Additives in winemaking

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Enzymes in Winemaking

Definition: Biological catalysts aiding specific chemical reactions

Primary categories: pectinases, glycosidases, proteases, glucanases

Benefits:

filtration	varietal optimization,
pressing,	clarification,
stability	color & phenolics
mouthfeel	aroma release

Color & Phenolics

- Enzymes accelerate the release of anthocyanins and tannins resulting in wines with brighter, more stable color and enhanced structure.

Mouthfeel

- Enzymes promote tannin extraction which impacts mouthfeel. Some enzymes, like beta-glucanase will aid with yeast autolysis, releasing mannoproteins which increases mouthfeel and sweetness perception.

Aroma Revelation

- Aroma compounds, if not released from their precursor form, can be undetectable. Some enzymes have the ability to release these compounds.

Sugar Level

- Enological beta-glucosidase/glycosidase enzymes are inhibited by sugar. It is recommended that these enzymes are used once the glucose level is <5%.

Filtration

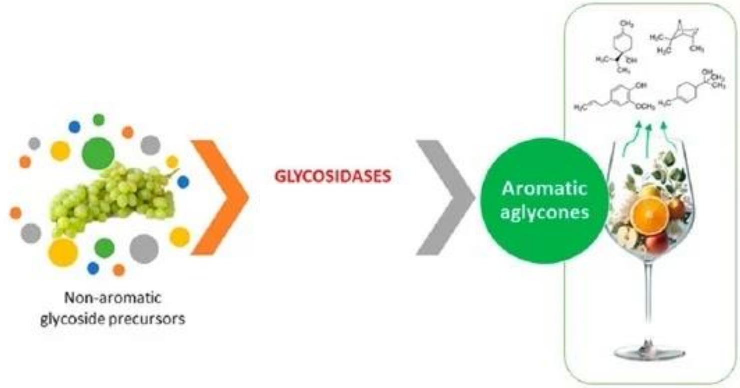
- Grapes impacted by Botrytis can be filtration nightmares. Enzymes help break down glucans and other polysaccharides that are colloidal in nature and can make the wine very difficult to filter.

Mechanism of Action – Enzymes

- Breakdown of cell walls for better extraction (pectinase)
- Release of aromatic precursors (glycosidases) — should be used only post fermentation **as sugars inhibit them**
- Protein stabilization (proteases)
- Break-down of glucans & polysaccharides
- Timing of use: Pre-fermentation, during fermentation, post-fermentation

Aroma precursors

- Aroma precursors are molecules that are linked to the sugar molecules in a grape as it is developing and ripening.
- Because these molecules are linked to the sugar, they are not volatile—they are absolutely aroma and flavor -less.
- Once the sugar molecule is released, they become odor active



Enzyme Applications in Blanc du Bois

Goal: Enhance aromatic profile and clarity

- Employ pectinases pre-press for better juice yield
- Use glycosidases post -fermentation for floral and fruity notes
- Use protease post fermentation for less hazing

Enzyme Applications in Lenoir

Goal: Enhance extraction of color and phenolics

- Use pectinases during maceration
- Proteases post-fermentation to reduce haze risk

Pros and Cons of Enzymes

Pros:

- Improved extraction
- Enhanced aromatic profiles
- Clarification and filtration ease
- Stability (protein, microbio)

Cons:

- Cost implications
- Overuse can lead to undesired texture, over extraction
- Cinnamyl esterases – "brett like", funk (vinyl phenols)

QUICK GUIDE TO CHOOSING ENZYMES

RAPIDASE CLEAR EXTREME	RAPIDASE EXTRA PRESS	SCOTTZYME CINN-FREE	SCOTTZYME HC	SCOTTZYME KS	LALLZYME MMX	SCOTTZYME PEC5L	SCOTTZYME SPECTRUM
109	110	110	111	112	109	112	113
Pressing, Clarification, Fining, and Filtration improvement							
Rapid clarification under difficult conditions	Increases juice yields and minimizes time in press	Aids in pressing	Clarification in American, hybrid, and non-grape wines	Filtration	Yeast autolysis	Clarification	Filtration
Lees compaction	Increased extraction of aromatic precursors	Extraction of aromatic precursors	Filtration	Clarification under difficult conditions	Filtration	Improves pre and post-fermentation processes	Clarification under difficult conditions
Juice (white, rosé)	Grapes/in press (white, rosé)	Grapes or juice (white, rosé)	Juice or wine	Juice or wine (all wines)	Wine (all wines)	Grapes, juice, or wine (all wines)	Wine (all wines)
Pectinase with essential side activities	Pectinase with essential side activities	Pectinase	Pectinase with cellulase activities	Pectinase with cellulase, hemicellulase, and protease activities	Pectinase with glucanase activity	Pectinase with main and side chain activities	Pectinase with cellulase, hemicellulase, and protease activities
Granular	Liquid	Liquid	Liquid	Liquid	Granular	Liquid	Liquid

