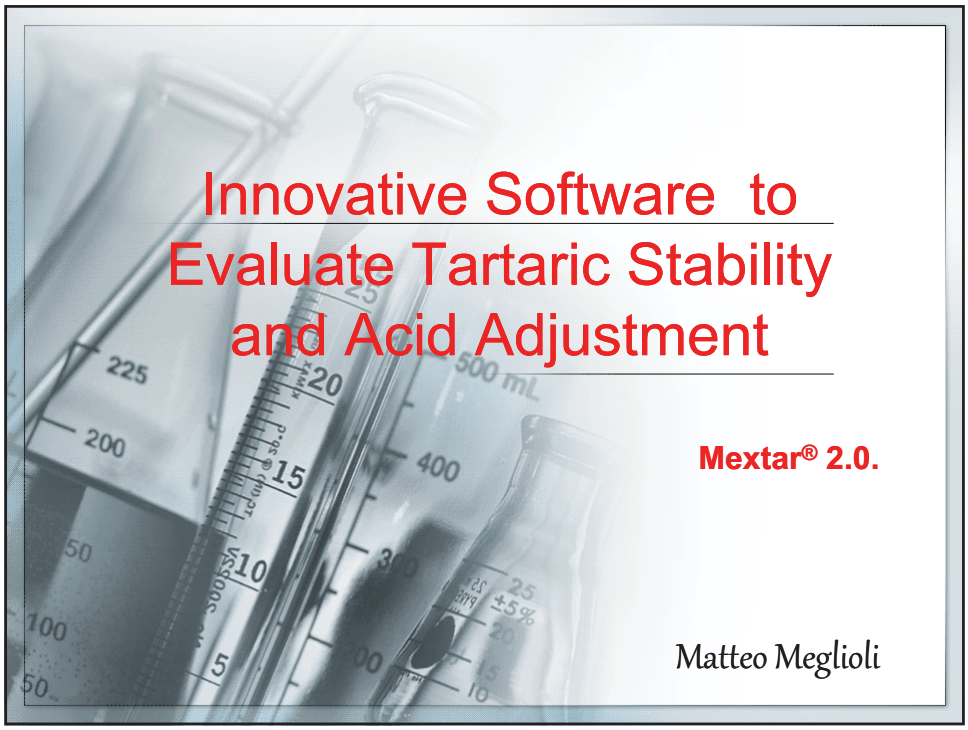


ACIDITY: Some References

- **Total Acidity** (= titratable acidity)

➔ Definition from OIV-CEE "summation of titratable acids"

- **pH**

negative decimal logarithm of the hydrogen ion activity in a solution.

pH = - log [H^+]; therefore [H^+] = 10^{-pH}

More precisely, **"activity" of ion H+** (= H^+), measured from the pHmeter:

pH = - log a[H^+]; therefore H^+ = m[H^+] •γ H^+

m H^+ = molality = concentration /molecular weight (mol /kg)

- **Buffer Capacity**

Variation of the pH after the addition of strong acid or base

Buffer Capacity = Total Acidity variation/ pH variation

Very important factor for the perception of the acidity

EFFECTS OF THE ACIDITY

High total acidity ⇔ low pH:

- Slows down microbiological activity
- Increases SO2 activity **-0,1 pH ➔ + 20% ACTIVE SO_2**
- Inhibits the alcholic fermentation
- Interacts with Anthocyanins

The ACIDITY is an essential constituent of the wine structure.

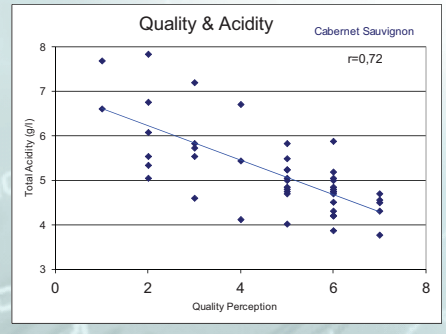
- Weak ➔ morbid, soft,
- Sharp ➔ crisp, aggressive

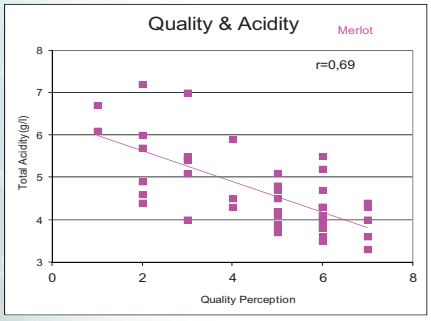
- **Red Wine** ⇔ the equilibrium of the flavor is fundamental:

