What sensors development to favor in order to reach the goals regarding monitoring of the quality ?

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The case of wine processes : from the harvest ... to the bottle.

Revaluation of winemaking technological steps according to the associated risks and the relevant missing data / aims:

- Mechanical harvesting / transport of the grape harvest
- Mechanical extraction of the grapes (white and rosé winemaking)
- Maceration in whole bunches or after thermo-treatment (red winemaking)
- Malolactic fermentation
- Conservation and aging of wines
- Conditioning

White/rosé winemaking

Red winemaking

Heterogeneous phase (measurement of solid / liquid)

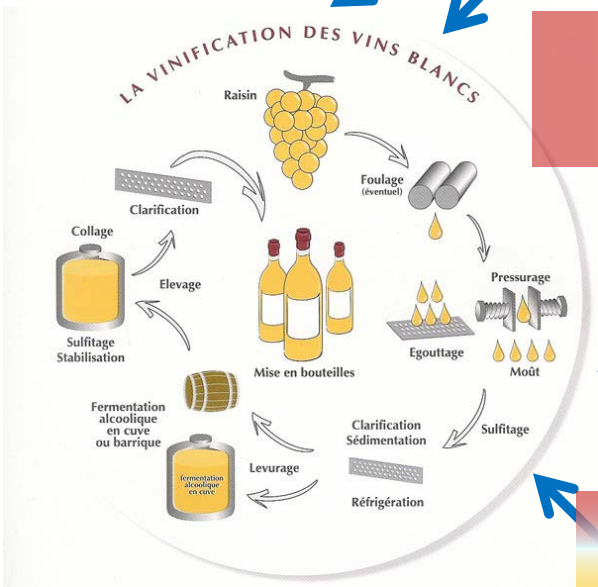
Oxidation from the harvest to fermentation (temperature / markers)

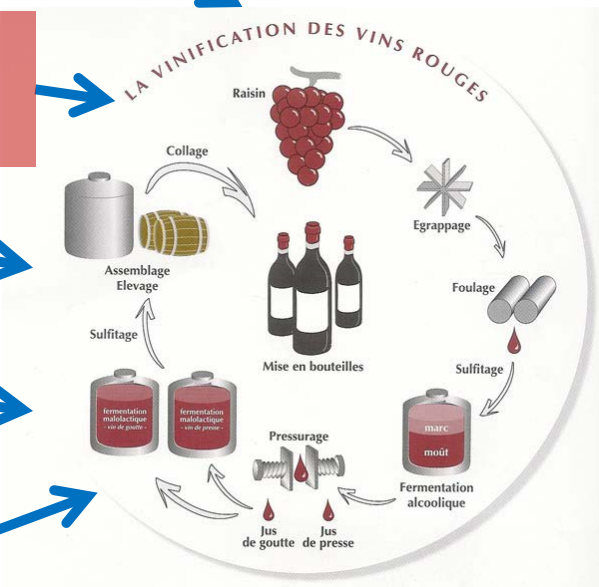
Polyphenol extraction (Color / marker compounds / astringency)

Malolactic fermentation (Ac.Lactic / Malic / $C0_2$)

Wine matururiton / ageing (Sulphites / volatile acidity)

Conditioning (Oxygen / carbon dioxide / sulphites)








Mechanical harvesting and transporting the harvest

Ratio Solids / Liquid
= f (maturity, distance, equipment,…)

↓

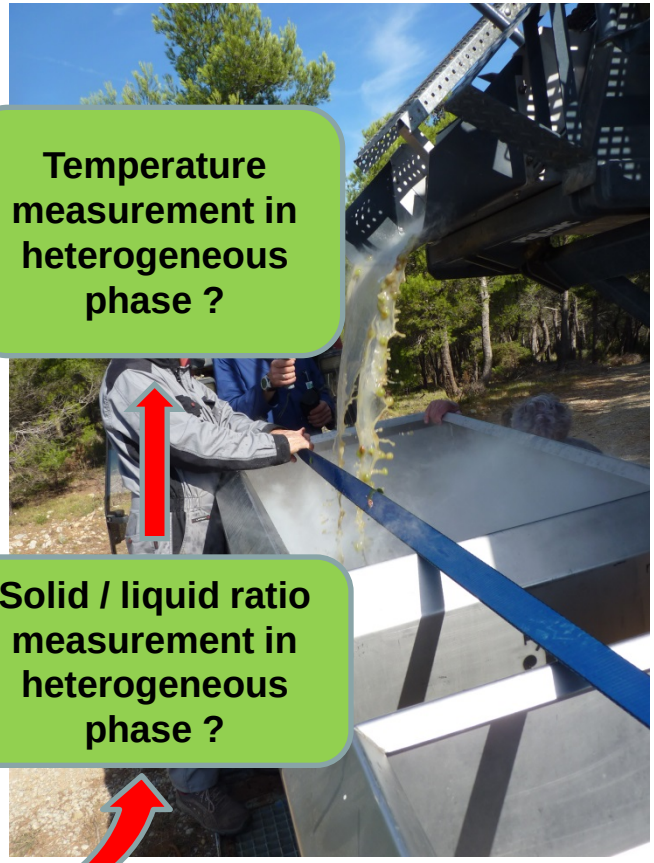
Heterogeneous phase
(measurement of solid / liquid ratio)

