Flash extraction – what can it do for you?

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Introduction

Flash extraction, now widely called 'flash détente' or 'flash release' in English, was developed by the INRA (Institut National de la Recherche Agronomique) at the Pech Rouge research station, near Narbonne in the south of France during the 1990s. The system was developed in order to reduce the skin contact time for red ferments streamline the processing of red fruit, and to potentially improve wine quality. This technique is also particularly relevant after a vintage such as 2011 as it can be used to handle 'problem' fruit. Della Toffola have been manufacturing this type of thermovinification system (now branded BioThermo) for 15 years with installations in Europe, California, South Africa, Argentina and China. In Australia a 20T per hour system was installed at Australia Vintage in the Riverland in 2001. Over 60 systems have been installed worldwide; the systems range in capacities from 1.5 to 60T per hour with most being between 5 and 30T per hour.

Process overview

The extraction of colour, flavour and aromas from the skins of the red grapes is a key component of the winemaking process. This extraction generally occurs during fermentation with the aid of a variety of techniques or systems including cold or extended maceration, cap plunging or pumping over. Thermovinification; the heating of the must prior or during fermentation, was developed for a similar purpose.

The process described by the term 'flash release' is an extension of thermovinification and occurs over two stages. Normally free run juice is removed before the must is rapidly heated to approximately 85°C, it is then pumped into a vacuum chamber where it rapidly drops 50°C in temperature. The intact berries explode with a loud popping noise as the heated must is added to into the vacuum tank. The vacuum causes the cells in the grape skins to burst and release anthocyanins, tannins and aroma compounds. The vacuum distinguishes this process from other pasteurisation or thermovinification techniques which do not cause the cells to rupture and therefore do not improve extraction to the same extent.

The vacuum, which is between 30 and 50 mBar also causes evaporation of water and other volatile components from the must. It is the 'flash' of the water into steam under the vacuum that lead to the process being named 'flash release'. Normally 6–10% of the liquid in the must is removed by the flash process, which results in the concentration of the remaining sugar, flavour and aroma components. The vapour from the must is collected using a condenser. In Europe the condensate is returned to the must (this is a regulatory requirement); however this practice is relatively uncommon in the New World. The condensate can carry negative aromas especially if the fruit contained mouldy or other negative characters such as methoxypyrazines (see more below), however positive aromas could also be removed. The heating of the must and the rupturing of the berry skin cells aids with extraction; which can dramatically reduce the required skin contact time during fermentation.

'Flash release' gives users a wide array of processing options. If processing efficiency is the primary aim of using the system, then the juice can be immediately pressed post processing and fermented in a liquid phase similar to white wine. However at least some skins contact is preferred during ferment (approximately 80% are done this way) as this helps retain some varietal character, and gives better colour stability due to extraction of seed tannin during fermentation. Different portions of free run juice and the 'flash water' can also be added back into the ferment depending on the initial quality of the fruit and the quality and style of wine that is being targeted.

The Della Toffola System

The Della Toffola system is operated as a continuous process. The fruit is crushed and de-stemmed using the wineries normal processing equipment. The must is then moved to a buffer tank, with most systems having more than one tank dedicated to this purpose to allow a continuous supply of must into the processing plant (Figure 1). An automated system removes a controlled amount of free run juice (varying from 0 to 50%, depending on how easy the must can be pumped) from the buffer tanks. This juice can be returned all or