  Sweet ⇔ Acid + Bitter **Alcohol ⇔ Acidity + Tannin**

  White Wine less complex, sugar has an important role

QUALITY vs ACIDITY





ORGANIC ACIDS STATUS

- **Partial ionizations:**
  - Constants of dissociation
  - pH of the solution
- Ex. :Tartaric Acid (to simplify H2T)

$$H2T \overset{K1}{\Leftrightarrow} HT^- + H^+$$

$$HT^- \overset{K2}{\Leftrightarrow} T^{--} + H^+$$

- Therefore there are few forms : H2T, HT^-, T^{--}
- **The Total Acidity is** :

AT = (2 H2T+HT^-) at pH of wine or (2 H2T+HT^-) at pH 7

Together with the salify forms

(2 T^{--}+ HT^-) = total of cations (K, Ca…)

EVOLUTION OF THE ACIDITY

- **Generally :**

Acidity of Must > Acidity of Wine

- **Often :**

Acidity of Must low < Acidity of Wine

➔ How to PREDICT ?

ORGANIC ACID EVOLUTION

Malic Acid

Alcoholic Fermentation ➔ 10 to 30%

- **d (H_2M) = - (H_2M (g/l) • a/100 • 1/134 • 1000** (mmol/l)

Ex. H_2M = 5 g/l; **a** = 20%; d (H_2M)

- = - (5 • 20/100) • 1/134 • 1000 = - 7,5 mmol/l

Malolactic Fermentation ➔ - 100% ➔ Lactic Acid

- **d (H_2M) = - H_2M • 1/134 • 1000** (mmol/l)

ORGANIC ACID EVOLUTION

Lactic Acid

Alcoholic Fermentation ➔ 10 to 300 mg/l of lactic acid D^+

- **d (HLq) = from + 1 to 3** (mmol/l)

Malolactic Fermentation ➔ 1 mole Lactic Acid (L^-)

- **d (HLq) = + H_2M (g/l) /134 • 1000** (mmol/l)

Ex: H_2M = 5 g/l; d (HLq) = 5/134 • l000 = 37 mmol/l

P.S. Important quantities of Lactic Acid are produced:

- From *Yeast* on High brix must
- From *Bacteria* from lack of hygiene

ORGANIC ACID EVOLUTION

Acetic Acid

Alcoholic Fermentation ➔

- **d (HAc) = +4 + (TAV - 10) • 2** (mmol/l)

Succinic Acid

Alcoholic Fermentation ➔ 200-600 mg/l, depends on TVA

- **dHSu = da + 2 + a 4** (mmol/l)

Citric Acid

Must ➔ 200-500 mg/l **1 a 2,5** mmol/l
FA ➔ alcohol 0
FML ➔ - 10 -20% a -100% **d (HCq) = da - 0,1 a - 0,5** mmol/l

MANAGEMENT OF PH AND TA

- **WHAT TO DO?!**

➔ Correction of the TA ?

If YES,
Which Product ?
In which quantity ?
What are the final results? TA and pH

HOW TO CORRECT THE ACIDITY

Decrease the TA

- Hot years
- Different cepage (ex. Merlot)
- Non Culturals
- Graft : S.O.4, Fercal – They absorb more K
- Excess of fertilization
- Maturity and type of harvest
- Long maceration
- Malolactic fermentation (Red wine)
- Evolution of consumers taste (??)
- pH > 3,6 is NOT A DEFECT!

