

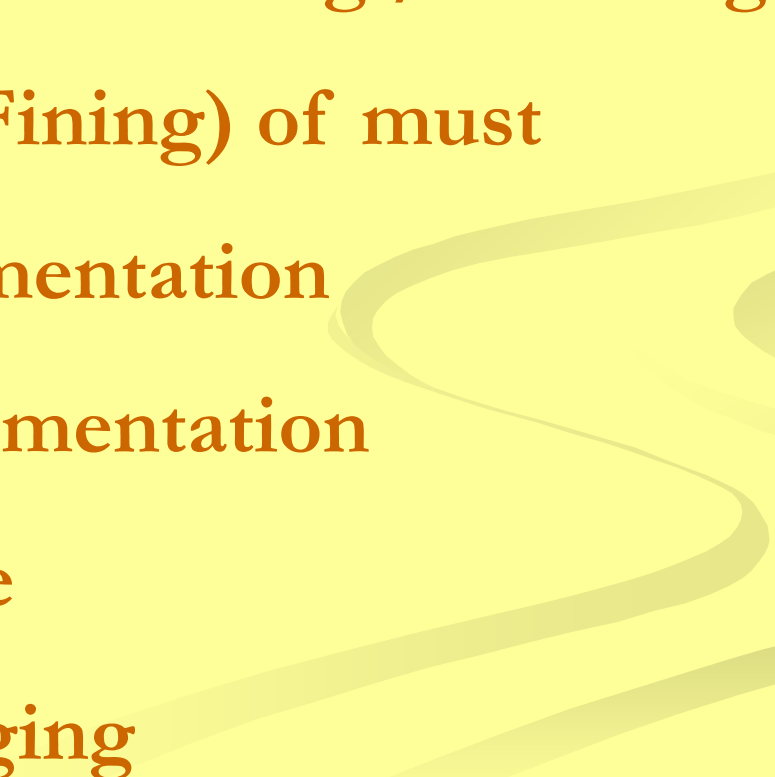
# PROCESSING THE GRAPES

## “ WHITE WINEMAKING “

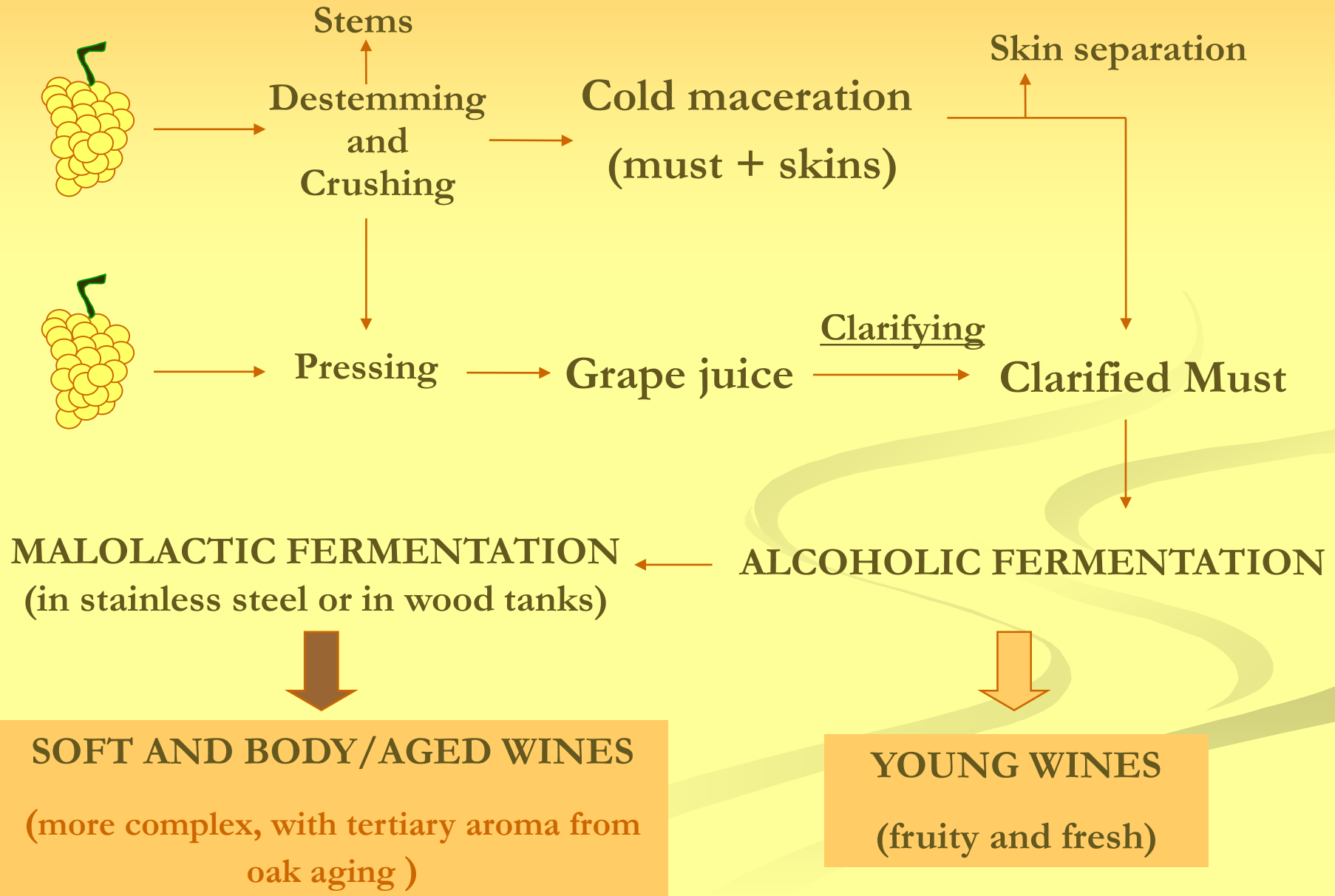
Milena Lambri

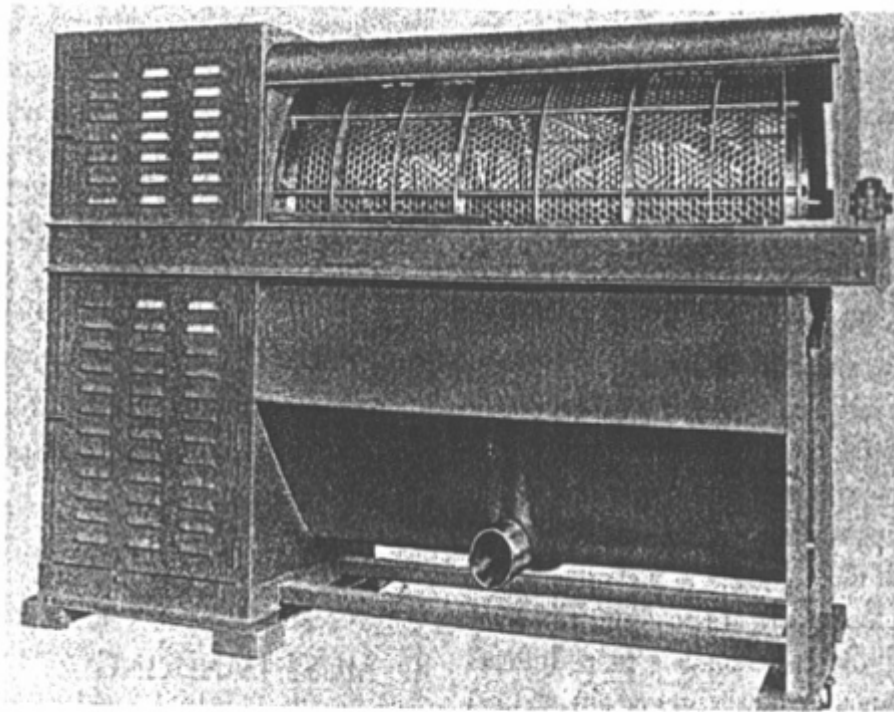
Enology Area - DiSTAS Department for Sustainable Food Process  
Università Cattolica del Sacro Cuore - Piacenza

# The Basic Steps of White Wine Production

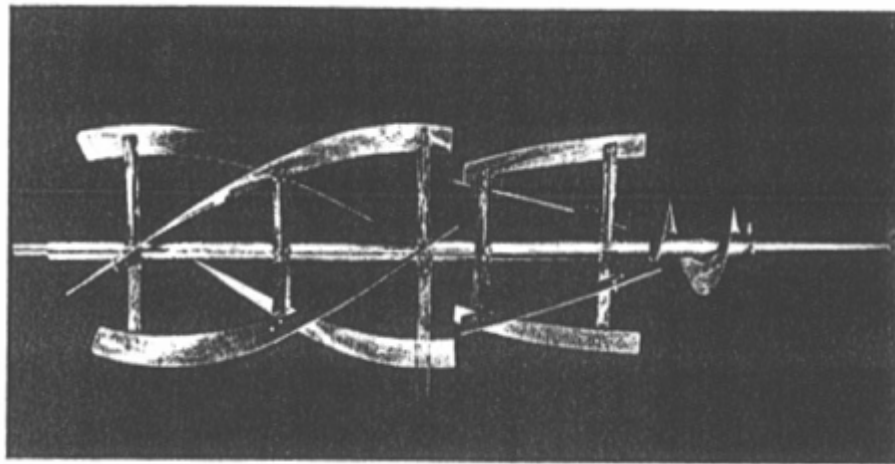
1. Destemming – Crushing / Pressing
  2. Clarifying (+ Fining) of must
  3. Alcoholic Fermentation
  4. Malolactic Fermentation
  5. Fining of wine
  6. Storing and Aging
- 
- Decorative wavy lines in shades of green and yellow on the right side of the slide.

# White wines production





(a)



(b)

# Destemming

Initial operation which usually occurs in white winemaking to remove stems giving an herbaceous character and adding phenolics to the further wine.

# Crushing

Immediately after destemming, the same machine crushes the berries and produces the grape juice composed of must (liquid fraction) skins and seeds.





