

Considering Carbon and Fermentation vs. Respiration

Elizabeth Polidan

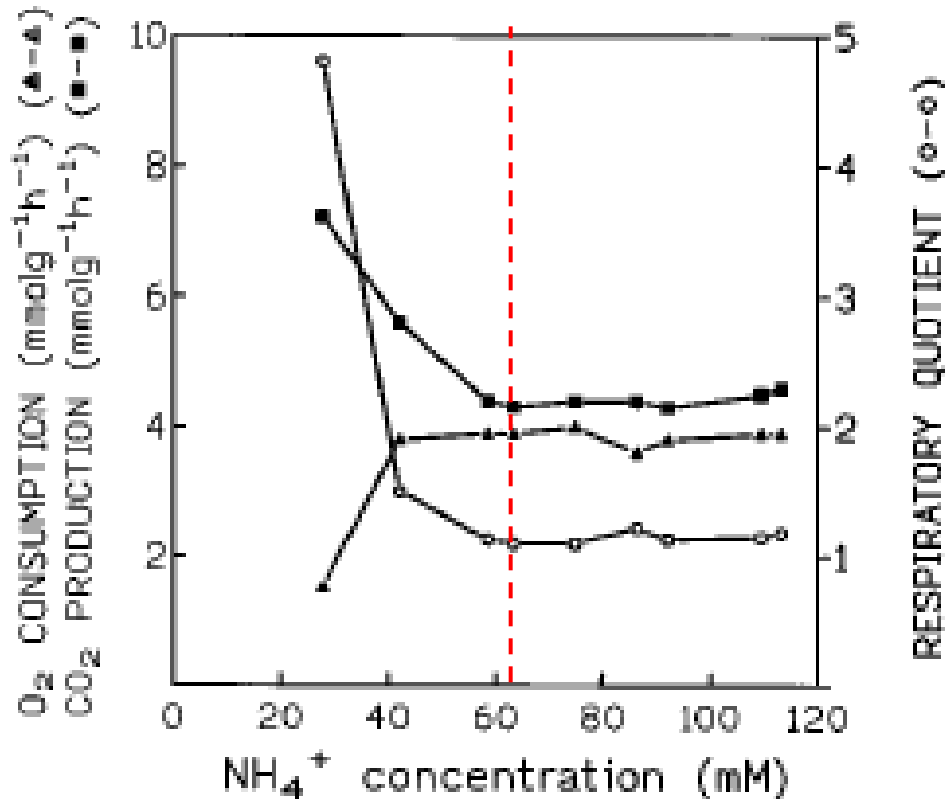
**Department of Mathematics
Loyola Marymount University**

**BIOL 398-03/MATH 388
February 28, 2013**

Outline

- **Point 1**
- **Point 2**
 - 2a
 - 2b
 - 2c
- **Point 3**
- **Point 4**

By the time NH_4^+ concentration goes from limiting to excess at 61 mM no more fermentation

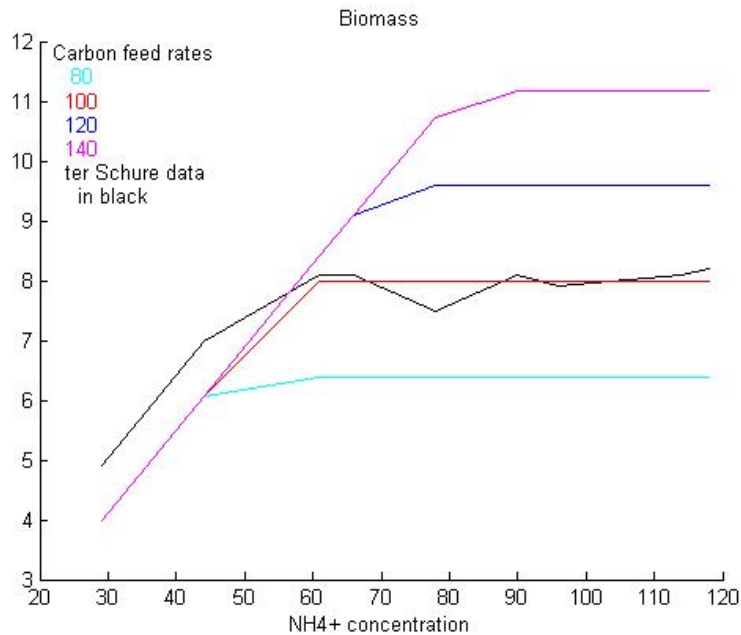


- Respiratory quotient shows at 29 mM NH_4^+ in the feed, the culture is performing fermentation.
- At 44 mM NH_4^+ , yeast begin to switch over to respiration.
- After nitrogen is no longer limiting (61 mM NH_4^+) complete respiration.

