

CHALLENGES AND OPPORTUNITIES FOR LOWERING ALCOHOL IN WINE



2014 Rosh Pina Winemaker Conference

May 29th, 2014

Rosh Pina, Israel

Jane Milligan- Consultant, Winemaking & Sensory

WHY ARE INCREASED ALCOHOL LEVELS CAUSE FOR CONCERN?

- *Other than obvious HEALTH benefits....*
- *Primary concern is effect on **SENSORY CHARACTERISTICS**.*
- *Issues of 'style':*
 - *Is this driven by select wine critics?*
 - *Extracted, ripe fruit, with often high oak.*
 - *Results in an **homogenized** 'international' style*
 - *Possible loss of the sense of place, "terroir"*



WHY REDUCE ALCOHOL?

HOW CAN THIS BENEFIT THE PRODUCER AND RETAILER?

Highest abv. – *Blockbuster 15%+ wines tamed to a “sweet spot” of <14% Flavour and/or taxation benefits*



– *8-10% abv Lower-alcohol and reduced-calorie brands, or brand extensions*

– *5.5% “reduced alcohol wine products”*

Lowest abv.

SENSORY EFFECTS OF HIGHER ALCOHOL WINES

Is Tasting Order Important?



Study of Red Wines at UC Davis

“The influence of alcohol on the sensory perception of red wines”

GOAL: Does the tasting order affect perception of wines with varying alcohols (12-16%)?

24 Cabernet Sauvignons, and blends were tested using three tasting orders:

- **Random**
- High alcohol (above 14%) first (**Hi-Lo**)
- Low alcohol first (**Lo-Hi**)