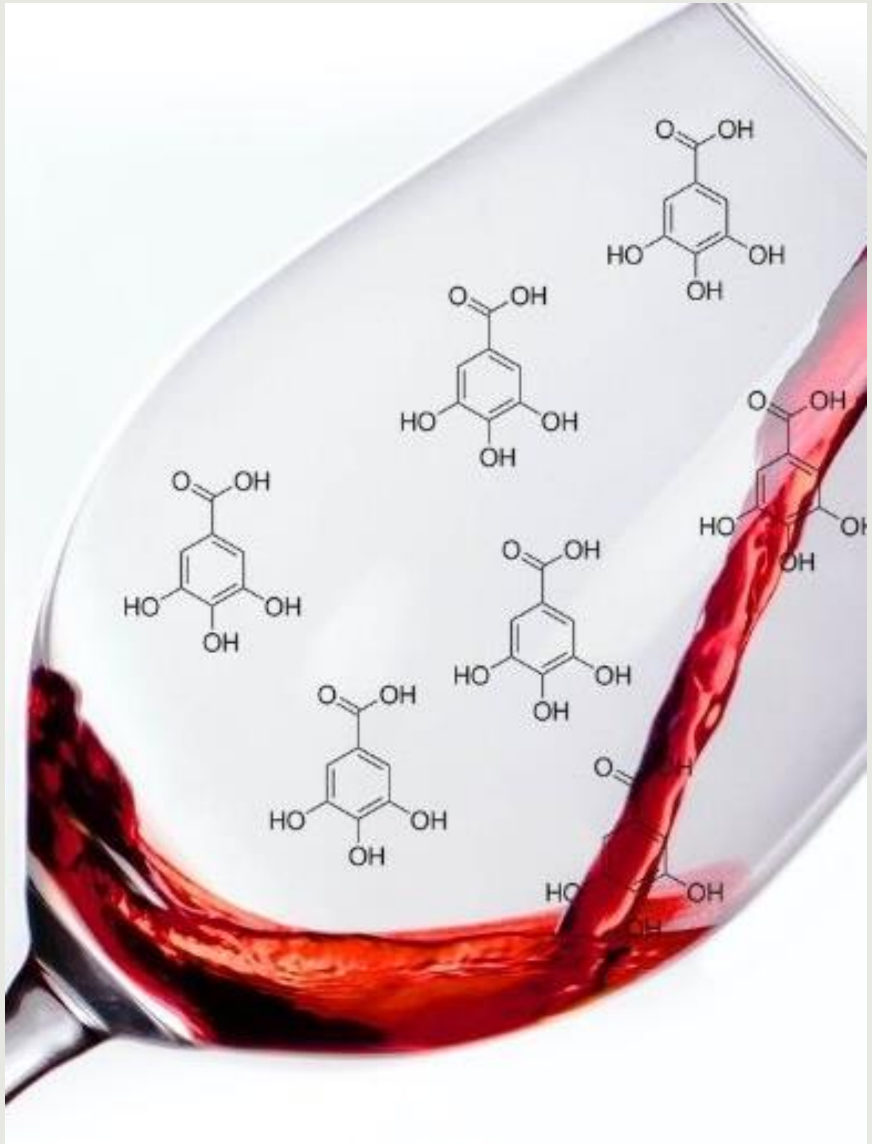
QUICK GUIDE TO CHOOSING ENZYMES

	LALLZYME CUVEE BLANC	RAPIDASE EXPRESSION AROMA	RAPIDASE REVELATION AROMA	LALLZYME EX	LALLZYME EX-V	SCOTTZYME COLOR PRO
Pg	108	109	110	108	108	111
	Aroma Release			Maceration		
Primary Use	Extracts skin-trapped varietal aroma compounds	Extracts skin-trapped varietal aroma compounds	Releases sugar bound aroma compounds	Higher yield at lower pressing pressures (smaller hard press fraction)	Higher yield at lower pressing pressures (smaller hard press fraction)	Higher yield at lower pressing pressures (smaller hard press fraction)
Secondary Uses	Higher yield at lower pressing pressures (smaller hard press fraction) Continued aroma release during fermentation	Higher yield at lower pressing pressures (smaller hard press fraction)	Clarification	Releases color molecules	Enhances structure Releases color molecules	Masks greenness Releases color molecules
Stage of Production	Grapes/in press (white, rosé)	Grapes (white, rosé)	Wine (all wines)	Grapes/must (red)	Grapes/must (red)	Grapes/must (red)
Formulation	Pectinase with glycosidase activity	Pectinase with essential side activities and hemicellulase activity	Pectinase with glycosidase activity	Pectinase with cellulase and hemicellulase activities	Pectinase with cellulase and hemicellulase activities	Pectinase with protease activity
Format	Granular	Granular	Granular	Granular	Granular	Liquid

Tannins in Winemaking

Polyphenolic compounds from grape skins/seeds or external sources

- Roles:
  - Structure and mouthfeel
  - Oxidative stability
  - Color stability
  - Bitterness and astringency balance



Mechanism of Action – Tannins

- Bind to proteins, precipitating haze and stabilizing wines
- Protect wine from oxidation
- Enhance phenolic structure by polymerizing with anthocyanins

Types of Tannins in Winemaking - origin

Seed Tannins: Extracted from grape seeds; more bitter and astringent; used sparingly to add structure during fermentation.

Skin Tannins: Softer and more integrated; enhance mouthfeel and structure; often naturally present in red winemaking.

Ellagitannins: Extracted from oak; provide oxidative stability and complexity; used post-fermentation or during aging.

Types of Tannins in Winemaking – time of application

Type	Functions
