TECHNICAL BOOKLET

FINING WINES

LAFFORT

l'œnologie par nature

1- Why should I fine my wines?

Fining consists of "adding to a wine a clarifying agent capable of coagulating and forming flakes, which settle causing particles to precipitate thus having a clarifying effect" (Ribéreau-Gayon *et al.*, 1977). Besides having a ***clarifying*** effect, fining leads to changes in the ***polyphenolic structure*** of wines and improves the ***stability of colouring matter*** by eliminating particles likely to precipitate later in bottle (Lagune-Ammirati and Glories, 1996). Fining also helps reducing the ***microbial load*** of the wine (Murat and Dumeau, 2003).

	Gelatins	Egg albumin	Isinglass	Casein	PVPP	Bentonite	Biolees®	Tannins	Gum Arabic	Charcoal
Changes structure	✓	✓	✓	✓	✓		✓	✓	✓ (colloidal)	
Stabilizes	✓	✓				✓ (proteins)		✓	✓ (colour)	
Clarifies	✓	✓	✓	✓	✓	✓	✓			✓
Reduces microbial load	✓	✓								
Used in red wine	✓	✓		In some Cases	✓		✓	✓	✓	✓
Used in white and rosewine	✓		✓	✓	✓	✓	✓	✓		✓

Table 1: *Effects of different fining agents*

2- How does a protein fining work?

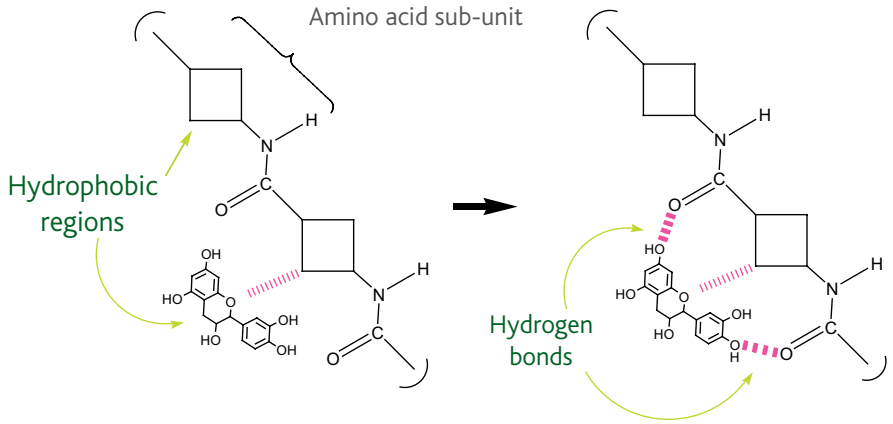

Figure 1*: The two-stages of tannin-protein interaction: hydrophobic association followed by hydrogen bonding*

The interaction of tannins and proteins initially involves a two-stage process (Figure 1). Tannins (negatively charged) and proteins (positively charged) first move into close proximity in order to lower the energy of the system and then form hydrogen bonds, locking the two structures together. ***At this stage the process is reversible***, and excessive energy being applied to the system (heating the wine for instance) is likely to ***lower the effectiveness of the fining process.***

Once the protein-tannin association is complete, ***flocculation*** follows, where the associated complexes aggregate, which is in turn followed by ***precipitation***. This process is, in part, governed by the concentration of the added protein. When this concentration is low, simple association occurs. When the protein concentration is high, cross-linking occurs between sites of association, affecting the overall reactivity and function of the fining agent.