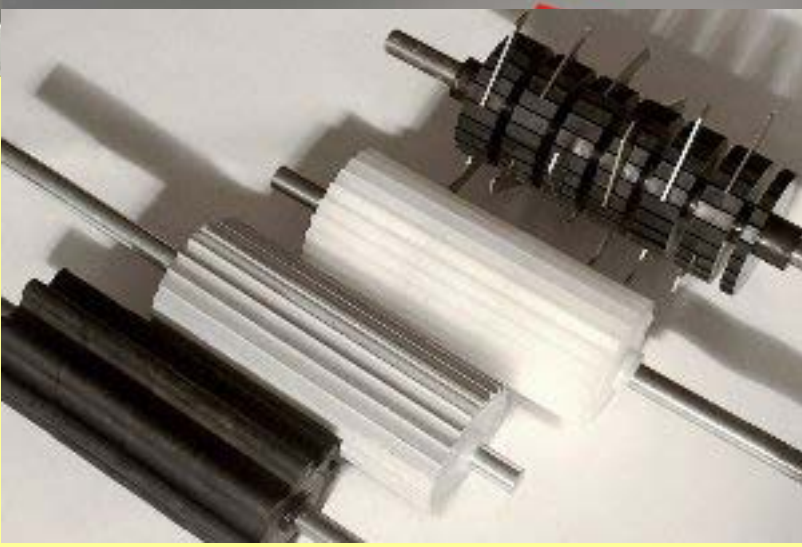
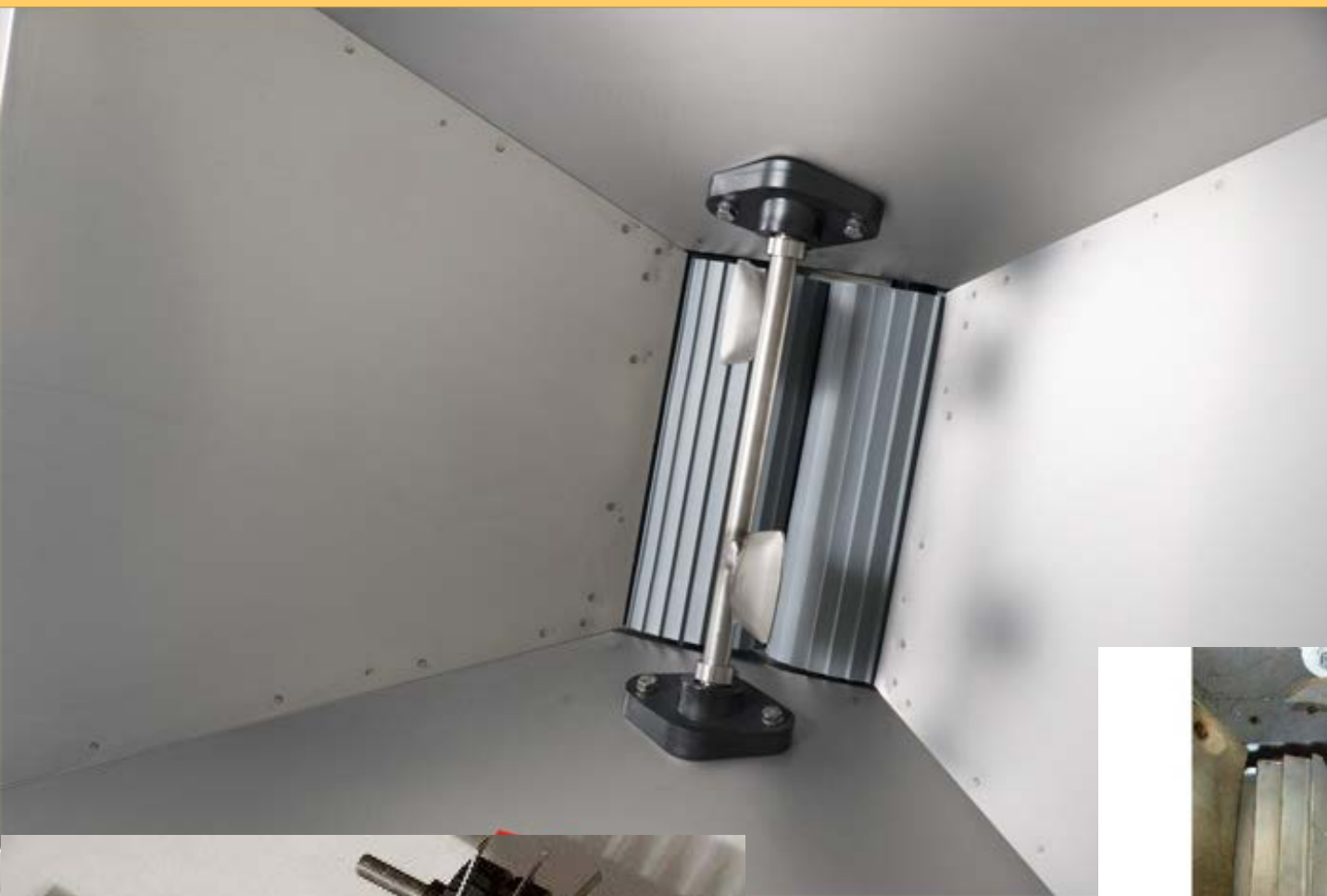