↓

Differential oxidation extents between Solid and Liquid phases

↓

Differential protection to reason



Mechanical extraction of the harvest (White and rosé winemaking)

Mass flow measurement in solid / Liquid heterogeneous phase ?

Color measurement in heterogeneous phase ?

On line monitoring and control of extraction !

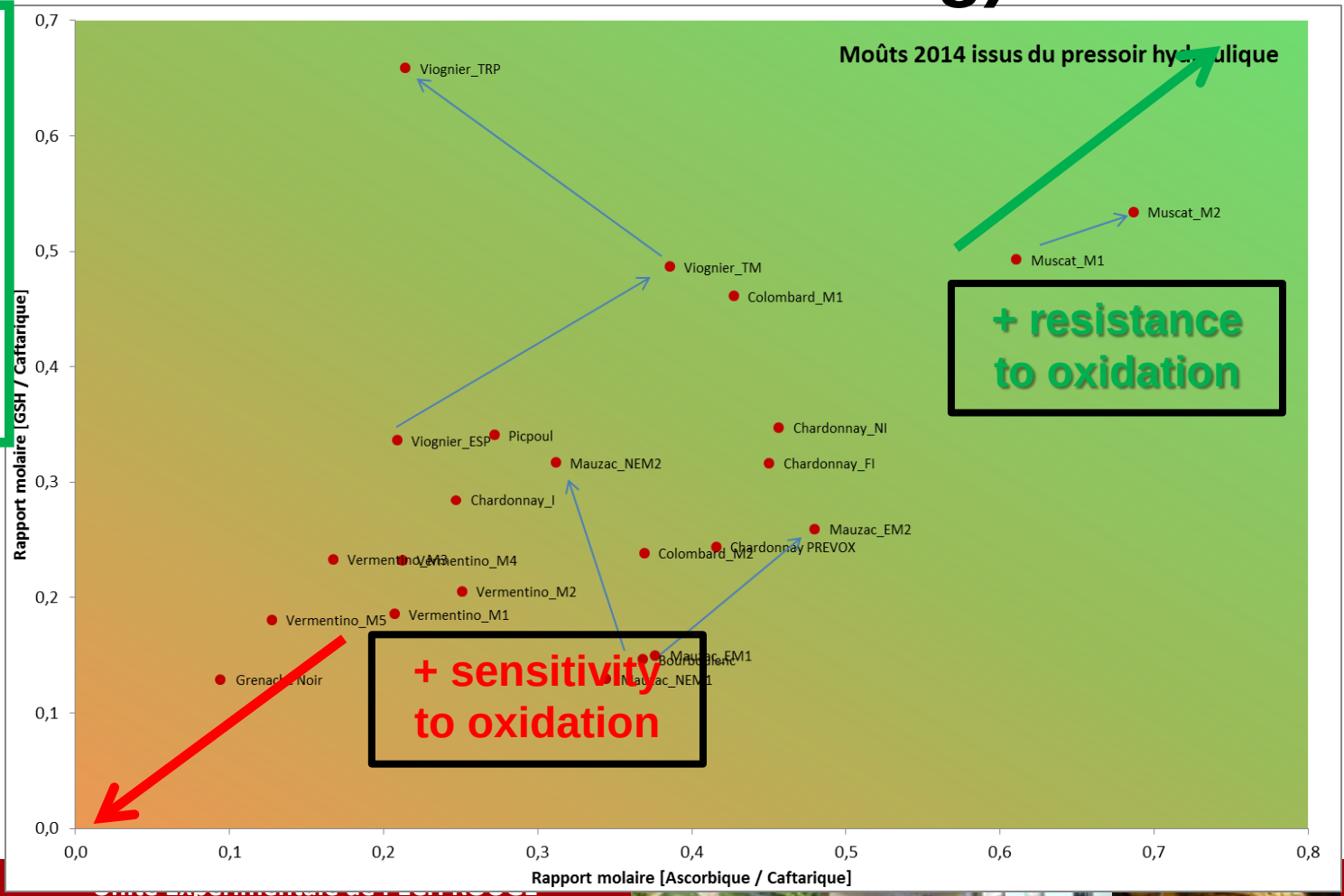
Mechanical extraction of the harvest (White and rosé winemaking)

