# White wine phenolics: what compounds are there and which ones cause problems?

Technical manager for Laffort Australia, **Alana Seabrook**, highlights the main compounds that can negatively impact the quality of white wines.

## What are phenolic compounds in white wine?

Phenolic compounds are a broad spectrum of compounds found in nature, characterised by a 6-carbon benzene ring. Their presence in white must and wine is influenced by many of factors ranging from vineyard and varietal to winemaking practices. In wine there are two sources of phenolic compounds, oak or grapes. Phenolic compounds from grapes can be broken down into Flavonoids and non-flavonoids[2].

Non-flavonoid compounds are mainly located in the pulp, while flavonoid compounds are localised in the skin, seed and stems. Given where these compounds are located in the grape, the quantity present in the must will be heavily influenced by viticultural and winemaking practices. Phenolic compounds develop and change over time, are influenced by pH, ageing conditions, oxygen and temperature. Importantly, their presence influences the sensory attributes of the resulting wine, from a taste and tactile point of view as well as aroma.

## Which compounds do I need to know about for the production of white wine?

For the purpose of this discussion, the focus will be placed on hydroxycinamates

**Table 1. Overview of the principal white wine phenolics (phenolic compounds produced and accumulated in grape berries (sourced from Teixeira A *et al.* 2013).**

| Principal White Wine Phenolics | | |
|---|---|---|
| **Group** | **Non -flavonoids** | **Flavonoids** |
| | Hydroxycinnamates | Flavan-3-ols |
| | Hydroxycinnamic acids (mainly caftaric acid) | (+)-Catechin,<br>(-)-Epicatechin |
| Localisation | | |
| Skin | ++ | ++ |
| Seed | ++ | +++ |
| Flesh | +++ | + |
| Quantity (mg/L)[5] | 130 | 10-50 |
| Factors affecting quantity | Varietal dependant[1] | Pressing cycles, rotation and max pressure[1] |
| Can they do good? | In combination with $SO_2$ these compounds can help scavenge oxygen and prevent the oxidation of key aroma compounds[6] | N/A |
| Sensory | No perceivable bitterness or astringency in wine [5] | Bitterness and astringency in simple form, astringency in bound form[5] |
| Negatives | Can contribute significantly to juice browning in white wines | Oxidation of these compounds can form a highly reactive quinone able to scavange oxygen from anything, including important aroma compounds like thiols. |
| Bottom Line | Potential browning | Trap for aroma compounds! |

Very abundant compound (+++) to less abundant (+)

## 10 Take home points

1. Combinations of fining agents have a better chance of attacking a broader spectrum of oxidisable and oxidised phenolics than a single fining agent alone.
2. The must/wine will oxidise if oxidisable compounds remain in the wine with insufficient protection.
3. Concentration and range of oxidisable and oxidised phenolic compounds will vary depending on varietal, harvesting technique, time before and during pressing, inert conditions and press fraction.
4. $SO_2$ is not enough to prevent oxidation of key phenolic compounds.
5. Understand the volatiles that need protecting in that varietal and whether they are susceptible to oxidation:
    - thiols in Sauvignon Blanc – very susceptible to oxidation, yeast derived
    - esters – less susceptible to oxidation, yeast derived
    - terpenes in Muscat– volatile overtime but not highly oxidisable, grape derived.
6. Understanding press cycles:
    - impact on the phenolic load of the wine
    - where are the ingresses of oxygen? (Increasing pressure and minimal rotations will minimise phenolic compound extraction).
7. Fining during alcoholic fermentation is a highly effective way of utilising the kinetics of fermentation to maximise fining-phenolic contact.
8. Fining after alcoholic fermentation is much more impactful on the sensory profile of the wine.
9. Oxidation in the grape must happens very quickly due to enzymatic activity from the grapes.
10. Chemical oxidation happens over time at a much slower rate.

(non-flavonoids) and flavan-3-oles (flavonoids) as these have the greatest contribution to white wine production. Oxidation of both flavan-3-ols and hydroxycinnamates can occur either enzymatically in fresh must or chemically over time. In their oxidised form both can cause sensorial defects in terms of binding to aroma compounds (thiols) and browning[2]. Enzymatic oxidation is very fast by grape oxidation enzymes (Tyrosinase), but can be controlled with $SO_2$ and settling strategies[10]. Enzymatic oxidation is more destructive in botritised fruit as the enzyme in question (Laccase) is more resistant to $SO_2$ and more suited to wine pH[10].

### Flavan-3-ols (Flavonoids)

Flavan-3-ols comprising principally of (+)-catechins and (-)-epicatechins are important in white wines as they are highly reactive towards oxygen. The amount in which they are present is highly dependant on grape processing methods (harvesting method, press cycle both cycles and maximum pressure) as these are located more in the skins and seeds than the pulp[7]. It is well documented that in their oxidised form they are highly reactive towards oxygen and can irreversibly bind to thiols which have been produced by yeast in high thiol varieties (i.e. Sauvignon Blanc) [1,2]. Once bound the thiols are no longer aromatically available. In the presence of glutathione the oxidised (+)-catechines and (-)-epicatechins will bind and leave the aromatic thiols to be available.

### Hydroxycinnamates (Non-Flavonoids)

Hydroxycinnamic acids are not only the principal form of non-flavonoid in the grape, but they are responsible for 80% of white wine phenolic compounds in white wine which has not had any skin contact. They are localised in the grape pulp and exist as esters of tartaric acid (Caftaric acid is Caffeic acid esterified with Tartaric acid). They are important in white wine as they are the first to oxidise. Hydroxycinnamates play a key role in juice browning; in juice, enzymes are released which oxidise these compounds very quickly. In the presence of glutathione (GSH), the oxidised hydroxycinnamate will form a colourless grape reaction product (GRP) and reduce the browning. $SO_2$ will also hinder the grape enzymes from oxidising in the must but won't hinder chemical oxidation over time if the hydroxycinnamates are still available. In their oxidised form they can bind thiols as flavan-3-ols can, but they aren't as good at it and as a consequence, are less of a concern with regards to aroma scavenging[3]. In fact, in combination with $SO_2$, the presence of Caffeic acid can actually slow the scavenging of volatile aroma compounds and be beneficial[4,6]. In the levels found in wine there is no perceived bitterness or astringency[8,9].

### References


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