Fermentation tannins (sacrificial tannins – multiple sources seeds, skins, oak, chestnut)	Bind with proteins React with oxygen Inhibit laccase Stabilize color Reduce perception of greenness
Aging tannins (grape/oak tannin blends)	Improve the structure and mouthfeel of wine Longer integration time (1-2 months)
Finishing tannins (extracted from toasted oak)	Boost aromatics Improve mouthfeel Reduce greeness

Sacrificial tannins

- Sacrificial tannins react with proteins **and enzymes** (including laccase from Botrytis) in grapes that would otherwise bind with natural grape tannins.
- Sacrificial tannins preserve the natural grape tannins in the wine.
- Tannins have high antioxidant power and can protect juice from oxidation when added during fermentation.
- In reds, loss of natural tannins can cause loss of color, structure, mouthfeel, and ageworthiness.
- In white wines, sacrificial tannins are added to bind with protein in the juice for wine stability or to protect the juice from oxidation when fruit is compromised by rot. Gall nut tannins have high reactivity for protein binding

Color stabilization

Color stabilizing tannins are added at the one-third mark of fermentation.

High in catechins that polymerize anthocyanins during pigment extraction from the grapes.

- Polymerization prevents excessive precipitation of the color during aging, thus maintaining more stable color over the life of a wine.

Remember!

- They do not **add** color that is not there – they simply **protect** the color the grapes naturally have in the skins.
- Must be added at one-third of the way into fermentation. At this point, they can interact with free acetaldehydes to form bridges to stabilize anthocyanins.

Tannins for mold or Botrytis

High reactivity tannins for binding and inactivating browning enzymes, and for antioxidant protection of the must.

For white grapes, the main concern is oxidative browning from laccase.

- Gall tannins react quickly with laccase, inactivating enzymatic action
- Used at destemming or juice collection

For red grapes, the concerns are

- preventing the browning enzymes from causing oxidation,
- lack of tannin for structure,
- loss of color, and
- negative flavors from the mold
- addition at the initial stages of processing!

Astringency in whites and reds

Low doses will not greatly affect astringency in whites and roses.

