Fine tuning flotation with a potato protein: quality and process flow

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In 2009, Laffort developed a protein derived from potatoes as an alternative to animal-based fining products.The results of trials using the protein as a flotation adjuvant and the lessons learned are reported here.

The potato-based protein patatin was first developed in 2009 and the OIV OENO 28/2004 resolution was amended in June 2013 to include it in the list of allowable plant proteins (OIV OENO 495/2013) in wine as an alternative to animal-based products for wine fining.

Whilst demonstrating a superior zeta potential to any other known fining agent, it was found to behave differently to standard animal proteins in flotation. Zeta potential indicates the balance of attractive and repulsive forces of a particle in a medium (Iturmendi *et al*. 2013).

Recent trials have demonstrated the parameters necessary for a successful flotation with the potato protein. It requires a specific balance between gas and protein to ensure the best results in terms of quality and efficiency. This work also supports using flotation with Vegecoll® — the commercial name of the protein — to achieve a high-quality product (Figure 1).

Flotation is the process of clarifying juice whereby solids are flocculated and pushed to the top with gas. The resulting juice may be racked off the bottom. Historically, white and rosé must have typically been clarified via the settling procedure, which can take a number of days and low temperatures. Flotation only takes a few hours in comparison to a few days (settling), exposing the wine to less oxidative and microbial risk. This can be done in batch or continuous mode. The refrigeration requirements are drastically reduced for flotation which can be done without it, as opposed to cold settling which requires low temperatures for 12 to 72 hours.

Normally, an adjuvant may be used to float the solids. The process will vary depending on the properties of the adjuvant which influences the time, gas volume and pressure required and the subsequent compaction of lees.

The flocculation capacity depends on the nature and the dose of the fining agent and of the wine. A high flocculation is not associated with a higher clarification speed. The sedimentation speed and the clarification speed depend on the size and the weight of the flake. It is the compromise between flocculation capacity and sedimentation speed that optimises the clarification effectiveness.

DEPECTINISATION

Depectinisation is a key factor in achieving a successful flotation. The pectin chain is a highly complex molecule, and its methylation level and structure will vary between varietals and degree of maturity. The combination of enzymatic activities is essential to achieving optimal depectinisation. Often with flotation, a shorter contact time between enzyme and substrate is allowed, making it critical that the spectrum of enzymatic activities is suited to the juice parameters. Factors like low pH (2.9) and low temperature may hinder the depectinisation process if the enzyme is not suited. Laffort's Lafazyme 600 XL^{ICE} is an example of an enzyme that retains over 70% of its activity at pH2.9 and 5°C. For particularly troublesome varieties, novel concepts such as Laffort's Lafase Boost may provide both a preventative and curative solution by targeting side chain

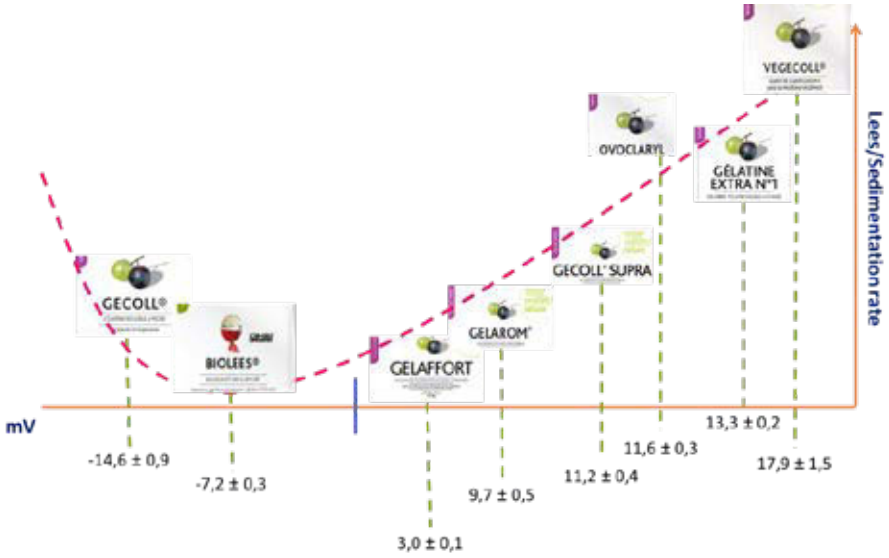

Figure 1. Classification of fining agents with respect to sedimentation rate — relative sedimentation speed compared with the zeta potential of the fining agent in a white wine at pH3.4. Vegecoll has the highest zeta potential (electrostatic potential in a colloidal system) compared with the other fining agents, which explains Vegecoll's high sedimentation and very effective clarification abilities.

