Influence of yeast strain choice on the success of Malolactic fermentation

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INTRODUCTION

- Changing conditions dictate different microbial population dynamics
  - e.g. high pH, SO_2 addition levels, cleaning and sanitation practices
- Winemaker must manage the microbial populations through out the process
  - Cold Soak to bottling
- Co-existing *Saccharomyces* and *Oenococcus* populations must be compatible, if not:
  - Ethanolic fermentation issues
  - Malolactic fermentation issues

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Saccharomyces cerevisiae

- ~180 enological strains available
  - Genetically different
    - Requirements may differ
    - Results may differ
  - Interactions with other organisms may differ!
    - Yeast: Yeast interactions
      - Positive, Negative or Neutral
    - Yeast: Bacteria interactions
      - Positive, Negative or Neutral

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Oenococcus oeni

- ~ 30 enological strains available
  - Strict environmental limitations
    - Alcohol
    - pH
    - FSO_2/TSO_2
    - Temperature
    - Malic acid concentration
    - Nutrient status

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POSSIBLE ORGANISM COMBINATIONS

- ~180 enological strains *S. cerevisiae*
- ~30 enological strains *O. oeni*
- 180x30….
  - 5400 possible combinations
    - assuming only 1 yeast and 1 bacteria present
  - Prediction for rate of success?
    - Dependant upon the combination
      - Various outcomes

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ALCOHOLIC AND MALOLACTIC FERMENTATIONS

- Malolactic fermentations should not be considered as an afterthought
  - Alcoholic fermentation dictates the success rate!

- Easy ALF=Easy MLF
- Challenging ALF=Difficult MLF
- Planned in conjunction…

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Inhibition of *O. oeni* by *S. cerevisiae*

- Ethanol production
  - Affects the capacity of the bacteria to grow
    - Select strain which is resistant to the Ethanol level

- SO_2 production
  - Yeast strains classed as high, medium or low producers
    - Production can vary from <20mg/L to >90mg/L
    - Amount depends on the availability of nutrients and the presence of compounds in the must that can bind SO2
      - Know what levels are present!

Loss of viability can be partially attributed to the inhibition of the ATPase activity

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Inhibition of *O. oeni* by *S. cerevisiae*

- Medium Chain Fatty Acids
  - Target and alter the bacterial membrane, interfere with ability to consume Malic Acid, and limit growth

Wine	Malic Acid (day 4)	Malic Acid (day 14)	% degradation after 14 days
Control	2.19	0.53	**81**
Wine + C6 145µM	2.24	0.46	**84**
Wine + C8 145µM	2.33	0.70	**75**
Wine + C10 145 µM	2.46	1.18	**58**
Wine + C6 52µM + C8 71µM + C10 µM	2.40	1.45	**49**