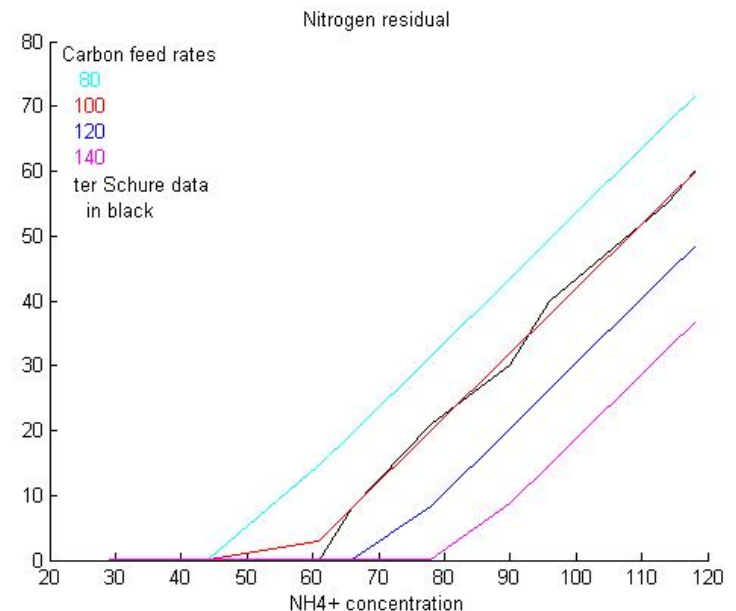
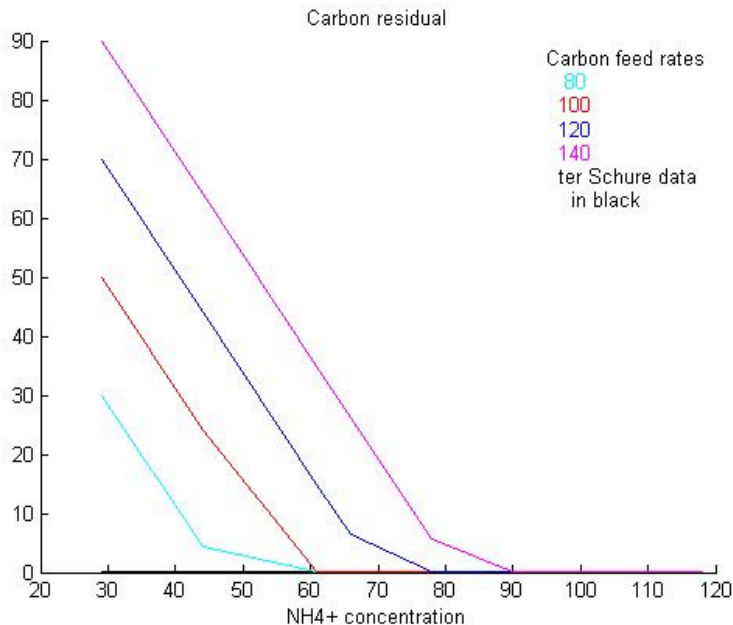
Respiration vs. Fermentation

- **Respiration (aerobic)**
 - $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 36\text{ATP}$
 - More energy, less glucose needed, but slower
 - Faster growth rate - ~3 times faster (Novak, et. al., 2007)
- **Fermentation (anaerobic)**
 - $2\text{ATP} + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{CH}_3\text{CH}_2\text{OH} + 2\text{CO}_2 + 4\text{ATP}$
 - Less energy, more glucose needed, but faster
- **Use the different growth rates and inefficiencies in the model**

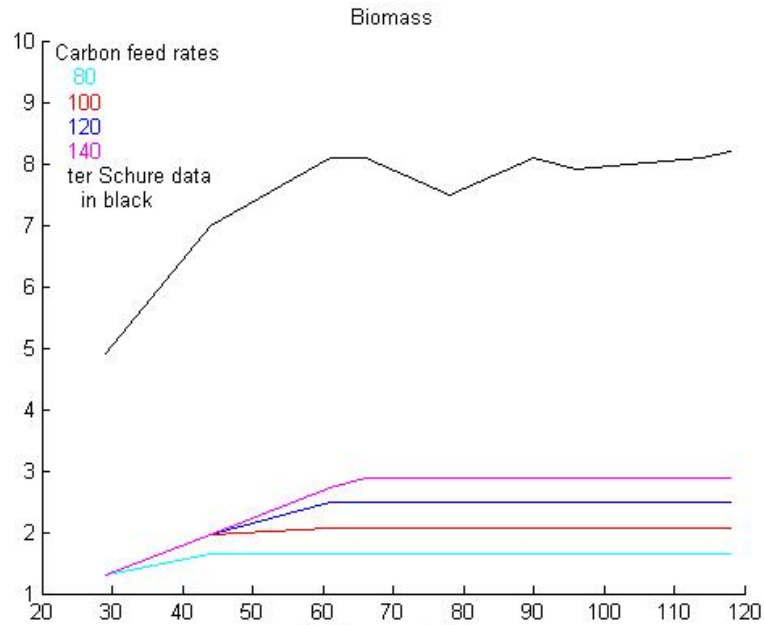
What happens at different levels of carbon?



