May 17th, 9:00 AM - 12:00 PM

Norms of reaction for pheromone response in Saccharomyces cerevisiae isolates

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Norms of reaction for pheromone response in yeast isolates

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Abstract

- Traits are commonly influenced by environmental and genetic factors. An important life history trait in baker's yeast (*Saccharomyces cerevisiae*) is the rate at which cells prepare for mating in response to environmentally released pheromones.
- It is known that pheromone response depends on pheromone concentration, but the effects of environmental factors are largely unknown.
- We are investigating the norms of reaction to environmental factors for pheromone response in genetically distinct yeast isolates. Initial results suggest isolates follow unique norms of reaction.

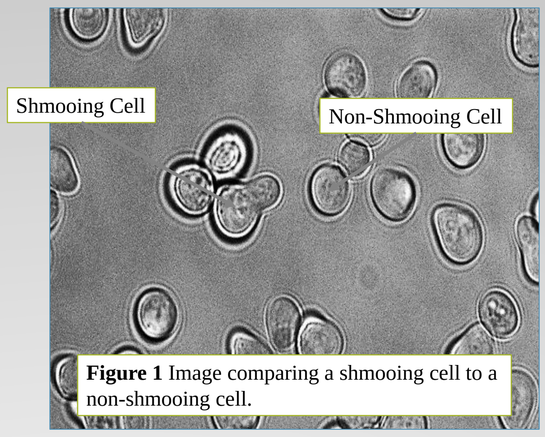


Figure 1 Image comparing a shmooing cell to a non-shmooing cell.

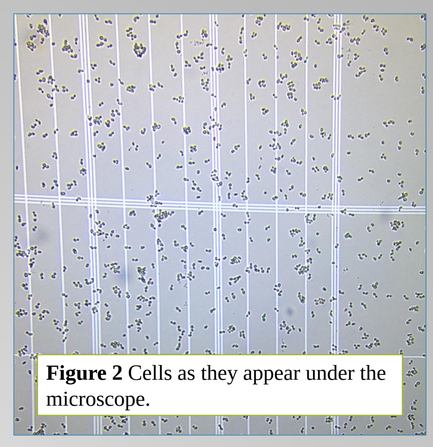


Figure 2 Cells as they appear under the microscope.

Mating Morphology

- In preparation for mating, yeast cells elongate in a process that is called shmooing.
- For each isolate we are measuring how the fraction of shmooing cells in a culture changes with time after exposure to pheromone.

Data

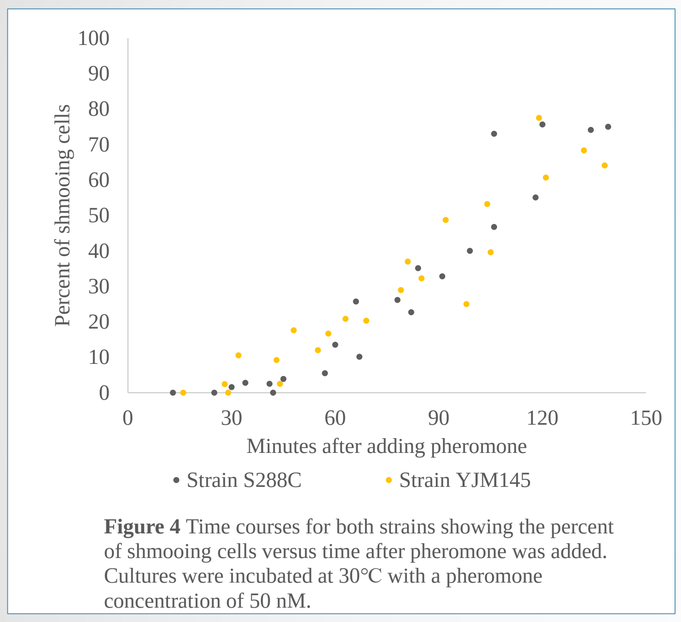


Figure 4 Time courses for both strains showing the percent of shmooing cells versus time after pheromone was added. Cultures were incubated at 30°C with a pheromone concentration of 50 nM.

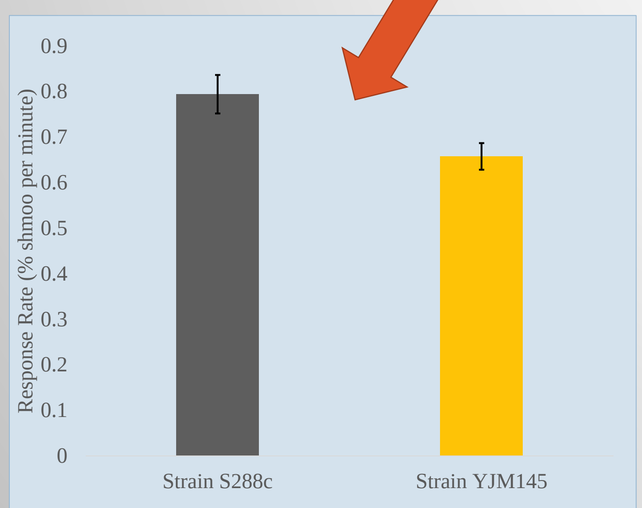


Figure 4 The average slope for each strain of the trendline created by plotting the percent of shmooing cells versus minutes after adding pheromone.