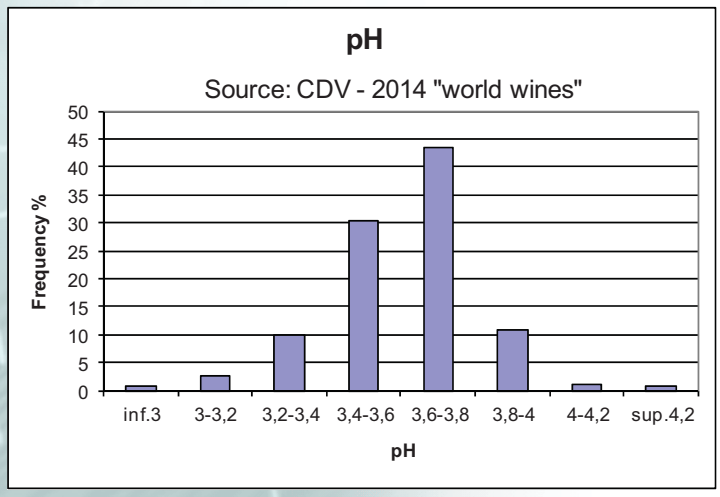
HOW TO CORRECT THE ACIDITY

Tasted Acidity ← TA, pH, Buffer Capacity, tannin…

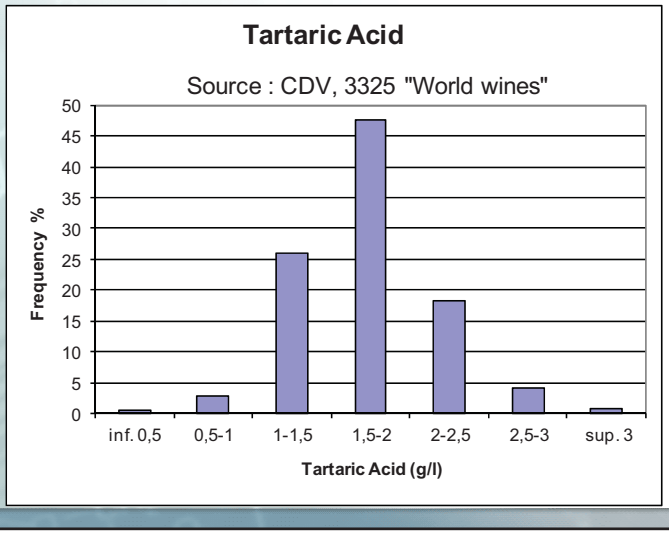
- The important acidity is the TA of the wine that will be consumed.
- TA optimal depends from wine, style, aging, year.

The *perfect* total acidity should be from a taste point of view only, without any relation to analytical results!

THE pH "world wines"



TARTARIC ACID "world wines"



ACIDITY ADJUSTMENT

MEXTAR® 2.0 simulates:

- **pH and TA, after malolactic fermentation or modification to the composition of the wine.**
- **Estimates the quantity of *deacidifier* or *acidifier* to reach the pH or TA wanted.**

ACIDITY ADJUSTMENT

- **pH and TA after crystallization:**
- **MEXTAR® 2.0 calculates the pH and TA after the crystallization of potassium and calcium salts**
- **MEXTAR® 2.0 guarantees the correct calculations of the variation, spontaneous or induced**

HOW IT WORKS
"vinico acid"

▪MEXTAR® 2.0 calulates the amount of a dummy diacid called "vinico acid" (specifics of MEXTAR®)

- It's important to consider possible analytical inaccuracy
- Not required to evaluate tartaric stabilty
- Indispensable to work with TA and pH.
- The "vinico diacid" is characterized from a pK2 = 5 (experimental value) and pK1 calculated from every wine from MEXTAR® 2.0
- The higher the quantity of "vinico acid", the less the pK1 will be, therefore the higher the analytical inaccuracy will be.

ANALYTICAL NEEDS

parameters	healthy grape	mouldy grape	white wines	red wines	sweet wines	IMPORTANCE
tartaric acid	+++	+++	+++	+++	+++	HIGH
total acidity	+++	+++	+++	+++	+++	HIGH
pH	+++	+++	+++	+++	+++	HIGH
K	+++	+++	+++	+++	+++	HIGH
Ca	(+++)	(+++)	(+++)	(+++)	(+++)	HIGH only for CaT
malic acid	+++	+++	+++	/	+++	HIGH only for MLF
citric acid	+	++	/	/	+	LOW
lactic acid	-	-	+	++	+	LOW
acetic acid	-	+	+	+	+	LOW
gluconic acid	-	(++)	-	-	(+++)	LOW
piruvic acid	-	+	+	+	+	LOW
α-chetoglutaric acid	-	+	+	+	+	LOW
succinic acid	-	-	+	+	+	LOW
SO2	-	-	+	+	+	LOW
PO4	-	+	+	+	+	LOW
Mg	+	+	+	+	+	LOW
Na	-	-	-	-	-	LOW

SOLUBILITY AND SALTS PRECIPITATION

Some references:

The concentration of KHT or CaT is expressed as :

- **Concetration**, grams for litres (g/l)
- **Molarity** number of mol for litres (in mol•l-1) variable in function of *Temperature* and *Pressure*
- **Molality** number of mol for kg (in mol•kg-1), variable in function of the *Pressure* but independent from the *Temperature*

SOLUBILITY

Quantity of KHT or CaT in solution with or without sediment.