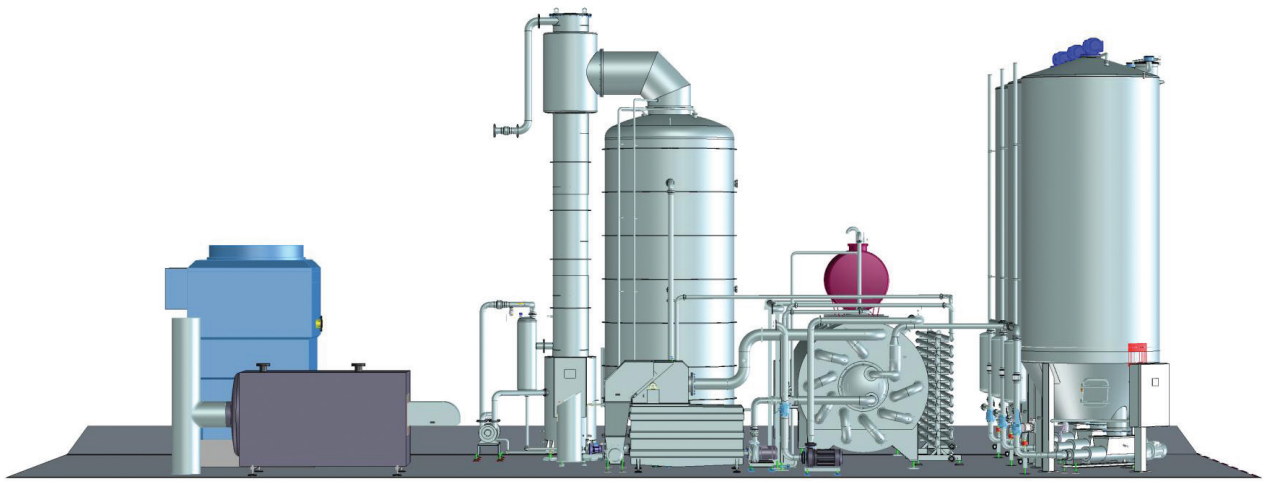

Figure 1. Diagram of the flash extraction system, showing three feeder tanks (right), the 'Biothermo' must heating system (centre) and the vacuum Cooler (left).

in part to the ferment after treatment. The first part of the processing system is the heating unit; Della Toffola produce an enclosed immersion based system called the 'Biothermo' (Figure 2). In the 'Biothermo' the berries (after the free run juice is removed) are carried through a heated tube system by a stream of pre-heated juice. The system is enclosed which prevents oxidation and as both the temperature of the carrier juice and the time in processing can be precisely controlled the juice temperature can be managed to within +/-1°C. Using a stream of juice, without mechanical components to move the berries, greatly reduces maceration of the berries and resulting solids content of the wine. As the amount of solids released is already an issue with 'flash release' this is a significant advantage, the lack of intricate moving parts also make cleaning significantly easier.

In the Della Toffola system the 'Cooler' (Figure 3a and 3b) comprises of a vacuum tank at the top of the unit which is maintained at 30–50 mBar, and a conical 'expansion' tank at the bottom of the unit, there is a separation grid between the two. The vacuum pump is connected directly to a condenser that is attached to the side of the 'Cooler' unit. Water us used to cool the condenser, allowing the collection of the condensate which can be added directly back into the vacuum tank or kept separate. There is a sealed single screw pump at the bottom of the 'expansion tank' which can draw of the processed grapes for delivery directly to the press or to a fermenter.