3- The toolbox: different fining and co-fining agents

1. Gelatins

Gelatins are used in many industries (even outside food and beverage production) and are derived from the hydrolysis of animal collagen (bovine or porcine). Not all are suitable for wine application (Ribéreau-Gayon *et al.*, 2006). The two factors having the largest impact on the effectiveness of a gelatin are the surface ***charge density*** on the proteins (***the higher the charge, the greater the fining effect***) and the ***mass distribution*** of the proteins (Ribéreau-Gayon *et al*., 2006). The clarification potential of a gelatin also relies on its amino acid composition and sequence (particularly Pro, Hyp, Gly), known as the Specific Sequence of Elimination (SSE) (Yokotsuka and Singleton, 1995). Contrary to popular beliefs, protein concentration and Bloom degree are not the most relevant factors in fining effectiveness. No linear relationship exists between the concentration of a gelatin, its effectiveness in winemaking nor its impact on wine sensory characteristics, as these factors depend directly on the ***raw material*** used, the way in which the gelatin solution is *produced* [chemical or enzymatic hydrolysis, intensity of hydrolysis, purity of the final product] and the ***tannins*** that the gelatin is interacting with in the wine (Ribéreau-Gayon *et al*., 2006). Gelatin hydrolysis decreases its charge density and molecular weight, but favours the protein structure opening, which improves its access to tannins, and therefore binding and precipitation (Sarni-Machado *et al*., 1999).
As a general rule, ***highly hydrolyzed gelatins (low molecular mass and low charge density) are highly reactive towards large molecules, remove a lot of tannins and usually suit young or astringent wines*** (Lagune *et al*., 1996). ***Less hydrolyzed gelatins, on the contrary, react with smaller molecules to produce a gentle fining action, and these highly charged gelatins better clarify balanced red wines at a lower dosage*** (Versari *et al*., 1998).
Gelatins are helpful for flotation. Preliminary trials are also recommended but best results have been found with a hydrolyzed gelatin having high clarifying, flocculating and rapid settling properties (like **GECOLL SUPRA®**).
Experiments have shown that certain gelatins can ***significantly reduce acetic acid bacteria and Brettanomyces yeast populations***, compared with samples that have been racked but not fined (Murat and Dumeau, 2003). This phenomenon may be attributed either to mutual flocculation with the proteins, or to flocculation of agglomerates colonized by the micro-organisms. An adsorption phenomenon or physical entrainment might also take place (Murat and Dumeau, 2003). Besides causing organoleptic spoilage, high population levels of these two micro-organisms are also likely to clog filters during bottling.

2. Egg albumin

Albumin (***ovalbumin***) is the major protein found in egg whites. It is a medium-weight protein and is classically associated with the fining of ***red wines***, due to its noted lack of reactivity towards smaller anthocyanin-tannin complexes and therefore ***lower colour removal***. Like gelatins, egg albumin also helps decrease ***spoilage micro-organism*** population (Murat and Dumeau, 2003). It is not typically used on white or young red wines. Albumin is also highly soluble in wine, so the addition rate should be carefully determined to avoid post-fining stability problems.

3. Isinglass

Isinglass is a derivative from tissue collagen and is made from certain fish species. Its molecular weight is very high, therefore it tends to react with smaller tannins, and over-fining is less likely. Isinglass is typically only used on *dry and sweet* ***white wines***. Despite its poor dissolution and its slowly formed diffuse lees, low addition rates restore high ***organoleptic clarity*** and remarkable ***brilliance*** to the wines. It can be used in combination with bentonite (added afterwards) for stabilization and better compaction of the lees, or with silica gel to speed the precipitation.

4. Casein

This very high molecular weight protein is isolated from skim milk, and is used mainly in ***white wines***. The potassium salt of the protein is often used (**CASEI PLUS**), as it is far more soluble and user-friendly than the protein itself, and does not add potassium to the wine (no stability modification). Casein improves wine ***filterability*** and is noted for its ability to remove ***oxidative browning***, often being used on ***juice*** for this specific purpose. Over-fining with casein is difficult due to its poor solubility in wine. The flocculation is fast due to the wine acidity, and settling is fast but partial; bentonite helps to complete the sedimentation.

	Colour removal	Phenolic removal	Tendency to overfine
Highest impact ↕ Lower impact	Gelatin	Gelatin	Gelatin
	Casein	Albumin	Albumin
	Albumin	Isinglass	Isinglass
	Isinglass	Casein	Casein

Table 2: *A rough comparison of proteinaceous fining agent characteristics. More accurate relativities cannot be provided due to the variable nature of products from different manufacturers and the wines being fined.*

5. PVPP

Polyvinylpolypyrrolidone (PVPP), a synthetic polymer, is not soluble in wine and is very rapid in its action. The relatively rigid structure of the polymer allows only reaction with small phenolic species, which are usually associated with ***bitterness***. PVPP is said to strip aroma and flavor at excessive addition rates, works well at low temperature and can be used on juice or wine. Used along with casein, it improves wine color in case of pinking or browning.

6. Bentonite

Bentonites used in winemaking are montmorillonite (mineral fining agent), a hydrated aluminium silicate with a net negative charge ready to react with positively-charged ***proteins*** in wine. Lab trials to determine adequate dosages are highly recommended.

Dominant cation	Swelling	Exchange capacity	Lees	Aroma removal	Example
Sodium	High	High	Slowly-formed and diffuse	High	MICROCOL® POUDRE
Calcium	Needs additional stirring to ensure complete dispersion	Lower	Rapid settling, compact	Minimal	MICROCOL® CL

Table 3: *Characteristics of the different bentonites*

MICROCOL® ALPHA, a natural sodium bentonite with a high adsorption capacity, has been specifically selected for its aromatic preservation and its lees compaction.

