Wood alternatives – a substitute for barrels, or merely an economical flavourant?

Andrew Peter Mitchell

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1. ABSTRACT

- This document looks at alternative oak products (AOPs) and sets out to answer the question: Are alternative oak products a substitute for barrels, or are they merely an economical flavourant?
- Firstly, a brief history of the use of wood with wine is examined, as well as the different types of wood traditionally used in the production of wine, in order to gain a sense of the context in which alternative oak products appear.
- The major areas responsible for the supply of oak to the cooperage industry are discussed, as well as the geographical influence on the terroir and how it affects oak trees.
- Sustainable production of oak is discussed, including organisations that monitor sustainable production and how the cooperage industry is affected.
- The influence of different factors that affect the wood used in cooperage, as well as the nature of substances extracted from wood into wine is explored, including how these substances interact chemically with wine.
- An important aspect related to the interaction of wine with extracted substances examined is the role of oxygen in wine making.
- A brief look at the legal implications involved in the use of wood with wine in South Africa and other major wine producing countries is included.
- The central part of the discussion logically revolves around alternative oak products and the actual products currently available, including oak powder, chips and staves. Exogenous tannins are also explored. Usage of the different products is also discussed, as well as dosage rates and applications.
- Micro-oxygenation and pointers to selecting dosing systems is followed by a discussion of the effects of micro-oxygenation.
- A review of current usage trends of AOPs and then a comparison of differences in cost between the use of AOPs and barrels follows.
- Recent research done in South Africa on comparisons between AOPs and barrels and the results of that research are examined, in order that a clearer picture of the pros and cons of each can emerge.
- Finally, a review of interviews conducted with selected winemakers and suppliers of AOPs and their views of the future of the product locally and internationally is included.

2. INTRODUCTION

Wine is progressively becoming more and more of a consumer-driven product. The current global wine glut is driving down prices, forcing wine producers to look carefully at input costs and innovative ways of producing quality wine while still managing to make a profit. Global consolidation of the market means fewer and fewer people are responsible for buying bigger and bigger shares of the total wine production. In the UK market, South Africa's largest market for wine, this centralisation of power means that supermarket buyers are able to not only determine styles of wine produced, but also to negotiate cut-throat prices. Brad Gold (2005) refers to the fact that there is only a handful of the same specific buyers who are purchasing 8 out of every 10 bottles of wine sold in the UK. Another phenomenon in the UK market is the demand for early release of young wines after harvest. Winemaking methods therefore have to be able to produce early-drinking wines at consumer-friendly prices (Grier, Interview 2).

When scrutinising all the extras that get added to the basic cost of the grape, wooding stands out as one of the larger expenses. Although the international appetite for the flavour of wood has paused to take a breath, the trend is, nevertheless, for subtler and better integrated wooding. The significant cost of wooding wines by traditional methods lends itself to scrutiny as a means of reducing input costs. Not only is a barrel an expensive item to manufacture, it is also an expensive item to manage. Barrels occupy a lot of space and require a lot of labour to manage. Winemaking utilising barrel ageing is a slow process in the hurly burly of modern life, particularly with an ever-growing demand for early release of young wines. This study will examine the growing practice of wooding wines using alternative methods, as well as looking at whether the results thereof are comparable to the tried and tested methods of using oak barrels.

With the demand for the world's natural resources growing, it is becoming imperative that those resources are sustainable and are utilised in an efficient way. Barrel manufacturing wastes a significant amount of the best part of the tree, whereas alternative oak products (AOPs) minimise wastage and are much more labour efficient to produce. The number of barrels being sold globally is diminishing, but the

volume of wooded wine is increasing, suggesting that alternative oak products are playing an ever more important part in modern wine production.

One of the clues to this trend is the recent relaxation of European Union legislation, allowing the use of oak chips and other alternative oak products in the production of “Vin de Paye” wine. The embattled French wine industry has been forced to allow the use of alternative wooding methods in its ever-growing fight to prevent loss of market share to New World wine producers. The use of AOPs in New World countries is widespread, especially in California, Australia and Chile. In South Africa, Distell has set up its own production of AOPs, and it is rumoured that the majority of their bulk label brands will never see the inside of a barrel in the near future (Howell, Interview 1).

3. HISTORY OF WOOD AND WINE

3.1 Types of wood used traditionally

According to Herodotus, merchants in Ancient Armenia shipped wine down the Tigris River in palm-wood casks in the seventh century BC. Eventually amphorae were succeeded by wooden barrels for shipping and storing wine in the 3rd Century AD. It was not until the 20th Century that more inert materials, i.e. glass bottles, began to replace wood for shipment (Robinson, 1994).

Although oak is currently the most predominant wood type used in conjunction with wine, over the years, many different types of wood have been used to make small barrels, vats and casks. In Europe, particularly in the Rhone, Beaujolais and parts of Italy and Portugal, chestnut was long used for the manufacture of large oval casks. Other wood types used include pine, eucalyptus, acacia, ash, redwood, cypress and poplar. Some of these woods, in particular pine, eucalyptus and acacia, produce wines with odd flavours, especially if the wood is not well seasoned. In North America, redwood was commonly used for the manufacture of large upright wooden tanks, but lost favour in the early 1970s when inert materials such as stainless steel made an impact. Redwood is also difficult to bend and tends to produce strong flavours (Robinson, 1994*).*

There are several reasons that resulted in the barrel as we know it today. One of the main reasons was the fragility of amphorae and the impracticality of transporting them. Barrels are sturdy and easy to roll or pivot without being broken. Pliny (27-29 AD) said “we owe gratitude to the neighbours of the Alps, the people of Piedmont, for the invention of the barrel and we would admire this industry if ever we saw it. It demands a great deal of care to construct a vase formed from several planks, held together only by wood, which contains a certain quantity of liquid, in a shape which is easily transported and which can withstand quite heavy shocks without losing the liquid” (Puisais, 2000).

Over time, barrels came to be recognised as valuable aids to the winemaking process. For white wines, primary fermentation in oak barrels not only increases the range of flavours, but also prepares the wine for battonage (lees stirring), which softens and integrates the flavours from the wood and lightens the colour. For both

red and white wines, malolactic fermentation (a secondary fermentation that converts malic acid to softer lactic acid) in barrel, or in contact with oak, adds richness and length of flavour on the palate, while softening the oak influence. The small aperture of the barrel, allows for a limited amount of oxygen exposure that softens wine tannins and introduces further complexity through oxygen's reaction with the wood tannins. The controlled amount of oxygenation also allows for stabilisation of wine colour (Winiarski, 2005)

In the middle of the last century, by which time the use of barrels was limited almost solely to the storage and transportation of wine, winemakers also began to value the qualitative virtues that oak bestowed – flavours such as vanilla, spice, smoke, cedar and nut qualities – enhancements that added to a wine's depth and complexity.

4. WOOD AND WINE

4.1 Nature of Volatile Substances released by Wood

Wood has a profound influence on the flavour profile and characteristics of a wine. There is an interaction between the wood and the wine, and certain substances are extracted directly from the wood to the wine, while other substances interact with yeasts and bacteria in the wine to form flavours different to the original flavours (Robinson, 1994). The organoleptic properties of the wine may be influenced by some substances that are extracted in large amounts. Some of the extractives can influence the bouquet, while others may influence the mouth feel (Fourie, 2004). The principal substances extracted from oak (the most commonly used wood), are as follows:

4.1.1 Oak Lactones

These compounds are responsible for the wood aromas or what is commonly called "oakiness". According to Singleton (1995), the cis- and trans-methyl-γ-octalactones, commonly referred to as "whisky lactones" (Waterhouse and Towey, 1994) are responsible for the oakiness of wines. *Figure 1.1* shows the chemical structure of the various isomers of β-methyl-γ-octalactone. The levels of toasting of the wood will also affect these flavours. Open-air seasoning of the wood, prior to use, generally decreases these flavours. Lactones can easily overpower wine's natural fruit aromas. The cis-isomer, with a threshold 12 times lower than that of the trans-isomer, possesses odours of coconut, celery and sawdust (Masson et al,1995) and is regarded as the most important of the volatile compounds in oak wood that are extracted into wine and spirits during barrel maturation (Wilkinson et al, 2004). Staves which have been naturally seasoned by air result in wines with higher quantities of the β-methyl-octalactone than wines matured in barrels produced from artificially seasoned staves (Masson et al,1995). The white oak, *Quercus alba*, contains significantly more β-methyl-octalactone than the European species.

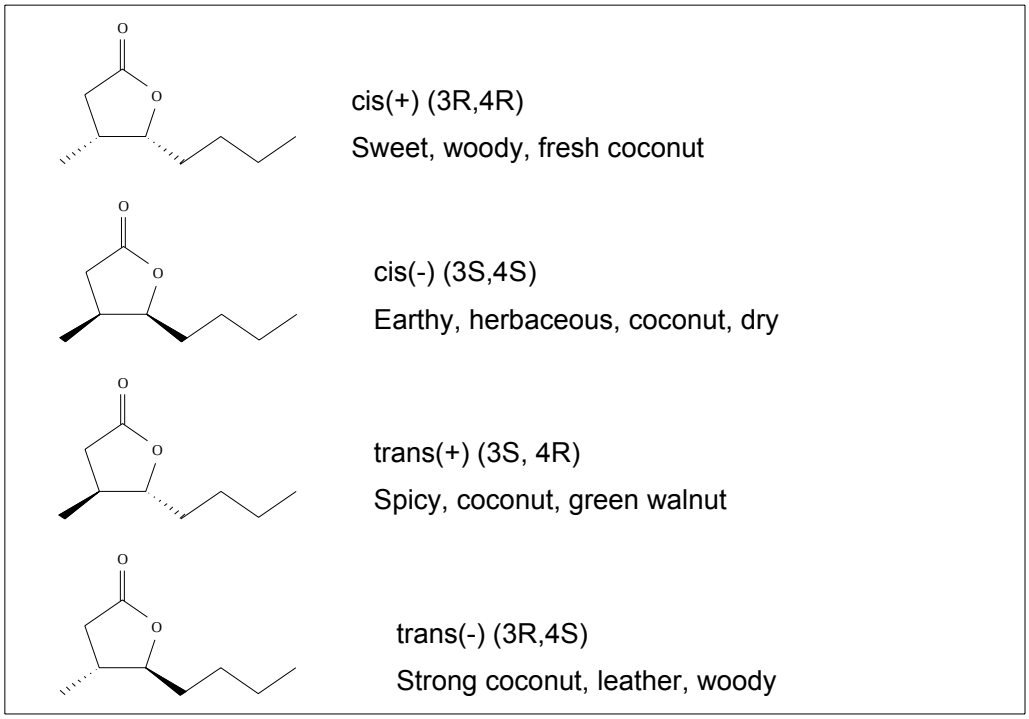


Figure 1.1 The chemical structure of various isomers of β-methyl-octalactone of which the first three have been identified (Ribereau-Gayon et al, 2000).

4.1.2 Volatile Phenols.

As a result of lignin degradation in oak, volatile phenols, based on guaiacol or syringyl nuclei are released (Sefton,1991). See *Figure 1.3*. The guaiacol derivatives have higher aroma and taste thresholds than the syringyl derivatives and impact wine flavour significantly more (Sefton,1991). In comparison to guaiacol, the syringyl derivatives have weak odours and little impact on wine flavour (Dubois, 1989) Vanillin is the most easily recognized member of this group. Levels of vanillin increase significantly with heating and toasting of oak (Nishimura et al, 1983).

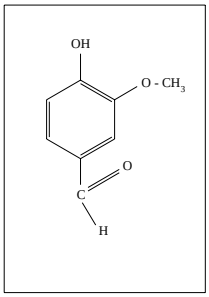
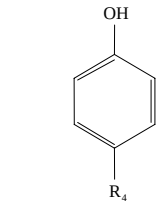
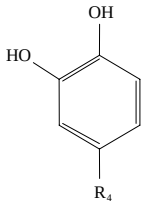


Fig 1.2 The chemical structure of Vanillin (Ribereau-Gayon et al, 2000).

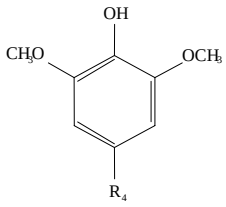
The aroma of vanillin is strengthened by other oak extracted compounds in the group, like acetovanillone, propiovanillone and propiosyringone (Singleton, 1995).



R4	Name	Origin
CH_2 - CH_3	Ethyl phenol	Red Wine
CH = CH_2	Vinyl phenol	White wine



R4	Name	Origin
OH	Guaiacol	Wood
CH_3	Methyl guaiacol	Wood
CH_2 – CH_3	Ethyl guaiacol	Wood
CH = CH_2	Vinyl guaiacol	Red wine
CH_2 – CH_2 –CH_3	Propyl guaiacol	Wood
CH = CH – CH_3	Allyl guaiacol	Wood



R4	Name	Origin
H	Syringol	Wood
CH_3	Methyl syringol	Wood

Figure 1.3 The chemical structure of volatile phenols that occur in wine: some originating from oak wood and others from the wine (Ribereau-Gayon et al, 2000).

Eugenol, the main aroma compound found in cloves, is also present in raw oak .See *Figure 1.4*. It's levels decrease during open-air wood seasoning. It has been found that for untoasted wood, eugenol is found at its highest levels in green oak (Sefton 1991). Boruff and Ritchuff (1959) described eugenol and isoeugenol as possessing a very similar, spicy clove aroma. As the toasting level is increased, so the release of eugenol and isoeugenol into wine is increased.

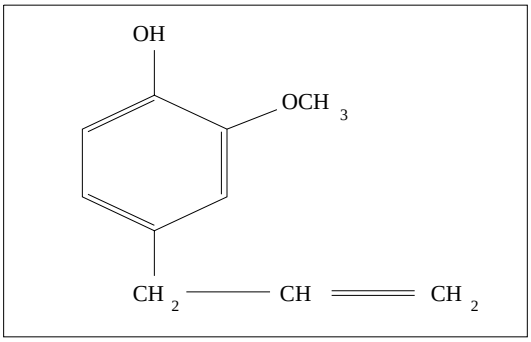


Figure 1.4 The chemical structure of Eugenol (Haluk and Irmouli, 1997).

4.1.3 Terpenes

These essential oils, important in fruit, tea and perfume, are found in American oak and to a lesser degree in French oak. See *Figure 1.5 a,b & c*. Their role in wine flavour is yet to be established (Singleton,1995), but these terpene derivatives are very odorous with aromas of resins, violets, lemon and leather. A combination of oak lactones, eugenol and terpenoids thus must be responsible for the "oakiness" of wines (Singleton, 1995).

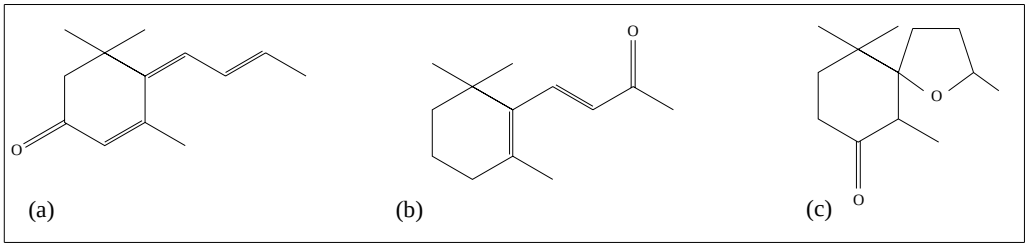


Figure 1.5 a, b and c The chemical structures of terpenes that occur in oak wood: trienone (a), ß-ionone (b) and oxaspiro (c) (Sefton et al,1993).