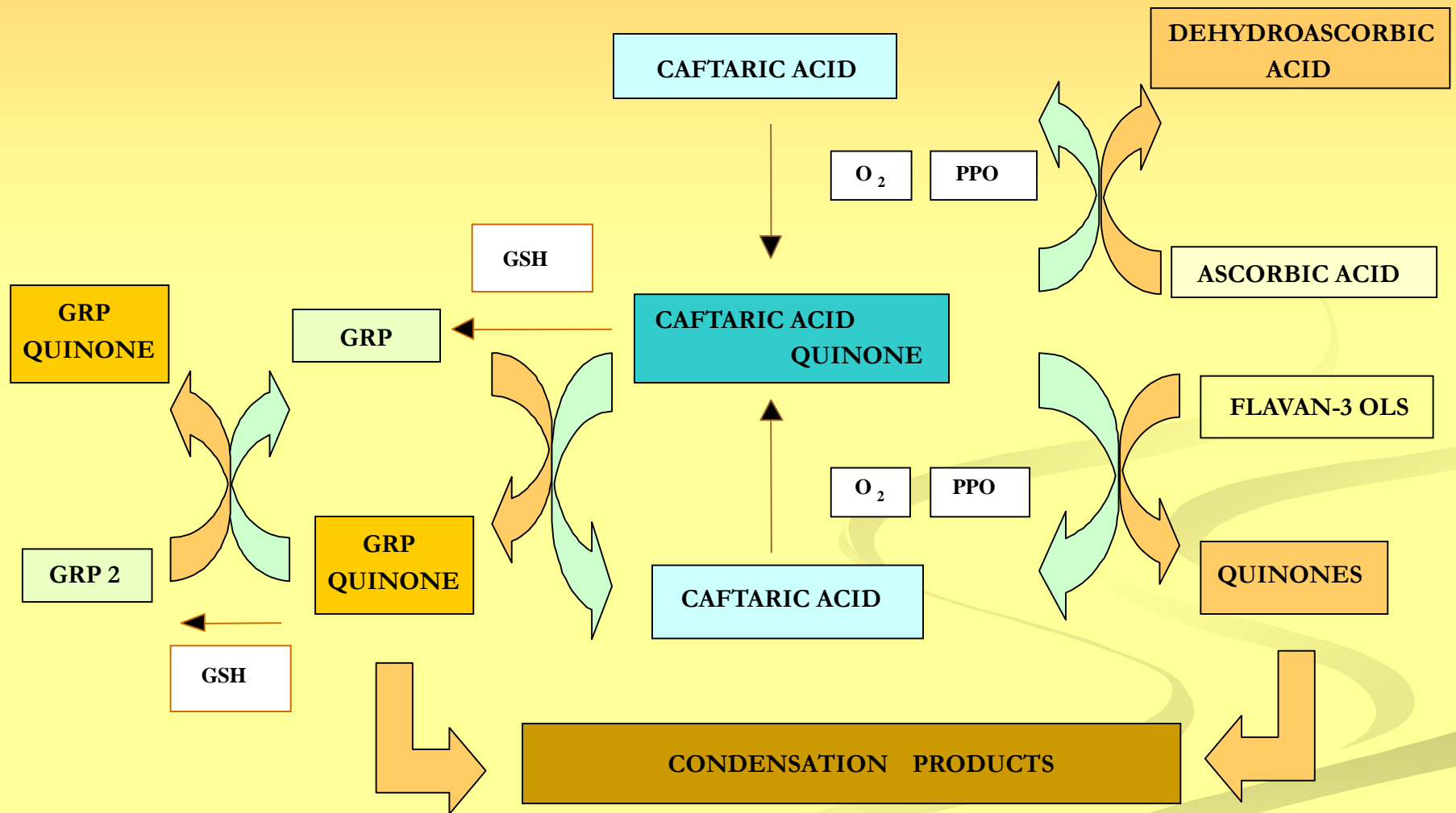




# Cold maceration technique

- White grape juice with skins and seeds can be transferred into a cooled tank or is cooled by an heat exchanger. The temperature must be reduced to a value of about 8-10° C.
- A brief contact period between juice and skins permits the release of primary aroma compounds and of flavor precursors.
- Low temperature and short time contact allow to limit oxydase enzyme action and release of phenolic substances.

# Auto-catalytic oxidation mechanism

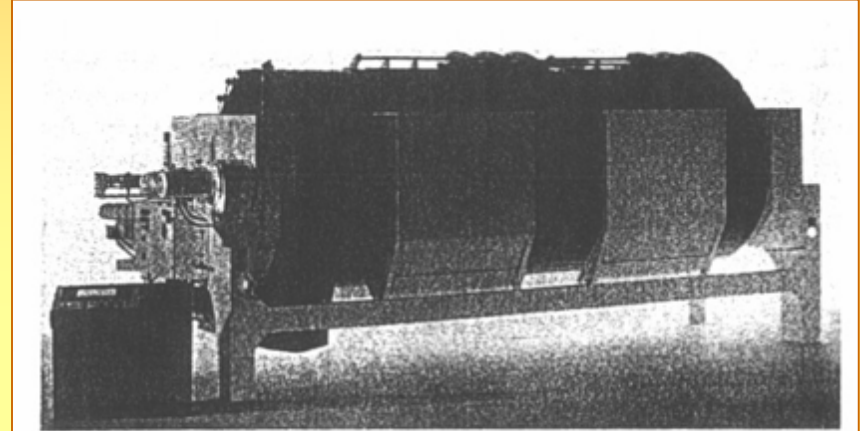


# Pressing

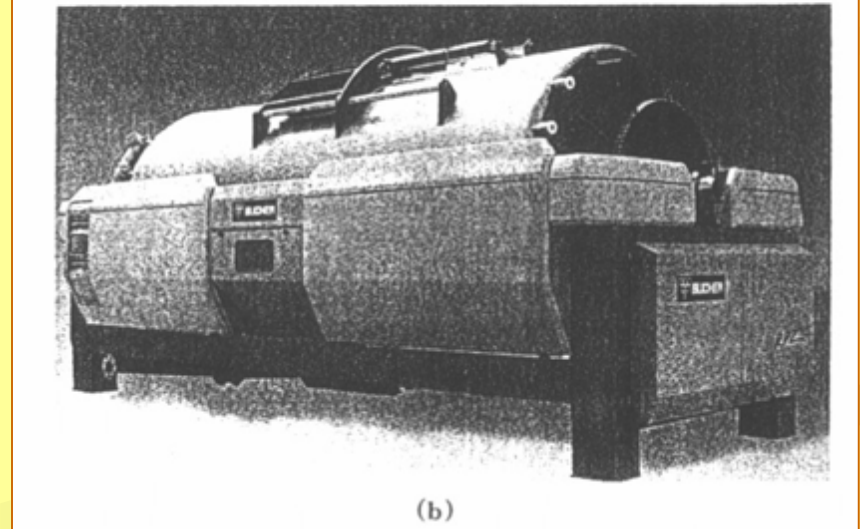
To separate juice from skins and seeds, it's possible to press the entire cluster or the crushed grapes. The material must be gently pressed at low values of pressure ( $< 0.2$  bar).

One of the better press designs is composed of a large air filled rubber tube inside a stainless steel shell.

As air is pumped into the rubber tube, the skins are compressed and the liquid is expelled.