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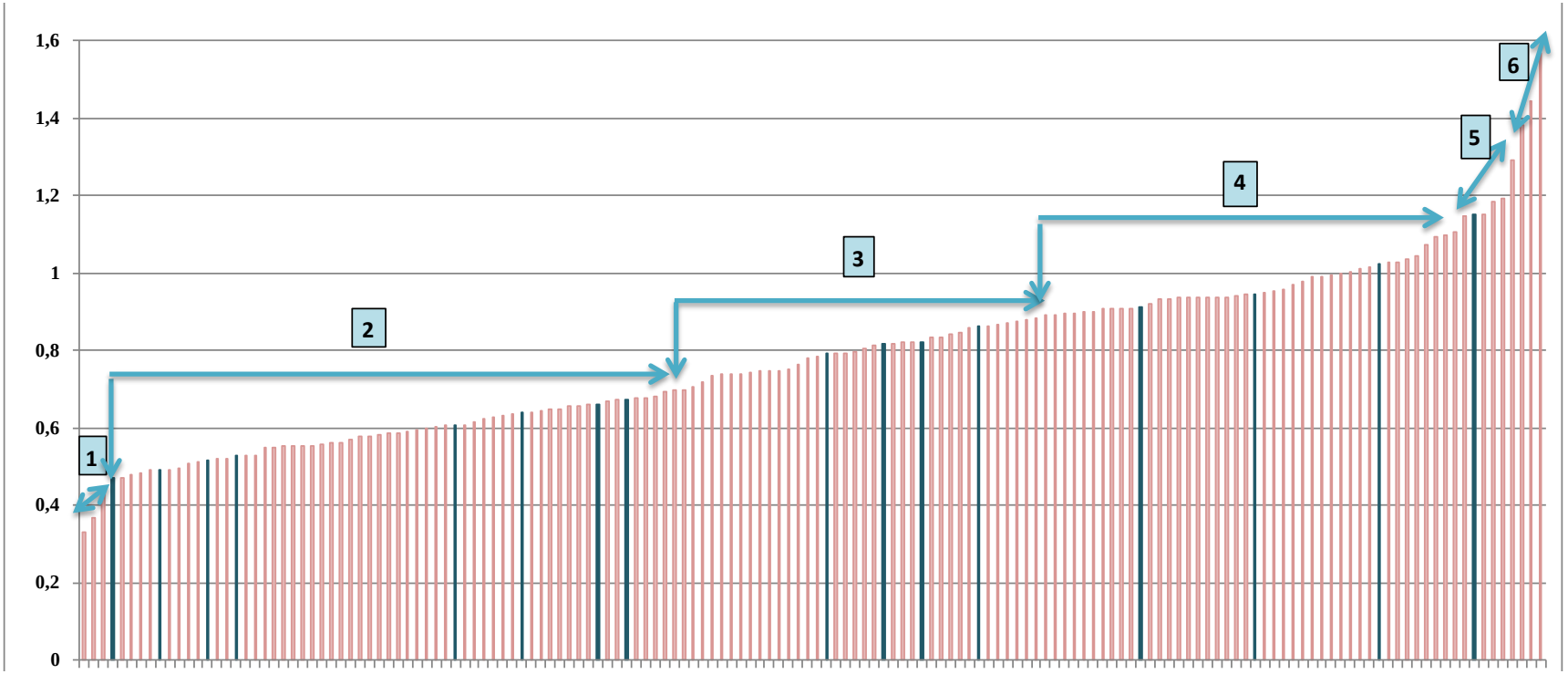
Medium chain fatty acids can also have a negative effect on yeast performance

YEAST NUTRIENT REQUIREMENTS



Nitrogen requirements : mg of YAN necessary to consume 1g of sugar

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Inhibition of *O. oeni* by *S. cerevisiae*

- Alterations of acidity
  - Utilization of Malic acid, or production of Succinic acid
    - Differential Malic Acid consumption by different strains
- Glutamic Acid deficiency
  - Essential for growth
- Aromatic Compounds
  - ß-phenylethanol
- Anti-bacterial metabolites ?

Phenolics and pesticide residues can also result problematic MLF

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Stimulation of *O. oeni* by *S. cerevisiae*

- Yeast autolysis rate
  - Strain dependant
    - Influences the nutritional composition of the medium
      - Releasing amino acids, peptides, mannoproteins
        - » Mannoproteins have dual functions
          - » Detoxification of medium by absorption
          - » Protection of cells from polyphenolic inhibition

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Inhibition of *S. cerevisiae* by *O. oeni*

- Production of Acetic Acid

- Glucosidase Production
- Bacterial protease production
- Production of other yeast inhibitors?

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BACTERIA: BACTERIA INTERACTIONS

- *L. brevis*
  - Produces Brevicin
    - Small thermostable protein (3kDa)
    - Broad range of action
      - Can inhibit *O.oeni, P. damnosus, L. brevis*
- *L. casei*
  - Produce Caseicin
    - Higher MWt, less stable
    - Inhibits fructose uptake

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OVERVIEW

- Wine is the result of complex interactions between organisms
- Yeast strain choice does have an impact on the success rate of MLF
- Interaction is dependant upon:
  - Yeast and bacteria strain present
  - Juice/Must/Wine conditions
  - Winemaking practices
    - E.g. timing of inoculation

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QUESTIONS

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