- Used descriptive analysis and wine competition conditions

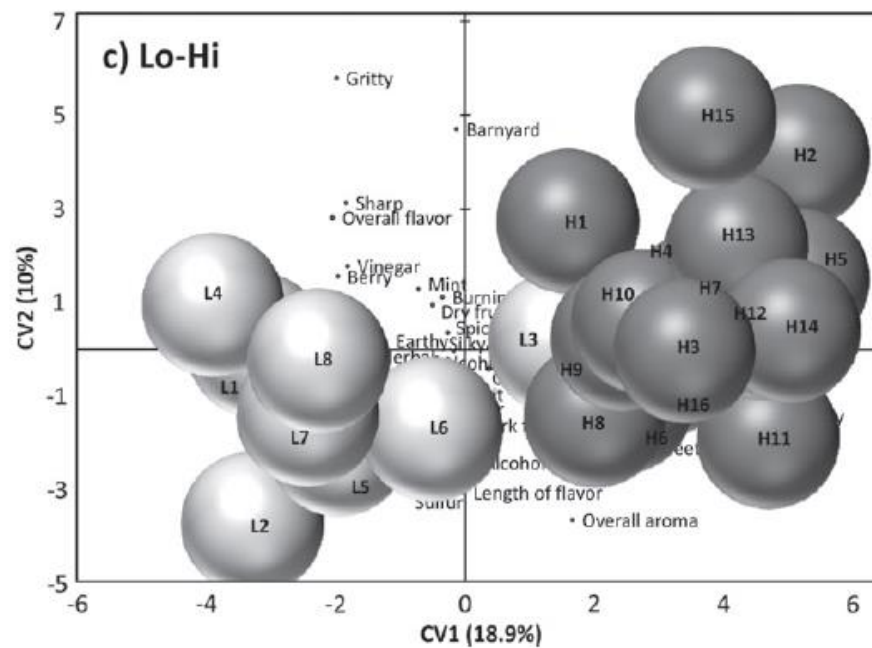
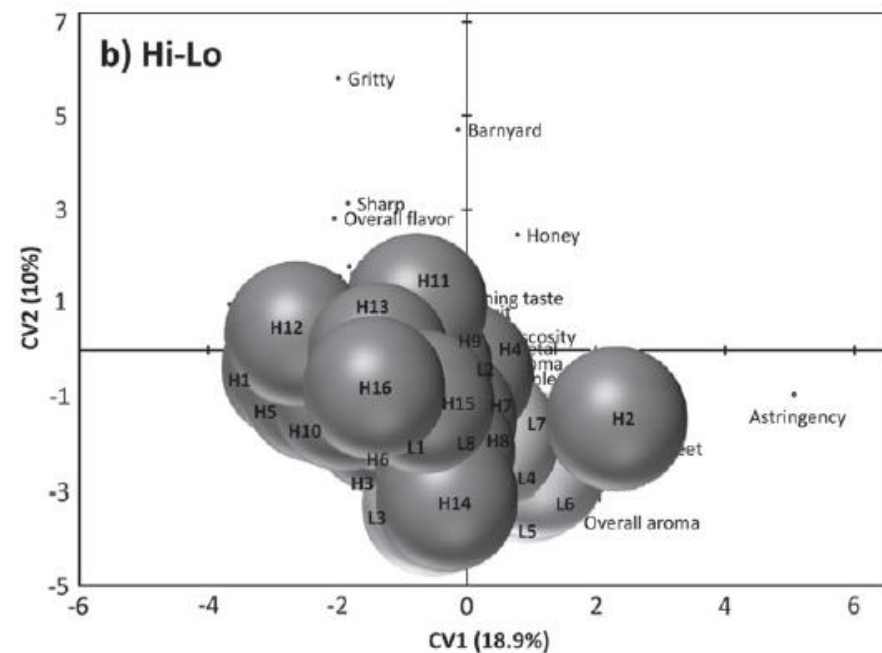
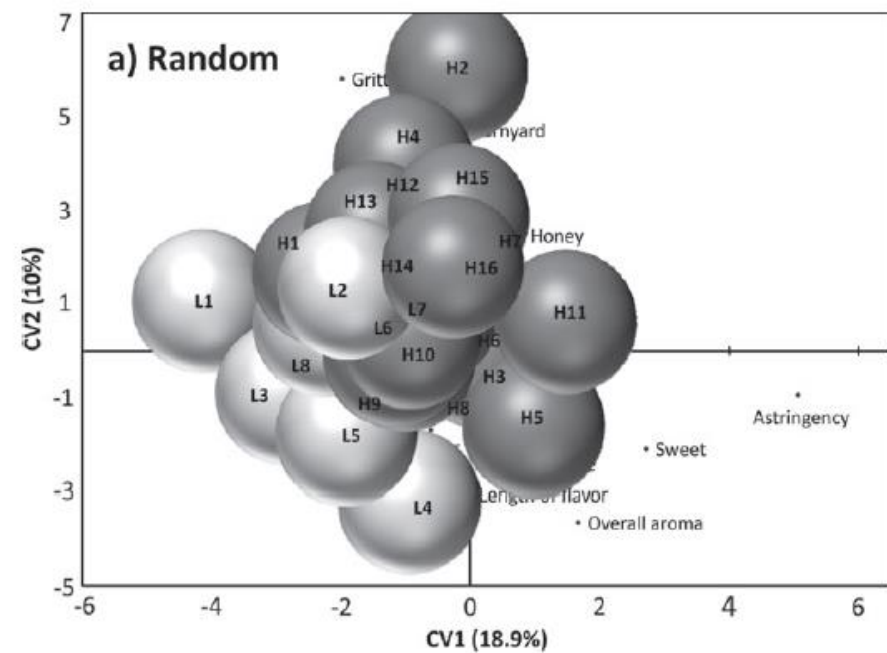
Range of styles, price points (\$3-125), vintages (2000-2009), blends (100% Cabernet vs blends)

Effect of Alcohol on Sensory Properties of Cabernet

UC Davis research key findings

As alcohol concentration increased:

- Significant *increases* in red and purple color, higher clarity
- *Thicker* visual viscosity
- Fresh fruit aroma *decreased* confirming that **ethanol** suppresses 'fruity' aromas.
- *Reduced* floral aromas
- *Enhanced* perception of wood, pepper and chemical aromas in *all* tasting orders (not previously documented)



So was **tasting order** important?

ABSOLUTELY, YES!

- Largest differences observed when **low alcohol wines are tasted first.**
 - **Lo-Hi group was most discriminating**
 - **Random group was moderately discriminating**
 - **Hi-Lo group was *unable* to discern differences**
- Results demonstrate **the importance of alcohol on sensory impact, and order of tasting is critical.**
- **HUGE implications for wine competitions or wine reviews.**



SO YOU NEED TO REDUCE ALCOHOL.....