4.1.4 Carbohydrate degradation products

As Robinson (1994) states, "The carbohydrates cellulose and hemicellulose are degraded during barrel toasting. The compounds furfural and 5-methylfurfural are produced from toasting wood sugars. They have sweet butterscotch, light caramel and subtle almond aromas. Maltol and cyclotene are also produced from the toasting process and not only have caramel-like flavours of their own, but also act as flavour potentiators. Like monosodium glutamate with food, these potentiators increase the perception of other flavours". Other important compounds in extracts of toasted oak

include ethoxylactone (sweet and fruity aromas), pyrazines, pyridines and isomaltol (Ribereau-Gayon et al, 2000) See *Figure 1.6*.

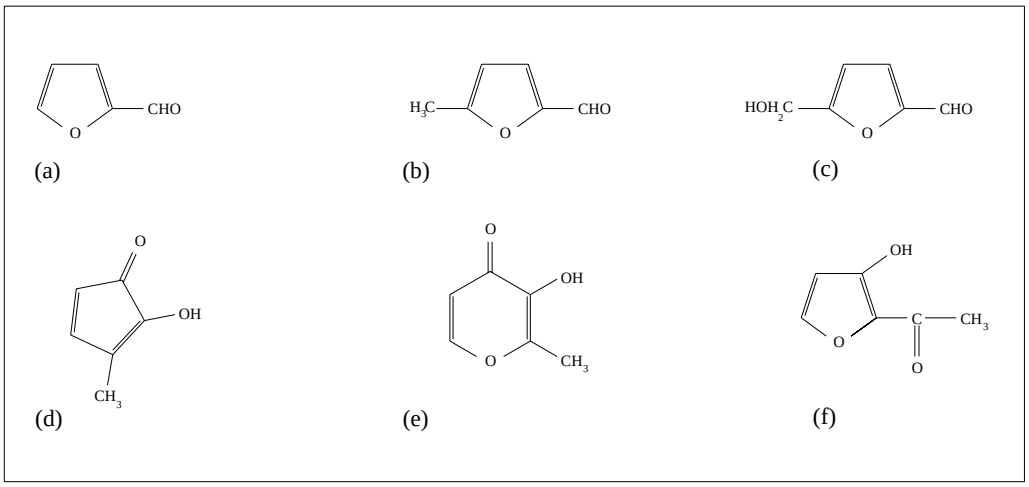


Figure 1.6 The chemical structures of common carbohydrate derived volatiles, (a) furfural, (b) methyl-5-furfural, (c) hydroxymethyl-5-furfural, (d) cyclotene, (e) maltol and (f) isomaltol as a result of the heating process during cooperage that occurs in wines matured in barrels (Ribereau-Gayon et al, 2000).

4.1.5 Volatile Acids

Vivas et al (1995) documented an increase in volatile acidity due to two reasons; firstly the acidity that may originate from oak as a result of the toasting process, and secondly due to the metabolism of acetic acid bacteria in wine. Yeasts can produce esters of ethyl acetate from the extracted acetic acid, due to the large excess of ethanol (Onishi et al, 1977).

4.2 Nature of Non-volatile Substances released by Wood

Tannins and other phenolics give wine colour and astringency, but more importantly act as a reservoir to balance the oxidative/reductive reactions of the wine, protecting it from oxidation and lessening the chance of unpleasant reductive aromas (Robinson, 1994). As Keulder (2005) explains, “Phenols and more specific tannins are of great importance in wine. They play an important role in oxidation reactions, the maturation and ageing of wine, as well as the organoleptic properties.” Phenolics are derived from two sources, extraction and the oxidation of aromatic aldehydes (Fourie, 2004). Aromatic aldehydes are considered to be degradation products of lignin (Vivas et al, 1996).

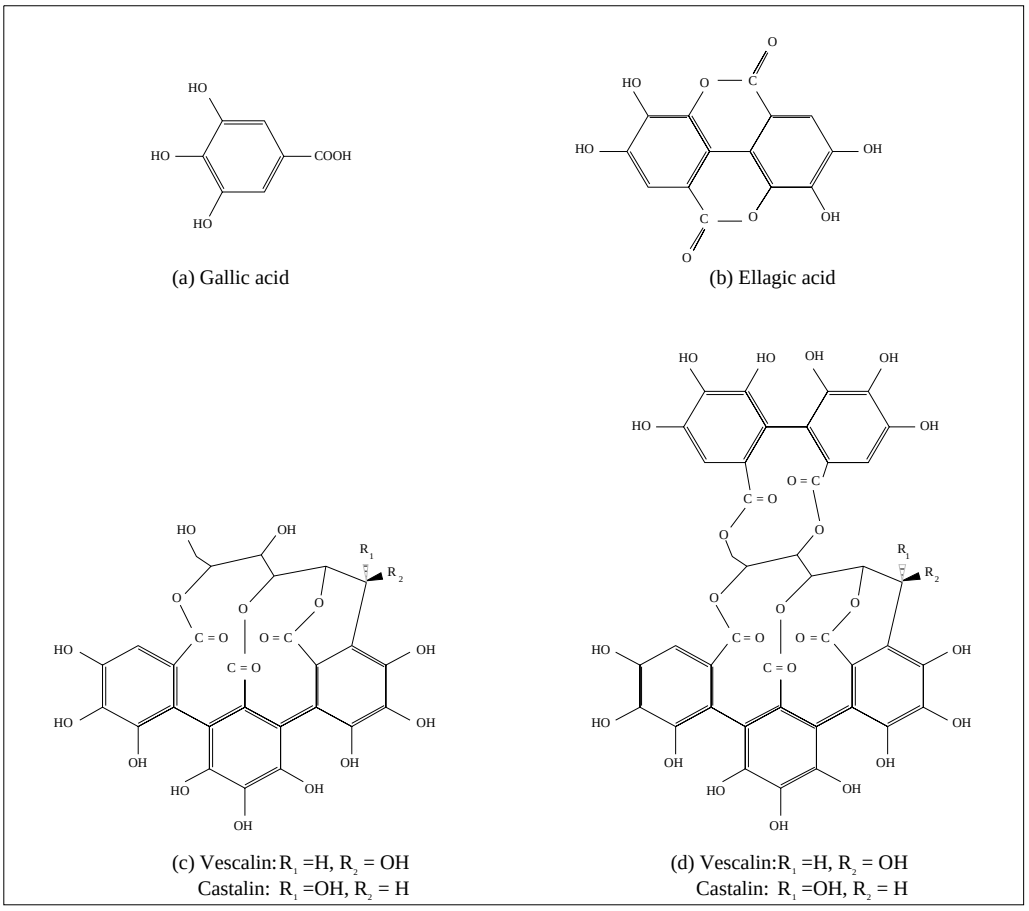


Figure 1.7 The chemical structure of phenolic acids (a and b) and ellagic tannins (c and d) in extracts from the duramen of oak wood (Ribereau-Gayon et al, 2000).

4.2.1 Tannins.

Tannins can be divided into two groups: 1) condensed tannins or proanthocyanidins that originate from the grapes and 2) hydrolysable tannins that are extracted from wood (Keulder, 2005). Ellagitanins are the only hydrolysable tannin that can be extracted from oak (Puech et al, 1999), while tannins may be added to wine in the form of commercial tannin extractions from nutgall, oak or grapeseed. Wood in general tends to contain large percentages of ellagitannins, which are highly soluble in wine. These compounds contain many hydroxy groups, which may serve as substrates for oxidative polymerization, and which are, together with oxygen, the reason for accelerated oxidation and polymerization of barrel matured wine (Quinn and Singleton, 1985). Ellagitanins can thus affect the quality and taste of barrel-matured wine and spirits (Zhentian et al, 1999).

These tannins are easily hydrolysed by enzymes or acid base conditions (Puech et al, 1999) and can be classified as either gallotannins or ellagitannins, according to the type of acid formed (Puech et al,1999) At the pH of wine, the hydrolysable tannins break down and generate gallic acid and mostly ellagic acid. See *Figure 1.7.* "Five to ten percent of the dry weight of oak is comprised of the hydrolysable tannins. These are a complex mixture of oligomers of gallic acid and glucose, bonded by oxidative couples and ester linkages, and they are chemically quite different from the condensed tannins of grapes and wines (Quinn and Singleton,1985).

4.3 Types of Oak and Influence of Wood Origin

Oak is a natural choice in the cooperage business, due to it being hard, supple and watertight. However, it also has other properties that have become sought after in the manufacture of quality wine – i.e. as a means of flavourant. As Bertus Fourie (2004) states, "The aim of using oak barrels and oak elaborated products is to flavour and to provoke a number of chemical and physical changes which are indisputable to the finished product".

There are three different types of oak commonly used in the winemaking industry. All three of them are white oaks, which are naturally more watertight than the more porous red oak varieties. Two of the varieties are grown in Europe, while the third is native to North America. All of them belong to the botanical genus Quercus (Puisais, 2000).

The peduncle oak tree (*Quercus pedunculata* or *Quercus robur*) is the common oak, thought of as the English or French oak, which grows all over Europe as far north as climate permits. Sweden is the northern limit, while it grows as far south as Turkey, Georgia and Portugal, and as far east as the Urals. It prefers fertile, damp soils and the wood is less dense and softer than *Quercus sessiflora*. It grows rapidly, and according to annual climates, may grow up to 10mm per year. It seeks light and has a tendency to spread in width. The wood produced is generally "wide grain" and rapidly releases tannins into the wine (Puisais, 2000).

Quercus sessiflora, also known as sessile oak, *Quercus rouvre* or *Quercus petraea*, is found in timber forests, especially around the center of France (and in the forests of Troncais) where it prefers sandy, silty soil with good drainage, but also thrives in a

variety of other soil types. It is found throughout the United Kingdom, from France stretching east to Poland and the Baltic states, and as far south as Italy and Yugoslavia. The wood produced is “fine grain” and is harder and denser than *Quercus pedunculata*. Its growth is slower than *robur*, but is also regular (about 1mm per year). Due to the proximity of surrounding trees, in forests it tends to grow tall and straight, seeking the maximum amount of light. Its tannins are considered the lowest and most supple of the three types of oak used for cooperage and AOPs. They are also the slowest extracting tannins of the three types of oak (Puisais, 2000).

Quercus alba, also known as the American white oak, is originally from North America. The flavours imparted to wine from this particular oak type are much more obvious than the other two varieties. American oak imparts strong coconut, vanilla and dill flavours and can leave an impression of sweetness on the palate. American oak is also cheaper than French oak and is commonly used in North and South America, Spain and Australia. Because American oak typically has a more powerful flavour, it is generally used in conjunction with more powerful red wines such as Rioja and other Spanish reds, Australian and other New World Shiraz, and also warm-climate Cabernet Sauvignon (Robinson, 1994).

4.4 Sustainability of Oak Forests

In the 19th Century, Baltic and Slovenian oak were the most admired oaks, however French oak has since become the standard by which all other oak is judged (Robinson,1994). Nearly a quarter of France, or 14 million hectares (ha) is forest, which constitutes more than forty percent of all the forest in the European Union. About one third of this forestland is oak, and of this, 2.6 million ha consists of *Quercus sessiflora* and *Quercus robur*. France is therefore the major source of European oak.

Part of the success of French forests is that a concerted effort has been made to sustain and protect them. Concern about their condition dates back to 1291, when scholars note the mention of “maistre de fôrets” in the Royal Ordinances. The most famous of these ordinances was written during the regime of Colbert in 1669 and he is commemorated in the Troncais forest, where he ordered systematic replanting of oak trees for use in shipbuilding. More recently, since the Second World War, around 2 million ha of the country has been reforested. Unlike some other countries where ancient forests have been cut down to provide for everyday commodities, France has

done a good job of managing its forests since that period. Sylviculture is also actively practiced in France, so that trees in government-owned forests are not allowed to grow wild, but are carefully farmed to yield suitable wood, just like any other crop (Robinson, 1994). Supplies of French oak should therefore hopefully remain abundant – barring unusual circumstances such as climate change.

More recently in the rest of Europe, there have been other efforts to effectively manage forestry. In the late 1990s, eleven European governing bodies, as well as associations representing 15-million European woodland owners, set up the non-profit NGO known as the Programme for the Endorsement of Forest Certification schemes (PEFC) (http://www.winebusiness.com/). The purpose of this independent organisation was to actively advocate "sustainably managed forests through independent third party certification" (http://www.winebusiness.com/) and to provide a firm guarantee to wood buyers (of paper products as well as staves) that they were supporting properly managed, well-sustained forests. PEFC has received enormous support from all over the world, and is the largest organisation of its kind. With a steady increase in members, 85 percent of the world's forests now fall under its large umbrella.

In terms of the wine industry, the PEFC plays an important role in ensuring that staves originate from properly certified forests. According to Lisa S. Hall there are two principal means of tracing the source of wood, and this is applicable for entire operations, large batches, or a single unit of production. The first is to use a percentage model, which is based on the tracking of material flow and inventory control; the second is by the physical separation of different wood types. If using the percentage model, and following the guidelines of the PEFC, an operation is only permitted to use the PEFC logo on the *proportion* of its output that corresponds to the amount of raw material used from certified sources. This is also only if inventory records have been evaluated during each step of the

production process. The full percentage of the production can only be labelled once over 70 percent of material is from certified sources.

Seguin Moreau became the first eco-certified cooperage in the world by adopting strict specifications established by the PFEC council. The company's wine barrels are now certified as coming from sustainably managed forests. Another cooperage that is PEFC certified is Merrain International, who has the World Cooperage stave mill in France, According to Amie Boswell Dewane, markerting director for World Cooperage, being PEFC certified means that the company promotes sustainable forest management. "Our French oak staves are processed from timber purchased in sustainable and managed forests. Certification can be given only by an authorized organization like CBTA in France, or CTIB in Belguim, which is the one we use" (http://www.winebusiness.com/).

4.5 The Influence of Origin

The characteristics or qualities of a wood tend to be influenced by its origin (refer to Table 1). A high polyphenol content, as well as lower aromatic components can be found in *Quercus robur* and *Quercus pedunculata*, whereas *Quercus petraea* and *Quercus sessilis* are high in aromatic components and have smaller amounts of extractable ellagitannins. American woods tend to be high in aromatic flavourants, but low in levels of phenols (Du Toit, 2005). According to Wessel du Toit, this is particularly evident when examining levels of β-methyl-octalactone (the so-called oak or whisky lactone), which gives wine a distinctive woody and coconut-like flavour: "Levels of between 0.5 and 16mg total lactones per gram of dry wood from Limousin have been found and 10.5mg per gram, for wood from Burgundy. For wood from the Vosges, 65mg per gram were obtained and for Troncais 77mg per gram. American wood gave levels of up to 158mg per gram. The cis isomer is more aromatic than the trans isomer, so it goes without saying that the wood with more cis oak lactone isomer will impart a stronger wood character to the wine. On the whole American wood also has more cis isomer " (Du Toit, 2005).

American wood tends to also have higher levels of vanillin (vanilla flavour) than its French counterpart –that is to say 11 vs 6mg/g (Du Toit, 2005). Other flavourants, such as vanillin acid, sinapaldehyde, coniferaldehyde among others, are also found at higher levels in American wood. French wood does tend to have more eugenol (with its clove-like quality) and French Oak has higher levels of non-volatile

components, especially phenolic compounds. Wood from Limousin in particular, has the highest extract and extractable polyphenols. In wood from this region, double the amount of total extract, ellagitannins and catechin tannins was measured than in wood from Central France and American wood. Wood from Limousin also contains more hydrolysable tannins (wood tannins) such as vescalagin and castalagin than wood from the Central and Vosges regions of France. Second fill barrels have shown, however, that wood from Limousin did not impart much more phenolic components to the wine than American wood. The greater measure of extract obtained from wood from e.g. Limousin, could contribute to a greater concentration of colour, although research at Stellenbosch University has shown that there are hardly any differences in colour in Shiraz and Pinotage, matured in French, Russian and American barrels.

