Optimal Yeast Type for Slowest Fermentation Rate of 20% All-Purpose Flour Solution

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Abstract

Data was collected to test the fermentation rates of different types of yeast with 20% all-purpose flour solution. We sought the slowest fermentation rate above zero as this is determined to develop the best flavor in bread. We hypothesized that lager yeast would be the slowest and this hypothesis was refuted by our data which shows the mean fermentation rate of wine yeast to be the slowest fermentation rate of the four types tested: active dry, ale, lager, and wine. This provides us with information that wine yeast may develop better flavor in bread.

Introduction

The quality of bread is determined by the fermentation rate. Previous research has suggested that slower fermentation would lead to a higher quality of bread. Typically bakers use active dry yeast for bread, however our group was curious how different yeast would compare. It was decided that we would test different alcohol yeasts alongside active dry since alcoholic beverages take a longer time to ferment. This lead us to the purpose of this experiment: which yeast (active dry, ale, lager, or wine) would ferment the slowest to provide the best flavor in bread? Our hypothesis was lager yeast, since lager-style beers often take the longest to ferment.

Methods

Materials & Equipment

50 mL of a 20% all-purpose white flour solution
5 test tubes (labeled 1-5)
5 fermentation tubes (labeled 1-5)
5 pipettes
1 pipette pump
5 100 mL beakers
50 mL of water
5 stirring rods
1 gram of active dry yeast, Ale yeast, Wine yeast, and Lager yeast

Location

This experiment was performed using the materials and equipment described in the BIOL 160 lab room between dates 10/31/2023 and 11/14/2023. Trial 1 was performed on 10/31/23, replicate trial 2 on 11/7/2023, and replicate trials 3-5 on 11/14/2023.

Procedure

Mix one gram of each yeast type with 10 mL of water in the 100 mL beakers. Leave one with only water for the control. Pipette 10 mL of the flour solution to each of the beakers and mix well. After solution is mixed put 10 mL of the solution into a fermentation tube. Put the tubes into the incubator and set the temperature to 37.2 degrees celsius. After one of the tubes passes halfway with CO_2 take them out and note the time. Measure the amount of carbon dioxide accumulated in each fermentation tube and calculate the fermentation rate.

Replicate Data of Yeast Type Fermentation Rates (mL CO_2/min)

Test Tube #	Yeast Type	Incubation Time (minutes)	Volume (mL) CO_2	Rate of Fermentation (mL CO_2/min.)
TRIAL 1	Date: 10/31/2023			
1	Active Dry	23	0	0
2	Ale	23	7.2	0.313
3	Lager	23	1.2	0.052
4	Wine	23	0.4	0.017
5	CONTROL	23	0	0
TRIAL 2	Date: 11/07/2023			
1	Active Dry	28	5	0.176
2	Ale	23	9.6	0.417
3	Lager	28	6.4	0.229
4	Wine	28	2	0.071
5	CONTROL	28	0	0
TRIAL 3	Date: 11/14/2023			
1	Active Dry	30	4.8	0.16
2	Ale	21	6	0.286
3	Lager	30	6	0.2
4	Wine	30	2.2	0.073
5	CONTROL	30	0	0
TRAIL 4	Date: 11/14/2023			
1	Active Dry	30	6.8	0.227
2	Ale	21	8.8	0.419
3	Lager	30	3.8	0.127
4	Wine	30	1.8	0.06
5	CONTROL	30	0	0
TRAIL 5	Date: 11/14/2023			
1	Active Dry	30	6.8	0.227
2	Ale	21	8.8	0.419
3	Lager	30	6.8	0.227
4	Wine	30	1.2	0.04
5	CONTROL	30	0	0

Table 1. Data of five replicate trials. Four types of yeast types tested plus control (no yeast) with 20% flour solution. Data contains incubation time, volume of CO_2 measured (mL), and fermentation rate (mL CO_2/min) by yeast type.