What are your options?



HOW CAN ALCOHOL BE REDUCED?

Rustic/Low Tech Methods:

- *Early harvest*
- *Blending*
- *Arrested Fermentation*
- *Dilution*
- *Winemaking Options*

Modern/High Tech Methods:

- *Reverse Osmosis (RO)*
- *Modified RO (Memstar)*
- *Spinning Cone Column (ConeTech)*

New Frontiers:

- *Advances in yeast genetics*
- *Other options...*

EARLY HARVEST

PROS

- *Simple*
- *Low cost*
- *No technology*
- *Unrestricted*

CONS

- *Mother nature dependent*
- *Weak flavor, aroma*
- *Thin mouth feel*
- *High acidity*
- *Diminished varietal character?*



BLENDING OPTIONS

PROS

- *Jump start on harvest*
- *Use weaker blocks?*

CONS

- *Mother nature dependent*
- *Uneven ripening*
- *Adverse flavor effects could dominate*
- *So...will final blend be jeopardized?*



ARRESTED FERMENTATION

PROS

- *Very simple*
- *No specialized equipment needed*

CONS

- *Far too sweet for most serious wine consumers*
- *Danger of re-fermentation*



DILUTION

PROS

- *Very simple*
- *No cost*
- *No technology*
- *Use for cleaning crusher to tank, making additions*

CONS

- *Thin mouth feel*
- *Acid balance diluted*
- *Flavors diluted*
- *Not yet legal in Israel....But 6.5% will be allowed.*



WINEMAKING OPTIONS TO REDUCE ALCOHOL

- *Yeast: e.g. AWRI 796 or 71B vs PDM BUT expect only minor adjustment for ANY yeast ($\leq 0.5\%v/v$)*

BISSON UC Davis: "The only sure fire low ethanol producers are those with low ethanol tolerance that stick and leave sugar behind"



- *Fermentation container: Open top*
- *Temperature: Higher \rightarrow more loss*
- *Aeration: Possible negative sensory effects*
- *Barrel storage - Relative humidity $>70\%$.
(Research- $0.2\%v/v$ drop, 12 months at $15^{\circ}C$ & $90\% RH$)*

AMOUNT OF ALCOHOL PRODUCED CAN VARY

*TYPICAL YEAST “CONVERSION
RATES” FALL BETWEEN 0.58 – 0.63*

*Is it really the yeast conversion rate
OR:*

- *Amount of **whole berries and raisins***
- ***Residual sugar remaining**- e.g. 71B*
- *Type of fermentation **container***
- *Fermentation **temperature***

**Yeasts are not *that* effective in
reducing alcohol levels...**



HIGH TECH METHODS

In New and Old World



MEMBRANE FILTRATION

REVERSE OSMOSIS -TRADITIONAL

PROS

- *Inexpensive, portable*
- *Easy to operate*
- *Easy to conceal*

CONS

- *Ingoing wine must be clear*
- *Repeated passage of entire wine = processing trauma*
- *Dehydrates wine*
- *Aroma/flavor adversely affected*
- *Huge volume of water needed*
- *And...creates large volume of low alcohol waste*
- *So...disposal issues*



MEMBRANE FILTRATION

REVERSE OSMOSIS - MEMSTAR

PROS

- *Improvement on traditional RO*
- *Smaller models portable*
- *Versatile*

CONS

- *Ingoing wine must be quite clear*
- *Batch process*
- *100% wine goes through, repeatedly*
- *Expensive for larger amounts*
- *Some flavor lost*
- *Huge volume of water needed*
- *And...creates large volume of low alcohol waste*
- *So....disposal issues*



SPINNING CONE COLUMN



PROS

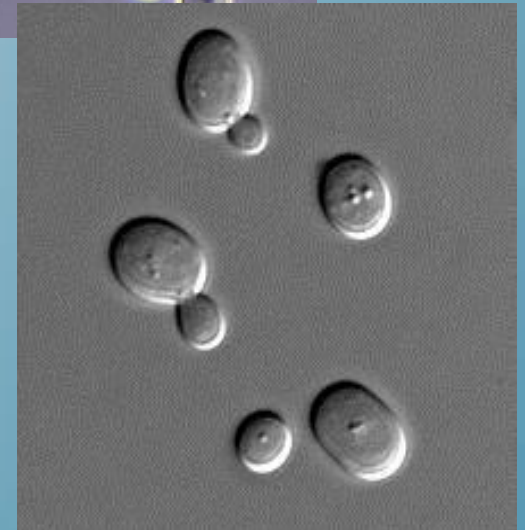
- *Final product is 100% wine, NO water added*
- *Highly efficient, continuous process*
- *Aroma & flavor remain intact*
- *Smaller treatment fraction (10% for every 1%abv drop)*
- *Very economical on large volumes*
- *No waste disposal issues*