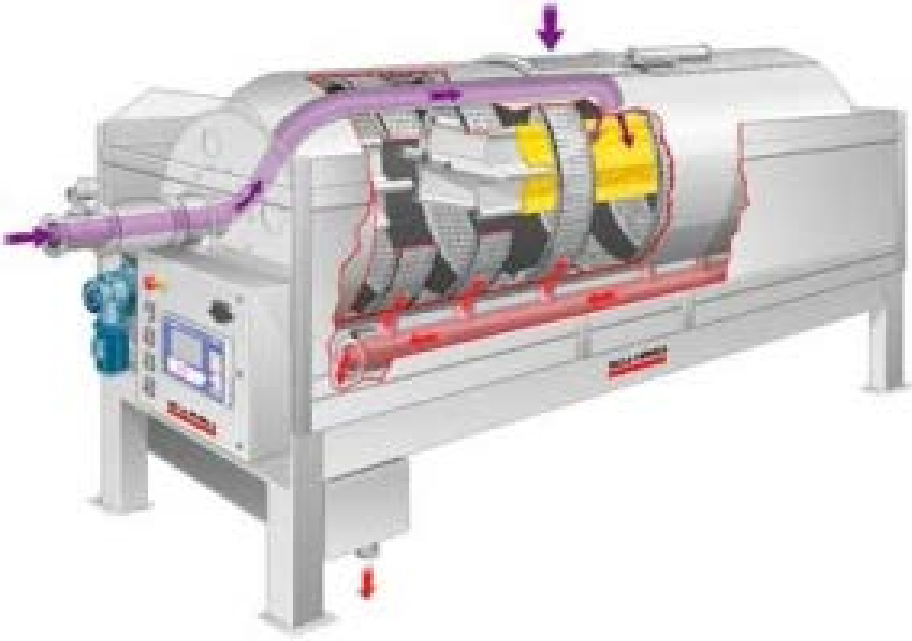


(a)



(b)





# Clarifying white grape juices



**SUBTRACTIVE TECHNIQUE**

**REMOVAL OF SOLID PARTICLES**

# Fining white wines and musts



**SUBTRACTIVE TECHNIQUE**

**REMOVAL OF SOLUBLE, BUT NOT STABLE MOLECULES**

**ADDITIVE TECHNIQUE**

**NOT STABLE MOLECULES BECOME SOLUBLE**

# Clarifying white grape juices

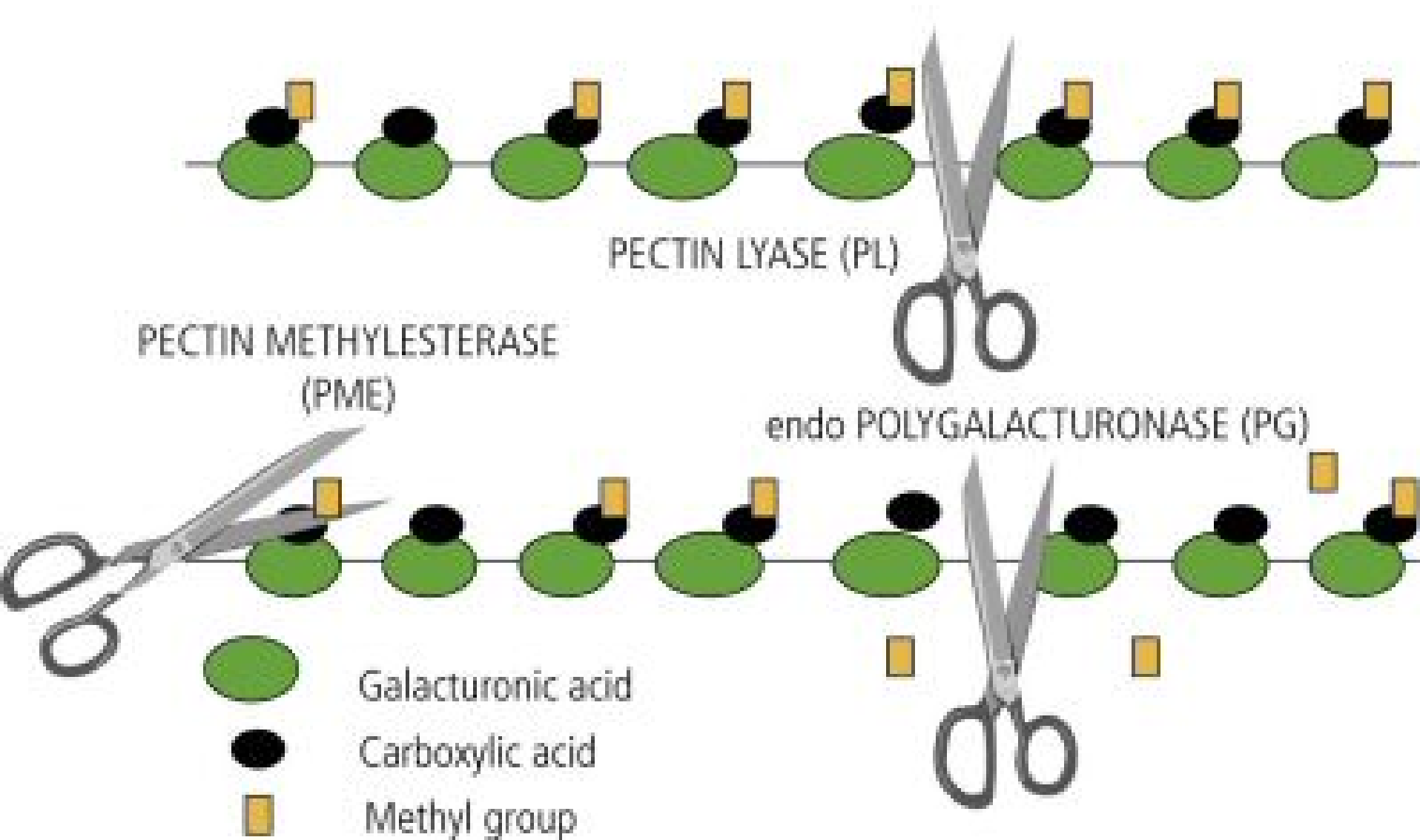
## Static clarifying (sedimentation)

