# Measuring the activity of Saccharomyces cerevisiae through different additives

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## Abstract

This research study is to measure the activity of Saccharomyces cerevisiae, known more commonly as Baker's yeast, through adding selected additives which have been added in the hydration and proofing phase of bread making. In doing this we can measure how active the yeast is by measuring the mean weight loss of batches and comparing the results through a One-way ANOVA test to see if there is significance to what is added to what was added to help kickstart the fermentation process of the baker's yeast. The fermentation process of Saccharomyces cerevisiae performs both aerobic and anaerobic respiration during the process. (Mazzoleni, S. et al.2015) The yeast needs to intake sugars in order to do this, and with the analysis of the One-Way ANOVA that there is a significance to the additives in how it relates to the total weight loss regarding the yeast activity, $F(9,20)=14.49$, $p<0.0001$. Showing that a good rise from the activity of the yeast is not based entirely on pH level or as simple as adding lemon juice to the dough or the hydration prep of the dough rather making an environment which is better for yeast by adding an easy food source that would promote early fermentation like sugar, honey or the control like just water.

## Introduction

Making bread is a science, pretty much every yeasted bread recipe calls for the same 4 ingredients. These four ingredients are Flour, water, salt and yeast. (Fromartz, 2014). Bakers use these four ingredients in a certain ratio to quickly communicate recipes. For this study on yeast activity, the baker's percent recipe was 100%/75%/4%/2% while using 150 grams of All purpose white flour at the starting point. The 75% is the hydration level of the dough in this experiment. The goal of this study was to keep all the doughs and their ingredients measured to be able to see which additive to the yeast would create the most activity in the yeast which would be measured after being combined and kneaded in sealed containers which was sealed to see how much the weight changed, measuring to the tenth of a gram due to the yeast's activity through its strength of fermentation caused by the selected additive.

## Methods

With the purpose of measuring the activity of the Saccharomyces cerevisiae through different additives in the hydration of the dough by using ten different additives to help the yeast ferment prior to mixing in the hydration step of the dough making and measured the weight of the dough every twenty minutes for two hours after the initial mixing to see how active the yeast was based on what was added to the hydration and tracked how much weight the yeast consumed to the tenth of a gram in three batches of ten doughs. The mean results of the weight changes of the batches were then would be compared through a one-way ANOVA test to compared to a 5% significance level to see how the additives and see if there is statistical evidence is significantly different and if conclusions could be drawn to what is the best additive to help the yeast start its fermentation process and how active the yeast was based off the measured weight loss of the doughs.

## Consideration for Variables

### Procedures followed for each batch before weighing

- The containers were weighed at the start before each batch to deducted from measured weight to obtain the doughs weight.
- I measured out all ingredients individually and added. Mixed the dry ingredients together and the hydration ingredients. Only mixed them when it was needed.
- The time before adding the yeast to the hydration mixture and let the yeast proof for ten minutes before mixing and making the dough balls. The dough after being kneaded for two minutes and pushed into a container so the sides of the dough so the dough can rise unimpeded. The containers stayed sealed the entire time.

### Considerations for possible variables

- All ingredients that were used in the 3 batches made were from the same sources. For every batch of dough made, a bowl was filled with local tap and left out for least an hour beforehand to make sure there was a constant temperature for all doughs.
- Surfaces were cleared and sanitized between every batch to prevent potential cross contamination of additives to the final products.
- All ingredients were measured to the nearest tenth of a gram using an electric scale. 150g for Flour, 4.5g for Sea Salt, 3.0g for Baker's yeast and 112.5g for the hydration (with additives)

## Results

### Statistical analysis

- A one-way ANOVA followed by a Tukey Multiple Comparison was conducted to compare the mean weight loss between the ten additives . The data showed that the mean weight loss was significantly affected by the additive. The mean weight loss for both sugars and honey were significantly higher than for the other additives. Where $F(9,20)=14.49$, $p<0.0001$.

- The data that was gathered from this experiment showed that certain additives created a better environment for the fermentation process of the saccharomyces cerevisiae, which resulted in a loss of more weight by the end of the two-hour rising period than others. After averaging them out, the trends that formed indicated that the yeast was shown to be more active in white sugar, brown sugar, honey, and even the control was more active than those additives that directly affected the pH levels of the dough like the lemon juice or vinegar.