WOOD	SOIL	GRAIN	EXTRACTION	FLAVOUR
Limousin	Granite / Sub-soil, rich soil	Widest grain, rapid oxidation	Rapid, imparts colour	Vanilla and lemon
Nevers	Tends to be rich and moist	Medium	Moderate	Buttery – slight citrus flavour
Allier	Deep fertile loam	Medium	Moderate, more subtle than Nevers	Flowery or perfumed character
Troncais	Deep fertile	Medium to tight	Moderate	Subtle with earthy character
Vosges	Chalky lime	Tight, slower oxidation	Subtle, prolonged	Most neutral
Burgundy	Clay, chalky, limey	Medium to open	Moderate	Soft and subtle
American	Various	Medium to tight	Moderate to rapid	Spicy, vanilla, oaky

Table 1. Influence of Origin on extraction and flavours imparted to wine by oak.

4.6 The Influence of Wood Grain

The quality of a wine is not just affected by the origin of wood used, but also by the grain of that wood. As WJ du Toit (2005) explains, the phloem and xylem of a tree comes from the cambium. Over time, xylem hardens and becomes pith wood – the key part of the tree from which barrels are constructed. Seasonal changes tend to affect wood growth, and subsequently the strength and grain too. In winter, the ducts found in wood are closed off by tyloses, but these reopen in spring and therefore the ducts in spring wood tend to be larger, making the wood lighter, softer, more flexible

and also more porous. Du Toit makes the important point that with no tyloses, “wine would leak from the ends of the staves” (Du Toit, 2005).

Wood grain is usually classified by the size and consistency of a tree’s annual growth rings, which can also be affected by season, as well as location. In France, for example, tighter grains can be found in the central areas (particularly Alliers), while wood grain in Vosges is less so, and Limousin wood the widest. Tighter and wider grain woods impart different properties to wine; according to Du Toit (2005), tighter grain wood has larger amounts of the clove-like eugenol, and more wood lactones, while wider grain woods contain more ellagitannins and dry extract. Another aspect that affects the chemical composition of wood that is linked to annual growth rings is its age, as well as the rate at which it grows. The older the pith wood, the less the presence of ellagitannins, while summer woods (which tend to grow quicker) have wider annual rings, thus a wider grain and more ellagitannins.

4.7 The Influence of Seasoning

Before freshly cut oak can be used for cooperage it needs to be seasoned, in order to reduce the moisture content of the wood from around 50% to approximately 15%. The seasoning time outdoors is generally between 15 and 36 months (Swan et al, year unknown). However, in order to increase productivity, some cooperages dry the staves in a kiln at a controlled temperature and humidity. Kiln drying can speed up the seasoning process to as little as 28 days, although it is unusual for staves to only receive kiln drying with no outside seasoning (Rasmussen et al, 1956).

It was shown by Chatonnet (1995) that due to fluctuations in climatic variations, natural seasoning outside is incapable of consistently providing the best condition for the wood’s evolution. He found that there is a large diverse population of microbes, including moulds, yeasts and bacteria present in the wood during seasoning. As a result of enzymatic action, these microbes easily assimilate the free sugars of the cellulose, hemicellulose and hydrolysable tannins to degrade the ellagitannins, but not to greatly affect the lignins. Chatonnet (1995) also compared the effects of natural seasoning to artificial drying in a kiln and found that the kiln-dried wood possessed a higher level of extractable phenolic compounds and also a higher level of (trans) β-methyl-γ-octalactone[1]. He also reported a decrease in the ellagitannins, especially in the upper layer (1-3mm), and found that the kiln-dried wood has a

[1] See section on *Oak Lactones* below

higher content of astringent tannins and bitter coumarins. It also contained less eugenol, vanillin and (cis) methyl-octalactone. Wood dried naturally had much higher levels of total lactones than artificially dried wood. This was also the case for other important flavour compounds in which the concentrations of vanillin and eugenol were twice as high as wood aged artificially. On the whole, seasoning results in a reduction of tannins and the hydrolisation of the bitter coumarins to aglicones (Chatonnet,1995) (refer to Table 2).

	Limousin Region		**Central Region**	
Parameters	**Natural Drying**	**Artificial drying**	**Natural drying**	**Artificial drying**
Dry extracts(mg/g)	135 (7)	145 (7.5)	90 (15)	113 (4)
Total phenols (D 280)	30.4 (1.8)	31.2 (2.4)	22.4 (2.9)	27.2 (1.9)
Colouration (D 420)	0.04 (0.008)	0.038 (0.002)	0.024 (0.001	0.03 (0.005)
Catechins (mg/g)	0.59 (0.08)	0.56 (0.65)	0.3 (0.03)	0.6 (0.09)
Ellagitannins (mg/g)	15.5 (1.5)	17.2 (6.5)	7.8 (1.4)	11.9 (1.2)
Methyl-octalactone(cis)	12	0.85	77	25
Methyl-octalactone(trans)	4.5	0.22	10	124
Eugenol (µg/L)	2	0.3	8	4
Vanillin (µg/L)	11	0.5	15	0.3

( ): Standard deviation

Table 2 : The effects of the origin of oak wood and the seasoning method on the composition (Chatonnet, 1995).

In seasoning tests done simultaneously in Australia and France, Sefton et al (1990) reported that climate affects the extracts and aroma of oak wood in a significant way. The oak aged in Australia was found to contain higher levels of lactones than that aged in France.

4.8 The Influence of Toasting

The toasting process is one of the most critical phases in the making of a barrel. In France, toasting of barrels was traditionally done over an open fire, in order to bend the oak staves into the correct shape, while in the USA, the same job was performed with steam and a gas flame. Pyrolisys (heat treatment) of the oak degrades the wood components on the surface of the stave, resulting in the formation of many aromatic compounds (Chatonnet, 1995).

Chatonnet (1995) found that as a result of the thermal degradation of polysaccharides, furanaldehydes such as furfural, methyl-5-furfural and hydroxymethyfurfural are formed. He also found the production of compounds with a carbohydrate origin, such as cyclotene, maltol and isolmaltol, derived from hexoses in the presence of nitrogenated substances. These components could contribute to the caramel flavours of wine. The thermal degradation of lignin results in volatile phenols with spicy, smoky odours. At low to medium toast levels, vanilla and spicy flavours are obtained. At medium toast levels, maximum concentrations of vanillin, syringaldehyde, coniferaldehyde and sinapaldehyde are reached, however, in heavily toasted wood, thermal breakdown leads to reduced levels of vanillin. At heavy toast levels the smoky and burnt aromas tend to dominate (Chatonnet, 1995). Toasting therefore increases the complexity of the flavour profile of the wood.

4.9 The role of Oxygen in the Wooding Process

During storage, wine can come into contact with oxygen (O_2) in various ways :- during racking, maturing in oak barrels, or via micro-oxygenation. The solubility of O_2 in wine at room temperature and atmospheric pressure is approximately 6 -8ml/ L (Singleton 1987). An important aspect of wood maturation in barrels, is the slow oxidation that takes place. Important by-products of the oxidation of ethanol are acetaldehyde and hydrogen peroxide. The acetaldehyde plays a pivotal role in the indirect polymerization (acetaldehyde mediated polymerization) of condensed tannins. This polymerization of flavonoids is responsible for the decrease in gallic acid, caffeic acid, ferulic acid, (+) catechin, epicatechin and trans-resveratrol concentrations. In wines which have had an O_2 addition, the total phenolics are reduced, with a simultaneous increase in the red polymeric pigments (Castellari et al, 2000). Thus with an addition of O_2, whether it be by racking, micro-oxygenation or

slow oxidation in barrel, an increase in colour density and stability is expected[2]. Gil-Munoz et al (1999) found that the presence of hydrolysable tannins (extracted from wood), in the wine can lead to increased acetaldehyde concentration. This happens because the hydrolysable tannins are more easily oxidized than condensed tannins. This oxidation of the hydrolysable tannins results in increased levels of peroxides, which in turn generate larger quantities of acetaldehyde.

[2] Refer to Chapter 6.3 on the effects of micro-oxygenation.

5. LEGAL ASPECTS OF THE USE OF ALTERNATIVE OAK PRODUCTS IN WINE MANUFACTURING

The benefits of an overly regulated wine industry versus an under-regulated industry are often the subject of fierce debate. On the one hand, one has Old World producing countries such as France with their strict *Appellation d'Origine Contrôlé* (AOC) classifications, and on the other hand, New World countries like Australia, Chile, South Africa and New Zealand, are relatively free from prescriptive legislation. Old World legislation is generally aimed at preserving traditions established over hundreds of years and maintaining the identity of specific wines from specific areas, while New World legislation is more concerned with health issues and the prevention of consumer deception.

In the Old World, wood was traditionally not seen as a condiment, or means of altering the flavour of the grape. It is only in relatively recent years that barrels and wood have taken on a new meaning in areas like Bordeaux and Burgundy. Many parts of France still shun the use of new wood to flavour the wine. They see it as being the antithesis of 'terroir.' In his article published in *Grape*, Tim James (2002) points out that merely objecting to the use of wood in wine because it is not traditional, is being reactionary. However, he feels that over-wooding is providing a "simple, powerful flavouring with which the new wine drinker can readily associate". The success of New World wines in the global market has forced the hand of the European law makers to make changes to European Union laws, governing the use of Alternative Oak Products. In 2006 European Union legislation was changed to allow the use of "pieces of oak wood." Many journalists view this attempt to update European Union law as akin to 'shutting the stable door after the horse has bolted.'

In her dissertation on "A comparison of legislation about wine-making additives and processes," Galpin goes into a lot of depth to compare legislation between major wine-producing countries. She postulates that South African legislation is more liberal than those of fellow wine producing countries in two areas, one of which is in the use of wood. She says that the fact that there is no restriction on the type of wood that may be used in the production of wine allows winemakers the freedom to experiment (See *Table 3*). Australian and New Zealand legislation permit the addition of tannin as an additive and the use of oak as a processing aid, while South African legislation permits the addition of tannin, with the rider that it should not be foreign to wine, and the use of wood (type unspecified) (Refer to *Table 3* below).

In the United States of America, “oak chips or particles in an untreated and uncharred state may be used to smooth wine. Tannin may be added to clarify or to adjust the tannin content of juice or wine, but it may not impart any colour to the wine” (Galpin, 2006). Thus we can see that all the major wine producing countries allow the use of alternative oak products.

Name of Substance	**Liquor products to which substance may be added**	**Manner and conditions of additions**
Tannin (if it is not foreign to wine)	All types and classes	
Wood	Wine	(Before 27th March 2003: wood originating from casks in which the liquor product is matured

Table 3: Substances that may be legally added to wine in South Africa (only substances pertinent to this document have been included) – Table 6. SA Regulations.

6. ALTERNATIVE OAK PRODUCTS

6.1 Summary of AOPs

Most suppliers of alternative oak products (AOPs) in South Africa are linked to overseas manufacturers. Their respective product lines are fairly similar in appearance but differ in physical size and in details such as method of toasting, toast levels and tightness of grain. The factors that are important to making a top quality barrel, for example good quality tight grain oak and seasoning of the staves, are also equally as important in the manufacture of top quality AOPs. All the research and development that has gone into toasting profiles of barrels is also applicable to AOPs.

Products commonly available, and their typical applications are :-

6.1.1 **Oak Powder** – Although suppliers claim that the addition of oak powder will assist with colour and tannin stabilization in red wine, this has not been proven to be true and is a common misconception in the wine industry. In fact, research at the University of Stellenbosch, has shown that oak powder addition made no difference to the colour when added to healthy fruit[3]. It is generally added at the commencement of fermentation. Oak powder has a similar effect to the addition of exogeneous tannins, which can help keep wine "fresh" while waiting to have other maturation products added. It is however not as efficient as liquid tannins in this respect, due to the extraction method of ellagitannins being more efficient in the production of liquid tannin products (Katz, Interview 3). Oak powder will flavour the wine in large enough doses, but this flavour will fade after a year or so (Katz, Interview 3).

[3] Refer to the examination of Daniel Keulder's thesis (section 7.2, pg 40).

6.1.2  **Oak Chips** – Like oak powder, suppliers claim these can be added during fermentation to help stabilize colour and tannins, however this is not yet proven to be true (Refer to *6.1.1*). They are mainly used in very commercial products, where very quick extract of flavour is required and where the shelf life of the product is not expected to exceed 3 years for red wines and 2 years for white wines (Howell, Interview 1)

6.1.3  **Oak Blocks, Beans or Dominos** – These are generally made from staves that have been damaged during production. When two to three metre oak staves are seasoned outside in the open air, then planed and toasted, there are usually a percentage of staves that split or break during handling. The damaged staves are then cut up into blocks or beans. Due to the nature of the size of the blocks, they are supplied in a 10kg bag which is added to the wine through the chimney of the tank. As they remain in a bag, they are also easy to remove from the tank

6.1.4 Zig-zags or Barrel revival kits – These are short lengths of staves joined together with flexible joints to form a long length that can concertina into a "zig-zag" form. They are inserted into an old barrel through the bung hole. The zig-zag gets tethered to the bung by means of an electrical cable-tie fastened to a stainless steel screw-in eye. The original sized zig-zags were $1m^2$ which was effectively a 50% contact rate (see calculations in *Guides for use of AOPs*). Due to the relatively high extraction rate, mini zig-zags were introduced which reduced the contact rate to $0.31m^2$.

These have been a big success as they are more subtle than the full-sized zig-zag (Howell, Interview 1).

6.1.5 **Slim or Mini Staves** – Slim staves are generally approximately 1000mm long x 50mm wide x 6mm thick (although dimensions can vary from supplier to supplier and also according to specific tank sizes). Like barrels, they are available in different toast levels and may also be toasted by different means viz. convection, infrared or open-fire toasting depending on the supplier and the customer's requirements. For example, convection toasted staves are more suited to short oak contact time, whereas a fire-toasted stave or infrared toasted stave is more like using a traditional barrel, in terms of contact time. The results are also much closer to traditional barrel maturing than chips or blocks. According to Mark Howell (Interview 1), this is the product where he sees the largest potential for growth in South Africa. Diemersfontein uses this product to wood their 4½ star (Platter 2003, 2004, 2005, 2006) Carpé Diem Pinotage. As with all AOPs, they are often used in conjunction with micro-oxygenation, or simply handled like traditional barrels with the wine being racked into a clean tank before being pumped back to the stave tank again. This process is followed whenever the wine starts exhibiting excessive reductive notes. Staves need to be secured fast inside the fermentation/maturation tank in a frame, to prevent them floating around on the surface.

6.1.6**. Oak Planks or Innerstaves** – This product produces excellent results in the same vein as the mini-staves. The only drawback is that due to the physical size, they are cumbersome to use, but they do allow for fermentation on wood. If the staves are manufactured from well-seasoned oak, the correct toasting level is selected and the dosing levels are carefully chosen, then the winemaker can produce the style desired.

6.1.7 **Enological Tannins** – A relatively new area of development is the addition of tannin to the wine in the form of either a liquid or a freeze-dried powder. The

products can be either an extract of natural grape tannins like "GrapEX™", in which case the tannins are proanthocyanidins, or they can be an extract of wood tannins as produced by Dr Katz (see Katz, Interview 3), in which case the tannins are hydrolysable tannins. There are also dried tannin powders available that are extracts from oak tree gall and grape seeds. These are known as gallotannins. "The reasons for tannin additions could include the following points:- stabilization of colour, increasing the ageing potential, modifying aromas, promoting the polymerization of phenols and subsequent precipitation of proteins, limiting the effect of laccase activity, as a substrate for micro-oxygenation, as a redox buffer and also as a means of modifying both mouth feel and structure" (Keulder, 2005). Although they can be used in the production of virtually every wine varietal, they are more commonly used in the production of red wine. They can be added at any stage of the winemaking process, beginning at the crusher, during maceration and fermentation, during aging and for fining.

