The Effect of Different Types of Alternative Sugars on Fermentation of Yeast

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Abstract

We collected data to see the effect of different types of alternative sugars on the fermentation of baker's yeast. We decided on this topic so that we could research if there was a certain type of alternative sugar that would be most effective to cook and bake with. We hypothesized that coconut sugar would produce the most CO_2. However, our hypothesis was not supported for this group of sugar. Honey ended up producing the largest amount of CO_2 on average.

Introduction

In this experiment, we tested the ability of yeast to ferment using different sugars. Two of the sugars (honey and agave) are monosaccharides, or simple sugars made up primarily of fructose. The other two sugars (coconut and maple) contain a large percent of sucrose which is composed of linked glucose and fructose monosaccharides. Only monosaccharides can be used precisely by yeast in fermentation. This means that sucrose must be broken down to its base monosaccharides by the yeast before fermentation can occur. In one of our sources, *White Sugar's Impact on Fermentation in Baking*, it suggests that both honey and maple syrup were the two best sugar substitutes for increasing fermentation process in baking because of their high mineral content.

Our research question with this project was **which sugar out of the four we tested would have the quickest fermentation results.** We decided as a group to hypothesize coconut sugar as giving us the best results out of honey, agave, maple and coconut. Ultimately though after three trial runs, honey won with an average CO_2 output of 0.25ml per minute. Coconut sugar did come in second place with an average of 0.24ml of CO_2 /min.

Methods

Materials & Location

For each individual experiment, we used 1 packet of baker's yeast, 70 mL distilled water, 5 fermentation tubes, 5 test tubes, 10 mL 20% agave solution, 10 mL 20% maple syrup solution, 10 ml 20% honey solution, 10 mL 20% coconut sugar solution, and 10 mL of control solution containing water, the incubator - set at 37.6 degrees Celsius, 6 pipets, 1 stir stick, 1 beaker, and 5 graduated cylinders. We collected our data for three weeks every Tuesday in our lab room.

Procedure

To conduct the experiments, we first labeled all our test tubes and fermentation tubes. We then mixed a stock yeast solution with our packet of yeast and water. We put 10 mL of that into each test tube, then measured out 10 mL of each sugar solution and put them into their respective test tubes. Those solutions were immediately put into their respective fermentation tubes and put into the incubator at the same time. We check the fermentation tubes until one of them reaches 5 mL of CO2. Last we removed all the fermentation tubes from the incubator and measured CO_2 at the same time.

Column1	Agave	Maple Syrup	Honey	Coconut Sugar	Control (Water)
Trial Day 1	0.24	0.25	0.28	0.16	0.01
	0.14	0.13	0.13	0.13	0.01
Trial Day 2	0.14	0.12	0.19	0.24	0.01
	0.34	0.39	0.4	0.42	0.01
Trial Day 3	0.13	0.11	0.43	0.34	0.01
	0.19	0.03	0.06	0.15	0.01
Averages (mL):	**0.20**	**0.17**	**0.25**	**0.24**	**0.01**

Table 1. This table illustrates the different measurements of mL/CO2/sec for fermentation on each trial day. It also represents the averages of fermentation rate that were found for each type of sugar tested.

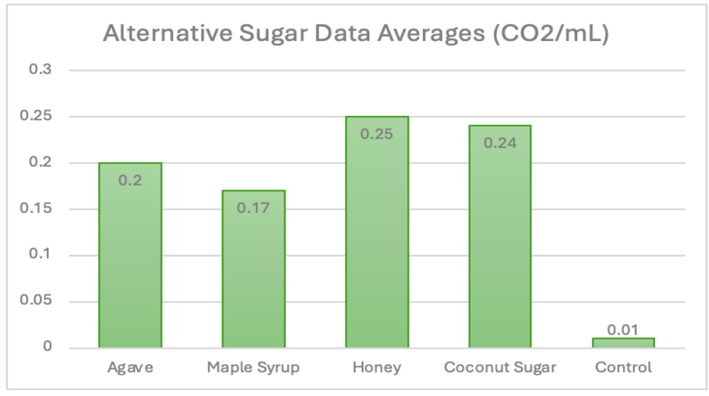

Figure 1. Is a chart showing the average measurement for each sugar out of all the trials.

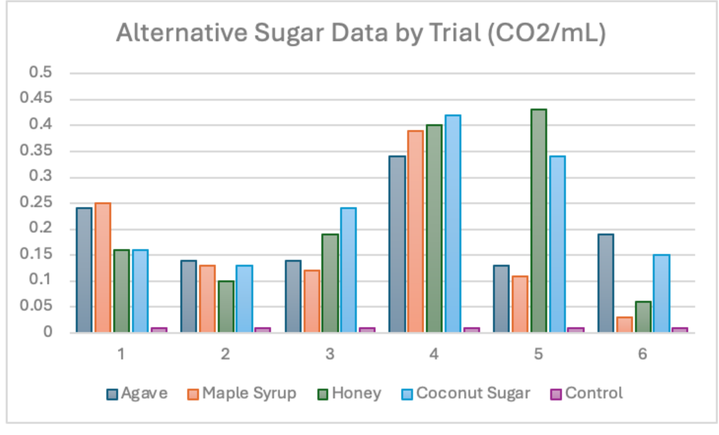

Figure 2. Is a chart showing the data for each sugar for each trial.

Figure 3. Is illustrating the fermentation tubes used for the experiments. This was after being removed from the incubator and when measurements were taken.

Discussion

After six trials were conducted, our results do not support our original hypothesis. We hypothesized that coconut sugar would produce the highest rate of fermentation in yeast. We had originally thought this due to coconut sugar being a natural sugar and possibly being less difficult for the yeast to break down. And while it came in at the second highest, it was not the highest. Honey ended up being the alternative sugar that produced the highest fermentation rate on average. On average, honey came in first at .25 mL/ CO_2/sec, coconut sugar was second at .24 mL/CO_2/sec, agave was third at .20 mL/ CO_2/sec, maple syrup was next at .17 mL/ CO_2/sec, and finally, our control group of water was the lowest, at .01 mL/ CO_2/sec.

After further research, we have found supportive evidence that honey would be a high producer of CO_2. In one of our resources, *White Sugar's Impact on Fermentation in Baking*, it states, "honey contains natural enzymes that can aid in fermentation." Additionally, as we learned in previous labs, yeast can break down monosaccharides much easier than disaccharides. Honey is a monosaccharide – our data supports this idea. Interestingly, compared to a similar study conducted by an earlier Biology class that also researched the fermentation of coconut sugar and honey (among other sugars), their results suggested coconut sugar had the highest rate of mL/CO_2/sec produced. I believe that what may have caused the difference in findings could be where the tubes were placed in the incubator and the temperature of the sugar solutions. We are guessing this may be a reason due to temperature being a catalyst for fermentation (within certain degrees).

Our study has helped us conclude that the best alternative sugar to use when baking is honey. This will help individuals who want to cook with alternative sugars, whether for dietary reasons or health reasons. Some suggestions to future researchers on this topic is to ensure when you conduct your trials, the temperature of the sugar solutions are the same for each trial and to try to get as many trial sets of tubes as early as possible, as mold/bacteria(?) began to grow in our sugar solutions after the 2nd week of trials.

Acknowledgements

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