- by Natural settling
- by Chemical adjuvants
- by Enzymes

## Dynamic clarifying

- by Flotation
- by Filtration
- by Centrifugation

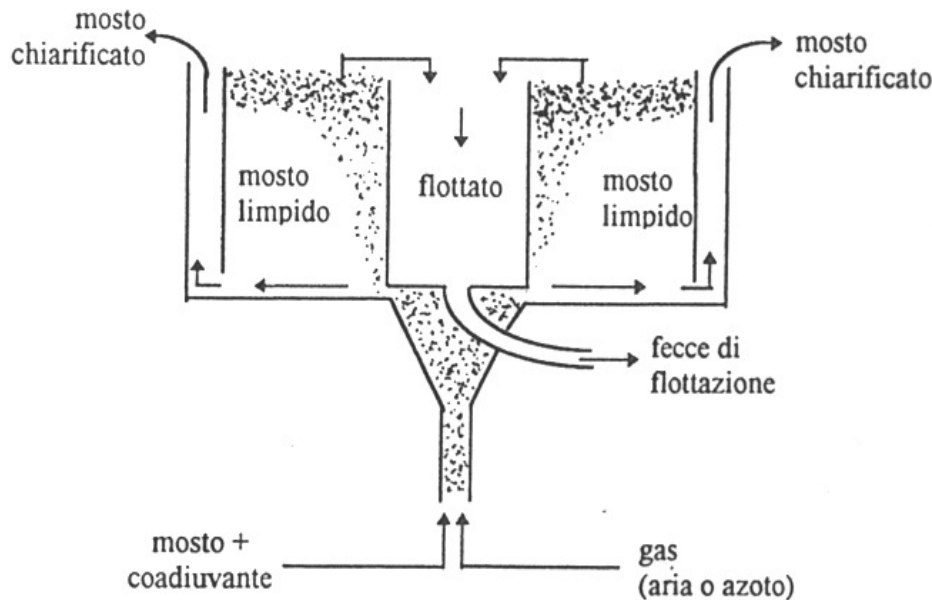
# MODE OF ACTION OF THE MAIN PECTOLITIC ENZYMES





# Dynamic solid-liquid separation

## Flotation



- Fine gas bubbles, usually nitrogen, are introduced into a static or moving juice.

- Much of the suspended solid becomes attached to the bubbles and so they float upwards toward the surface where it can be collected.

- Both batch and continuous approaches are possible.

- Juice contains 6-12% by volume of solids.
- At the end a recovery of about 85% solids occurs.

# Dynamic solid-liquid separation

## Rotary drum vacuum filter

Diatomaceous earths mixed with the juice to clarify are commonly used.

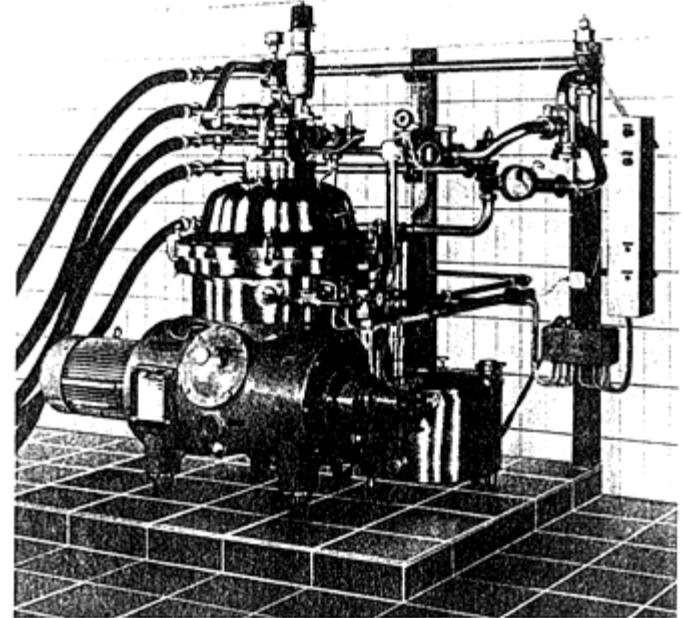


- A rotary drum is maintained under vacuum. It rotates into a vessel where there is the juice mixed with the earths.
- The outer layer of the drum is a thin stainless steel net. Thanks to the vacuum the mixture juice + earths sticks onto the drum.
- The earths remain attached to the net and the juice passes across them.

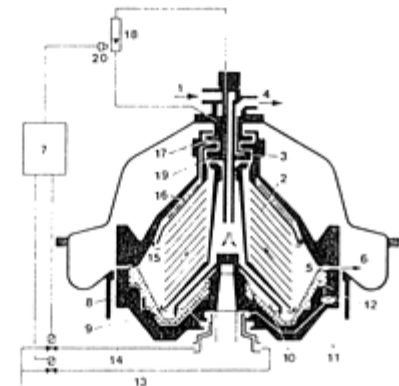
# Dynamic solid-liquid separation

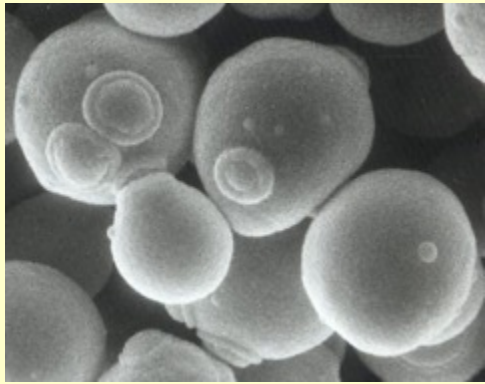
## Disc centrifuges

- Used to clarify juice of solids less than 4% by volume.
- The centrifuge consists of a stack of truncated cones which are mounted in the centre on a spindle.
- The spindle is hollow and allows the feed stream to enter from the top and then to be distributed at the base of the centrifuge bowl.
- The entire bowl, outer wall, and disc stack are rotated at high speeds producing outward radial forces on particles  $>10,000$  times that of gravity.