In an interview with Dr Katz, I posed the question as to where his product fits in relation to other AOPs. The response was as follows: "I was hoping that it would be a replacement for barrels, but I think that's a little early at present. It certainly is better than chips or staves. If you use either chips or staves you get this wonderfully woody taste, which is much sought after. However, it doesn't last very long, about 12 months and then it starts to wane. But for entry-level wines which are drunk within a couple of days, this is fine…We would need to match this and give a little extra, like integration. If you add enough liquid tannin, you get that woody taste. But in order to give the wine legs, good mouth feel, buffering capacity, longevity, we think the tannin does a better job. It fixes colour very well, but then so does tannin powder for a short period of time" (Katz, Interview 3). He also commented on the fact that of all the various types of AOPs, liquid tannins have the most wood components, due to the fact that the tannin is extracted from the wood with ethanol, heat and pressure, resulting in the liberation of a vast quantity of phenols. In other words, he is saying that his process is hugely efficient in extracting as much of the available phenols as possible, whereas the process of soaking the wine in a tank with chips or staves is relatively inefficient and only extracts a small percentage of the available phenols. There is currently a lot of testing going on between Dr Katz and some of the better-known wine cellars. This product has been approved by the Wine and Spirit Board and appears to have a lot of merit.

6.2 Guides for the use of AOPs

The one big factor that needs to be taken into account when using AOPs is the fact that the extraction rate from small pieces of wood with multiple surfaces exposed to the wine is much higher than the same wine exposed to only one surface in the interior of an oak barrel. Getting the correct amount of wood (measured in surface area) right for each type of wine produced will take some experimentation. Suppliers will be able to give guidelines as to the right amount depending on the level of extract required, however, trials should be run to determine the right mix of products. A standard 225 litre barrel is just under $2m^2$ in surface area, which translates to 109 litres per m^2 of wood. The solid wood products, not chips or powder, will normally be used in a contact percentage, measured against a base of the 225 litre barrel being 100% (Howell, Interview 1).

Example 1.
225 litre barrel is = $2m^2$
= 109 litres / m^2
If a stave with the following measurements is used:- 1000mm x 150mm x 12mm (total surface area = 0.33 m^2), this equates to 36 litres of wine (0.33 * 109 = 35.97 litres)
Total Tank capacity less 6%, divided by 36 = no of staves required to equate to a new barrel. (Note – the 6% is the volume loss inside the tank due to the wood and it's frame). This would effectively give a 100% contact ratio.

Example 2.
Slim staves have the following dimensions :- 1000mm x 50mm x 6mm (total surface area = $0.113m^2$). This equates to 12.3 litres of wine per stave for 100% contact.
If one only wished to use 50% contact, then one would use 24.6 litres of wine per stave.
Likewise 30% contact would equate to 41 litres of wine per stave.

With respect to the use of AOPs, Mark Howell had the following to say:- "I think South Africa is the only place in the world where the winemakers work on the weight of the wood per litre of wine, where the rest of the world work on surface area per litre of wine" (Interview 1).

Wood chips and *powder* are generally added by weight. *Oak Powder* is generally added at the crusher and is lost when the grape skins are pressed. At lower dosages of 0.5g per litre to 1.0g per litre, the main function is for the polymerization of tannins and stabilization of colour. At higher dosages of up to 4g per litre, wood character (flavours) develops. *Oak Chips* are added in similar doses to powder, from 0.5g per litre to 4.0g per litre. As Howell states "This is a very hit and miss system, however, this is how most of the commercial early drinking styles of wine are made" (Interview 1). *Blocks, beans or dominoes,* are supplied in 10kg bags and are added at 2g per litre. It is becoming common practice, especially by larger commercial wine producers, to use AOPs in tandem with artificial micro-oxygenation to help simulate the environment inside of a barrel. *Enological Tannins* are still fairly young and undergoing experimentation. They are added by weight or volume, in the case of liquid tannin. There are generally no good guidelines for tannin use, so winemakers should conduct their own trials to determine appropriate dosages and timing of additions (Rieger, 2005).

6.3 Micro-oxygenation

One of the big advantages of maturing wine in oak barrels is the natural micro-oxygenation that takes place. Micro-oxygenation, or micro-ox as it is commonly referred to, is the treatment of a wine with well-controlled small doses of oxygen over a short period of time (Cottrell, 2004). Artificial micro-ox has been employed commercially in France as a wine treatment technique since 1991, when Patrick Du Courneau began experimenting on the wines of Madiran in southwestern France. The Tannat wines of the area are renowned for their harsh tannins, so he experimented with micro-ox as a means of taming the wild tannins without having to send the wine to barrel (Smith, 2001).

Michel Rolland is said to be a proponent of the use of micro-ox. In the film *Mondovino,* Rolland is seen on several occasions advising his clients to micro-oxygenate their wines, however, since the film, Rolland has said that he is not that great a fan of micro-ox except in special conditions when the tannins are fierce or hard, in which case micro-ox can make them softer and rounder. He proposes micro-ox in certain countries like Chile or Argentina (http://help.com/wiki/Michel_Rolland/Microoxygenation).

The purpose of artificial micro-ox is to bring about desirable changes in wine texture and aroma, which cannot be obtained by traditional ageing techniques. The objectives of the process include improved mouthfeel (body and texture), enhanced colour stability, increased oxidative stability, and decreased vegetative aroma (Smith, 2001). The key to the process is the small controlled dose of oxygen (O_2) that is sparged into the wine via a frit, or porous stone, or possibly a block of fused metal powder, so as to produce tiny bubbles in the wine. The O_2 needs to be introduced in the form of tiny bubbles at a point just above the lees at the base of the tank. The reason for this is to ensure that the bubbles will be dissolved in the wine before they reach the surface (Cottrell, 2004). The amount of O_2 added is usually indicated as ml/L or mg/L. At 15^0C 1mg of O_2 is equal to 1,47 ml and at 20^0C, 1mg of O_2 is equal to 1,5 ml (Senese, 2000). The equipment needed is an oxygen cylinder, regulator and sparger. According to Clark Smith (2001), co-owner of Vinovation Inc. in the US, and representatives of OenoDev, the aim in micro-ox is to bleed O_2 in at just the right rate – which may vary from 0,25 to 100 ml per litre per month, without over-exposing the wine to it.

When selecting micro-oxygenation systems, one needs to be aware of the different methods for the dosing system. Some units only measure the O_2 in terms of volume and not the pressure and temperature of the gas. Other units, such as the Parsec system, measure O_2 in mg/l. As explained above, the volume varies depending on the temperature. This can lead to inaccurate dosing. The pressure varies according to atmospheric pressure (height above sea-level), which is usually not a big factor, but more importantly due to the back pressure on the sparger, caused by the size of the micro-holes and any dirt clogging the holes, as well as the level of wine above the sparger. The dosing systems need to account for all these factors, in order to know exactly how much O_2 is being added.

The timing of micro-ox is important. During primary fermentation, micro-ox stimulates the growth of yeast cells and begins the protection of colour molecules by facilitating the bonding of anthocyannins with tannins. As explained by Dr Katz (Interview 3), this is the time when the wine is least susceptible to damage by O_2. Immediately after primary fermentation and before malo-lactic fermentation (MLF), is the period when the most stabilization of colour takes place. This is an important time for micro-ox. (Smith, 2001). According to Smith, it is important to start immediately after primary fermentation, because wine rapidly loses its ability to absorb O_2. He also advises tasting three times per week to adjust the dosage based on several sensory clues. If

the acetaldehyde aromas are present in anything more than a chocolate-like aroma, then the O_2 levels should be turned down. If there are sulphide or reductive notes, then this means that the O_2 level should be increased. The most important sensory note, however, is with respect to tannins. According to Smith, the treatment should change tannins from green, to hard, to soft, but should not reach dry.

After the completion of MLF and dosing with sulphur dioxide (SO_2), the important phase of "structuration" begins. This is the manipulation of the wine's structure. The O_2 dosage is reduced by a factor of ten while the evolution of the tannins continue (Smith, 2001). Smith advises that caution needs to be exercised depending on the initial structure of the wine. Wines with initially high anthocyanins and high tannins, make the best candidates for micro-ox. Wines high in tannins and low in anthocyanins, risk the development of dry tannins, while wines with high anthocyanins and low tannins show minimal risk of developing dry tannins. Wines with both low anthocyanins and low tannins make for the poorest candidates for micro-ox. Following the structuration phase, is a "harmonization" phase, which falls between structuration and bottling. The objectives of this phase are to replicate those sought by barrel maturation. This is the phase that would be important in the use of AOPs to replicate the slow aging of the wine, developing the desired aromatic complexity, stabilizing the wine against reductive flavours, erasing herbaceous flavours, and developing the desired aromatic and taste qualities. This is the riskiest time for overdosing with O_2 with the resultant development of dry tannins, excessive maturity accompanied by lost freshness and oxidized aromas (Smith, 2001).

As Dr Woolf Katz (Interview 3) illustrates, in order for the oxygen to participate in a redox reaction and turn into the molecular form, rather than just remain in a dissolved state in the wine, the temperature of the wine needs to be above 15^0 Celsius. If the redox reaction does not take place, then the wine will become oxidized and volatile acidity will rise. He points out that the sparging of O_2 during fermentation is very important and it is unlikely at this stage that the wine can be badly damaged due to overdosing of O_2, however once malolactic fermentation is complete, one needs to exercise great care not to overdose with O_2, as the wine's ability to self-heal is greatly diminished.

6.3.1 Effects of Micro-oxygenation

According to Dr Tom Cottrell (2004) "micro-ox seems to enhance and cleanse the fruity character of both red and white wines. The mechanism for this is unknown. It

does not produce more colour *per sé*, but helps the wine hold onto the colour that was originally extracted from the grape skins. Like a barrel, micro-ox encourages the formation of short-chain polymers between the anthocyanins (red-colour), and the tannins[4]" (www.winebusiness.com). Short-chain anthocyanin-tannin polymers are more soluble than long-chain anthocyanin-anthocyanin polymers that would normally have formed and come out of solution. This increased solubility leads to a more stable colour. "The limits of micro-oxygenation are still being discovered. Every wine is different in terms of tannin structure and will therefore react differently to micro-ox. We still have a lot to learn about the complex structure of wine" (Nel, 2001).

6.4 Trends in Useage

The number of new suppliers of AOPs in South Africa, including existing coopers or cooper's agents, has increased dramatically in the last two years. In the September 2006 issue of *Wineland* magazine, which had a special feature on wood, there were seven companies advertising AOPs. Of these seven, four are also suppliers of barrels. This reflects an increased demand for AOPs and it also points to a confidence in the growing demand and bright future for the market for AOPs. During a recent interview, Mark Howell of Tonnelaria Nacional estimated that the market had been growing at a steady ten percent per year, and would continue to do so in the foreseeable future. In his words, "My feeling is that the stave market will continue to grow at about ten percent per year, as more and more winemakers become more receptive to the idea and are forced to look at these products, due to the constraints placed on them by the bean counters of this world" (Interview 1). Jeff Grier of Villiera Wines, a current user of AOPs, felt that "like screwcaps or riddling machines, AOPs are technically better than barrels but suffer from an image problem and are perceived as being a shortcut method of winemaking." (Interview 2, pg 3). However, he does seem to feel that they are the future.

This growth in the AOP market is not only a local phenomenon; rather it is a mirror of the international wine industry, especially in the so-called New World. The *Wine Business Monthly* magazine has produced an annual "Barrel and Oak Survey Report" in the USA for a number of years. Their 2005 survey, published in the December of that year, was based on 267 responses, including 161 from California,

[4] See section on *The role of Oxygen in the Wooding Process* with regard to the formation of aldehydes and nitrogen peroxide, and their role in polymerisation of tannins.

23 from Washington, 14 from Oregon, 12 from New York, 4 from Michigan, 5 from Virginia and 3 from Texas. It could therefore be construed as being a fair reflection of the winemaking industry in the United States of America. It is, however, not a scientific study. The report rates wineries as follows: small as 50,000 cases per annum, medium as 50,000 to 499,999 cases per annum and large as greater than 500,000 cases per annum. The report finds that due to the surplus of wine in the market, the glut of grapes available, stiff foreign competition and the weak US dollar/Euro exchange rate, the barrel industry has had a difficult year. As a result of these factors, large and mid-sized wineries have increased their use of AOPs and also American oak. However smaller wineries have still continued to favour French oak barrels.

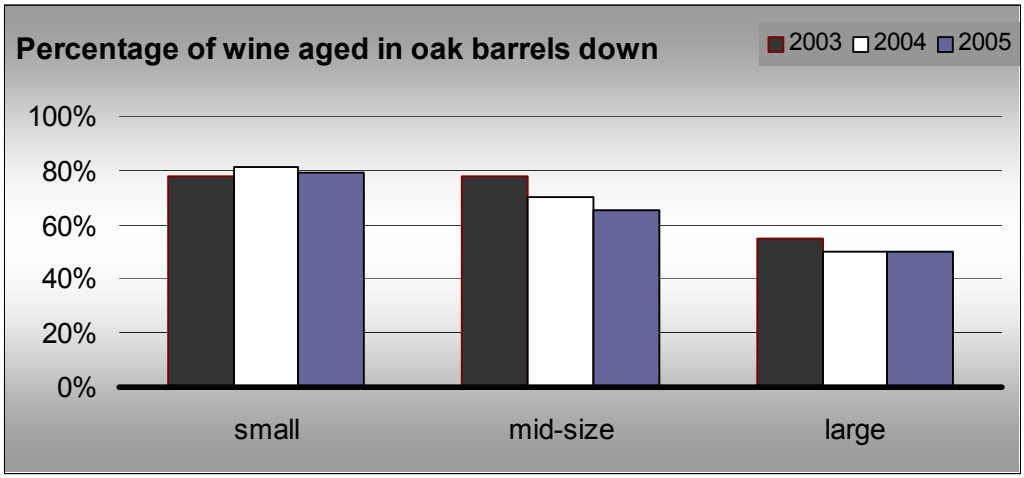


Chart 1. Percentage of wine aged in oak barrels in an American study

The survey found that mid-sized wineries, in order to stay competitive with large wineries, are adopting more practices consistent with those large wineries. Overall, the percentage of wine aged in oak barrels has declined slightly (see *Chart 1*), with mid-sized wineries making the biggest move towards the use of AOPs. Large sized wineries are the biggest users of AOPs. In 2003, 100% of the large wineries surveyed had tried alternative (see *Chart 2*). About half of all small wineries surveyed had used alternatives – 53% in 2003 and 2004, increasing to 54% in 2005. Small wineries generally strive to produce Premium wines and are therefore less likely to cut costs, explaining the lower percentage of AOPs. Consistent with the move away from ageing wine in oak barrels, the percentage of mid-sized wineries that have tried alternatives has increased from 69% in 2003 to 81% in 2005; a marked increase.

Initially AOPs gained popularity due to their cost-saving function, but now winemakers are enjoying other advantages. “Alternatives were first used because of cost, but I think their growth is also driven now by the fact that some products are very good and winemakers have learned to make barrel-quality wine in tanks with alternatives and micro-oxygenation,” says Joe Kidd, winemaker at Sterling Vintner’s Collection, California, and “Alternatives have become more accepted by winemakers and suppliers have continued to produce better quality products. We have seen that in many cases we can make wine that is approaching the quality one sees in barrels” (Kidd, www.winebusiness.com).