Knowledge of the natural variability of the anti-oxidant contents of grape

=

Fine tuning of artificial anti-oxidant addition

Fast measurement of ascorbic ac. / GSH / caftaric ac. contents in musts / grapes ?



Mechanical extraction of the harvest (must racking efficiency vs oxidation)

Variétés (date, origine)	Activité totale PPO (nkat)	Répartition	
		Soluble	Particulaire
Bourboulenc (08/10/2013, UEPR parcelle 68)	842	74,5%	25,5%
Bourboulenc (22/09/2014, UEPR parcelle 68)	739	79,2%	20,8%
Chardonnay (30/08/2013, UEPR parcelle 81)	821	84,2%	15,8%
Chardonnay (26/08/2014, UEPR parcelle 81)	726	43,8%	56,2%
Chardonnay-FI * (25/08/2014, UEPR parcelle 81)	759	65,7%	34,3%
Chardonnay-I * (25/08/2014, UEPR parcelle 81)	701	87,0%	13,0%
Chardonnay-NI * (25/08/2014, UEPR parcelle 81)	744	58,2%	41,8%
Grenache blanc (17/09/2013, UEPR parcelle 75)	834	10,7%	89,3%
Grenache gris (17/09/2013, UEPR parcelle 71)	693	10,8%	89,2%
Grenache noir (18/09/2013, UEPR parcelle 64)	799	26,3%	73,7%
Grenache noir (19/08/2014, UEPR parcelle 64)	574	20,9%	79,1%
Maccabeu (17/09/2013, UEPR parcelle 66)	802	97,6%	2,4%
Mauzac-E-M1* (23/09/2014, Limoux parcelle A)	761	45,2%	54,8%
Mauzac-E-M2* (02/10/2014, Limoux parcelle A)	732	28,8%	71,2%
Mauzac-NE-M1* (23/09/2014, Limoux parcelle A)	677	97,6%	2,4%
Mauzac-NE-M2* (02/10/2014, Limoux parcelle A)	740	69,5%	30,5%
Muscat (25/09/2013, UEPR parcelle 98)	773	25,4%	74,6%
Muscat (25/09/2013, UEPR parcelle 91)	781	96,7%	3,3%
Muscat-M1* (01/09/2014, UEPR parcelle 51)	797	64,9%	35,1%
Muscat-M2* (10/09/2014, UEPR parcelle 51)	682	52,1%	47,9%
Piquepoul (12/09/2014, UEPR parcelle 8)	726	44,9%	55,1%
Roussanne (17/09/2013, UEPR parcelle 68)	866	64,5%	35,5%
Sauvignon (09/09/2013, UEPR parcelle 10)	795	31,6%	68,4%
Syrah (19/09/2013, UEPR parcelle 22)	802	74,3%	25,7%

Non soluble PPO accounts for 3 to 98 % of total PPO activity

The ratio between soluble and particulate PPO activities affect the **effectiveness of racking operations without or little SO_2 addition**

Fast measurement of the distribution of PPO activities once extraction is realized ?

Maceration in whole bunches or after heat treatment (Red winemaking)

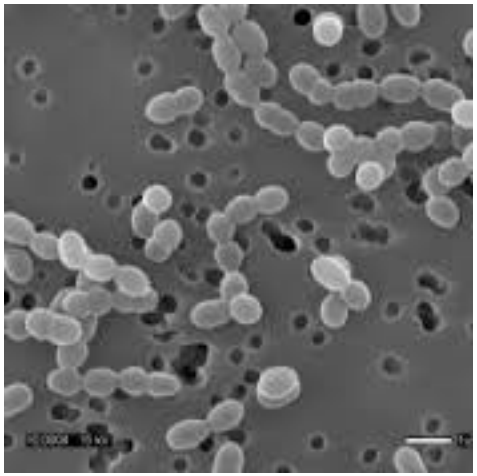
Online measurement of polyphenols (Tannins and coloring matter) ?