CONS

- *Not portable*
- *Very high capital cost*
- *Requires expert personnel*

NEW FRONTIERS IN ALCOHOL MANAGEMENT:

*Anything new on the
horizon?*



ADVANCES IN YEAST GENETICS

*Saccharomyces + glucose →
Ethanol + CO₂*

Simple enough?

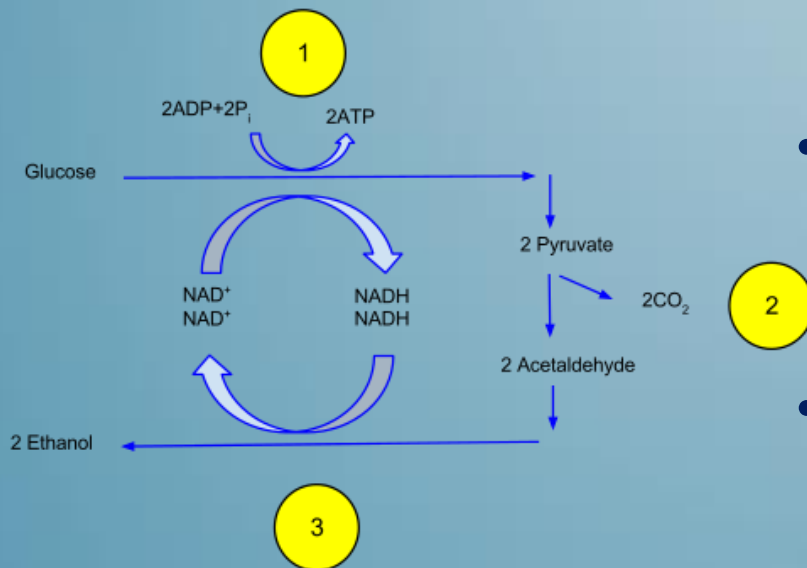
- *Wine yeasts are diverse....*

- *But ONLY < 0.5%abv difference in ethanol production (Dequin 2007)*

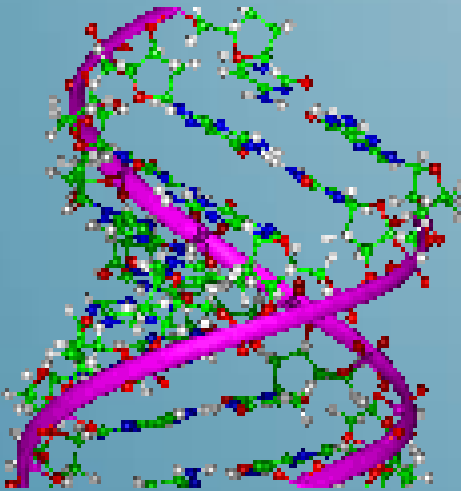
- *Advances in genetic engineering, and phenotype selection*

– Do these work?

– What does the future hold?



**MODIFY
METABOLISM
PATHWAY
USING
GENETIC
ENGINEERING**



In theory Saccharomyces cerevisiae can be genetically engineered to:

- 1. Increase **glycerol** by overexpressing GPD1, a gene that codes for glycerol 3-phosphate dehydrogenase (GPDH)*
- 2. Use **lactate dehydrogenase** resulting in the simultaneous conversion of pyruvate into ethanol and lactate*
- 3. Produce **glucose oxidase** Aspergillus niger glucose oxidase gene has been successfully integrated into Saccharomyces cerevisiae- showed 2% drop.... BUT.....*

DISADVANTAGES OF GM YEASTS

Appear promising, but nothing yet marketed.

Why aren't these the immediate solution?