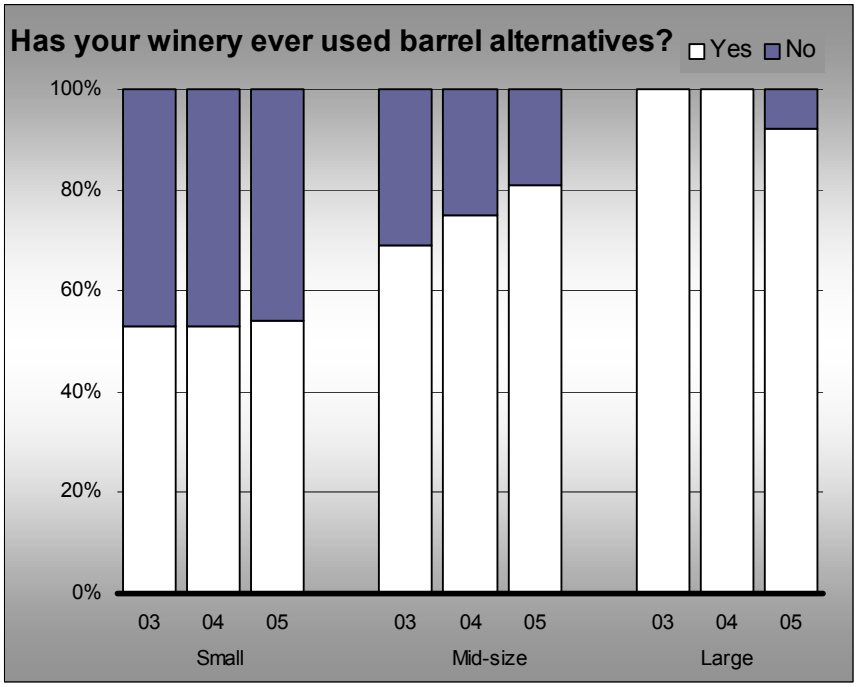


Chart 2 – Percentage of different wineries using AOPs in an American study

When it comes down to choice of alternative products, oak chips and blocks are the most popular choice with wineries of all sizes: 78% of small, 91% of mid-size and 92% of large wineries that use AOPs, use chips and blocks (see *Chart 3*). Staves, and lengths of oak that are toasted and infused with different flavours, are the second most popular alternative, with 51% of small, 59% of mid-sized and 92% of large wineries using AOPs, reporting the use of staves. Oak powder, added during fermentation to stabilize colour as well as enhance flavour, is used by 25% of small, 32% of mid-size and 38% of large wineries that use AOPs. Barrel inserts or renewals

are the least used, by 21% of small, 32% of mid-size and 38% of large wineries using AOPs (See *Chart 3)*.

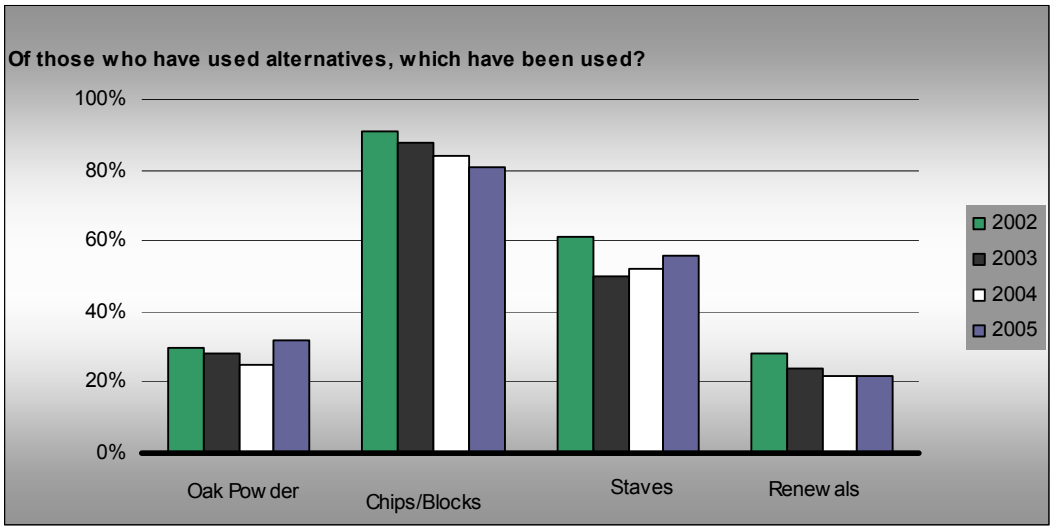


Chart 3 – Chips and blocks used in an American survey

Due to the large difference in price between American oak and French oak, many larger US wineries have changed their barrel programmes over to predominantly American oak. Others, who prefer to stick with French oak, have swapped their French oak barrels for French oak staves instead. The advantage of staying with French oak staves instead of opting for American barrels is that the flavour profile of their wines stay the same (See *Chart 4*).

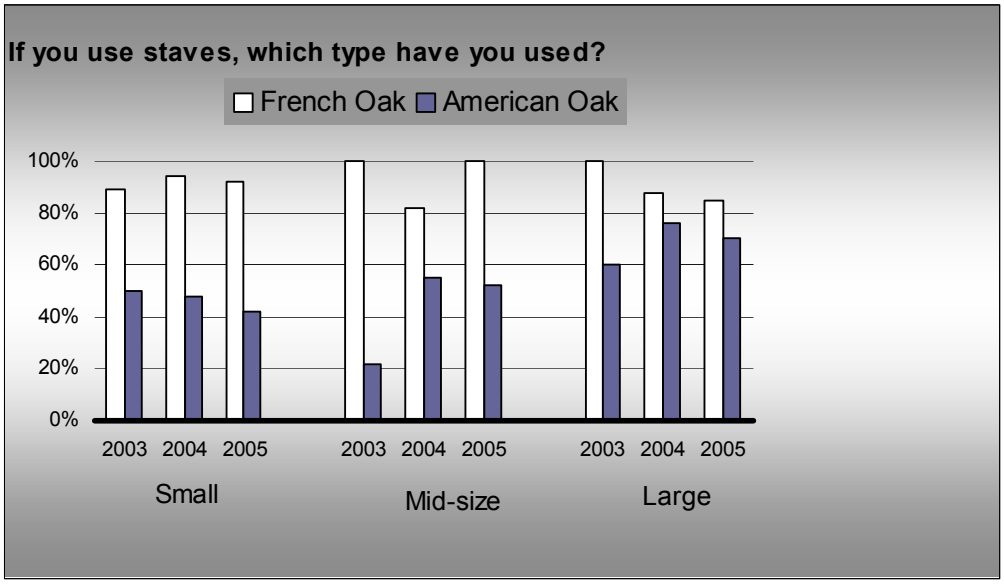


Chart 4 – Different staves used as found in an American survey over 3 years

One of the results of the move towards the use of AOPs by mid-size and larger wineries is the increase in retail price-points of wine made with alternatives. The ceiling for wines made with AOPs was around the US$15.00 per bottle range (in excess of R100.00 per bottle), but winemakers are now considering them for the next level of price-points – US $ 14 – 25 (i.e. sub R200.00 per bottle price level). "Currently we use alternatives only on wines below $14.00, but I am curious about using them on $14 – 25 wines. However, I wouldn't use them on wines above $25.00" said Jonathan Oberlander, winemaker at Silvan Ridge-Hinman Vineyards in Eugene, Oregon (www.winebusiness.com).

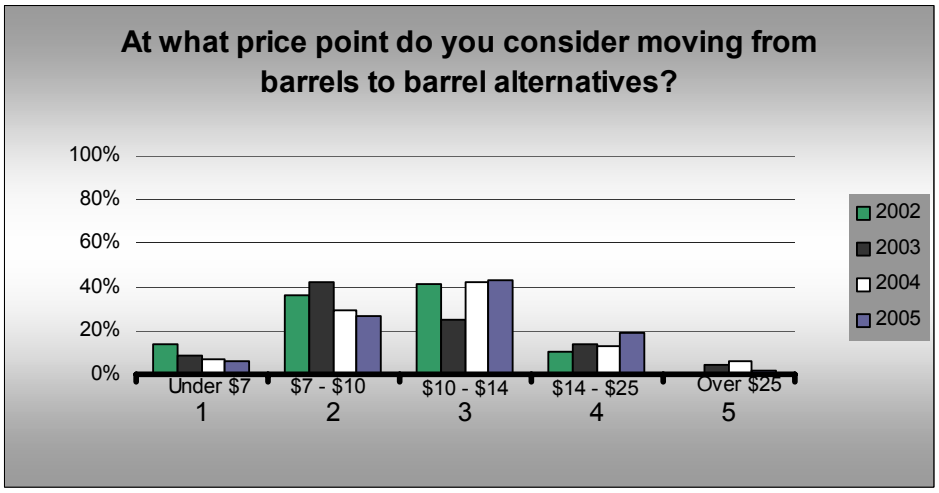


Chart 5 – Price points up for wines with barrel alternatives in an American survey

In South Africa, winemaker Bertus Fourie (currently at KWV) used 100% new innerstaves to wood the Diemersfontein Carpé Diem Pinotage (see Howell, Interview 1). This wine was awarded four and a half stars by Platter in 2003, 2004, 2005 and 2006 and consistently sells out shortly after release (www.winebusiness.com). The cellar door price of the 2004 vintage was R99.00 per bottle.

Due to the reluctance of many local South African winemakers to admit to wooding their wines with AOPs (because of a certain attached stigma) it is difficult to find out how many other top class wines were wooded with alternatives and to determine the upper price-points locally. There are plenty of mid-priced, premium quality wines wooded with alternatives, e.g. Villiera Cellar Door Merlot and also their Villiera Chenin Blanc, that sell from the farm at R55.00 and R27.00 respectively (Grier, Interview 3). With winemakers of the calibre of Bertus Fourie, it is likely that KWV will be following the international trend of large wineries moving more toward alternatives. As shown by Mark Howell (ex-Tonnelerie Radoux) in his interview, Distell is moving heavily towards the use of oak alternatives. The South African wine industry will not buck this trend. Rather, if one looks at a winery like Swartland Winery, that now has a production agreement with EJ. Gallo in California (the largest wine producers world-wide), there will be a trickle-down effect to other producers locally.

6.5 Cost Differences between Barrels and AOPs

Example 1: Wooding with 100% new French wood

The current price for a French Oak barrel varies between € 580.00 and € 630.00 which at the current average exchange rate (November 2006 €1 = R9.50) is the equivalent of R5500.00 to R6000.00. For the purpose of this exercise, we will disregard the more expensive French barrel. The standard depreciation for oak barrels is : 1st Fill = 50%, 2nd Fill = 30% and 3rd Fill = 20% (Interview 1). If we assume that the barrel will be sold off or used in a different range of wines the following year, then the cost per litre is R12.22 which equates to *R9.17 per 750ml bottle*. Additional costs are incurred in the labour to manage that barrel (time spent racking and topping), top-up wine added to the barrel and the cost of space. The equivalent cost to wood the same wine in a tank on 100% new French oak staves with 100% contact (equivalent surface area to 225lt barrel) would be R2.77 per litre or *R2.08 per 750ml*

bottle. ie 23% of the cost of new French barrels (see Howell, Interview 1). Additional costs with the staves may be CO_2 or N_2 gas to fill the headspace in the tank, micro-oxygenation, reduced labour from barrels and reduced cost of space due to more efficient useage. It is unusual with alternatives to use 100% contact, due to the high extraction rate[5] of alternatives. A much more normal scenario is 50% contact rate which gives an equivalent cost of *R1.04 per 750ml bottle.* ie 11.3% of the cost of new French barrels

Example 2: Wooding with 1/3 new French barrels, 1/3 2nd Fill and 1/3 3rd Fill French barrels.

For costing purposes of the barrels, we assume the new barrel is purchased at current exchange rates and costs R5500.00. The 2nd fill barrel was purchased in 2005 and cost R4500.00 while the 3rd fill barrel was purchased in 2004 and cost R4700.00. Assuming the standard depreciation on barrels as per *Example 1,* then the total wood cost for 3 x 225 litres = 675 litres would be R920.00 (3rd fill) + R1350.00 (2nd fill) + R2750.00 (new) = R5020.00 which equals R7.43 per litre or *R5.57 per 750ml bottle*. Again comparing this to a 50% contact ratio with new French staves, as per *Example 1,* wooding with the staves would be 19% of the price of the barrels. Wooding with alternatives other than staves is even more cost effective. Vini blocks cost approximately R0.38 per 750 ml bottle, while oak chips (depending on the dosage will cost approximately R0.24 per 750 ml bottle. If one looks at the cost of using enological tannins, then the costs diminish again to approximately R0.23 per 750 ml bottle for red wine and R0.08 per 750ml bottle for white wine. *See Chart 6* below.

It should be noted that AOPs are normally made from inferior wood, hence the much lower costs of these products. Normally a barrel is made from the bottom third part of the tree and the rest is used for AOPs (Du Toit, 2006).

[5] Discussed in full in *Guide for the use of Alternative Oak Products*

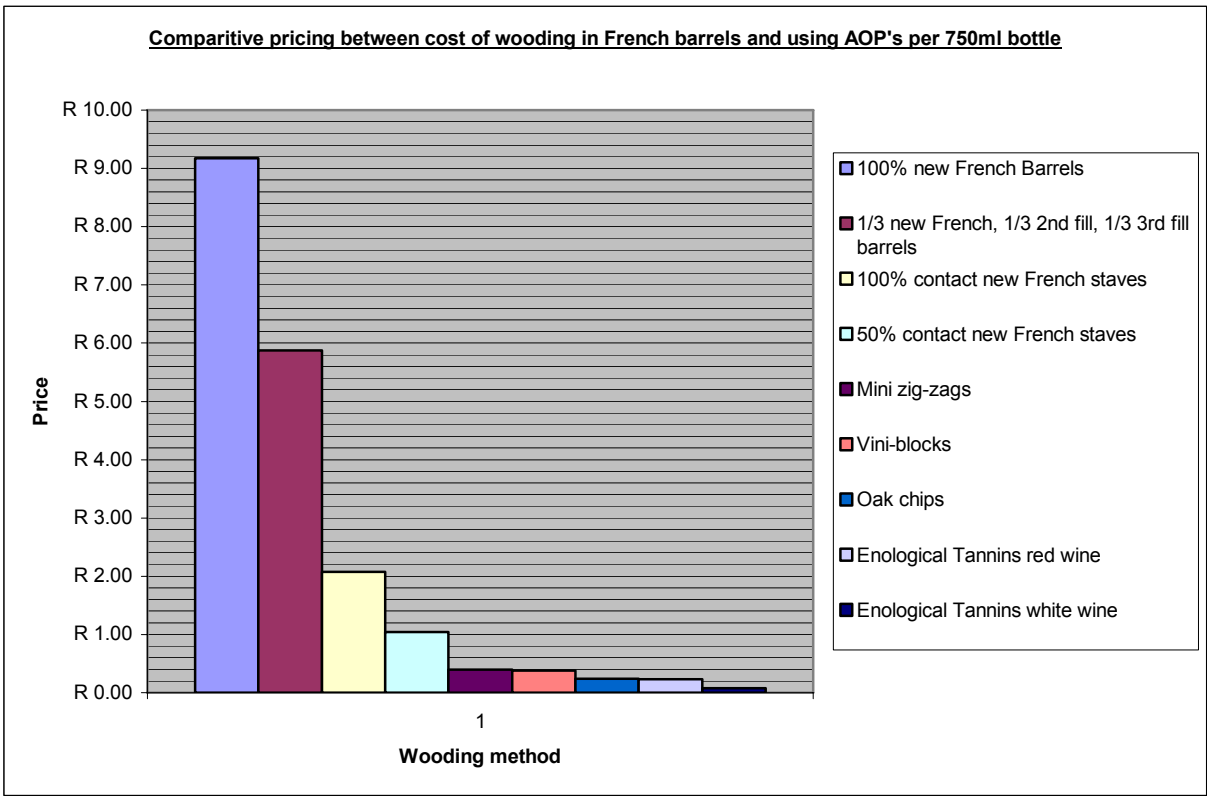


Chart 6: Differences in price per 750ml bottle, depending on wooding method

When one sees the major cost saving to be made by using AOPs in preference to barrels, it is not difficult to see why they have such a bright future, especially in the everyday drinking wine category.