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pectin structures only. This is ideal for use in conjunction with the standard winery pectinase to complement its activity for problematic varieties or overripe fruit.

FINING EFFECT

The aim of this work was initially to find out whether the quality of the juice could be increased with flotation compared with cold setting. Most flotation adjuvants will have a fining effect; the qualitative effect will be determined by the type of fining agent, dose and application time. In trials conducted in Castilla-La Mancha (2015), the grape varietal Viura (the most extensive grape plantings in this area) was used to compare both gelatine and Vegecoll (both at 15g/hL addition) in flotation. The juice floated with Vegecoll demonstrated lower levels of brown pigment, total catechines, and total polyphenol index when floated with the same amount of gelatine (Figure 2a-c). The juice bottoms were also analysed after flotation (Figure 2a-c) and demonstrated the same trends as the floated juice.

There was also an increase in the amount of aroma compounds present in the final wine (Figure 3, page 24)). Lees compaction was shown to be comparable to other fining agents including gelatine (Figure 4, page 24).

In 2017, in-depth trials were carried out in South Africa at Orange River on the varietal Colombard to:

- increase efficiency — less lees; no lees on the bottom
- test the ability for flotation to be completed within three hours
- decrease costs
- test for reductions quality: thiolic/ oxidation precursor aromas
- respond to market demands to find an allergen-free alternative.

Vegecoll was found to be the optimal solution in terms of offering an allergen-free alternative, the lowest cost ($0.0027AUD/L) at a dose rate of 50mg/L; and the lowest amount of lees compared with all the other fining agents trialled. The other main differentiation was the ability to carry out the flotation in the one tank, as opposed to the standard method of going from one tank into a second tank with the use of animal-based protein agents.

IMPORTANT POINTS TO REMEMBER ABOUT VEGECOLL (POTATO PROTEIN)

- flocs are larger than standard animal protein flocs
- flocs are more delicate (they break up easily with high levels of pressure), whereas animal protein flocs can be more resilient to higher pressures
- ease of filtration – both juice bottoms fined with Vegecoll and flocs floated with Vegecoll as opposed to gelatine are easier to filter through a crossflow
- Vegecoll is a potato protein which has a higher reactivity than any other fining agent towards phenolic compounds prone to browning and oxidation in juice
- results suggest that increasing the quantity of gas relative to the amount of potato protein (more gas and less