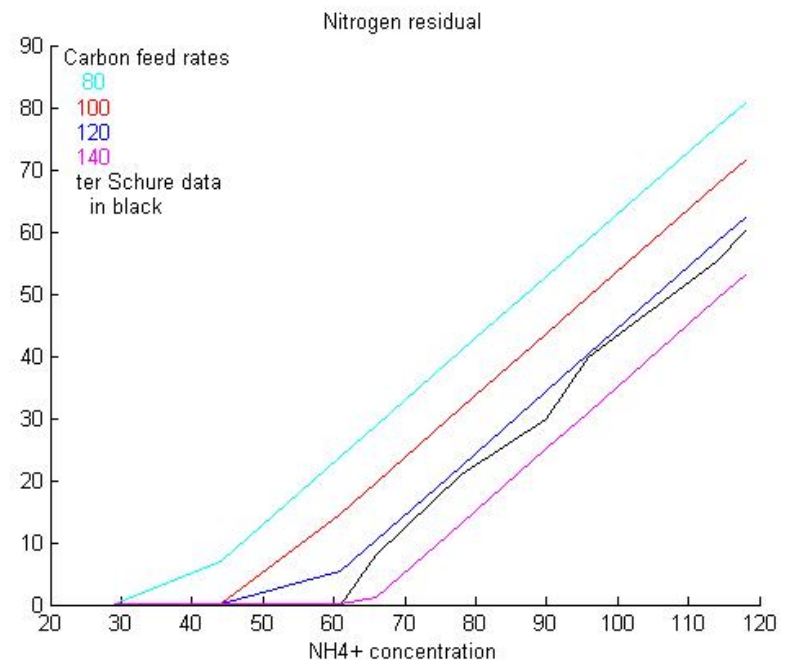
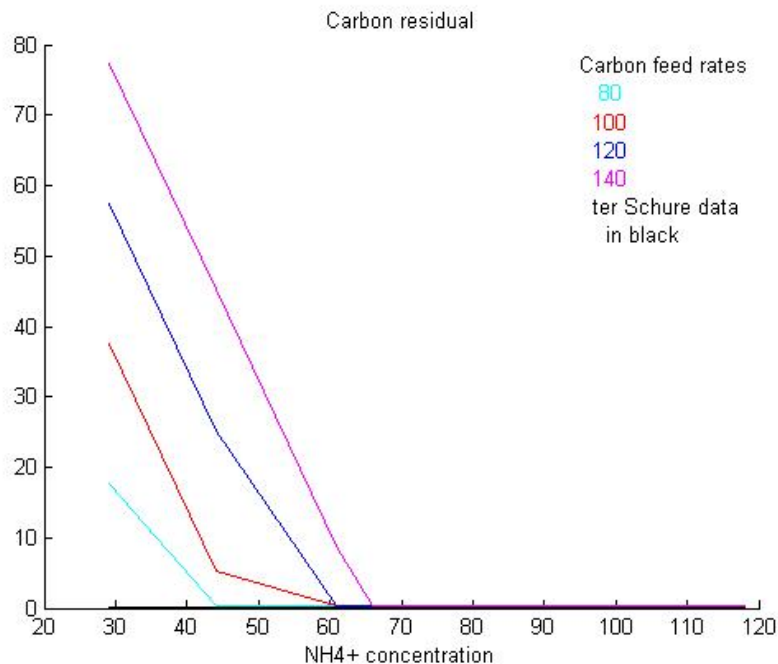
- Biomass
- Carbon Residual
- Nitrogen Residual



And if it is fermentation?



- Biomass
- Residual Carbon
- Residual Nitrogen



Summary

- **Yeast may prefer anaerobic metabolism, but aerobic is much more efficient**
 - Summ 1a
 - Summ 1b
 - Summ 1c
- **Summ 2**
- **Summ 3**
- **Summ 4**
 - Summ 4a

References

Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2004) *Essential Cell Biology*, 2nd edition, New York, NY: Taylor & Francis Group, pp. 431-433.

Novak, J., Basarova, G., Teixeira, J.A., & Vicente, A.A. (2007) Monitoring of Brewing yeast propagation under aerobic and anaerobic conditions employing flow cytometry, *Journal of the Institute of Brewing*, **111**:249-255.

Ter Schure, E.G., Sillije, H.H.W., Raeven, L.J.R.M, Boonstra, J., Verkleij, A.J., and Verrips, C.T. (1995a) Nitrogen-regulated transcription and enzyme activities in continuous cultures of *Saccharomyces cerevisiae*, *Microbiology*, **141**:1101-1108.

Ter Schure, E.G., Sillije, H.H.W., Verkleij, A.J., Boonstra, J., and Verrips, C.T. (1995b) The concentration of ammonia regulates nitrogen metabolism in *Saccharomyces cerevisiae*, *J. Bacteriol.*, **177**:6672-6675.