7. RESEARCH RESULTS

In this chapter, I have reviewed the results and conclusions of recent research done in Stellenbosch University, on various types of alternative oak products and barrels. The projects are as follows:-

7.1 Research done by Bertus Fourie for his thesis for his degree in Master of Agricultural Sciences at the University of Stellenbosch. The subject of his thesis is *The influence of different barrels and oak derived products on the colour evolution and quality of red wines*.

7.2 Research done by Daniël B. Keulder for his thesis for his degree in Master of Agricultural Sciences at the University of Stellenbosch. The subject of his thesis is *The influence of commercial tannin additions on wine composition and quality*.

7.3 An *Introductory study on the use of alternative wood maturation methods* by P. van Rensburg and J. Joubert, Dept Viticulture and Oenology, Institute for Wine Biotechnology, University of Stellenbosch.

7.1 "The influence of different barrels and oak derived products on the colour evolution and quality of red wines." – Bertus Fourie.

In his thesis, Fourie investigates differences in colour and phenolic development on Shiraz and Pinotage wines, between new barrels of different origin (French, American and Russian), and also between barrels of differing ages and alternative oak products (AOPs) on Pinotage wine. His study showed the following results:-

1. New oak barrels have a more significant effect on wine colour than used oak barrels and AOPs.
2. The differences between new barrels of different origins on colour evolution of Shiraz and Pinotage wine is minimal
3. The differences between used barrels and AOPs on colour evolution is minimal.
4. New barrels give a higher degree of oak aromas and a lower degree of fruit aromas than used barrels and AOPs.

5. Used barrels and AOPs give a higher degree of fruit aromas and a lower degree of oak aromas than new barrels.

Conclusion

Fourie concludes that maturation of red wines in oak barrels leads to more complex wines, probably due to higher available amounts of ellagic tannins. He attributes the modification of the red wines in his experiment to the aroma constituents and phenols extracted from the oak. He also credits a wide range of attributes to the toasting of the wood. He also shows that the results from AOPs are inconsistent in their chemical diversity and complexity and attributes this to inconsistent quality of the AOPs. He also identifies small differences in the values tested for, between the barrels of different origins - although after 36 months bottle ageing, the stylistic differences between the different barrels is apparent. He postulates that terroir is most probably more important with regards to colour evolution than the differences in the origin of barrels.

7.2 "Evaluating and characterizing different commercial tannin additions to wine after fermentation." – Daniël B. Keulder.

In his thesis, Daniel Keulder investigates the effect of three commercially available tannins (hydrolysable, condensed and a mixture of hydrolysable and condensed) on two wines from the same grapes. One wine received no post fermentation maceration and the other received extended post fermentation maceration. The tannins were added strictly according to the manufacturers specifications. The effect of three other commercially available tannins (hydrolysable, condensed and a mixture of hydrolysable and condensed) was also investigated on a wine that received different amounts of oxygen. The following parameters were monitored in both experiments; colour density, hue, sulphur dioxide resistant pigments, modified colour density, total red pigments, colour composition, total anthocyanins, total phenols, total tannins and gelatine index. Keulder found the following results:-

1. Commercial tannin additions do not affect most of the colour characteristics of both the non post-maceration wine (NM) and also the extended post-maceration wine.
2. The effect of oxygenation on phenolic composition is larger than the effect of added tannin on phenolic composition.
3. There is an effect when rotten fruit is used.

Conclusion

From his results, Keulder concludes that the commercial tannins in use in the wine industry are different in composition because of differences in colour, types of tannins, extraction methods and other compounds. He postulates that these differences will result in differences in wine composition. He suggests that the different commercial tannins should be thoroughly analysed to determine their exact composition and what the effect of adding an unknown factor can have on wine quality.

7.3 "Introductory study on the use of alternative wood maturation methods." – van Rensburg and Joubert.

Van Rensburg and Joubert suggest that due to the current expense of new barrels, it is not economically feasible to use them in the production of price sensitive wines. The purpose of this study is to compare the results of maturing red wine on a variety of alternative oak products in comparison to two new oak barrels as a control.

Cabernet Sauvignon (2001) was fermented dry on the skins after being innoculated with Saccharomyces cerevisiae NT50 yeast. After malolactic fermentation was complete, the SO_2 levels were adjusted to 80mg/ L. Wood treatments, strictly in accordance with the suppliers recommendations were applied, as per *Table 1.* The old French 300 litre barrels used in the experiment were fifth fill, and were thoroughly steam cleaned before use. No wood character was transferred to the wine; only the barrel environment was thus imitated. The wine was left to mature for 150 days, following which it was bottled unfiltered, directly from the barrels. Screw seals were used to prevent any other contamination.

The following analysis was done on the various samples:-

1. Colour analysis according to the methods of Evans (1977).
2. The quality of the extract was determined using the pycnometer method.
3. All non-volatile components extracted from the wood, or oxygen added, which was still in the solution, were thus determined.
4. Organoleptic judging was conducted by a panel of five experienced, trained judges. Wines were described in detail by each judge and scored on a 20

point tasting chart. A line chart, on which the mouthfeel and volatile oak component were evaluated separately, was also supplied to the panel.

Maturation container	Treatment	Concentration
Barrels (fifth fill)	2 x barrels with French oak staves	*
	2 x barrels with French oak shavings (coarse)	4 g/l
	2 x barrels with French oak shavings (fine)	4 g/l
	1 x barrel with water extracted French oak tannins (powder form).	35mg/l
	2 x barrel with 2x alcohol extracted French wood tannins (powder form).	35mg/l
	1 x barrel with alcohol extracted American oak tannins (liquid form).	4 ml/l
	1 x barrel with alcohol extracted French oak tannins (liquid form).	4 ml/l
	1 x fifth fill barrel as internal control barrel	-
New Barrels	2 x first fill barrel as controls	-
Tanks	1 x tank with French oak staves	4 g/l
	1 x tank with French oak shavings (coarse)	4 g/l
	1 x tank with French oak shavings (fine)	*
	1 x tank with water extracted French oak tannins (powder form).	35mg/l
	2 x tanks with 2 x alcohol extracted French oak tannins (powder form).	35mg/l
	1 x tank with alcohol extracted American oak tannins (liquid form).	4 ml/l
	1 x tank with alcohol extracted French oak tannins (liquid form).	4 ml/l
	1 x Control tank	

- Staves in a bundle suitable for 1 000 litre barrels were received from the supplier and were allotted to barrels and tanks according to staves per litre volume.

Table 4: The explanation of the various treatments and concentrations.

Van Rensburg and Joubert found the following from their testing:-

1. The alternative wood treatments conducted within the barrel maturation environment are better in terms of fullness, overall tannins and volatile oak characters, than the alternatives matured in a tank.
2. The exogenous tannins perform better in a tank than in the barrel environment.
3. The exogenous tannins derived from toasted oak, impart more oak character than exogenous tannins from untoasted oak.
4. The toasted exogenous tannins impart less fullness and tannin character than the untoasted version, due to a reduced amount of ellagitannins in the toasted oak wood.
5. New oak barrels gave the most balanced result in overall character and that in comparison, each of the alternative treatments were lacking in one or other characteristic.

They concluded that possibly a combination of some or all the alternative wood treatments may imitate new barrels. They also found that the fifth fill control barrel gave good results and that the influence of older barrels should not be underestimated.

7.4 Summary of Research Projects reviewed

1. Fourie and van Rensburg both found that new oak barrels have a more significant effect on wine complexity and colour than older barrels and AOPs, probably due to higher levels of available ellagic tannins and better natural micro-oxygenation in new barrels versus old barrels.

2. Keulder found commercially available exogenous tannins to have little effect on colour.

3. Van Rensburg and Joubert found AOPs generally to produce unbalanced results, but that a combination of different types may produce a result closer to barrels.

8. REVIEW OF INTERVIEWS

The consensus of opinion of all people interviewed is that at a certain level in the market place, there is no substitute for alternative oak products. As Bruce Jack says, " if you are trying to battle the rest of the world in the commodity market, then AOPs are the only option" (Interview 4, pg 6).

Jeff Grier sees AOPs as being the future, "like screwcaps and riddling machines" (Interview 2, pg 1). He pointed out all the benefits that make huge business sense to anyone serious about producing volumes of "value for money wine." Villiera is renowned for their range of top quality "value for money" wines.

Dr Woolf Katz acknowledged that it is still early days for oak alternatives, but like the scientist that he is, he has unwavering confidence in the fact that his research and development will solve problems experienced with exogenous tannins (Interview 3).

Mark Howell, as a supplier of both barrels and alternative oak products, feels that barrels will always give a superior result - at a price (Interview 1). No one foresees the imminent demise of the barrel in the premium sector of the market. All these opinions are consistent with the findings of the *Wine Business Monthly's* 2005 survey on barrels and alternatives, conducted in the US wine industry and reviewed in the section on *Trends in Useage*.

There is a certain stigma attached by "wine nerds" to wine made with AOPs, but as pointed out so succinctly by Bruce Jack "The consumer doesn't care. That's why the consumer eats McDonalds and feeds their spaced-out kids refined sugar and refined wheat on a daily basis. The consumer of wine is as clueless about wine as they are about nutrition – you either live with this fact or join the agnostics" (Interview 4, pg 6).

Jeff Grier also felt that the consumer couldn't generally tell the difference between wines wooded with AOPs and wines wooded with barrels. He found that even experienced tasters regularly make mistakes both ways at wine tastings. He felt there was more resistance towards AOPs from fellow producers and some journalists than there was from consumers.

Most people interviewed expressed a concern about the effects of "flavouring" with certain AOPs fading with time. Bruce Jack felt strongly that they could not be used for

long-lived wines “because of the chemistry involved” (Interview 4, pg 6). Woolf Katz mentioned that he had heard complaints from supermarket buyers in the UK that wines wooded with chips had a definite shelf life of not much over a year. This would support changes to labeling by certain South African producers, who have introduced a sell-by date on their labels.

Internationally, the US sees strong moves towards AOPs with price-points at which AOP wines are sold, creeping up every year. This is most probably more due to the global red-wine glut and pressure on pricing, than anything else. As Mark Howell states, Italy is already a big user of AOPs, but not in the Super Tuscan brackets. France has long been covertly using AOPs (see Jack, Interview 4), even in areas where they were strictly verboten by law, and before they were legalized by changes to EU law in 2006.

Bruce Jack summed up the role of AOPs with the following comments:-
“ AOPs have a very important role to play in the commodity side of the business. Winemakers should not be judged negatively in this regard – it is like asking how much is their soul worth. Winemakers are, in the main, making a commodity product, not penning poetry, leading communities or painting landscapes. Our worth in general, and as a working segment of our economy, is clear in as much as we do what is necessary to survive – to pay the bills. However, if we choose to be artists, that is our own fault and no one should forgive or pity our follies. But like artists, winemakers who believe in authenticity will either use oak barrels or perhaps when they see the light use no foreign matter at all. Ultimately, the most relevant of winemaking decisions will perhaps only be answered by the smile of a normal consumer sipping long after the winemaker is dead” (Interview 4, pp 7-8).

9. FUTURE OF ALTERNATIVE OAK PRODUCTS

As long as oak remains the flavour of the month, there will always be a growing demand for alternative oak products. The large wine producers such as Distell and KWV will be wooding a large part of their production with alternatives in the future (Fourie, 2006) (Howell,Interview 1). According to Fourie, KWV will be doing research projects together with AOP suppliers in 2007, to determine which products will be used.

More and more suppliers are offering ranges of AOPs to winemakers in South Africa. In the conclusion of his thesis, Fourie, argues that the quality of AOPs is often very suspect. He also advises potential purchasers of AOPs to look at the credentials of the supplier, to see how much money their parent company had invested in research and development on their products. The temptation for some companies to climb on the bandwagon and make a quick buck, will obviously be too great to resist. As they say in Afrikaans, “goedkoop is duurkoop!” In his summing up, Keulder (2005) also referrs to the unknown factors in exogenous tannins. There is no guarantee what concentration of tannin is in that bottle of liquid tannin, or quite what is in the mix of freeze-dried powder.

However, wine journalists have been slating the over use of wood in many cases. Some producers are now starting to question wooding wines at all. In his interview, Jack mentioned the fact that for the 2007 vintage, Flagstone Winery would be doing away with oak maturation in their top ranges, Music Room and Dark Horse. In commenting on the move away from wood, Jack said “primarily this is because we don’t believe you can truly express the energy of memory of a corner of our world, by putting the wine in wood – too much background noise” (Interview 4, pg 5).

Is this the beginning of a new phase – unwooded wine, or rather wines with minimal wood influence?

10. CONCLUSION

The chemistry of winemaking is highly complex and not all the interactions between wood, wine, yeasts and environmental components are fully understood. Oak trees vary from one tree to the next and between different forests and countries. If terroir affects grapes, it also affects every other plant, tree and bush. Differences between grape varieties, vintage variations and terroir all help to provide an infinite number of permutations in each batch of wine. It is all these differences that make wine such a fascinating blend of art and science.

The oak barrel is a remarkable self-contained wine factory. As long as the wood is not contaminated by unfriendly bacteria and basic winemaking practices are followed by keeping barrels topped, then the quality of the resulting wine is usually in keeping with the quality of the raw materials.

Evolution of wine in a barrel is a slow process and allows the winemaker plenty of time to make important decisions. However as we have seen from the preceding facts, slow-wine is only a small part of the overall wine market. The majority of wine sold today is purchased in a supermarket and consumed within 72 hours. Purchasing power in the hands of relatively few buyers accompanied by a global wine surplus puts producers under pressure to keep margins and costs in line with selling prices. It is this pressure to make the winemaking process more efficient, both in terms of time and in terms of the actual process that drives the quest for evolution. It doesn't take a rocket scientist to work out the potential savings in overheads, labour and costs of materials to see that making wine in a barrel is just not feasible at the commodity-end of the market.
However, can wine equivalent to the very best quality be made using alternatives? This is the question we are trying to answer.

From the research results we have reviewed, we have seen consistent evidence that no, alternatives are not yet, in the same league as barrels. However, it is this permutation of different factors that complicates the maturation process. Flashes of brilliance, by some award winning wines, show us that yes, there is light at the end of the tunnel. Part of the reason for poor performance by some AOPs is discussed by Fourie in his dissertation. He points to the fact that many AOPs were made from raw materials that do not compare to the quality of wood used in the better barrels. Coopers have expended an enormous amount of energy in researching what makes

better and more consistent barrels. If that same energy is directed towards the production of quality AOPs, then current ideas and research may change quickly. Micro-oxygenation is still a new tool, not totally understood, but a combination of AOPs and micro-oxygenation will most probably be the 20th Century substitute for the Iron Age Barrel.

There are many reasons to think that we have the technology to make AOPs work and shed the title of “cheap flavourant,” but until then, the barrel will continue to reign supreme.

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APPENDIX 1

Interview 1

05/09/2006 Interview with Mark Howell from Toneleria Nacional – Oak Alternative Supplier.

1. Mark, please will you give me some history behind TONELERIA Nacional and how they came to supply Oak Alternative products. Did they start out as a regular cooperage?

Toneleria Nacional is a Chilean Based company started by an Italian national who commenced life as a forester having studied in Europe. Coming from a reasonably comfortable background and having seen the difference in cooperage between the USA and the French based cooperage, decided to set up a operation in South America focusing on wine barrel production as most of the American Cooperages are geared around barrel produced for Bourbon. Not only did he see the gap in the market for this sort of business, but he also saw that the production of alternatives was in most cases using inferior raw material, which was not doing the industry any favours. He, as well as his partners (as the company had grown quite a bit at this stage), decided to enlist the help of a well-known Oenologist who had the know-how to do the research as well as give accurate and precise results. Pascal Chatonet and Exell Labs were brought on board to assist in the development and production of convection toasted Staves, Chips, Powder and, very recently an exciting new barrel toasted by the same method. Naturally we also produce barrels with the conventional way of toasting.

2. Can you describe the product range, the options for each product e.g. toast levels, types of wood available etc., and tell me the advantages and disadvantages of each product?

