Equipment evolution: Heating for rapid skin extraction in red wine production

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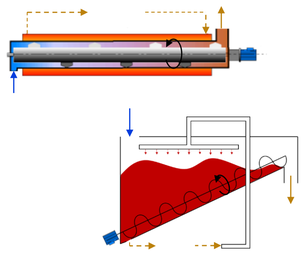
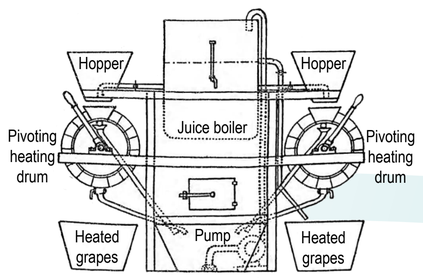
The Romans used heat to produce concentrate (sapa and defrutum) for sweetening wines

Pliny (c. AD 80) and other agricultural authors of the era recommended this be done in lead vessels. Some researchers have suggested that lead poisoning contributed to the demise of the Roman empire (a theory refuted by others).



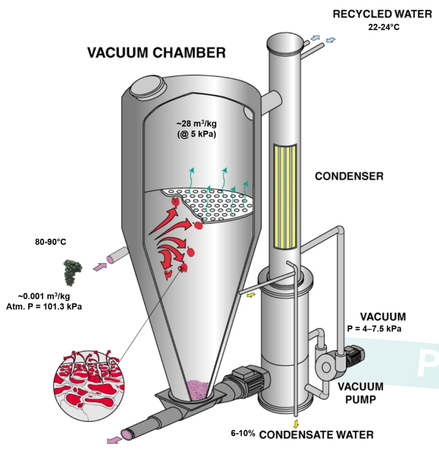
Bad weather and high throughput equipment

There were some disastrous vintages in France in the 1960s with widespread rot/laccase. This promoted interest in heat as a means to denature laccase. High throughput continuous equipment was developed that allowed large tonnages to be rapidly heated. There were also big production efficiencies as liquid ferments were performed without skins occupying tank space or needing to be managed.



Heating whole grapes by immersion in Burgundy

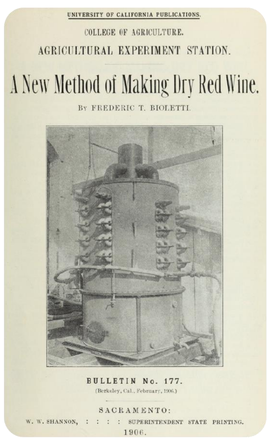
In Burgundy in the 1920s, researchers studied immersing whole grapes in hot juice for 4-5 minutes then draining and leaving the grapes for 12-24 hours. During this time the colour from the skins would diffuse inwards. Crushing, destemming, pressing and liquid ferment followed.



Flash détente

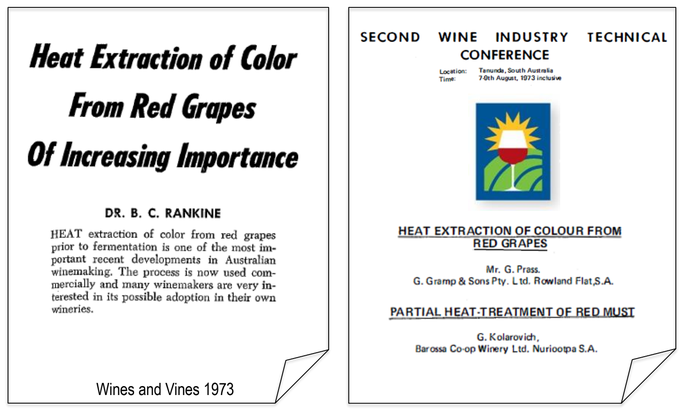
Thermovinified wines (minimal maceration period) can lack structure and colour stability because of a lack of tannins. Flash détente (patented by INRA in 1993) exposes heated grapes to a vacuum so that a portion of liquid boils immediately (it flashes) - some from inside the skin cells. This increases the extractability of tannins and polysaccharides. It instantaneously cools the grapes and allows removal of pyrazines in the condensate water if desired. There are also some preliminary anecdotal reports of flash détente's use in mitigating smoke taint.

