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## Spotlight on whole-bunch fermentation

The AWRI's recent tasting workshops have showcased small-lot Pinot Noir and Shiraz wines from single batches of fruit, produced specifically to demonstrate the sensory effects of changing one winemaking variable at a time. One of the treatments that attracted significant interest from participants was whole bunch fermentation. This article looks at current knowledge and some winemaker experiences of this technique.

### Whole-bunch fermentation

Whole-bunch fermentation involves placing intact bunches of grapes in the fermenter, rather than grapes that have been removed from the stems. Destemmed and/or crushed berries are then generally placed on top, and as the fermentation progresses, the intact bunches are often partially or wholly crushed by plunging, or traditionally by foot-treading. The technique is most commonly applied to Pinot Noir and Shiraz, with the proportion of whole bunches used in Pinot Noir being as high as 100%, but with 15 to 20% being more common, especially with Shiraz. Use of the technique is uncommon with Cabernet Sauvignon and related varieties because of the high methoxypyrazine concentration in the grape stems, which can result in 'cut grass' and 'herbal' characters in the wine, although Anson (2016) discusses recent increases in the use of whole-bunch fermentation in Bordeaux.

It should be noted that this is a different technique from carbonic maceration, which involves placing 100% intact whole bunches of grapes, with absolutely no free grape juice, in a closed fermentation vessel filled with carbon dioxide. The vessel is then left alone for between one and two weeks, prior to destemming, crushing and fermenting with yeast under normal winemaking conditions. During carbonic maceration, enzymatic reactions occur within the grape berry that produce characteristic aroma compounds including benzaldehyde ('cherry', 'kirsch', 'almond'), vinylbenzene ('styrene', 'plastic') and ethyl cinnamate ('cinnamon', 'strawberry', 'honey') (Ducruet 1984).

### Sensory effects

The major sensory differences between whole-bunch fermented and conventional wines made from de-stemmed fruit relate to phenolic profiles and wine aroma. During the period that intact berries remain attached to the stems, it is possible that similar enzymatic reactions occur as with carbonic maceration, and thus the wines may contain some similar 'fruity' or 'spicy' aromas. The inclusion of stems can result in higher concentrations of compounds which confer 'cut-grass' and 'herbal' aromas, as well as potentially 'fruity' and 'floral' aromas, and there is some evidence that it can also result in higher pH and decreased acidity. There

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is also strong evidence of increased tannin concentrations, which if overdone can lead to excess astringency and a perception of ‘greenness’ in the wines.

There is only a small amount of peer-reviewed or other literature on the sensory differences related to the inclusion of whole bunches in fermentations, and this is an area being addressed through current AWRI research. In 2014, the AWRI conducted trials with Adelaide Hills Shiraz, and examined fermentations consisting of 100% destemmed berries, destemmed berries plus grape stems, destemmed berries plus peduncles, and destemmed berries plus grapevine leaves at a concentration commonly found in machine-harvested grapes (Capone et al. 2016). During sensory analysis, wines made with inclusion of stems were rated higher for ‘colour intensity’, ‘green capsicum’, ‘herbal’, ‘green stalks’, ‘astringency’ and ‘acidity’, with the added-leaves treatment being rated highest for ‘red fruit’ and ‘confection’. The stem-inclusion wines contained higher concentrations of methoxypyrazines, which are recognised as contributing ‘green’ characters to wine. In other research, Hashizume and Samuta (1997) found higher concentrations of these compounds in Cabernet Sauvignon grape stems than in the berries or leaves.

It is noteworthy that in the 2014 AWRI study the stem-inclusion wines were rated higher for ‘colour intensity’, because many of the anecdotal winemaker observations in the literature maintain that the colour of whole-bunch fermented-wines is lower. This effect is thought to be due to colour being adsorbed onto the grape stems during fermentation. Work conducted at Oregon State University with Pinot Noir found that in whole-bunch ferments the concentration of flavonols increased due to the extraction of quercetin from grape stems (Price et al. 1996). The paper states “Stem tissues are loaded with phenolics, including a high concentration of catechin, caftaric acid and quercetin”. The same team later reported that the concentration of total phenols was more than 1.5 times higher in the whole bunch-fermented wines, with gallic acid, catechin and polymeric phenols present at more than double the concentrations found in control wines (Watson et al. 1996). Although total anthocyanin concentrations in the whole bunch-fermented wines were similar to control wines, the polymeric anthocyanin content was more than 1.5 times higher than the controls. The authors concluded that “The increase in polymeric anthocyanin content is presumably due to increased polymerisation of pigments with phenolic fractions from the stems”.