A 2006/7 price list, as well as all the brochures, are included to answer this question. Could you also please take a look at the CD I gave you.

3. Please explain how each product should be used – dosage / Hl, surface area / Lt., etc.

Barrels I think are self explanatory so let's move on to the staves.

I think South Africa is the only place in the world where the wine makers work on the weight of wood per litre of wine where the rest of the world work on surface area per litre of wine. The formula is as follows:
The inside surface area of a 225 lt barrel is just under 2 m2
IE 109 lt of wine per m2 of wood
Using a 1 stave measuring 1000mmx 150 mm X 12 mm equates to 36 lt of wine
Tank Capacity – 6% divided by 36 = meters of wood required to equate to a new barrel (the 6% is what you lose to the amount of space the wood and frame take up in the tank).

Slim Staves
Here the same formula applies but we use the following formula as it is quick and easy.
Slim Staves are just under 1000x 50x6 mm
100% contact of a 225 lt = 15 l per stave
50% contact = 30 lt per stave
30% contact = 50 lt per stave
The most common order is for a 30% contact unless the wine maker is planning to blend the wine with an unoaked tank. There are so many permutations that each and every stave sale needs to be investigated fully before supplying the product.

Chips
Here most guys work on Grams / Litre. Anything from 0.5g per lt all the way up to 4g/l
A very hit and miss system and yet most of the commercial wines are made on chips.

Powder.
This product is mainly used at the crusher and is lost when the grape skins are pressed. At lower dosages (5g per lt inc skins, to 1g per lt) the main function is for the polymerization and stabilation of colour. When higher dosages are added up to 4g/l you do start to pick up a wood character. In larger commercial cellars wine makers also mage use of powder (very small doses) on wines that are queuing for barrels or staves. This addition of powder just prevents the wine from taking on that dull or lomp character.

Zig Zags – 1meter squared – A rather large amount of wood for a barrel but some wine makers cut them in half, others use them for 2 or 3 fills in older barrels.

Mini Zig Zags- 0.31meters squared – Good results as it was designed to assist wine makers using newer barrels and should impart a subtle amount of oak to wine in older barrels at the same rate as newer barrels. So this is planned to allow wine makers the use of this product in conjunction with new 2nd 3rd 4th & 5th fill barrels.

Viniblock – Inserstaves cut up into beans 10 kg usually used at 2g / lt

4. How does the wine produced by each product compare to ageing wine in barrels?

    - Premium Oak Powder – Should only be used for colour stabilization and keeping the wine “fresh” whilst waiting to go to other maturation products.
    - Premium Oak Chips- Should only be used on very commercial products where the shelf life of the bottled wine is not expected to exceed 3 years (Red) an 2 years (white).
    - Premium Oak Domino’s - Here we have had very good results as this product is made from Inserstaves that have been damaged during production - as you will understand with 2 to 3 meter staves that have been aged outside for 2 years, then planed and toasted there are always staves that split or brake whilst being handled. The surface area is very difficult to calculate but it is 10 kg bag and the winemakers find it very easy to add or remove from the tanks as it is a bag and can be removed through the chimney of the tank.
    - Premium Zig-Zag Barrel Revival Kits - Discussed above.
    - Premium Oak Staves - Or as we call them Slim or mini staves - Here I see the greatest potential growth in South Africa. This product at a dosage of 50 lt per stave is a winner. I have clients that have achieved 4 ½ Platter star ratings on wine that have been made with these staves. They are reasonably easy to get into and out of the tanks and

together with micro oxidation or simply a few pump overs or even completely pumping the wine into a second tank and then splashed back over the staves.

- Premium Oak Tank Planks - Or as we call it Inserstaves – (Planks-NAA). Again good results but rather cumbersome to use, but do allow for fermentation on wood and do give excellent results. As with all oak alternatives, if the aging of the wood is done properly and the toasting and the dosing is correct, winemakers are able to attain a very fit for purpose result.

5. How do you perceive the disadvantages of Oak Alternatives in comparison to regular Oak barrels?

   As stated above, New Barrels will always give a superior result, but in order to produce premium quality wine and use only new barrels and then sell them off the wood cost per litre would be in the region of R12.00 per litre. That is if you are able to sell your barrels after one use. Danie de Wet only uses his barrels once and then sells them off at 60% of the purchase price. Granted he only does Chardonnay in them, but a barrel is very much like a new car, drive it off the show room floor and it loses 30 to 50 % of its value. Given the current glut of wine in the world and the wine consumer is now much more orientated to drinking the wine with in 24 hours of buying it, Alternatives are more suited to the producing of wine for today's market. On the down side, alternatives are not suitable for wines that are made to age for more that 7 or 8 years, as the quicker the wood becomes apparent on the wine the quicker it will fall away. The exchange rate also plays a big factor on profitability. S.A wine makers have been finding it very difficult to make a profit with the Rand $/€ exchange rate being under R7.00 to the $ and R9.00 to the €. But that is due to their pricing structure being set when the rate was far more advantageous and they were used to getting a natural increase of about 15% due to the falling rand over the last 10 years or so.

6. How do Oak Alternatives compare in cost to barrels?

Barrels: Let us say a 225 lt French oak barrel today cost R5500.00 (French), last year R4500.00 and the year before R4700.00 (the exchange rate again). The standard depreciation of a barrel is calculated as such Fill 1 = 50%;
Fill 2 = 30%; Fill 3 = 20%

So R920.00 (3rd fill) + R1350.00 (2nd fill) + R2750.00 (new) Total = R5020.00 for 675 lt of wine = R7.43 per lt of wine.
Alternatives: The most expensive wine made on staves in S.A. is the Diemersfontein Carpe Diem Pinotage where they use 100% of a 225L barrel contact surface area on Inserstaves . This year their cost per lt was R2.77 a litre. And this as always was all new oak.
Mini or slim staves usually come in at about R0.32c per litre
Vini block is around R0.50c a litre and mini zigzags at about R0.53c

7. How do you foresee the market for Oak Alternatives growing ? Is the market becoming more acceptable of the products ?

Now that the rand is back over R7.00 to the $ and R9.00 to the €, winemakers are more likely to try and purchase barrels as they say they are able to afford them. However a large group like Distell have made it common knowledge that within 3 years all their standard products, i.e. FDC Nederberg Zonnebloem etc will only be made on Staves and chips. However they have an in-house stave and chip production house and that is not Radoux S.A. who are 50% owned by Distell. My feeling is that the stave market will continue to grow at about 10% per year as more and more winemakers become more receptive to the idea and are forced to look at these product due to the constraints placed on them by the bean counters of this world. In other words they are never going to make a top wine on staves because their top grapes go to barrels. Unlike a winemaker in the States who produces a 100us$ wine and does not own 1 barrel.

8. Is there a difference in acceptability between small, medium and large producers?

Discussed above re. Distell, but yes. The smaller, more focused producers are more reluctant to try alternatives. However a producer who shall remain unnamed put all of his 2002 harvest out as a 2nd label due to the wine being “lighter” than normal now has to produce a 2nd label wine using staves from his tanks of 2006 wine in order to meet demand. So this is a never-ending, evolving business.

9. How do you think the changes in EU law allowing the use of Oak Alternatives will affect the acceptability of the product in the following areas / countries :

- Bordeaux

The Bordeaux boys will possibly be the last guys to start using alternatives but I restrict this statement to the Growths. The further down the scale they are the more chance there is of them trying something different. The 2005 prices of classed Bordeaux will be the highest ever but I don't know who is going to buy it all.

- Languedoc

Already using alternatives extensively and have been for many years as you must remember the influence of the flying wine makers. Although illegal up until recently, the double standard of being able to "experiment" with 10% of the total crop has been allowed for the past few years.

- Rhone

Again the serious players in this area will hold off using anything new and one must remember the Rhone has very recently undergone a total upsurge in its quality as well as its pricing structures. The demand for Rhone or Rhone styled wine has also increased and their grapes don't always call for that much new oak.

- Burgundy

Again they don't always need that much new wood when producing wine with their cultivars. One must remember that a lot of producers use very old large oak fermenting vessels as well as using these tanks for ageing.

- Italy

Already big users of alternatives but not in the super Tuscan cases. Given the demand for the super Tuscan wines I don't think they will ever consider the use of these products. However on the outskirts of Tuscany,and the rest of Italy, the demand is huge and growing all the time.

- Rioja

Up until a few years ago the whole of Spain was subsided to the tune of 50% when it came to their barrel / Oak tank purchases. Given that Rioja has traditionally been big users of American oak, their costs were never as high as the rest of Europe when it came to barrels. However this subsidy fell away when the EEU was formed and since then the Cooperage industry has battled a bit in

Spain. A prediction made from a few people in the know is that the future is Spain and given that they are able to produce Quality wine at 1€ a bottle I feel the whole of Spain will be looking at alternatives very soon.

- Rest of Spain

Discussed

- Any other European areas – eg Porto?

My feeling here is that Portugal is working very hard at producing quality table wine and will continue to do so for a while until the flying wine makers influence them to change. Huge potential but it will take time. The rest of Europe i.e. Germany will defiantly try alternatives, but their wines are not conducive to much new oak and the Eastern European countries are already using a small amount of alternatives.

10. What have you learnt in the last few years about the use of "AOP"? – new methods eg micro-oxygenation?

Speaking personally here I have never really seen the difference between adding wine to wood (Barrels) or wood to wine (Alternatives) However the alternatives have to undergo the same very rigorous seasoning program / toasting program in order to achieve a similar result. This costs money and in many cases Alternatives are not afforded this treatment. Just as a winemaker would rack his barrels thus giving the wine a form of oxygenation, wine made on staves needs the same treatment in order to achieve a similar result. The advent of micro- ox has brought about a far more high-tec approach to the addition of oxygen to wine. Personally I feel that a winemaker with any soul will always be able to judge when a wine needs a racking, be it in tank barrel or what ever. So possibly technology frightens me, but is it necessary? For the large players I can understand that micro allows for an ease of working, as they are able to meet the goal without moving the wine at all. In this instance I feel that possibly the standard recipes of between 1 and 2 milligrams of oxygen per lt of wine per month added to wine over a limited period only hastens the wine maturing which is a little unnatural, but also effects the long levity of the finished product. However if we are in a market where one strives to make a drink that tastes the same year in and year out (eg. Coca Cola) then this is the way to go.

12. How do you see the market for “AOPs” growing and developing in the future?

As hinted above, when wine is considered a commodity, AOPs are a necessity and the more the winemaking world is forced into producing bulk generic wines for the masses, this market can only grow.

APPENDIX 2

Interview 2
5-11-06 Interview with Jeff Grier of Villiera Wines

Winemaker's Questionnaire on "Use of Alternative Oak Products" – AOP's

1. Do you currently use any "Alternative Oak Products" **(*AOP's*)** in your cellar, or have you tried using any AOP's in the past? Please explain.

Yes, staves for a different dimension, different fixing systems, different wood toasting. Also tried chips and powder.

2. If your answer to Question 1 is ***affirmative*** in any way then please go to ***Question 3***. If your answer to Question 1 is ***negative***, then please answer ***Part B*** of this questionnaire.

3. How would you rate the size of your cellar – small, medium or large? (small < 50,000 cases, med < 500,000 cases, large > 500,000 cases)

Medium size.

4. Which ranges of wine do you use AOP's on and at what quality level would you classify those ranges ? (e.g. med quality, premium or ultra-premium)
   - Villiera Chenin Blanc - Premium
   - Villiera Cellar Door Merlot - Premium
   - Down to Earth Red - Medium

5. What types of AOP's do you use – powder, blocks, beans, chips, zig-zags or staves?
   - Powder – only at fermentation for fixing colour and instead of tannin addition – limited use.
   - Mostly staves – smaller staves on white wines – Chenin and larger staves on reds – Merlot.
   - Chips – tried but don't use very much

6. Do you use Barrels along with AOP's in the same ranges of wine?
   - Yes, in the Merlot

7. Do you use micro-oxygenation in tandem with AOP's and if so, what dose of oxygen do you use (mg/l) and over what period of time ?
    - Yes, always together with micro-ox 2.0 – 2.5mg / lt wine / month for a period of 3 months after the completion of MLF.

8. How would you rate the results of using AOP's in comparison to using Barrels?
    - Good results – colour improves (more stable)
    - Softens wine – improves mouth feel
    - Reduces reductiveness
    - Reduces green flavours

However quality needs to be checked + SO2

9. Do you plan to increase your use of AOP's in future ?

Yes, definitely. As price becomes more & more of an issue it becomes more of a necessity. Also the UK market – our largest foreign market – is demanding wines earlier & earlier after harvest. This is one sure way to speed up the release of wine.

10. Why do you choose to use AOP's? Is it related to the price of Barrels or is there another factor that made you change?
    - Price advantage
    - Time saving
    - Labour saving
    - Huge advantage in space which has to be cooled

11. What do you perceive to be the advantages of using AOP's ?

    - Price advantage
    - Time saving
    - Labour saving
    - Huge advantage in space which has to be cooled

12. What do you perceive to be the disadvantages of using AOP's ?
    - The potential for oxidation (as per barrels not being kept topped up)
    - Potential for spoilage – Brett / Acetic Bacteria
    - Image – currently perceived by other winemakers and journalists to be inferior / associated with cheaper wines

13. What factors do you look for when choosing AOP's – e.g. grain, toast levels, source of wood, price etc.
    - Source of wood – supplier integrity, origin, age, grain
    - Toasting of wood – wood fire, electrical, level of toast
    - Size of staves
    - Tested – experimentation
    - Fixing method – in tanks
    - Application

14. How do you perceive the future of AOP's? Do you think their use would be restricted to wines at certain price-points or do you think that they could be used for all quality wines?
    - They are the future (like screwcaps or riddling machines).
    - They are technically better but have an image problem as they are perceived as being a shortcut way to make wine.
    - The results can be as good or better than barrels.
    - Their use will grow due to surplus of wine & pressure on price.
    - Also will grow due to space, time constraints, & wood availability
    - More efficient use of wood – less wasteage.

15. Do you advertise the fact that you use AOP's in the making of your wine or do you specifically not mention their use ?
    - No, not advertised, but mentioned or admitted if asked

16. Do you think there is consumer resistance to the use of AOP's? i.e. Do you think it is viewed as a "cheap means of flavouring wine?"

- Less resistance from consumer than from fellow producers and journalists. Some producers are negative and AOP's receive negative press from some sources.
- Most consumers are not aware enough to know the difference, especially young consumers – less likely to bother them anyway.

17. How easy do you think it is to discern organoleptically, whether a wine was made using AOP's or Barrels?

- Very difficult to tell the difference if wine is well made.
- I notice mistakes being made regularly – both ways

Part "B" (do not complete if you completed the 1st part of the questionnaire)

1. How would you rate the size of your cellar – small, medium or large ? (small < 50,000 cases, med < 500,000 cases, large > 500,000 cases)

2. Have you considered the use of AOP's (Alternative Oak Products), and if so why did you choose to not use them ?

3. If you haven't yet considered the use of AOP's, is this something you would consider the use of in the future ?

4. What do you perceive to be the advantages of using AOP's ?

5. What do you perceive to be the disadvantages of using AOP's ?

6. How do you perceive the future of AOP's ? Do you think their use would be restricted to wines at certain price-points or do you think that they could be used for all quality wines ?

7. Do you think there is consumer resistance to the use of AOP's ? i.e. Do you think it is viewed as a "cheap means of flavouring wine?"

8. How easy do you think it is to discern organoleptically, whether a wine was made using AOP's or Barrels ?

Thank you for your time in completing this questionnaire. I appreciate your assistance. Please e-mail to andy@za.northsails.com or fax to 021-510-1266

Andy Mitchell – 083-558-5085

APPENDIX 3

Interview 3

17-10-06 Interview with Dr. Woolf Katz - Scientist, Supplier of Liquid Tannins and authority on AOPs

1. Wolf can you give me some of your background and tell me what got you started on producing liquid tannins?

I am a qualified Microbiologist, and spent most of my life producing children's vaccines. Did most of the wine courses you did. That the amount of wood available for making barrels was limited (very wasteful, especially for French oak which cannot be sawn, to few tyloses). Chips and staves are good flavourants but do very little for wine integration, so developed liquid tannin which can be added to wine at its inception or once it's already completed ferment.