- Heating grapes for extraction is not new, but understanding and techniques have evolved through research and experience.
- A variety of outcomes can be achieved depending on process conditions.
- As an indication of the amount of pre-fermentation heating used in red wine production in some countries, around 500 ML of wine was made in France using these techniques in 2008.
- Heat could be a useful tool for some larger Australian producers to help manage compressed vintages, keep production costs low, and tailor some wine styles for consumers.



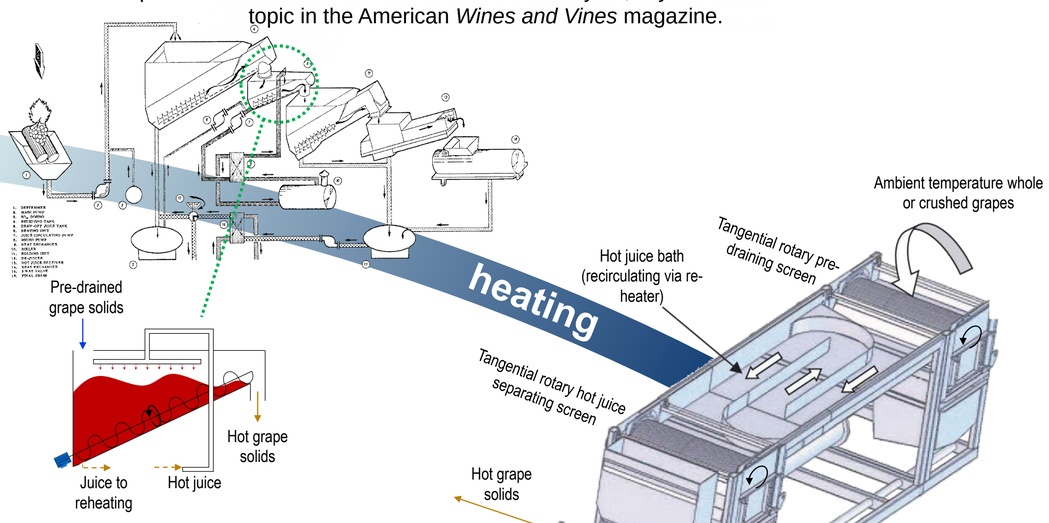
California investigates heat extraction

In the early 20th century heat extraction was investigated in California. Grapes were crushed, destemmed and drained with the juice being heated by steam in the device shown and added back into the tank with the skins. After sufficient contact time for colour extraction, juice was drained, cooled and the liquid fermented.



Australian interest in thermovinification in the 1970s

This is the 16th Australian Wine Industry Technical Conference. At the 2nd Wine Industry Technical Conference in 1973 there were two speeches from industry technical leaders on their experiences with thermovinification. In the same year, Bryce Rankine wrote on the topic in the American *Wines and Vines* magazine.



Industrial scale continuous immersion

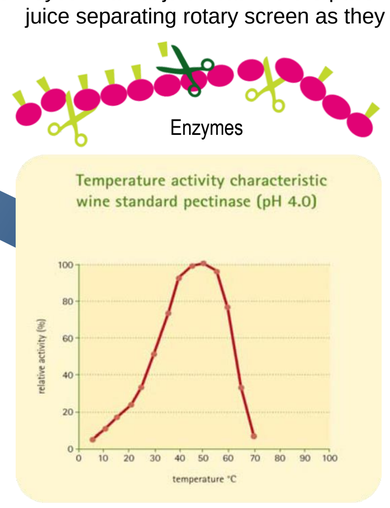
One of the industrial scale thermovinification systems developed in the 1970s was the IMECA continuous system. A portion of pre-drained juice was heated and sprayed on the grape solids. This hot juice loop was reheated and recirculated.

Modern continuous immersion

The modern immersion processes are more gentle. In this design from Pera-Pellenc, the incoming grapes are drained by a rotary screen. They are then heated as they are conveyed in a hot juice bath before passing over a hot juice separating rotary screen as they exit.