Yeast Type	Mean Rate of Fermentation (mL CO_2/min.)
Active Dry	0.79
Ale	1.854
Lager	0.835
Wine	0.261
CONTROL	0

Table 2. Mean data of five replicate trial fermentation rates by yeast type.

Figure 1. Image of fermentation tubes of trial 1.

Mean Data of Replicate Fermentation Rates of Yeast types

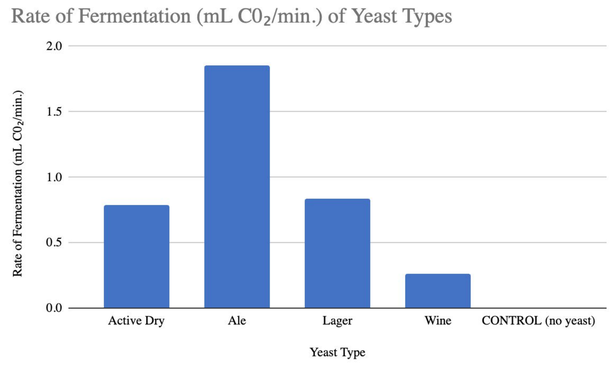

Figure 2. Mean fermentation rates (mL CO_2/min) of five replicate trials by yeast type: Active dry, Ale, Lager, Wine, and control (no yeast).

Discussion

Wine yeast is determined to be the slowest fermentation rate of the four types of yeasts tested. These findings do not support our original hypothesis that lager yeast would be the slowest, however, this does provide us with valuable insight to the behavior of wine yeast fermentation.

Matsushita, K., et al. (2019) found that rate of fermentation greatly influenced the qualities of bread with slower fermentation placing less strain on the dough, producing more desirably textured bread. We hypothesized that lager would ferment at the slowest rate and therefore be a good choice for bread-making, given that in a home-brewing context, lagers generally take the longest to produce. We did not consider the disparity in sugar content between home-brewing recipes and a solution of only flour and water, however, and found that wine yeast fermented at the slowest rate, followed by active dry yeast, lager, and ale, respectively. This made sense given that *Saccharomyces cerevisiae* found in packets of Active Dry yeast is the most commonly used yeast in bread-making. It should be noted that Aslanhooki, E, et al., (2016) in their investigation of bread-making using non-traditional yeast strains, eliminated the wine yeast, *Lachancea thermotolerans*, from their experiments due to the production of potentially harmful biogenic amines. For this reason, it may be fortuitous that we did not utilize our tested yeasts in actual bread-making, as that was not a factor we had considered. The same researchers reported promising results with champagne yeast however, so that may be a topic of further investigation in using slower fermenting yeasts in bread-making.

Acknowledgements

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References/Works Cited

Aslankoohi, E., Herrera-Malaver, B., Rezaei, M. N., Steensels, J., Courtin, C. M., & Verstrepen, K. J. (2016). Non-Conventional Yeast Strains Increase the Aroma Complexity of Bread. *PLoS ONE*, *11*(10), 1–18. https://doi.org/10.1371/journal.pone.0165126

Matsushita, K., Goshima, D., Iwata, J., Santiago, D. M., Takata, K., & Yamauchi, H. (2019). Analysis of the Relationship between Bread-Making Qualities and Dough Stress during the Proofing Process. *FOOD SCIENCE AND TECHNOLOGY RESEARCH*, *25*(2), 237–243. https://doi.org/10.3136/fstr.25.237

Jiang, L., Song, J., Qi, M., Cao, Y., Li, Y., Xu, M., Li, L., Zhang, D., Wang, C., & Li, H. (2023). Carbon and nitrogen sources consumption by ale and lager yeast strains: a comparative study during fermentation. *Applied Microbiology and Biotechnology*, *107*(22), 6937–6947. https://doi.org/10.1007/s00253-023-12778-9

Maicas S. (2020). The Role of Yeasts in Fermentation Processes. *Microorganisms*, *8*(8), 1142. https://doi.org/10.3390/microorganisms8081142