2. Can you describe your product and the means of production?

Purchase the best quality French, Romanian and American seasoned oak. The wood is roasted and chipped and then extracted with a 50:50 water ethanol mixture. A mix of woods can be used to produce this extract or blending of different wood extracts can be made to suit the winemakers taste.
This liquid tannin is a very concentrated extract of most of the wood components.

3. I assume your tannins are derived from oak, which species of oak do you use? Do you differentiate between the different species – i.e. package them separately?

The tannin is all wood derived: Romanian, American and Russian. It's usually Quercus sessiliflora or Quercus alba. Very tight grain wood is what is most desirable, the species does make a difference, but you can get very ordinary French wood that is wide grained. We make the blend of tannins once we know what the effect the winemaker would prefer. The packaging is only for white or red wine and is blended specifically for the wine cultivar. I cannot make a bold blend of liquid tannins for pinot noir or for white wine, so I do need to be careful as the stuff is potent.

4. I assume that as your product is a tannin addition, it is not viewed as a flavourant as such. Does it have “flavouring” properties and if so what are those properties?

It is both a flavourant and an ‘’integrator’’ but predominantly the latter. More has to be added to bring out the flavour of the wood.

5. Do you recommend micro-oxygenation to complement the use of liquid tannins?

Absolutely imperative. Without 02 the effect is very one-dimensional. We recommend adding 02 after the exponential growth phase of the yeast (20-30 hours). About 50ml of o2/L of red wine over the 2 week fermentation period. After ferment this O2 concentration should not exceed 5ml/L/month for red wine.

We did speak about this. I am not very happy at this stage to use a sparger, as the wine needs to be at a temperature above 15 degrees to allow the redox reaction to take place. This means heating the tanks in winter; not a popular idea. However, if you can get O2 to permeate into the tank, this circumvents the necessity to keep the tank at 15 degrees. The O2 will now be in a ‘’molecular’’ form without the hazard of dissolved O2 in the wine, which leads to oxidation. I am working on this concept. It does mean that you can turn the tank into a large barrel. Sparging O2 during ferment is very important and it’s unlikely that the wine could get very badly damaged if there was an error in addition at this time. The wine has a great capacity for healing itself at this early stage. After malo you need to exercise great care as that healing capacity is very much diminished.

6. Where does your product fit in, in relation to other AOPs?

I was hoping it would be a replacement for barrels, but I think that’s a little early at present. It is certainly better than chips or staves. If you use either chips or staves you get this wonderful woody taste, which is much sought after. However it doesn’t last very long, about 12 months and then it starts to wane. But for entry-level wines which are drunk within a couple of days, this is fine.

We would need to match this and give a little extra, like integration. If you add enough liquid tannin you get that woody taste. But in order to give the wine legs, good mouth feel, buffering capacity and longevity, we think the tannin does a better job. It fixes colour very well, but then so does tannin powder for a short period of time.

7. At what stage of the winemaking process is the product added – during fermentation or after?

Can be added during ferment and also after.

8. As a scientist, can you give me your opinion on AOPs in relation to barrels? Do you consider that AOPs can and will replace barrels in the production of quality and premium wines?

Chips and staves are very popular at present, and many hundreds of tons are used in South Africa every year. The use of chips and staves has also been approved for use in France.

The amount of wine produced for premium grades is tiny in comparison to general drinking wines, and it's at this level that you can still afford to use barrels.

Chips and staves have already replaced barrels in most cellars. Remember it was only in about 1985 that we started to use barrels in this country to wood wines. It is now too expensive to do this anymore.

Because of the extraction method used liquid tannin has the most wood components of all the AOPs. The reason for this is that the tannin is extracted with ethanol and heat and pressure which liberates a vast quantity of phenols which are important in wine maturation generally. Chips or staves in wine with an alcohol concentration of 12-15% cannot possibly take out enough of the phenols necessary for good integration. Leaving wine in a barrel allows you to do this to some extent, but with the added advantage of micro-oxygenation. So yes, chips and staves are used extensively as barrel replacements.

Unless we can sort out the problem of turning a stainless steel tank into a barrel, we will be in a bit of a fix.

Liquid tannin is a redox buffer, its completely sterile (no contamination by TCA), modifies vegetative aromas, precipitates laccases, and improves wine made from intermediate quality grapes. It costs 30 cents per litre to wood red wine and 10 cents for white and its been passed by the Wine and Spirit Board for use in wine and spirits.

There is no mess with chips and staves, no loss of wine due to absorption into these products, and when added at fermentation gives barrel fermentation characteristics. All extracts are monitored by gas chromatography and high-pressure liquid chromatography resulting in similar extracts being prepared each year with the result that the degree of wooding can be very accurately controlled with consistency from year to year.

9. It would appear to me that the use of AOPs is still very much “trial and error” and that winemakers are often scared of experimenting with a tried and proven formula of producing a quality wine. Most winemakers have spent literally years getting to grips with different coopers and their products and deciding which ones suit the varietals and style of wine that they like to produce. Also it appears that local winemakers often view AOPs as an inferior product and would not be keen to advertise the fact that they use them.
   Would you agree with those statements?

Yes. Not so much trial and error anymore, it’s used extensively. No 2 barrels can be, made exactly the same by a cooper, for obvious reasons. This is a big problem so coopers have introduced infa-red heating of the barrel. Convection heating is also applied where hot air is blown up inside the barrel so the temperature remains constant on the internal surface of the wood, resulting in more uniform barrels. Its all computer controlled. Andy, there is a great desire to continue with this antiquated method of wooding as there is a small fortune involved in this industry. There appears to be a ‘’mystique’’ associated with barrels which the French have kept alive as it is to their advantage. The belief exists that nothing could possibly surpass the barrel, as a means for wooding premium quality wines. Of course this is a lot of rubbish and the Australians have made huge inroads into the French and American wine markets, predominantly because they are always trying new ideas and attempting to bring costs down and improve quality. There is a huge lake of wine around the world at present and its not going to diminish unless someone drinks it or it’s thrown away. There are wine makers in South Africa wooding wine in barrels and selling it in the UK for £6 a bottle. In my opinion the day of the barrel is numbered for the following reasons: it's very expensive, incredibly difficult to clean, one in five barrels leaks O2, there is a great loss of wine due to evaporation (200ml-500ml/month), oak porosity leads to evaporation of wine aromatics giving rise to reduced wine freshness, barrel vacuum allows air entry, ullage making regular topping imperative with very high labour costs, and finally, short barrel life, wicking in the wood capillaries reduces the air porosity by 10% per year, resulting in costly artisanship wasted.

There is of course the argument that the above losses ‘’concentrate the flavour,’’ but flavour and aroma components as well as ethanol are lost. It is the wine wood aroma from barrels that signals the loss of wine aromatics i.e. esters. Finally, winemakers are

certainly very averse to using chips and staves and talking about it. Similarly with liquid tannin.

APPENDIX 4

Interview 4
05-11-06 Interview with Bruce Jack of Flagstone Winery

Winemaker's Questionnaire on "Use of Alternative Oak Products" – AOPs

1. Do you currently use any "Alternative Oak Products" **(*AOPs*)** in your cellar, or have you tried using any AOPs in the past ? Please explain.

No, but we continually experiment with staves and chips on small batches – none of the results go into any of the core Flagstone Range.

However, I used chips on a commercial scale as a winemaker once. It was the 1994 vintage in Bordeaux. I have never felt more like 007. We had to drive three cars into the cooperage compound in central Bordeaux and fill up each car with unmarked bags. Two of the cars left the compound carrying bags filled with paper shreddings and the one "hot car" carried the oak chips (swept off the floor of the cooperage no doubt).

We would drive in convoy down the motorway until we suspected someone was following us; then the two cars with the bogus cargo would drive erratically and head off towards the Left Bank. This, we were confidently told, would ensure the wine police would follow the decoys and the booty would be delivered (under cover of darkness) to the designated co-ops in the Entre-Deux-Mers.

Of course no one ever followed us, but we got to talk often on our new cell phones. The Bordeaux wine police knew exactly what was going on as they do now, but like reverse osmosis and the First Growth extraction machines they turn a blind eye – by the way: good name for a Bordeaux blend; "blind eye".

Still, the "Chip-Run" was exhilarating, especially as I had to drive very fast on the wrong side of the road. The climax of each evening's adventure included a celebration of hearty Cassoulet freedom, roguish Armagnac and Van Morrison played loudly over the sleeping Gironde River. I deeply love France as a result of my 007 days.

I was employed by an English flying winemaker company to make wines for BRL Hardy (big Ozzie company then) for UK supermarkets. The French regarded us with

a wonderfully incongruous mixture of disdain and curiosity. My continual headache was explaining that; NO, Bob Marley was not from South Africa.

As for the effect of said chips – like everywhere, when the integrity isn't there, the end product falters. The only passable result was with a Merlot Rose we made at one particularly good co-op where they actually cleaned their tanks and the winemaker drank wine more than beer.

2. If your answer to Question 1 is ***affirmative*** in any way then please go to ***Question 3***. If your answer to Question 1 is ***negative***, then please answer ***Part B*** of this questionnaire.
3. How would you rate the size of your cellar – small, medium or large ? (small < 50,000 cases, med < 500,000 cases, large > 500,000 cases

4. Which ranges of wine do you use AOPs on and at what quality level would you classify those ranges ? (e.g. med quality, premium or ultra-premium)

5. What types of AOPs do you use – powder, blocks, beans, chips, zig-zags or staves ?

6. Do you use Barrels along with AOPs in the same ranges of wine ?

7. Do you use micro-oxygenation in tandem with AOPs and if so, what dose of oxygen do you use (mg/l) and over what period of time ?

8. How would you rate the results of using AOPs in comparison to using Barrels ?

9. Do you plan to increase your use of AOPs in future ?

10. Why do you choose to use AOPs ? Is it related to the price of Barrels or is there another factor that made you change ?

11. What do you perceive to be the advantages of using AOPs ?

12. What do you perceive to be the disadvantages of using AOPs ?

13. What factors do you look for when choosing AOPs – eg grain, toast levels, source of wood, price etc.

14. How do you perceive the future of AOPs ? Do you think their use would be restricted to wines at certain price-points or do you think that they could be used for all quality wines ?

15. Do you advertise the fact that you use AOPs in the making of your wine or do you specifically not mention their use ?

16. Do you think there is consumer resistance to the use of AOPs ? i.e. Do you think it is viewed as a "cheap means of flavouring wine?"

17. How easy do you think it is to discern organoleptically, whether a wine was made using AOPs or Barrels ?

Part "B" (do not complete if you completed the 1st part of the questionnaire)

1. How would you rate the size of your cellar – small, medium or large ? (small < 50,000 cases, med < 500,000 cases, large > 500,000 cases)

Medium

2. Have you considered the use of AOPs (Alternative Oak Products), and if so why did you choose to not use them ?

Commercial winemaking is an explosive combination of privilege and hell. I am sure this bizarre combination of worlds exists in other walks of life, but I doubt it is survived (or realised) in as much clarity, panic and passion as ours.

At every stage of the day and the season, we wake to a fork in the winemaking road. The extraordinary thing is that the more you venture into this forest the more bloody forks in the road there are. Like life, winemaking isn't fair, and like everyone else we deal with that on a very pragmatic level.

More difficult is the continual challenge of our warm artistic essence juxtaposed against a cold canvas of financial reality.

Real Winemaking is a bit like entering forever a monastery of agnostics. Many of us could pay the school fees more effectively doing something else.

What oak we use is essentially about this dichotomy. It opens up an unconfident quicksand of reflected ego.

The question of what oak to use is just part of that at once disillusioning and inspiring quagmire of posturing – as though opportunity can only be fired in your direction by the barrel pointing at your head.

Ultimately we end up asking why do we use oak at all. For interest, Flagstone is planning on moving away from any oak maturation in our top wines from the 2007 vintage. So from now on, Music Room and Dark Horse, etc… will be unwooded. Primarily this is because we don't believe you can truly express the energy of memory of a corner of our world by putting the wine in wood – too much background noise.

That is not to say barrels don't play a role – like spices when cooking they are great to have.

3. If you haven't yet considered the use of AOPs, is this something you would consider the use of in the future ?

For the commodity end of this business AOPs are essential.

4. What do you perceive to be the advantages of using AOPs ?

Cheaply achieved homogenisation of nice aromas and flavours... This is a bit like asking what are the advantages of using vanilla in Coca Cola.

5. What do you perceive to be the disadvantages of using AOPs ?

If you are trying to make wines your kids will pull out of the cellar in reverence after your death, then chips and staves are going to disappoint a lot of half-pissed university students.

If you are trying to battle the rest of the world in the commodity market then AOPs are the only option.

6. How do you perceive the future of AOPs ? Do you think their use would be restricted to wines at certain price-points or do you think that they could be used for all quality wines ?

Can not be used for long-lived wines, because of the chemistry involved.

7. Do you think there is consumer resistance to the use of AOPs ? i.e. Do you think it is viewed as a "cheap means of flavouring wine?"

No, definitely not. The "consumer" doesn't care. That's why the "consumer" eats McDonalds and feeds their spaced-out kids refined sugar and refined wheat on a daily basis. The "consumer" of wine is as clueless about wine as they are about nutrition – you either live with this fact or join the agnostics.

The wine nerd might think AOPs are a "cheap means of flavouring wine", but who cares.

If you want to sell wine as a commercial offering you follow some rules. These are continually changing. The "consumer" is suddenly going to start caring if the

nutritionally negative hamburger is organic, but that is only a trend. And like sideburns, fashion is seldom about good taste.

These are interesting, but ultimately irrelevant considerations if you want to craft an authentic statement of integrity – a wine that trumpets the soil in which it was grown and shines with the reflected sun of its environment.

You need to decide if you are willing to live in this industry; because worrying about the concept of integrity is going to cause problems for your cash flow. Do you have sufficient passion to counter the onslaught of reality? Even thinking about authenticity may stop you using barrels all together… - what a crazy idea!

If you are keen to chance the mayhem, then join the community, but don't expect any quick fix. Authentic "Real" winemaking is actually an extremely tedious, continually debilitating, but ultimately rewarding journey – a bit like a very slow revolution.

8. How easy do you think it is to discern organoleptically, whether a wine was made using AOPs or Barrels?

It depends on the variety and the time in bottle. It is also very dependent upon how the AOPs have been applied. It is very difficult to tell organoleptically in a wine's youth if AOPs have been applied with practical skill and managed by a winemaker who understands the chemical reactions taking place. But time always exposes chips and staves – the flavour achieved thereby stands apart like a broken promise.

9. Quotable quote on Alternative Oak Products (This one's specially for you Bruce)

AOPs have a very important role to play in the commodity side of the business. Winemakers should not be judged negatively in this regard – it is like asking how much their sole is worth . Winemakers are, in the main, making a commodity product, not penning poetry, leading communities or painting landscapes.

Our worth, in general, and as a working segment of our economy, is clear in as much as we do what is necessary to survive – to pay the bills.

However, if we choose to be artists, that is our own fault and no one should forgive or pity our follies. But, like artists, winemakers who believe in authenticity will either use oak barrels or perhaps when they see the light use no foreign matter at all.

Ultimately, the most relevant of winemaking decisions will perhaps only be answered by the smile of a normal consumer sipping long after the winemaker is dead.

Thank you for your time in completing this questionnaire. I appreciate your assistance. Please e-mail to andy@za.northsails.com or fax to 021-510-1266

Andy Mitchell – 083-558-5085