(a)





# ALCOHOLIC FERMENTATION

*Saccharomyces cerevisiae* INDIGENOUS OR SELECTED STRAINS



$$\frac{1 \text{ g sugar (glucose or fructose)}}{100 \text{ ml must}} = \frac{0,6 \text{ ml ethanol}}{100 \text{ ml wine}}$$

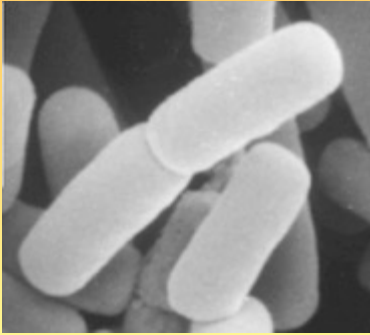
*Secondary metabolites*

acetic acid, acetaldehyde, aroma compounds (higher alcohols, esters)

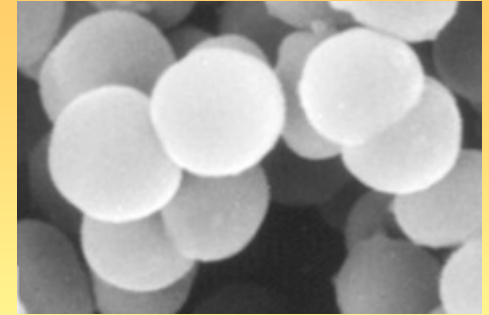


# Yeast and white wines production

- Generally for the production of a quality white wine temperature should be maintained low, in the range 12 – 20 ° C. This fact leads to the formation of secondary metabolites, such as pyruvic acid, acetaldehyde and acetic acid.
- At low temperatures, in relatively clarified juices, yeasts go more rapidly toward “stress conditions”. Therefore they need to find growing factors and nutritional compounds in the juice.
- Ammonia compounds, amino acids, vitamins (B12) are usually added in the second part of the fermentation. From this moment of fermentation ethanol becomes an important inhibitor.
- The yeast strain has to conduct a “clean” fermentation, not to produce any negative characters detracting from wine quality.
- With protection from air, at low temperature, in clarified juice, a special fruit aroma reminiscent of juicy fruit chewing gum is found. This is a very attractive odour in young white wines, but it is very unstable and disappears rapidly at room temperature. It is due to volatile esters.

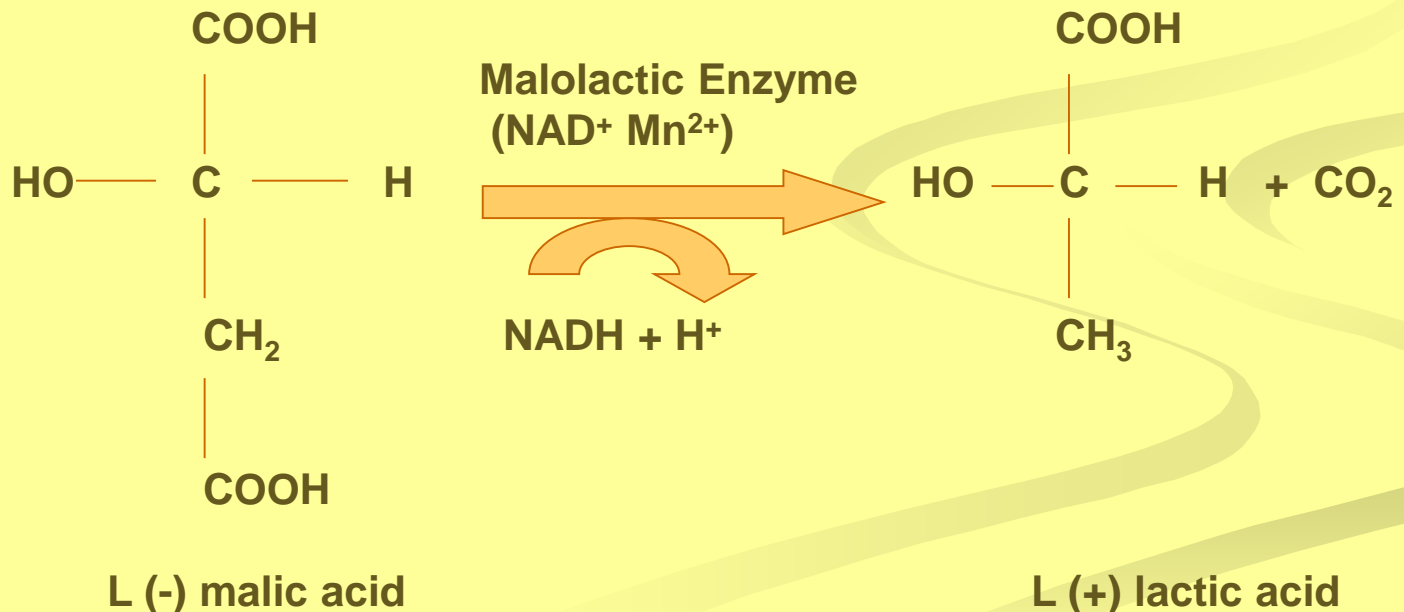


# MALOLACTIC FERMENTATION



*LACTIC ACID BACTERIA* (*Lactobacillus* spp., *Oenococcus oeni*)

*INDIGENOUS OR SELECTED STRAINS*



# The Malo-Lactic Fermentation

- After alcoholic fermentation, the enzymatic conversion of malic to lactic acid and CO<sub>2</sub> in white wine by lactic acid bacteria can occur. (In steel or in wood tanks).
- Traditional occurrence in wines during barrel aging in some regions for reasons of acidity adjustment. In other regions it is considered undesirable when fruit character is a major attribute of the wine style.
- Generally it is not encouraged in varietal wines (Sauvignon blanc) and in terpene cultivars (Gewurtztraminer, Muscats). It can be avoided by SO<sub>2</sub> / lysozyme addition.
- At now for many white wines (f.e. Chardonnay) the malolactic fermentation (in wood) is sought for reasons of flavor and mouth feel rather than for reasons of deacidification.

