Yeast Assimilable Nitrogen (YAN) Control and Use

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Vinmetrica

• Started 2010
  – Preceded by 16 years of amateur winemaking
  – Need for better $SO_2$ analysis
• Developed the SC-100 system for $SO_2$
• Wine lab tools that are
  – Easy
  – Accurate
  – Affordable
Vinmetrica Today

• Over 8000 analyzers in use worldwide
• Instrument kits for SO₂, pH & TA, Malic acid
• Test systems for RS, YAN, DO & %ABV
• Lab Services
  – Wine chemistry
  – Microbiology
Rich Sportsman

- Ph.D. analytical chemistry U. Arizona 1982
- Bay area biotech 1992 - 2008
- Amateur winemaker since 1993
- Started Vinmetrica 2010
- Started Little Oaks Winery 2012
YAN: important for smooth fermentation

• YAN deficiency
  – Higher risk of incomplete fermentation
  – Higher stress levels that produce off-odors and -flavors.
  – Low yeast growth rate = slow fermentation rate

• YAN appropriate
  – Better wine aroma/flavor intensity.
  – Lower production of undesirable odors/flavors.
  – Higher production of desirable esters and beneficial autolysis products.

• YAN excess
  – Too rapid initial growth of yeast
  – At end of fermentation, can promote spoilage microorganisms
  – Production of ethyl carbamate (carcinogen), histamine
Nitrogen Metabolism and sulfide

Yeast cell

YAN
Amino Acids
Ammonium

Nitrogen Pool

OAS
Cysteine

Sulfide ($S^{2-}$)
SO$_3^{2-}$
SO$_4^{2-}$

OAH
Methionine

SO$_4^{2-}$
Nitrogen Deficiency and Sulfide

Hydrogen sulfide “rotten egg”
Supplements for YAN

• DAP (diammonium phosphate)
  - Advantage: stable, simple nitrogen source; cheap
  - Disadvantage: excess can be toxic to rapidly growing yeast
  - Best used at ~30% completion of fermentation
  - Be careful if used for prefermentation adjustment

• Fermentation supplements (e.g., Lallemand)
  - GO-FERM
  - Fermaid K, O
  - Opti-Red, -White
YAN additions: timing

• At fermentation start (SG 1.09 – 1.11)
  - Yeast energizer or starter, e.g. GO-FERM to activate
  - Fermaid K or similar after pitching yeast
    • Usually provides sufficient YAN. Measure if in doubt.
    • Further adjustments made with Fermaid or DAP
      - Here, I suggest don’t add DAP above 0.5 g/L if at all

• At 30% fermented (SG 1.06 – 1.08, 3 to 5 days typically)
  - Measure YAN
  - Additions if needed: DAP or Fermaid K, O

• DON’T add YAN after ~50% completion (i.e. ~12 Brix or SG 1.050)
YAN needs at start

<table>
<thead>
<tr>
<th>BRIX</th>
<th>Typical YAN Required, mg/L</th>
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<tbody>
<tr>
<td>21</td>
<td>225</td>
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<tr>
<td>22</td>
<td>250</td>
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<tr>
<td>23</td>
<td>275</td>
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<td>24</td>
<td>300</td>
</tr>
<tr>
<td>25</td>
<td>325</td>
</tr>
</tbody>
</table>
YAN additions: amounts

- Use FermCalc
  - Android
  - Java
YAN additions: amounts

Enter:
- Number of nutrients/stages = 2
- Must volume
- Must SG
- Initial YAN
- Relative Mass Contribution at each stage
  - Stage 1: 1 3
  - Stage 2: 1 0
YAN additions: amounts (cont.)

- Get:
  - Mass to add at each stage (g/L)
  - Both DAP and Fermaid K amounts
2021 wines at Little Oaks Winery

• Viognier
  • Harvest: pH 3.45; TA 5.7; SG 1.100 (24 Brix)
  • Added 1 g/L Fermaid K and 1 g/L tartaric acid
  • 3 days: pH 3.25; TA 7.1; SG 1.062; YAN 37 mg N/L
  • Added 1.9 g DAP/gal => YAN = 93 mg/L ✓

• Sangiovese
  • Harvest: pH 3.33; TA 5.7; SG 1.105 (24.8 Brix) YAN 37mg N/L
  • Added 0.7g/L Fermaid K, 1 g/L tartaric acid, 0.9 g/L DAP
  • 1 day: pH 3.33; TA 8.2; SG 1.105; YAN 204 mg N/L
  • 4 days: YAN = 56 mg/L; added 0.3 g/L DAP
Measuring YAN

- Send out for analysis
  - $35 (Vinmetrica) to $60 (ETS)

- Enzymatic or colorimetric test kits
  - Requires spectrophotometer/microplate reader

- Formol (formaldehyde) titration
  - Vinmetrica and others
  - TA titration → add formaldehyde → TA titration
  - $\text{NH}_3^+ + \text{CH}_2\text{O} \rightarrow \text{N}=\text{CH}_2 + \text{H}_3\text{O}^+$
  - Caution! Formaldehyde is toxic
    - Use in well-ventilated area, gloves, goggles
Measuring YAN: 2 TA titrations

• Prepare samples and formaldehyde (10 min)
  – Calibrate pH, de-gas wine, neutralize formaldehyde
• Perform 1\textsuperscript{st} TA titration with 0.133 N NaOH (Vinmetrica TA Titrant)
  – Take 10.0 mL degassed wine into titration vessel. Insert pH probe, stir
  – Titrate to pH 8.2, [optional: calculate your TA from volume used]
• Perform 2\textsuperscript{nd} TA titration after adding formaldehyde
  – Add 1 mL neutralized formaldehyde solution to above vessel
  – Stir 1 min; pH will drop to between 6.0 - 7.5
  – Titrate back to pH 8.2, record volume ‘V’
• YAN, mg N per L = V * 0.133 * 1400
Measuring YAN: TA Setup + kit

- Burette with TA Titrant (0.133N NaOH)
- pH meter (SC-300) and electrode
- Lab stand with burette clamp and electrode holder
- Magnetic stirrer
- YAN kit
  - Formaldehyde
  - Neutralizer
  - Droppers and test tube
Example YAN titration

- 10.0 mL ‘21 Sangiovese
  - (from 50 mL shaken/vented 3 times to expel CO₂)
- 1st TA Titration with Vinmetrica’s 0.133 N NaOH
  - Took 8.40 mL to pH 8.2  (BTW: then TA is 8.4 g/L tartaric)
- 2nd TA titration after +1 mL neutral formaldehyde
  - pH dropped to 6.6
  - Took 1.09 mL to get back to pH 8.2

- YAN = 1.09 x 0.133 x 1400 = 204 mg/L
Summary

• Incorrect YAN levels can lead to poor outcomes
• Control YAN by measuring and supplementing early in fermentation
• Use FermCalc to guide additions
• Vinmetrica’s YAN kit is one good way to measure
  – fast, cheap and accurate
Thank you!

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