7. Biolees®

Biolees® is a new yeast-based product that performs two functions in wine. The yeast cell walls have been specifically tested and selected for their fining capacities, consequently promoting the elimination of certain polyphenols responsible for ***bitterness*** and ***astringency***. They are also enriched with a natural sapid *peptide* fraction (derived from yeast) that contributes to increasing ***sweetness*** and ***roundness*** sensations.

8. Gum Arabic

Gum Arabic comes from African Verek or Seyal Acacia trees. Different formulations aim to stabilize ***unstable coloring*** matter and increase protection regarding metallic (Cu^{2+} up to 1ppm) ***casses***, or to contribute to the colloidal structure of the wine.

9. Carbon

Carbon is essentially purified charcoal, yet some have remarkably specific attributes on ***specific odours***. **TOXICAL®** for instance, originally developed for removing ***ochratoxine A***, is also effective on smoke taint; **GEOSORB®** particularly removes geosmine and octenone from must and young wine. Carbon also has activity towards small phenolics and anthocyanins. Carbon has a very high surface area, very small pores and operates on an adsorptive mechanism.

10. Silica gel

Silica gel is a suspension of silica, and is used as a ***co-fining agent***, most commonly with gelatin. It is added prior to fining agents to *avoid over-fining*, to optimize flocculation and accelerate settling. Faster and better lees compaction results in a *decreased loss of wine* and *saves time*.

11. Tannins

Tannins can be used either as a ***co-fining agent***, in a similar way to silica gel and with similar effect, or to remove ***proteins*** and ***lower the required bentonite*** load. A tannin addition prior to bentonite on white wines with gallic **TANNIN GALALCOOL®** thus preserves aromatics and overall wine quality.

4- How do I choose the right fining aid?

1. Lab trial

Each wine is different, and each wine will need a different fining agent at a specific dose. The first step is to taste the wine, taking notes regarding its color, aromatic quality and phenolic structure. Knowledge of the specific winemaking process (fermentation and ageing) is also important to characterize the wine. This information will help you decide the goal of your fining: do you want to mainly polish your organoleptic profile? Is the clarification more important? Or do you only want to stabilize your wine regarding colouring matter or proteins? Keep in mind your constraints (time, volume, labeling legislation regarding allergens, etc.).
For each wine, we highly encourage you to try ***different fining agents***, and different ***products*** at different ***dosages***. It is a tedious preparation work but critical as it is very difficult to predict which fining product will work best on any given wine.
If your lab results are not satisfactory after a few days, you may want to consider treating your wine first with an ***enzyme***: pectinases and ß-glucanases will clarify the wine, helping with the flocculation and saving time.

For improved success in your lab trial:

- Correct the free SO_2 to 30mg/L if necessary
- Use 375mL bottles as a minimum volume
- Include a control in the series of wines
- Keep the wines at ambient temperature (unless there is a specific recommendation otherwise)
- Allow 2 to 3 days before tasting the wines
- Taste blind and measure the turbidity (including control)
- Choose the fining agent and dosage according to your tasting preferences and constraints.

In case of a bentonite treatment, you may want to first determine the instability degree of your wine with the following protocol.

Measure the turbidity of your wine; if the result is above 2NTU, filter the wine and measure it again (turb1). Heat the wine for 30 minutes at 80°C/176°F, and leave it at ambient temperature for 45 minutes. Timing is important for an accurate estimation. Measure the turbidity again (turb2). The wine is stable if (turb2 – turb1) < 2.

If the wine is not stable, test 2 to 3 doses of bentonite (dosage should be either side of the number calculated by (turb2 – turb1)*2.5). 30 minutes after the bentonite addition, you can perform the stability test again. Bentonite preparation for small volumes is easier: dissolve in 20 times its weight in water and allow at least 1 hour of rehydration.

2. Avoid over-fining

Over-fining occurs when a fining agent is not fully dispersed in the wine, leading to over treatment of part of the wine and under treatment of the rest of the wine. The result is that a fraction of the protein added in the fining agent does not flocculate and stays in the wine. This phenomenon is more likely to happen with gelatin, but it might occur with different agents if the preparation is not properly homogenized in the wine or if the concentration is too high. It can happen on white wines with a high dosage of gelatin, when tannins have been added after fining or when a bad cork diffuses into the wine. Poor flocculation, fast additions, high temperatures or the presence of a colloidal haze can also lead to over-fining in red wines.
The use of silica gel (before the fining agent) and laboratory trials help preventing over-fining.
If your wine has been over-fined, add bentonite (whites) or tannins (reds) with preliminary trials.

