

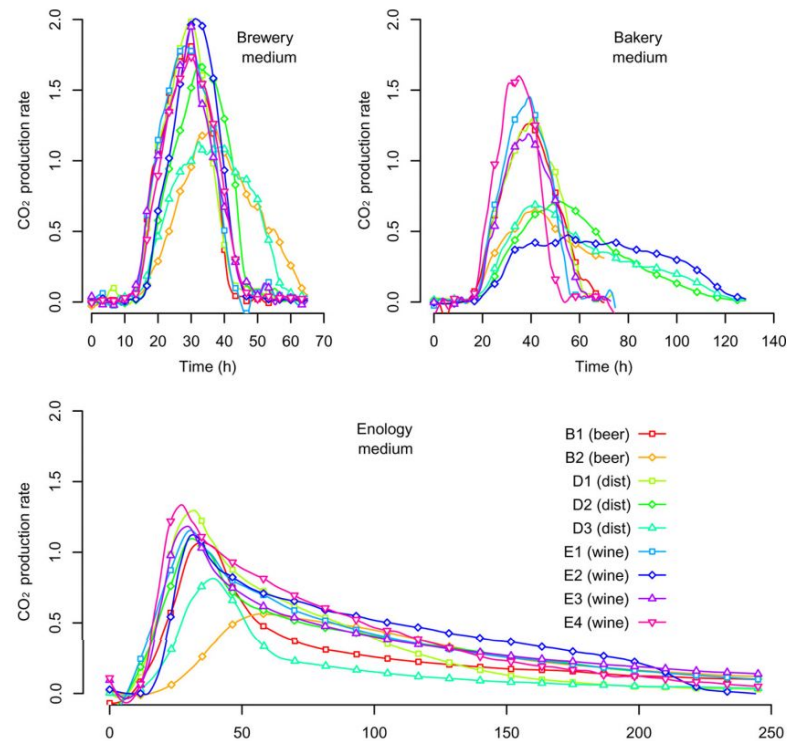
Paper 1 Topic 1:

Looking at 9 types of yeast in 3 different mediums

Measuring CO₂ production over time in

Figure 1

- Fermentation Kinetics
 - Lag-phase time
 - AF time
 - V_{\max} - maximal CO₂ production rate
- 10 metabolic traits:
 - CO₂ tot
 - Ethanol
 - Acetic acid
 - Glycerol
 - Glycogen
 - Trehalose
 - Biomass
 - Nitrogen consumption
- 4 life history traits:
 - K - carrying capacity/ max population size
 - r
 - Cell size
 - Growth recovery



Relationships between AF kinematics and metabolic and life history traits

- No correlation found between V_{\max} and J_{\max}
- Significant correlation found between V_{\max} and K
- Significant tradeoffs between K and acetic acid and K and trehalose
- K also positively correlated with relative nitrogen consumption
- K and biomass significantly correlated, but no correlation between cell size and biomass
- Positive significant phenotypic correlation between mean cell size and maximum CO₂ production rate per cell (J_{\max})
- K found to be negatively correlated with cell size
- Cell size and growth recovery positively correlated
- Cell size and trehalose positively correlated
- K main component in V_{\max} variation accounted for 78.7%, 86%, 94.5% of total V_{\max} in brewery, enology and bakery media respectively
- J_{\max} significantly related to V_{\max} only in bakery medium and accounted for little V_{\max} variation

Alcoholic Fermentation is Driven by Population Size Rather than Specific Flux/ Considering K for a New Selection Approach

- Fermentative ability at the population level is the result of specific flux (flux per cell) and cell number
- Population parameters = major factors controlling fermentative abilities
- Correlation found between K and V_{\max} suggests increasing K would increase fermentative ability
- Accordingly, previous data showed that a higher carrying capacity was associated with a higher CO₂ production rate in nearly isogenic *S. cerevisiae* strains (38), and Varela et al. (66) showed that adding biomass reduced the time to achieve sugar consumption in slow fermentations. Using K as a selection criterion for AF would therefore increase the rate of fermentation
- Increasing K does not seem to be associated with a reduction of the ethanol yield but rather seems to be related to a reduction of the yield of other by-products.
- Indeed, we showed that K was negatively correlated with acetate formation. This suggests that increasing K by selection may also allow decreasing acetic acid

Comparing to Previous In-class Models

- V_{\max} in our model represented the maximum volume in the chemostat rather than a fermentation kinetic for maximal CO₂ production rate
 - However, knowing that V_{\max} stands for different variables allows for including the maximal CO₂ production rate somewhere in the model as being related to the maximal population size (K)
- Hypothesis seems to be leaning towards there being at least 3 equations present, ammonium concentration, possibly CO₂ concentration or EtOH concentration, and population size.