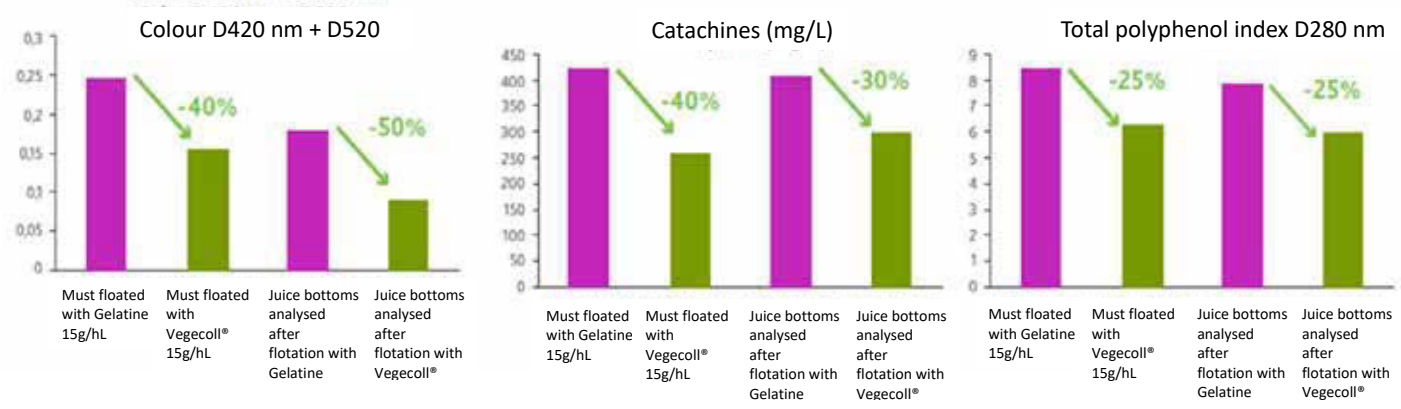


Figure 2. 2015 trials in Castilla la Mancha on Viura, comparing must and juice bottoms floated with gelatine and Vegecoll, a) colour D420nm is a change in the brown pigmentation combined with total colour in the must; b) analysis of catechins specifically which are prone to oxidation and can lead to oxidation and browning of the juice/must; c) total polyphenol index as measured by D280nm for all trials.

Table 1. Trials conducted in 2017 using Vegecoll with varying individual variables.

	Type of Gas	Qty gas L/minute	Pressure (bar)	Dosage mg/L Vegecoll®	L gas/hL	Turbidity after flotation
1	Nitrogen	6.66	5	50	1.33	130
2	Nitrogen	16.66	5	50	3.33	90
3	Nitrogen	16.66	6	50	3.33	100
4	Nitrogen	16.66	5	150	3.33	****
5	Nitrogen	16.66	5	25	3.33	95
6	Air	16.66	5	25	3.33	65

****Successful flotation was not achieved**

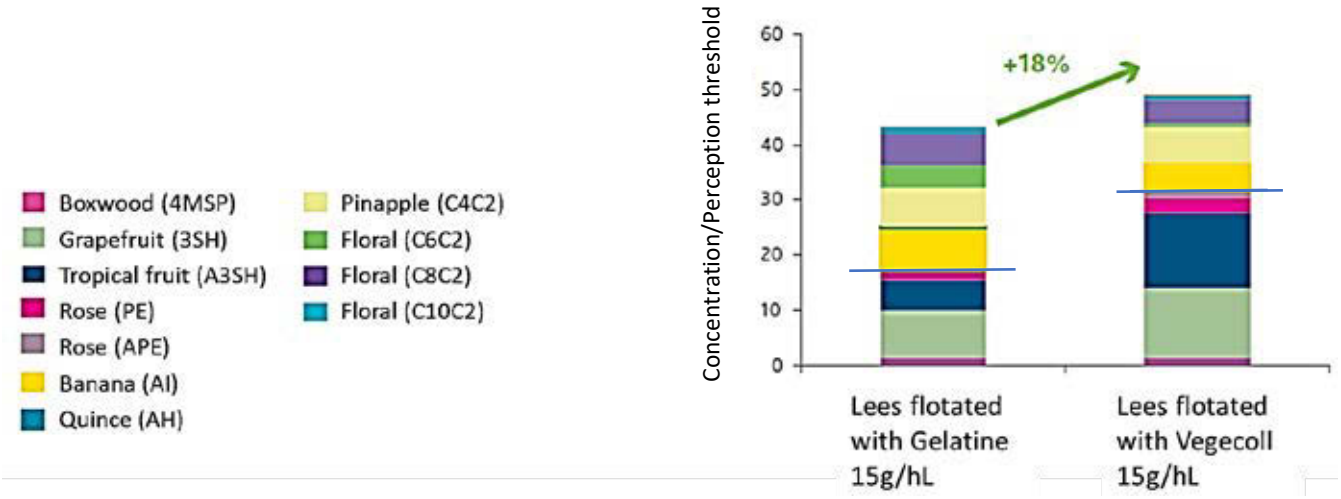


Figure 3. Analysis of aromatic compounds present in the resulting wines floated with gelatine and Vegecoll both at 15g/hL.

protein) is critical to achieving the best results; it requires a specific balance between gas and protein to ensure the better results in terms of quality and efficiency (Table 1).