Suriano et al. (2015 and 2016), working with Primitivo, examined three treatments (100% destemmed and 25% and 50% whole-bunch inclusion) and found increasing tannin concentration and colour density with increasing stem inclusion. They maintained that the presence of stems in ferments conferred greater structure and flavour to the wines. In the

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25% and 50% whole-bunch inclusion wines, they also found higher concentrations of a range of compounds which can contribute ‘green-grass’, ‘herbal’ and floral’ sensory characters.

Pascual et al. (2016) working with Grenache found that the presence of stems, whether using intact bunches or crushed whole bunches, resulted in wines with higher pH, and in most cases an increase in ‘total polyphenol index’. Eder et al. (2004) found that both carbonic maceration and whole bunch fermentation produced wines with higher concentrations of resveratrol and ‘antioxidant capacity’, although no data on these variables is presented in the paper. Cohen (2014) quotes Californian winemaker Ryan Hodgins in relation to comparative trials he conducted, which were analysed using the Harbertson-Adams assay: “(we) almost always saw big increases in tannins when stems were included. In Pinot I almost always see higher pH and lower TAs in whole cluster ferments (presumably, potassium is being extracted from the stems). In Syrah I see more tannin, but for whatever reason, I typically don’t see lower acids”.

### **Increasing popularity?**

According to many articles published in recent years, the popularity of whole bunch fermentation is growing. This appears to be strongly supported in Australia by anecdotal observations, including the numbers of wines displaying ‘whole-bunch character’ in wine shows, straw-polls of winemakers attending the AWRI’s tasting workshops and industry feedback to the AWRI regarding future research priorities.

As a possible explanation of the increasing use of whole bunches, Jamie Goode (2012, 2016) says that “..... very few young winemakers worldwide are looking to produce bigger wines – certainly not at the high end. They tend to prize elegance, freshness and definition above all else”. He maintains that whole-bunch fermentation can result in wines displaying those characteristics. Goode (2012,2016) goes on to state that “People in the past used stems by default, and the results weren’t always good. Now the choice to use stems is an active one, so the people doing it are doing a better job of it”. Similarly, Andrew Jefford (2016) refers to a time when “... many Burgundian producers carried out whole bunch fermentation badly using inadequately ripened, unsorted fruit, and the wines smelt and tasted composty, green and impure as a consequence. Those taking on whole-bunch fermentation today are far less cavalier”.

### **Risks as well as reward**

The biggest risk associated with the use of whole bunches is the potential for ‘green’, ‘grassy’ and ‘herbal’ aromas and flavours, and overly astringent tannins in the wine. The importance

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of lignification ('woodiness') of the grape stem is a common theme in many articles, and there is consensus that the nature of the resulting wine can be markedly different depending on the degree of lignification. The best results are achieved when bunches with a high degree of lignification are selected (i.e. stems that are 'woody' rather than green), and the most well-lignified bunches are likely to be found in relatively low-vigour sections of the vineyard. Lignification is likely to be lower in cool climates, and in cooler years, and is known to commence at the cessation of shoot growth. Consequently, lignification tends to be lower in wet years, especially when there is mid- to late-season rainfall which stimulates vine growth, and in high-vigour vineyards.

When trialling whole-bunch fermentation (or indeed any new winemaking technique) it is advisable to take a cautious approach. A good option is to only use a small percentage of whole bunches at first (10 to 15%), and assess the results over time. It is also sensible to initially only make a small amount of whole-bunch fermented wine, which can then be blended into other wines to the point where the desired sensory effects are achieved.

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