- **Constant of Equilibrium KST** = **activity of composts in solution**
- **KST is a "constant" of the product KHT, depends on T° and TAV**
- **γ is the ionic acitivity :** inonic strength (mol/l). For wines and must γ ~40 mmol/l
- **Solubility S,** (in mmol or kg/l) of T°, TAV, others ions, pressure, calculated for each wine.

Calculation for KHT:

- **KST = γ (K^+) • γ (HT^-)** (in mole2•kg^{-2})

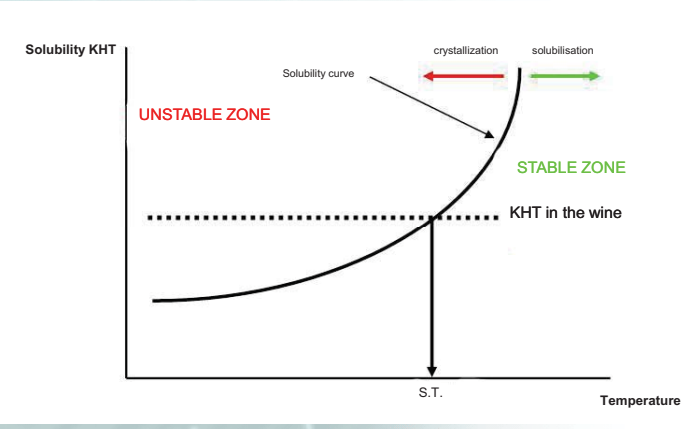
- Calculation for CaT:
  - **KST = γ (Ca^{++})• γ (T^-)** (in mole2•kg^{-2})

P.S.

- MEXTAR will also consider **chemical complex between HT^- e K^+.**

SOLUBILITY CURVE OF KHT

SIMPLE SOLUTION



TARTARIC STABILITY

KHT is at risk of precipitation?

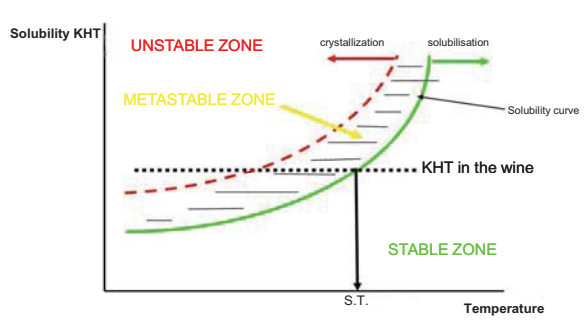
- YES, the **KHT "wine" > KHT "soluble"**

KHT "wine" activity of K^+ and HT^- on the wine

KHT "soluble" Constant of Equilibrium function of T°, TAV

TARTARIC STABILITY

WINE (COMPLEX SOLUTION)



METASTABILE ZONE

- The actual precipitation temperature < T° theoretical, because other composts are present in the solutions.
- METASTABLE ZONE, there are no deposits but high risk of precipitation.

MEXTAR® 2.0 contributes to a sustainable and Green Enology:

- Avoids unnecessary treatment
- Reduces the use of energy and products

MEXTAR® 2.0 calculates the "real" oversaturation of KHT and CaT.

(OVER)SATURATION

- **Saturation ratio R SAT** = *activity*/solubility constant (at T° fixed)

IMPORTANT :
ACTIVITY = value calculated for the wine under study
SOLUBILITY CONSTANT= THEORETICAL value, fixed T° end TAV

- **R SAT = 1** Solubility equilibrium
- **R SAT <1** **under-*saturated*** solution
- **R SAT > 1** ***over-saturated*** *solution*

- **Saturation temperature ST** = temperature (°C) where the activity of the wine equals the solubilty constant (at the evaluated temperature).

- T wine < TS ⇔ oversaturation; temperature under which the precipitation will start.

TARTARIC STABILITY

MEXTAR® 2.0 Calculates:

1. **The oversaturation of KHT and CaT.**

with ions activity and complex H2T/K and Ca

2. **Saturation Temperature of KHT and CaT**
3. **Quantity of KHT and CaT cristallizable**

MEXTAR® 2.0

- It`s an instrument of calculation and analysis, the interpretation of the results needs to be done based on enological chemistry and enological requirements.
- Used for support and quick response to technological problems.

LET`S TRY THE SOFTWARE

MEXTAR® 2.0

QUESTIONS

MEXTAR® 2.0

For more Information, Reference and Bibliography

• matteo.meglioli@mostimondiale.com