As a result of this work, Laffort proposes a dedicated protocol for flotation with Vegecoll. It should be noted that this data was all carried out on batch flotation systems, and work is being carried out in the 2019 vintage on continuous flotation units.

LAFFORT METHOD: FLOTATION WITH VEGECOLL

- **Step 1:** *Flotation set up*. Float in one tank for the best results. Factor in tank size and width. It is generally easier to float in a wider tank than a taller tank.
- **Step 2:** *Mix.* Venturi in 25-50mg/L of Vegecoll (well mixed into the tank). Mix tank well for 20-30 minutes with no gas addition, at 2 atmospheres of pressure.
- **Step 3:** *Flotation.* Float at 4-5 bar of pressure for at least 120 minutes. Findings suggest that more gas flow is beneficial whilst keeping the pressure at 5 bar.
- **Step 4:** *After flotation – rest and relax!* Leave the tank sit for 60-90 minutes.

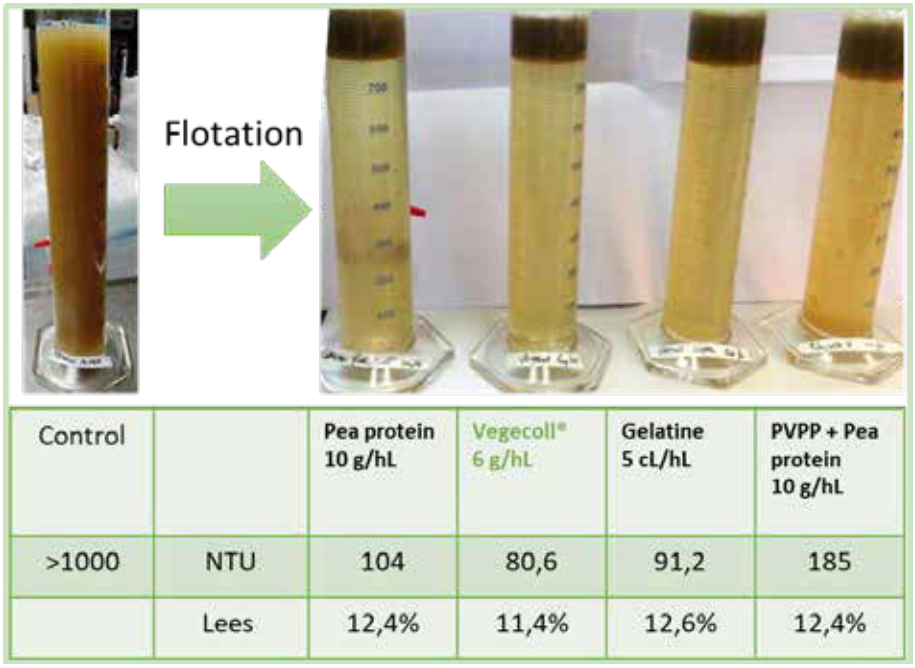
Total time: 3.5-4.5 hours

SUMMARY

Past and ongoing trials support the use of Vegecoll as a flotation adjuvant for the dual purpose of increasing the final quality of must and achieving a successful flotation. This work has led to a greater understanding of the use of Vegecoll as a flotation adjuvant, and it is recommended that the ratio of grams per hectolitre of Vegecoll and litres per hectolitre of gas be utilised to achieve the most successful flotation outcome.

It is important to understand that the protein itself is very different to animal-based fining agents in that it forms a bigger and more delicate floc, and may require more gas in relation to the amount of potato protein without increasing the pressure.

In combination with highly efficient depectinisation strategies (e.g., Lafase 600 XL[ICE] and Lafase Boost), low doses of Vegecoll in flotation can achieve better quality outcomes than traditional cold settling in a much shorter amount of time without the microbial and oxidative risks associated.



Control		Pea protein 10 g/hL	Vegecoll® 6 g/hL	Gelatine 5 cL/hL	PVPP + Pea protein 10 g/hL
>1000	NTU	104	80,6	91,2	185
	Lees	12,4%	11,4%	12,6%	12,4%

Figure 4. Comparative lees compaction in 2014 trials with a range of fining agents in comparison to Vegecoll.

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