Higher doses depend very much on the specific wine (bench trials!!).

Lighter white or rosé wines may need a much lower dosage to avoid any astringency

With heavier, full-bodied whites made with oxidative fermentation methods and aged in oak barrels, there may be more room to use tannins without affecting astringency.

Sweet whites or rosé wine styles can still benefit from tannin additions without astringency due to the mouth-coating effects of the sugar.

Tannins for structure

Structural tannin additions are best addressed in red wines **after malolactic fermentation is complete.**

When wines need a bigger tannin addition, **the earlier the better** (tannin helps protect wine during aging & there is more time for the added tannin to integrate into the wine).

Every time the wine is racked, is another opportunity to make a structural tannin addition

Tannins and ageability

Fermentation tannins.

- Sacrificial tannins during grape processing bind with proteins, enzymes, and oxygen that would otherwise reduce the concentrations of innate tannins extracted from the skins and seeds or degrade aromas and flavors.
- Color-stabilizing catechin tannins polymerize anthocyanins, thus creating more stable color that lasts longer during bottle aging.
- Structural ellagic and proanthocyanidic grape tannins build mouthfeel and function as antioxidants

Aging Tannins

- Ellagic and proanthocyanidic grape tannins add structure and function as antioxidants.

Finishing Tannins

- Structural ellagic tannins quickly reduce oxidation, improve mouthfeel and function as antioxidants.

Mouthfeel Enhancers in Winemaking

Additives improving perceived body, texture, and richness

Categories:

- Polysaccharides
  - Mannoproteins
- Gums

Polysaccharides

Naturally occurring compounds derived from **yeast cell walls** or plants (gum Arabic)

Improve organoleptic perception, as they **contribute to improving the sensations of body and volume in the mouth**,

Increase perception of sweetness without any sugar additions

Reduce astringency and increase persistence and balance.

Stabilize the aromatic fraction and delay its perception (aftertaste).

Provide tartaric stability (blocking crystallization reactions), protein and coloring matter stability (interaction with tannins and proteins).

Can replace the fermentation lees whenever the lees do not have the necessary sensory or microbiological quality (reduction aromas, high volatile acidity, coming from grapes at the end of the harvest, from stuck fermentations, unhealthy harvests, etc.).

Can increase structure and body, reduce some tannic astringency or attenuate the excessive impact of wood, before bottling.

Polysaccharides from yeasts

Several yeast derivatives are available within the group of commercial polysaccharides, but their composition changes considerably:

Inactive yeasts:

- have a relatively low polysaccharide content.
- require a prolonged contact time to release the polysaccharides.

Yeast hulls:

- only the **cell wall** of the yeast.
- higher polysaccharide content and
- require a shorter contact time to release the polysaccharide, as well as a higher mannoprotein fraction versus inactive yeast.

Purified mannoprotein:

- The only the soluble polysaccharide fraction which has an immediate effect on the wine.

Application in winemaking:

- **Sur lie aging:** Leaving wine in contact with lees (dead yeast cells) naturally increases the content of mannoproteins and polysaccharides.
- **Commercial products:** Many winemaking companies offer commercially prepared mannoprotein and polysaccharide blends that can be added to wine during fermentation or post-fermentation to enhance specific qualities.

Yeast hulls and H2S

Act as an adsorbent, effectively binding to the H2S molecules and removing them from the liquid, thus reducing the "rotten egg" smell associated with high H2S levels

Less effective method compared to the more common treatment using copper sulfate, which is typically the preferred option for H2S removal in winemaking.

Mechanism:

- Yeast hulls contain a porous structure that can trap and absorb various compounds, including H2S molecules.

Application:

- To use yeast hulls, they are typically added to the wine after fermentation is complete, allowing them to bind to the H2S present.

Gum arabic

- Gum acacia or Arabinol – carbohydrate polymer from the sap of Acacia trees
- Softens tannins & astringency
- Stabilizes anthocyanins
- Increase in viscosity
- Increase in sweetness perception without sugar addition
- More effective at higher pH
- Not to be used with wines meant for aging
- Increases tartrate stability (encases tartar crystals keeping them separate and preventing growth)
- Helps prevent ferric casse in high iron wines

THANK YOU!

Questions?

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