Thermo détente

Heated grapes enter bottles where they are pressurised to 100 to 400 kPa above atmospheric. The pressure is then released and the grapes enter a mixing vessel. Thermo détente is quite different to flash détente because there is no evaporative flash expansion of fluid from the skin cells, but the pressurisation and release does have some smaller effect on skin extractability.



Modulated flash détente

In this variation on flash détente patented by INRA and Pera-Pellenc in 2011, a slightly weaker vacuum is used that only cools the grapes to 55°C instead of 30°C. Enzymes are added to assist extraction and are near their optimum activity at this temperature. A lot can be achieved with a short contact time. This step can be performed while filling a large membrane press.

Hot colour extraction to stop adulteration of wines with synthetic dyes

In the 19th century there were issues in Burgundy with the adulteration of wines with fuchsine (a synthetic aniline dye). Hot maceration was proposed as one natural alternative means to enhance colour.

RDV clarification to stabilise colour

With thermovinification, colour is often high initially but then dissipates during fermentation and storage. This is a consequence of there not being enough tannins to stabilise anthocyanins and there also being lots of small particles that may fine out anthocyanins. Rotary drum vacuum (RDV) filtration provided a thorough clarification that minimised the latter effect. This extreme clarification tended to lead to very fruity estery red wines. Later, with the adoption of longer periods of pre-fermentation hot maceration and post-heating techniques like flash détente that extracted more tannin and stabilised colour, such strict clarification could be relaxed to modulate sensory profile (if desired).

Influence of heat treatments on wine style

(excerpt translated and adapted from www.vignevin-sudouest.com)

Treatment		Aroma	Palate	Comments
Thermovinifcation (<1 hr hot maceration)		• Fresh fruit • Estery	• Little body • Not very stable colour (tannin addition helps)	• Weak concentration • Used in blending to add fruitiness • Suitable for grapes with green or neutral aromas
Pre-fermentation hot maceration (MPC) (up to 12 hrs hot maceration)	*Liquid ferment*	• Riper fruit • Less green	• Balance approaching a classic red	• Used pure or in blends with thermovinified or classically made wines • Useful for under-ripe grapes
	Ferment on skins	• Very ripe fruit (jammy) • Less green aromas but some still present	• Wealth of tannin, sweetness • Hard tannins, rarely dry	• Needs aging (micro-oxygenation or wood) • Used in blends with MPC or thermovinified wines
Flash-détente	*Liquid ferment*	• Fruity to estery • Reductive and green if must poorly clarified	• Balanced wine • Green tannins if insufficient phenolic maturity	• Used pure • Not very suitable for under-ripe grapes
	Ferment on skins	• No estery notes • Ripe fruit characters if good grape maturity • Green characters if average or insufficient grape maturity	• Richness and sweetness of ripe grapes • Aggressive tannins with under-ripe grapes	• Used for blending • Not very suitable for under-ripe grapes (aggressive tannins)

Thermovinifcation / MPC variable	Detail
Maceration time	• Determines extraction of tannin • 30 mins to 12 hrs, 3 to 6 hrs is typical • Tannin/anthocyanin ratio of 2-3 is optimal for stable colour without tannic aggressiveness
Maceration temperature	• Has a greater influence on anthocyanins, but also some influence on tannin extraction • 65-85°C is typical
Clarification level for liquid ferments	• Influences weight and fruitiness • >400 NTU favours weight, <100 NTU favours esters
Fermentation temperature for liquid ferments	• Can modulate wine aromas • 18°C gives esters, 23°C gives ripe fruit

Sources include: Ageron et al. (1995), Blouin and Peynaud (2012), Boulet and Escudier (1995), Debaud (2006), Ferré (1926, 1928), Gros and Yerle (2014), Kolarovich (1973), Moutounet (2008), Escudier et al. (2008), Peynaud (1981), Prass (1973), Rankine (1973), Razungles (2010), Wagener (1981), Yerle (2008), and several equipment and additive suppliers.