Response rate was not significantly different between strains ($t_{0.05(2),2}$=4.09, P-value=.055).

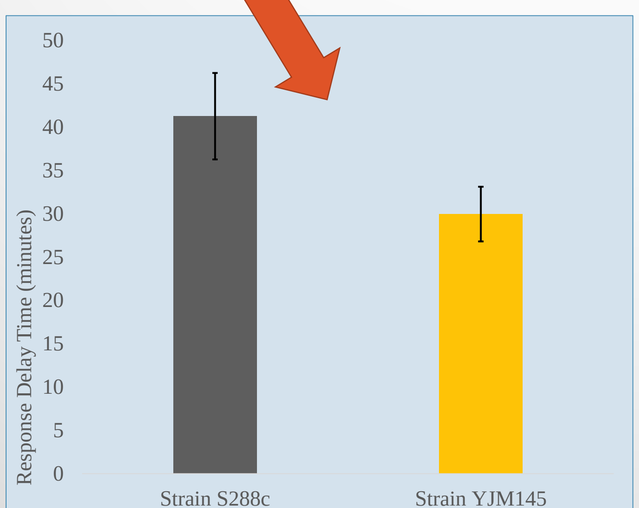
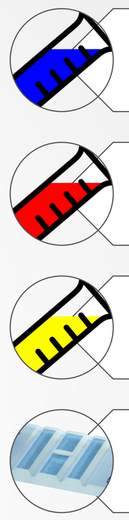


Figure 5 The number of minutes between adding pheromone and the first shmooing cell for each strain.

Response delay was significantly different between strains ($t_{0.05(2),2}$=4.99, P-value=0.034).

Conclusion

- Results after three experiments suggest the response delay for each strain is significantly different. In general, the first shmooing cell appears in strain YJM145 before strain S288c. While the response rates for each strain are not significantly different, the response rate for S288c appears to be faster than that of YJM145.
- The magnitudes of the differences observed between response rate and delay for each strain are small. Further trials will help solidify these differences and develop a deeper understanding of pheromone response for these strains under controlled conditions.



Overnight Cultures

- Cells from a single colony were suspended in YPD media and incubated overnight at 30°C.

Morning Cultures

- A small sample from the overnight culture was added to YPD media and incubated for three hours at 30°C.

Alpha Factor Added

- 10 µL of 10µM alpha-factor was added to each 2mL test tube for a final 50nM solution.

Sample Taken

- A sample taken from morning culture was loaded onto a hemocytometer and observed under a microscope.

Comparison of Yeast Isolates Used*	
S288c	• A common haploid laboratory strain originally obtained from a fig. • Grows poorly at high temperatures relative to YJM145.
YJM145	• A homozygous diploid strain derived from the lung of an AIDS patient. • Known to have the high temperature growth phenotype.

Figure 6 Table describing and comparing the two strains of yeast we are studying.

*Steinmetz, Lars M., Himanshu Sinha, Dan R. Richards, Jamie I. Spiegelman, Peter J. Oefner, John H. Mccusker, and Ronald W. Davis. "Dissecting the Architecture of a Quantitative Trait Locus in Yeast." *Nature* 416.6878 (2002): 326-30. Web.

Future Directions

- The next steps are to study potential variation in response rate and delay for S288c and YJM145 due to the manipulation of temperature and pheromone concentration.
- Understanding norms of reaction for pheromone response will facilitate future analysis of genetic mechanisms and help the larger community of researchers studying this model environmental response network.

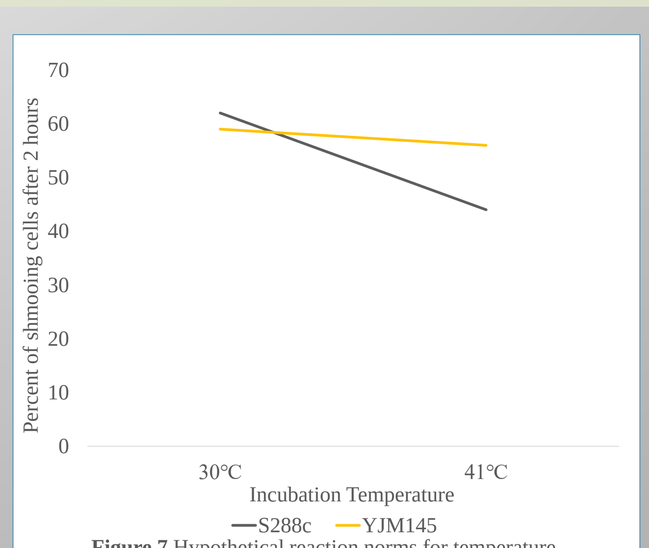


Figure 7 Hypothetical reaction norms for temperature for each strain. Hypothetical data was used for the 41°C treatment.