The Acidity of Hope
- pH, Potassium and TA

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Indiana Wine Grape Council

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Outline

- Juice & Wine Acids and their Salts
- *Total Acidity vs. Titratable Acidity*
- *Extent of Exchange w/Potassium*
- *pH*
- Viticultural Impact on Acidity
- *TA & pH Impact on Wine Quality/Stability*
Growing Season
Northern Hemisphere

<table>
<thead>
<tr>
<th>MONTH</th>
<th>APRIL</th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
<th>AUGUST</th>
<th>SEPT.–OCT.</th>
<th>NOV.–FEB.</th>
</tr>
</thead>
</table>

**LIFE OF THE VINE**

**GRAPEVINE PHYSIOLOGY**

<table>
<thead>
<tr>
<th>USE OF CARBOHYDRATES</th>
<th>PLANT</th>
<th>FRUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Budbreak</td>
<td>Flower Formation</td>
</tr>
<tr>
<td></td>
<td>Grand Period of Growth</td>
<td>Fruit - Bud Differentiation</td>
</tr>
<tr>
<td></td>
<td>Growth Slows</td>
<td>Storage in Roots &amp; Wood</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TITRATABLE Acidity (T.A.)
**T.A. and Extent of Exchange**

**Total Acidity**

[Total Acidity in mg Tartaric/L]

<table>
<thead>
<tr>
<th>pH</th>
<th>0</th>
<th>3.0</th>
<th>6.0</th>
<th>9.0</th>
<th>12.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>T.A. [mg Tartaric/L]</td>
<td>3.4</td>
<td>4.6</td>
<td>5.8</td>
<td>7.0</td>
<td>8.2</td>
</tr>
</tbody>
</table>

**Extent of Exchange**

- **COO^-**
- **H-**
- **HCOOH**
- **K^+**

**T.A.**

[Total Acidity in mg Tartaric/L]

<table>
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</thead>
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<td>T.A. [mg Tartaric/L]</td>
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<td>0</td>
<td>3.0</td>
<td>6.0</td>
<td>9.0</td>
</tr>
</tbody>
</table>

**Legend:**

- **COO^-**
- **H-**
- **HCOOH**
- **K^+**
Extent of Exchange and pH

\[
\text{Extent of Exchange} = \frac{\text{Tartaric}}{\text{Malic}}
\]

\[\text{Extent of Exchange} + \text{pH} = \text{pH}\]
Diurnal Berry Expansion

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Day</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>10.0 mm</td>
<td>10.5 mm</td>
</tr>
<tr>
<td>Volume</td>
<td>0.524 mL</td>
<td>0.606 mL</td>
</tr>
<tr>
<td>pH</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td>T.A.</td>
<td>10.0 g/L</td>
<td>8.6 g/L</td>
</tr>
</tbody>
</table>
Viticultural Impact on pH & T.A.

- Rootstock
- Cultivar
- Water Relations
- Trellising & Spacing
- Growing Season
- Growing Region

<table>
<thead>
<tr>
<th>Condition</th>
<th>pH</th>
<th>T.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-ripe Fruit or Hot Region</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Early Harvest Fruit or Cool Region</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Long Growing Season + Cool Climate</td>
<td>high</td>
<td>high</td>
</tr>
</tbody>
</table>
Acidity, pH, K⁺ and Wine Quality

T.A.
- Impact on Perceived Tartness
- No Impact on Wine Stability

pH
- Microbial Stability (Molecular SO₂)
- Protein plus Color Stability
- No Sensory Impact at pH > 3.0

Acids
- pH
- T.A.
- Malolactic Fermentation

Potassium
- pH
- T.A.
- Fermentation Performance
Deacidification w/KHCO$_3$

0.66 g/L KHCO$_3$

$\Rightarrow$ -1.0 g/L T.A. (-0.1%)
Potassium Bitartrate Stability

Temperature (°F)

<table>
<thead>
<tr>
<th>Alcohol (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>20</td>
</tr>
</tbody>
</table>

Temperature (°F)

g/L Bitartrate
Potassium Bitartrate Stability

T (°F) 25 32
Alcohol (%) 10 12 14 16 18 20

g/L Bitartrate

+200 mg/L
# Potassium Salt Additions

<table>
<thead>
<tr>
<th>Salt</th>
<th>K⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitartrate</td>
<td>+200</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>+660</td>
</tr>
<tr>
<td>Sorbate</td>
<td>+268</td>
</tr>
<tr>
<td>Metabisulfite</td>
<td>+ 50</td>
</tr>
</tbody>
</table>

=> Cold stability compromised!

=> For bottled-fermented *sparkling wine dosage* use SO₂ gas dissolved in water, not potassium metabisulfite.
1. Microbial Stability
2. Inhibition of Browning Enzymes
3. Binding of Acetaldehyde
4. Antioxidant

$\text{SO}_2$
pH and Molecular SO$_2$

![Graph showing the relationship between pH and molecular SO$_2$. The graph depicts the percentages of different forms of sulfur compounds (HSO$_3^-$, SO$_2^{\text{molecular}}$, SO$_4^{2-}$) as a function of pH and the concentration of free SO$_2$.](image)
Measure both TA and pH => blume@purdue.edu
Add up all potassium additions

Tartaric microbially stable - Citric not
Citric soluble/cold stable - Bitartrate not

Use KHCO₃ only for small acidity reductions
Release CO₂ & (re-)cold stabilize afterwards

Know your pH before bottling
Add SO₂ accordingly => enology.butzke.com
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2008 Spring Grape and Wine Workshop - Wednesday, March 19
   Host: Oliver Winery
   Program and Registration (Jill Blums)

2008 Italy for Wine Professionals
   Program  May 15-16 (Christian Butzke, Bruce Rocklein & Jill Blums)
   Registration

2008 Wineries Unlimited
   Program  March 4-7, King of Prussia, PA
   Registration

2008 Michigan Wine Industry Annual Meeting
   Program  February 28, Crystal Mountain Resort, Thompsonville, MI
   Wine Filtration Workshop  (Christian Butzke)

2008 AEEV Symposium honoring Purdue University alumnus Dr. Vernon L. Singleton
   Program  February 1, Hyatt Regency, Sacramento, CA
   Registration

2008 Indiana Horticultural Congress and Trade Show
   Program  January 28-31, Adams Mark Hotel, Indianapolis, IN
   Registration

2008 Unified Wine & Grapes Symposium
   Program  January 28-31, Convention Center, Sacramento
   Ecological Session  Reduction Reduc; the Good, the Bad and the Nutty (Christian Butzke)
   Registration

2007 Family Grape and Wine Workshop
   Purdue Wine Area - Descriptor Manual (Christian Butzke)

2007 Indy International Wine Competition
   Press Release  (Jeanneth Morris)
   IndyInternational.org  (Jill Blums)
   Medal Winners

2007 Annual Meeting of the American Society for Enology and Viticulture (AEEV)
   Wine Grape Action Team member selected VP of AEEV National (Christian Butzke)
   AEEV Membership Application
   American Society for Enology and Viticulture - National
   American Society for Enology and Viticulture - Eastern Section
   American Journal of Enology and Viticulture
   Indulged Wine & Grape Symposium

2007 Summer Grape and Wine Workshop
   Maymester in Italy (Jill Blums)
Thank You For Hosting!

OLIVER WINERY