How Alternative Sugars Affect Yeast Growth

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Abstract

How do alternative sugars affect yeast growth? We hypothesize that glucose will support the most yeast growth because it is a monosaccharide—a simple sugar that yeast can easily break down and use. Yeast samples were treated with deionized water (control), glucose, monk fruit, and coconut sugar. Weekly cell counts over three weeks using methylene blue staining and microscopy showed DI water had the highest viability, while monk fruit had the lowest. The data does not supports our hypothesis. This topic is important for understanding how sugar substitutes influence fermentation, which has applications in baking, brewing, and microbiology education.

Introduction

Just as bakers rely on quality ingredients, yeast depends on quality energy sources to thrive; however, not all energy sources are created equal. Sugar serves as one of yeast's primary energy sources, fueling the metabolic processes to grow and reproduce (Verhagen et al. 2022). While glucose has been shown to be the most studied and efficient energy source for yeast, less is known about how alternative sugars affect yeast growth over extended periods of time. In this study, we compared glucose, monk fruit, coconut sugar, and water to assess their effect on growth. As a group, we asked the question: How do alternative sugars affect yeast growth over time? We hypothesized that the yeast would grow fastest in a glucose concentrate, followed by monk fruit, coconut sugar, and diluted water, with different growth patterns varying across all sugars.

Methods

Materials & Location

Yeast samples were prepared by dissolving active dry yeast in water and dividing them into four treatment groups: DI water (control), glucose, monk fruit, and coconut sugar. Each treatment was incubated at room temperature in the lab at Whatcom Community College for three weeks. Weekly samples were collected and stained with methylene blue to count live and dead cells. Cell counts and viability percentages were determined using a hemocytometer and light microscope.

Procedure

To assess yeast growth over a three-week period, begin by adding 5g yeast packets to premade solutions. Extract 1ml of the yeast suspension and place it into a test tube, then add 9ml of methylene blue and stir to mix. Transfer a portion of the diluted solution to a hemocytometer and observe under a microscope to count live and dead cells. If necessary, further dilute using a 1:1 ratio of yeast suspension to methylene blue. Record the data and calculate cell viability by dividing the number of live cells by the total cell count. Repeat this process weekly for three weeks.

Total Live Cell Count Over Time

Treatment	Wk 1	Wk 2	Wk 3
DI Water	18000000	13100000	25000000
Glucose	6300000	52000000	22000000
Monk Fruit	800000	29200000	15000000
Coconut Sugar	9120000	44400000	28500000

Table 1. The table above provides data on the total live cell count/ml for each treatment over a three week period.

Cell Viability Over Time

Treatment	Wk 1	Wk 2	Wk 3
DI Water	73%	33%	81%
Glucose	50%	78%	37%
Monk Fruit	24%	36%	34%
Coconut Sugar	62%	63%	54%

Table 2. The table provides data on cell viability for each treatment over three weeks (Live cell count/total cell count)

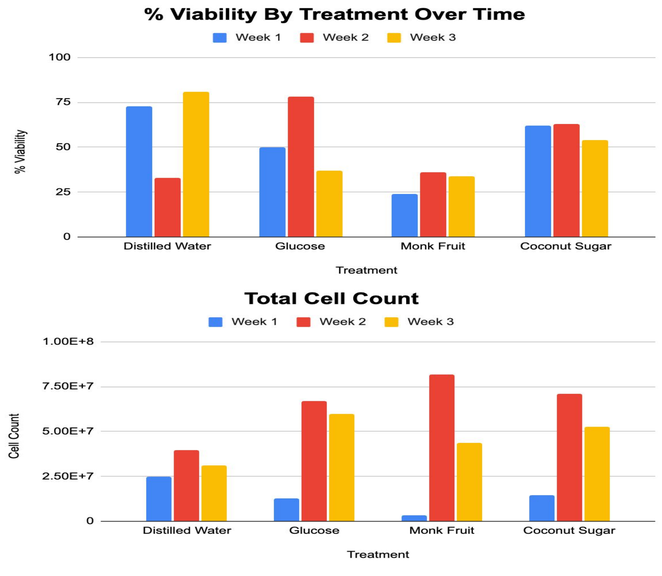

Figure 1 & 2. The graphs above illustrates the average cell count and % viability over a three week period for each treatment.

Discussion

Over the course of three weeks, we observed and collected data for three sugar types: glucose, monk fruit, and coconut sugar, as well as water. We hypothesized that glucose would produce the greatest increase in yeast growth, with monk fruit and coconut sugar showing slightly lower but comparable effects. The results of our experiment failed to reject this hypothesis, though we found notable similarities in growth patterns between the different sugars.

Results indicated there was a spike in reproduction because of a significant increase in the total cell count for glucose, monk fruit, and coconut sugar during week two, followed by a decrease in week three. To a degree of similarity, water showed a minimal increase in cell count before also diminishing in week three. For cell viability, all three sugars displayed a similar increase in week two, then a decrease in week three. In regard to our hypothesis, glucose exhibited the largest increase in cell viability from 50% to 78% between weeks one and two. As established in previous studies, glucose appears to be yeasts' preferred sugar over other alternatives. (Timmermans et al., 2025) This preference may be due to glucose monosaccharide structure, compared to coconut sugar primarily disaccharide structure and monk fruit's mogrosides content. (Daniels, 2018).

While this experiment did not give a definitive answer to our question, it did provide useful insight into how alternative sugars affect yeast cell production. Due to the drastic fluctuations in the data, a revised experiment that collects measurements at more frequent intervals may provide more reliable results, yet these findings are helpful for future research.

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