# Fining white wines



Gaining stability (mainly proteic / colloidal)

## SUBTRACTIVE TECHNIQUE

REMOVAL OF SOLUBLE, BUT NOT STABLE  
MOLECULES

## ADDITIVE TECHNIQUE

NOT STABLE MOLECULES BECOME SOLUBLE





Tartrate / Salts / Cristalline  
precipitations with inclusions



# Aging of white wines

- White wines can be stored in stainless steel tanks completely filled and sealed to keep out oxygen or they can be kept in oak barrel, tonneaux or barrique.
- Aging for months in wood induces desirable changes in the body and flavor of the wines, giving them the characteristic tertiary aroma.
- Oxygen permeation throughout wood favors some phenomena:
  - ✓ color evolution toward deep yellow tone
  - ✓ increasing in mouth feel and in body
- Tertiary aroma and color evolution are affected from:
  - ✓ type of wood
  - ✓ seasoning procedure of wood
  - ✓ toasting level of barrique or tonneaux





# Aging programs and white wine style

- Program of maturation and aging chosen for a particular wine depends on the type of wine, the style within that type, the price category and the marketing approach.
- Stylish differences that distinguish one producer from another may exist within each type or class of wines. For example vintage-dated Sauvignon blanc could emphasize the grape aroma, the fresh and the fruitiness (pic-nic style) and oak-matured complexity on the “dinner” extreme of style.
- Wines made for rapid marketing and consumption not only have relatively little aging, but also might not respond well to aging for various reasons. Conversely, some wines made to be matured and aged would not show well if tasted too young.

**Table 2** Wine chemical analysis.

	<b>pH</b>	<b>Alcohol (% v/v)</b>	<b>Total nitrogen (mg/L)</b>	<b>Total proteins (mg/L)</b>
Chardonnay A	3.30 ± 0.02 <sup>a</sup>	11.00 ± 0.10	340 ± 18.7	41.5 ± 8.3
Chardonnay B	3.60 ± 0.03	14.20 ± 0.20	2700 ± 176	318.6 ± 70.1

<sup>a</sup>Values are means ± SD (n = 3).

## A: YOUNG CHARDONNAY

**Table 4** Odor-active compounds

<b>Compound</b>	<b>Control A</b>
Ethyl butyrate (µg/L)	3798 ± 228 a <sup>a</sup>
Ethyl hexanoate (µg/L)	777 ± 62 a
Ethyl octanoate (µg/L)	114 ± 6 a
Isomyl acetate (µg/L)	2975 ± 208 a
Phenylethyl acetate (µg/L)	812 ± 41 a
β-Phenylethanol (µg/L)	9595 ± 576 a
1-Hexanol (µg/L)	3362 ± 168 a
Hexanoic acid (µg/L)	92 ± 8 a
Octanoic acid (µg/L)	1547 ± 155 a

<sup>a</sup>Values are means ± SD (n = 6). Within each

## B: AGED CHARDONNAY ONTO LEES

**Table 5** Odor-active compounds

<b>Compound</b>	<b>Control B</b>
Ethyl butyrate (µg/L)	4145 ± 497 a <sup>a</sup>
Ethyl hexanoate (µg/L)	1199 ± 96 a
Ethyl octanoate (µg/L)	232 ± 23 a
Isomyl acetate (µg/L)	4428 ± 399 a
Phenylethyl acetate (µg/L)	157 ± 14 a
β-Phenylethanol (µg/L)	2082 ± 187 a
1-Hexanol (µg/L)	77 ± 6 a
Hexanoic acid (µg/L)	33 ± 3 a
Octanoic acid (µg/L)	730 ± 73 a

<sup>a</sup>Values are means ± SD (n = 6). Within each



# Effect of Bentonite Fining on Odor-Active Compounds in Two Different White Wine Styles

Milena Lambri,<sup>1\*</sup> Roberta Dordoni,<sup>2</sup> Angela Silva,<sup>3</sup> and Dante Marco De Faveri<sup>4</sup>

**Abstract:** Bentonite fining is commonly used in the wine industry as a clarifying technique to remove proteins that are a potential source of haze in wines. Because of mutual flocculation with positively charged hydrocolloids and adsorption, bentonite interacts not only with proteins, but also with other molecules. Aroma depletion during fining is generally observed as a secondary, nonspecific effect of bentonite, but mechanisms and occurrence in white wines are not clear. The effect of fining on odor-active compounds of two white wines was examined using three samples of sodium bentonite applied at three different concentrations. Two Chardonnay wines were produced with different winemaking processes to obtain two wine styles. The period of aging on lees was adjusted to produce two different protein contents. Bentonite dose, bentonite sample, and wine style significantly affected the percent reduction of some odor-active white wine compounds during bentonite fining. Most of these volatiles were indirectly removed via deproteinization, as they can be fixed to macromolecules by weak bonds, and only a few odor-active molecules were directly removed by bentonite through adsorption. Moreover, low adsorbent amounts, useful to stabilize wine, did not significantly affect the concentration of the most odorous substances. Results suggested that the chemical nature, the hydrophobicity, initial concentration of wine odor-active compounds, and the abundance and nature of wine proteins are the “matrix factors” modulating the removal of wine odor-active compounds during bentonite fining.

**Key words:** bentonite, fining, wine proteins, wine aroma compounds