*Comparing 1.Lemon(5g), 4.Honey (5g) 8.Brown Sugar (5g), 11. Control (Water)*

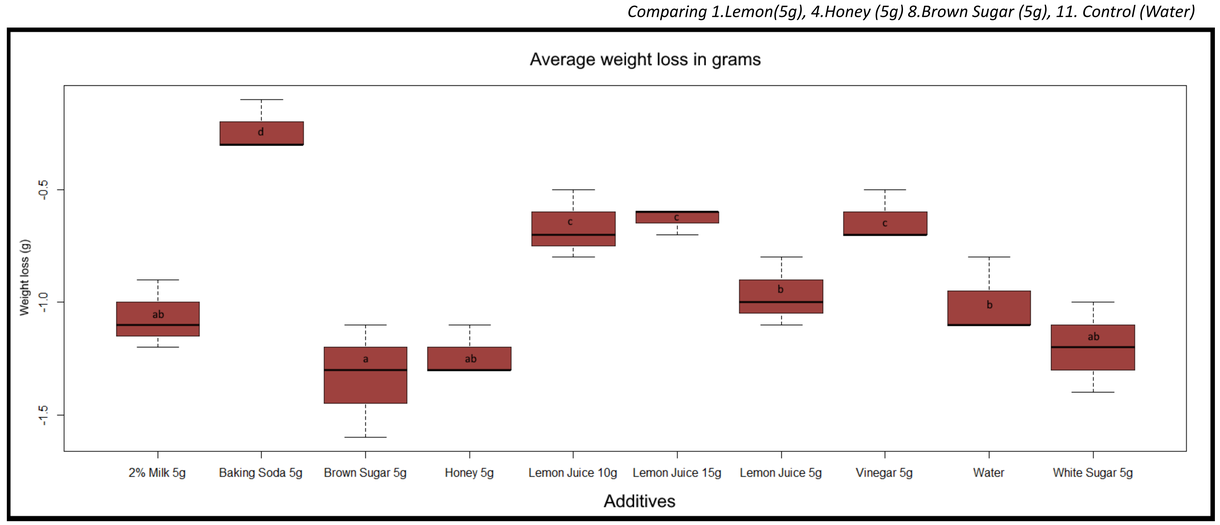


*Fig 1. This table shows the average net weight loss in grams of all three batches based off the additives that were added to the hydration and yeast proofing step. Letters in the boxes show what group they are most closely associated with in a 95% family confidence variable.*

## Conclusions

- By adding easily digestible sugars to saturate the hydration with the yeast rather than changing its pH environment is much more beneficial to the yeast for its activity to increase its rate of reaction. (Mazzoleni, S. et al.2015) We can see this by comparing the mean weight changes with each other to directly relate it to the activity of the yeast. As shown by the One-Way ANOVA test results $F(9,20)=14.49$, $p<0.0001$.
- On comparing the mean average weight loss from the dough, we saw that there is significance in the data to show that the weight loss is attributed to the additives and can relates to the activity of the Saccharomyces cerevisiae. Where $p<0.05$

## Future uses for this data

Saccharomyces cerevisiae has a wide variety of industrial uses. Using what we found here about what creates a better fermentation process could can help industries that saccharomyces cerevisiae to make things from wine and beer to ethanol. Having knowledge in what helps the saccharomyces cerevisiae in being more productive in its fermentation processes can help many industries and people who rely on it.

## Limitations

- The sample size was small. This was due to me having to do all the work to remove potential variables, Because of this I was only able to make 30 batches of dough, a larger sample size for each additive would give more data for more conclusive results.
- Time, all this was done in 1.5 weeks to try to keep the temperature both inside and outside the house consistent.
- No professional setting or measuring tools. If possible, I would of loved to have a team of people to help with the experiment.

## References

Fromartz, S. (2014) *In Search of the Perfect Loaf: A Home Baker's Odyssey.* Penguin Books.

Mazzoleni, S., Landi, C., Cartenì, F., de Alteriis, E., Giannino, F., Paciello, L., & Parascandola, P. (2015). *A novel process-based model of microbial growth: self-inhibition in Saccharomyces cerevisiae aerobic fed-batch cultures.* Microbial Cell Factories, 14(1), 1–14. https://doi.org/10.1186/s12934-015-0295-4

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