1. Consumer dislike of ANYTHING GM

2. Adverse flavor effects

3. They don't work too well! With RS left, Sacc. Cerevisiae still needed...

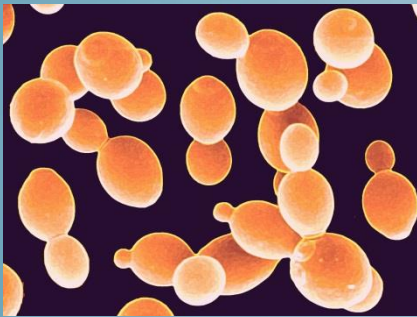


UC DAVIS Dr Linda Bisson states "So far no one has found a good one"...

Newly Identified Yeast Produces Lower-Alcohol Wine

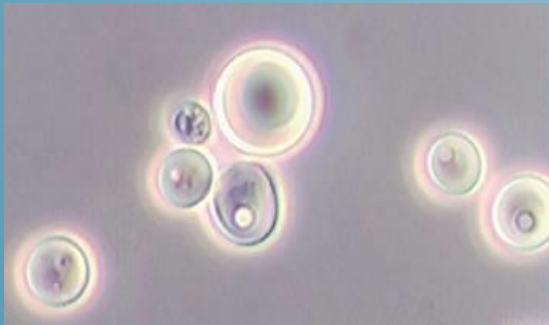
Australian scientists identify a yeast strain that can reduce alcohol levels by up to 1.5 percent

Posted: February 26, 2014



- *Metschnikowia pulcherrima*, or **AWRI 1149**, isolated from 40 strains found in nature
- Achieved the greatest balance of lower alcohol and negative side effects
- Reduction of alcohol by 1.6% in Shiraz, 0.9% in Chardonnay

HOWEVER
SIGNIFICANT
HURDLES
REMAIN FOR
AWRI 1149



- *Higher ethyl acetate levels in Chardonnay*
- *Did NOT complete fermentation, so needed to add Sacc. Cerevisiae*
- *Other species of metschnikowia take over*

Linda Bisson- UC Davis Professor of Yeast Microbiology warns of the:

“translatability of laboratory-scale fermentation data to production conditions.”

AWRI 1149 is NOT ready for industry although several companies interested

OTHER
METHODS
TO REDUCE
ALCOHOL

1. Glucose Oxidase Enzyme:

Researched since 1980's.

Glucose Oxidase (GOX) can reduce alcohol by 0.7%, but issues with raised acidity, also other undesirable by-products produced.

1986 US PATENT:

**Method for production of a low
alcoholic wine**

US 4675191 A

Glucose Oxidase Enzyme:-

1999 Research

Negative effects:

- Loss of fruit aromas
- Shorter length of flavor
- High acidity

The Production of Reduced-Alcohol Wine Using Glucose Oxidase-Treated Juice. Part III. Sensory

G. J. PICKERING^{1*}, D. A. HEATHERBELL², and M. F. BARNES³

Treatment of Riesling juice with glucose oxidase (GOX) significantly modifies the taste and appearance attributes of the resultant reduced-alcohol wine. However, aroma, aroma-by-mouth, and mouthfeel characteristics are relatively unaffected except for fruit aromas such as 'lime', 'apple', and 'fruity/floral' which are generally less intense in GOX wines due to the juice aeration required. Length of flavor (persistence) is reduced in these wines and high acidity is a detracting characteristic.

Am. J. Enol. Vitic., Vol. 50, No. 3, 1999

OTHER METHODS TO REDUCE ALCOHOL

2. *Distillation/ stripping with CO₂*

“Partial Removal of Ethanol during Fermentation to Obtain Reduced-Alcohol Wines”

Am. J. Enol. Vitic. 61:1 (2010), Aguera et al

*In 100 L pilot-scale fermentations, **2% ethanol was removed** halfway through fermentation, either by distillation under vacuum or by stripping with CO₂.*

- *Timing very tricky; difficult to scale up to commercial size*
- *Potential by-product issues. Some stripping.*

CONSIDER AN INTEGRATED APPROACH IN ISRAEL



- ***Early harvest of select vineyard blocks***
- ***Blending with lower alcohol lots***
- ***Dilution up 6.5%***
- ***Winemaking Options-Combination***

Thank you....
Any questions?