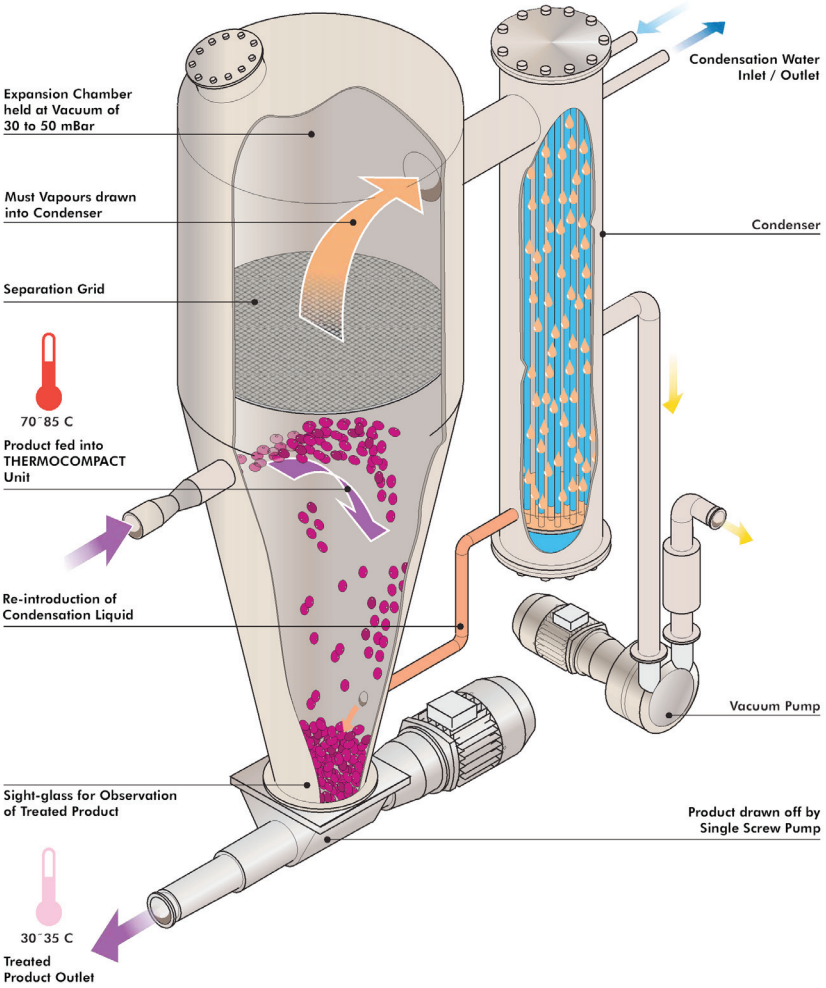

Figure 3a. Schematic illustration of the 'Cooler' vacuum chamber.

Managing disease-affected fruit

While wet weather can lead to may many diseases in grapes, one of the most common and damaging is botrytis (grey mould). The agent in botrytis that is responsible for much of the quality loss in wine is the enzyme laccase, which is strongly oxidative towards the polyphenols that are found in wine. Wines containing laccase turn orange/brown in the glass, and if left to stand for a few hours, a characteristic oily film will form on top of the wine. Unfortunately normal winemaking practices such as the addition of sulphur dioxide, aren't effective on laccase. By rapidly heating the berries to 85°C as part of the 'flash release' process any laccase present is denatured (broken down) so it is unable to subsequently affect the wine. Note that any free run juice that is removed from the must prior to the 'flash release' treatment may continue to carry the

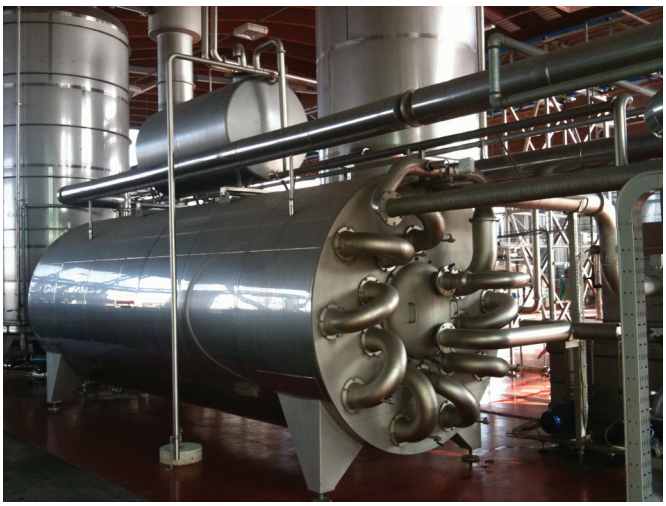

Figure 2. Large capacity 'Biothermo' must heating system.

Figure 3b. The 'Cooler', with the condenser of the left and the vacuum chamber on the right.

laccase enzyme, and also needs to be pasteurised if it is going to be added back to the ferment.

Improving extraction and processing efficiency

While 'flash release' is often seen as a tool to manage disease affected fruit it was originally designed to aid extraction and reduce the processing time of red grapes. Red grapes treated using the 'flash release' system can be pressed immediately after processing of after a minimal skin contact time. This reduces winery requirements for red wine fermentation capacity, and can reduce the number of wine transfers, improving efficiency.

Advantages in processing are demonstrated by a trial that was conducted on behalf of Della Toffola by Scorpex at the University of Adelaide Hickinbotham Winery. The trial was conducted during the 2003 vintage and was designed to compare the effects of 'flash release' to a standard ferment with 5 days fermentation on-skins prior to pressing (Table 1). The 'flash release' treated must was pressed immediately after processing and fermented without skin contact. All wine analysis was carried our according to the methods described in Iland et al. (2000). The wines made using 'flash release' had a higher colour density than those made using conventional fermentation. The 'flash release' also extracted more phenolic material from the grapes and produced wines with a more brown hue than on-skins fermentation. These findings have been well supported and documented by field trials at other sites using this system. For example trials conducted on Grenache, Mourvedre and Carignan grown in the south of France showed that greater amounts of phenolic compounds were extracted more rapidly from fruit treated with 'flash release' and then fermented on skins, as apposed to a conventional red ferment. The skin contact post treatment by 'flash release' was critical to the stability of the polyphenols, as when the grapes were pressed immediately the concentration of polyphenols dropped throughout fermentation and in the final wine (Morel-Salmi et al. 2006).

