as much of the wine still present in the wet husks as possible. By distilling the same we can extract the alcohol and produce either a strong spirit or dopbrandy ("eau-de-vic de marc" in French). The residual wine can be removed from the husks by some or other press or by the process of diffsusion. With the first we are not here concerned and with the last I do not propose dealing as it may easily lead to abuse and is not legally sanctioned in most wine countries. I shall therefore limit myself here to the extraction of this wine by some suitable press.

Wine-presses I have already previously discussed in connection with the extraction of wine from the wet husks; I strongly advise every one to study the *quality* of the press wine as well as its quantity. In all cases the husks should be pressed as soon as the wine has run off and begins to trickle. Unless this is done, your press wine may easily be sour owing to the development of acetic bacteria on the husks. Where pressing must unavoidably be somewhat delayed, spray some of a 2% solution of potassium meta-bisulphite in water over the husks to keep them sound.

Where a fine wine has been run off the husks, so that a good quality press-wine can be obtained, use by preference a hydraulic press or otherwise some or other kind of hand-press. A continuous press should only be used in case of common wines or *after* the best press wine has already been removed by one of the previously mentioned kinds of presses in order to remove the wine then still left.

The Yield of Press Wine.—In his experiments previously referred to, Professor Ventre gives the following results obtained in pressing the husks from 100 kg. grapes after the "free-run" of wine had been removed.

On comparing the yield of press wine with the "free-run" wine obtained from 100 kg. grapes, we get the following results.

From the above figures we see that 20-22% of the total wine in the husks is still left in them after pressing, so that we cannot extract it all by pressing. Still we notice that the press wine obtained amounts to about 14 and 15% of the total wine and 16.5 and 17.3% of the "free-run" wine in case of Aramon and Alicante Bouschet respectively. This naturally pays very well for the cost of pressing.

Composition of the Press Wine.—In general one can say that the press wine is darker in colour, more astringent, i.e., richer in tannin, less rich in alcohol and total acid but richer in volatile acid, and much less delicate and fine than the wine that ran off freely, so that the press wine should be kept separate from the "free-run" and used for blending as required. This the more so since the press wine usually has a higher content of micro-organisms than the "free-run".

Nessler-Windisch, l. c., p. 284, quote the following comparative figures for "free-run" red wines and the press wines obtained from their husks:

TABLE 1.

Grape.	Vintage.	Moist husks.	Wine in them.	Press wine obtained.	Percentage yield of wine present in husks.
Aramon	1907	24·0	14·3	11·2	78·3
,, ...	1908	25·6	15·1	11·8	78·1
Alicante	1907	27·6	14·3	11·3	79·0
,, ...	1908	28·7	14·1	11·5	81·6

TABLE 2.

Grape.	Vintage.	"Free-run wine."	Press wine.	Total wine.	Percentage yield of total wine.
Aramon	1907	70·2	11·2	81·4	13·73
,, ...	1908	69·4	11·8	81·2	14·53
Alicante	1907	66·2	11·3	77·5	14·60
,, ...	1908	65·9	11·5	77·4	15·00

TABLE 3.

	In 100 CC. wine are contained grammes:						
	Alcohol.	Extract.	Sugar.	Total acid.	Volatile Acid.	Tannin.	Mineral substances.
Wine I "free-run" ..	7·46	2·72	0·01	60·3	0·073	0·171	0·331
,, press wine ..	7·26	3·09	0·15	50·3	0·108	0·283	0·384
Wine II "free-run" ..	7·33	2·71	0·01	50·9	0·100	0·169	0·338
,, press wine ..	7·26	3·15	0·16	0·53	0·154	0·375	0·399
Wine III "free-run" ..	7·66	2·82	0·02	0·67	0·127	0·181	0·331
,, press wine ..	7·46	3·21	0·19	0·60	0·132	0·360	0·362

These were dry wines and the figures bear out the general statement made above regarding the composition of the press wine relative to the " free-run ". Where the wine was not dry when run off and particularly where the grapes had been harvested overripe and with some raisins, the press wine may, when dry, be richer in alcohol than the " run-off ". This is due to sugar that fermented out after the " free-run " had been allowed to run off.

From *Professor Ventre*, l. c., p. 322, I quote the following:

	"Free-run"	Press wine.
Alcohol in vol. %	9.6	9.8
Total acidity in H_2SO_4 per mil.	5.20	5.00
Volatile acidity idem	0.32	0.48
Fixed acidity idem	4.88	4.52
Dry extract at 100° C. per litre	21.45	22.95
Total ashes	2.72	3.05
Total tartaric acid as cream of tartar	4.73	4.35
Astringent substances	1.80	2.50
Reducing substances	nil	traces
Tasting	fine, fruity	hard and astringent

This is in agreement with the figures quoted from Nessler-Windisch except for the alcohol, but this is evidently a case referred to above.

10. Special Dry Red Blending Wines.

The dry red wines of Central Europe as well as some French wines are sometimes too thin and have too much fruit acid and too little alcohol and colour. These wines are much improved by blending them with suitable wines from warmer wine countries like Spain, Algeria, Tunis, Italy, Greece, South Africa and Australia. Bearing in mind the purpose the blending wine has to serve, it has to possess the following properties:

(1) It must be *dry* to avoid subsequent fermentations in the blended wine.

(2) It must be perfectly *sound*, i.e., free from micro-organisms (bacteria, etc.) and should be low in volatile acidity.

(3) Its *dry extract* should be at least 28 grams per litre.

(4) Its *total acidity* should be reasonably low (say 5-6 g/l as tartaric acid).

(5) It should have 12-14 vol. per cent. alcohol.

(6) It should have a rich dark colour.

(7) It must be free from antiseptics.

In order to produce such a wine the grapes should be harvested dead ripe or even slightly overripe and the must should perferably show about 23-24 Balling. The grape varieties and locality should be suitable and the wine must be carefully and properly made in order to comply with all the necessary conditions. It is usually shipped when only 4-6 months old and will previously have been given a suitable fining or filtration as the case may be.

ROOSTER VAN K.W.V. DIREKTEURE

Kiesafdeling.	Naam.	Adres.	Tree af in Jaar.
Robertson	S. E. Warren, L.V.	Posbus 41, Robertson	1944
Robertson	J. A. van Eeden, W/Seun	Vinkrivier, Robertson	1944
Montagu	A. J. H. Burger	Talana, Montagu	1944
Stellenbosch	J. H. N. Morkel	Voorsorg, Noordwal Onder, Stellenbosch	1944
Paarl	Paul Roux	Di Rialto, Suider Paarl	1945
Paarl	C. W. H. Kohler	Riverside, Suider Paarl	1945
Worcester	J. A. Conradie	La Motte, Nuy	1945
Worcester	P. J. van der Merwe, A/Seun	Merwida, Rawsonville	1945
Kaap	S. P. Lategan, W/Seun	Constantia Uitsig, Constantia	1946
Malmesbury	S. F. Malan, L.U.K.	Brandwag, Riebeek-Wes	1946
Caledon	F. K. Siebrits	Milnerstraat, Villiersdorp	1946
Ceres en Tulbagh	H. F. Theron	Mont Pellier, Tulbagh	1946