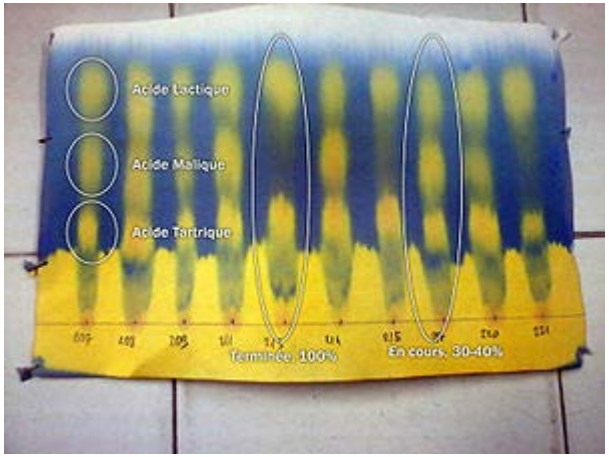
Racking and pumping

On line monitoring and control of extraction!

and extent.

Malolactic fermentation

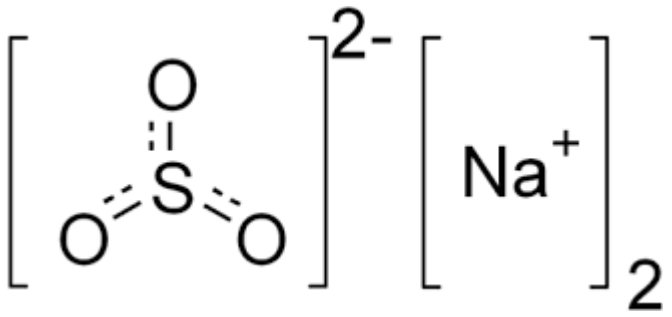




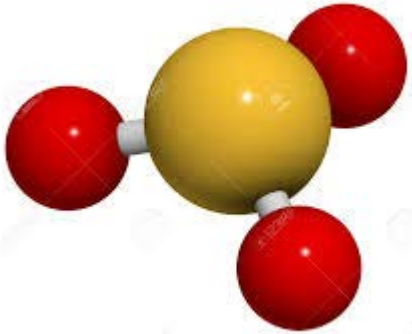
Fast online measurement of the progress of this fermentation ?

Conservation and aging of wines

Volatile acidity



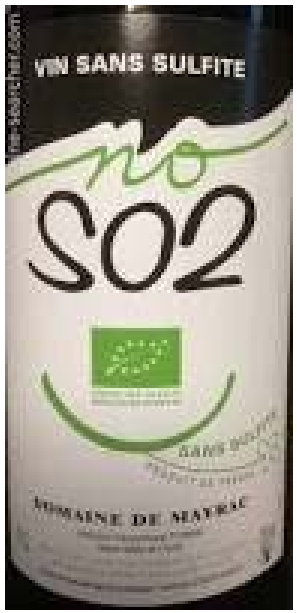
<u>Non-invasive</u> measurement of these parameters ?



Free SO_2 contents

Wine conditioning

Free SO_2 levels



Non-invasive measurement of these parameters ?

Dissolved CO_2 (freshness of white and rosés wines)

- ***Needs for sensors, modeling and control (minimum specifications):***

- Online measurement of the **amount of liquid** generated during the transport of grape berries.
- **Temperature** measurement in these **heterogeneous masses** in the **presence of high water vapor and carbon dioxide**.
- On line measuring of **mass flows** of harvest (**heterogeneous liquid / solid phase**) in the intake pipes.
- Assessment of several **grape metabolites before oxidation occurs**.
- **Color tracking** (absorbance) at various wavelengths on a very **heterogeneous phase**.
- Online tracking of **malolactic fermentation** (homogeneous liquid phase).
- Monitoring the amount of **free sulphit**e in wine (above 15 mg / L) and / or of **volatile acidity**.
- Online measurement of **dissolved carbon dioxide** in the wine (contents between 0 and 1 g / L).




Enology of the future or the future of enology ?

Thanks for your attention !

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