3. Product preparation and tank treatment time

	Form	**Bench trial contact time before tasting**	Preparation /Addition * (check labels and technical data sheet for more information)	**Over fining risk**	**Use with Silica gel**	**Treatment contact time** before racking or filtration**	Notes
Gelatin	Liquid or solid	2-3 days	Liquid: gradually add during a pump-over, then homogenize carefully Solid: dissolve carefully in hot water (40°C/104°F) at 50g/L and keep in hot water bath during incorporation	✓	✓	7 days – 3 weeks	
Egg Albumin	Liquid	2-3 days	Shake before opening. Mix gently before adding to the wine. Homogenize. Use the open bag immediately.	✓		7 days – 3 weeks	100g/L of Albucoll® is equivalent to 32-33 egg whites. Refer to local legislation for specific labeling (allergen)
Isinglass	Powder	2-3 days	Dissolve at 10g/L. Let swell for 2 hours, and stir to optimize dispersion. If gelling appears too fast, add more water. Add to the wine and homogenize.		✓	2 -4 weeks	
Casein	Powder	Overnight	In 10 times its weight in water, until dissolution. Add to the wine with a pump-over.	✓		10 days – 3 weeks	
PVPP	Powder	Overnight	In 4 times its weight in water, 1 hour prior use.	✓		10 days – 3 weeks	
Bentonite	Powder	2-3 days	Dissolve in 10 times its weight in water, and keep stirring for 2 hours (Hot water 50°C/ 122°F is recommended). Let it hydrate for 12-24 hours. Mix to obtain an homogenous preparation before incorporation. Homogenize after addition.	✓		5 days – 2 weeks	Can be used on young red wine to eliminate unstable colouring matter.
Biolees®	Powder	1-2 days	Dissolve in 5-10 times its weight in water. Homogenize after addition.			4 – 6 weeks	
Gum Arabic	Liquid	Overnight	Use on clarified and filtered wine. Add to the wine and homogenize carefully.			No racking	
Carbon	Powder	2-3 days	Incorporate directly into the wine			1 day	Creates a lot of dust
Silica gel	Liquid	-	Incorporate directly or dilute with water or wine. Mix thoroughly.			-	Add prior to the fining agent
Tannins	Powder	Overnight	Dissolve in 10 times its weight in water. Homogenize after addition.			No racking	The LAFFORT Instant Dissolution Process (IDP) helps the dissolution in water or in wine.

* Preparation: avoid high temperature during the preparation and application, especially with gelatins. The efficiency of the treatment highly depends on the quality of the preparation.
** Contact time: the settling time will depend on the temperature of the wine, the volume and the shape of the tank, the use of Silica gel, etc. As a general rule, the longer you allow to settle, the better compacted your lees will be.

Table 4: *Different fining agents, their preparation and contact times*

5- What fining agent should I use? General advice

Type of wine	Possible fining agents		
Aromatic white wine	Gallic tannin Galalcool® + isinglass Ichtyocolle®	Siligel® + gelatin Gelarom®	
Qualitative press white wine	Siligel® + gelatin Gecoll Supra®		
Bitter or herbaceous white wine	Casein Casei Plus	PVPP	PVPP + casein Polylact®
Oxidized white wine	Casein Casei Plus	PVPP + casein Polylact®	Polymust® AF
Protein stability	Bentonite Microcol® Alpha	Tannin Galalcool® + bentonite	
Light red wine	Gelatin Gelarom®	Tannins Tan'Cor Grand Cru® or Biotan®	
Structured red wine	Gelatin Gelatine extra n° 1 or Gecoll Supra®	Albumin or Albucoll®	Biolees ®
Astringent red wine	Gelatin Gecoll Supra®	Albumin or Albucoll®	PVPP or Biolees ®
Press red wine	Gelatin Gecoll Supra® or Clarpress	Albumin or Albucoll®	

***Table 5**: General indications of suitable fining agents for different types of wines. Lab trials are highly recommended, with a wide variety of products and dosages.*

For more information about proteinaceous and non-proteinaceous fining agents, 2 articles from Dr Paul Bowyer under the Laffort news section (Research and Innovation) of our website www.laffort.com.

Bibliography is available upon request.

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