Table 1. A comparison of skin contact during fermentation (5 days) and 'flash détente' on Shiraz wine colour parameters.

	Wine 1		Wine 2		Wine 3	
	Skin Contact	Flash Détent	Skin Contact	Flash Détent	Skin Contact	Flash Détent
Total phenolics (a.u.)	53	56	52	56	50	56
Colour density (a.u.)	11.1	11.3	11.0	11.5	10.4	11.0
Hue (ratio)	0.76	0.99	0.77	1.01	0.83	1.02
Total anthocyanins (mg/L)	423	386	428	374	394	391

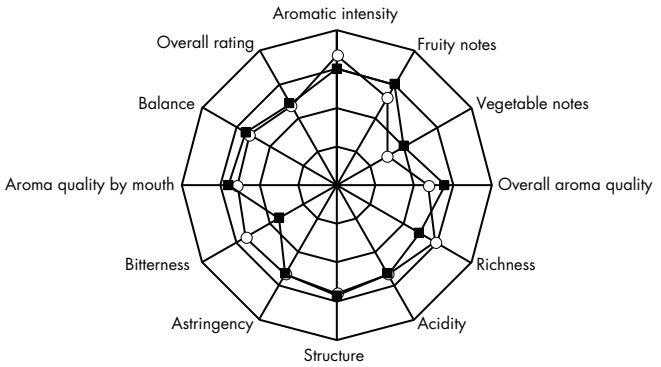

Figure 4. The effects of flash release on the mean sensory profiles of Cabernet Sauvignon grown in Bordeaux (Vinsonneau et al. 2006). Hollow circles are the 'flash release' treated wine and the solid squares are the control.

Removal of aromas

During the 'flash' extraction, 6 to 10% of water is removed from the must which concentrates the sugars and grape skins and solids. The process also has the potential to remove herbaceous, mouldy and even jammy aromas as part of the condensate collected from the vacuum chamber (Rieger 2011). An example is the removal of methoxypyrazines which can give undesirable 'vegetal' or 'bell pepper' characters to Cabernet Sauvignon grapes and desirable characters to Sauvignon Blanc. When the Cabernet Sauvignon grapes from Monterey County (in California) were analysed they had an initial iso-butyl methoxy pyrazine concentration of 19.2 ppb. After processing the condensate (or 'flash water') had a methoxy pyrazine concentration of 112.4 ppb and the treated must had a concentration of less than 1 ppb. The 'flash release' treatment effectively eliminated the green aromas. The levels of methoxy pyrazines in unripe Cabernet Sauvignon are significantly higher, so the 'flash release' offers another option in difficult seasons where disease pressure is high and fruit might be picked without developing riper flavour profile. As the methoxy pyrazines are mostly contained in the skins, any free run juice that is removed from the must prior to the 'flash release' processing can be safely added back to the must without fear of increasing the 'vegetal' or 'bell pepper' characters. These benefits wouldn't be realised by using pasteurisation or thermovinification alone, to deal with unripe and disease affected fruit.

In more detailed trials using Cabernet Sauvignon grown in Bordeaux a reduction in vegetal notes was also seen in wine made using 'flash release' (Figure 4, Vinsonneau et al. 2006). Winemakers in California have also reported the extraction of contaminant aromas that are readily identifiable in the condensate. These have included diesel exhaust aromas from fruit grown besides a highway, amaretto for a vineyard grown next to an almond grove and cooking grease from a fruit harvested from near a truck stop (Smith 2011). The removal of the 'flash water' isn't an all or nothing decision and many winemakers choose to add back only a portion of the 'flash water' depending on the desired aroma profile.

Conclusions

'Flash release' is often seen as been analogous to pasteurisation to manage botrytis affected fruit, it offers a lot of other benefits in processing efficiency, must concentration and the beneficial removal of herbaceous characters that can be present in a difficult vintage.

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