

Impact of Alternative Sugars on Yeast Cell Growth and Viability

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Abstract

This study shows the relationship between yeast cell growth and alternative sugars. We predicted that yeast grown with alternative sugars would show a different growth pattern than yeast that is fed cane sugar. Our data shows that the yeast fed with the three alternative sugars(Monk fruit, Stevia, and Coconut Sugar) constantly stayed below the yeast that was fed cane sugar. As the demand for healthier alternatives increases, understanding how alternative sugars affect yeast-leavened products is crucial for the baking industry to ensure high-quality traditional products are maintained while keeping up with changing consumer preferences.

Introduction

How do different sugars affect yeast cell count? Our data does not support our hypothesis that alternative sugars would decrease cell growth of the yeast. We found from our data that cane sugar, monk fruit, and coconut sugars speed up cell growth in the yeast, while stevia does not. During alcoholic fermentation, yeast converts sugars into carbon dioxide and ethanol, preferring glucose consumption opposed to fructose and maltose (Timmermans E, et al. 2022), this is why cane sugar had the highest and steadiest live cell growth. Our findings are useful for baking with yeast fermentation, for reference sourdough, because if choosing to use an alternative sugar over cane sugar, the best low-calorie option between stevia and monk fruit would be monk fruit. This is because monk fruit shows live yeast cell growth similar to cane and coconut sugar, representing yeast feeding. Stevia is an alternative sugar that is not fermentable (Orellana-Paucar, A.M., 2023) which is represented in our data, it was not feeding the yeast compared to the other sugars. Interestingly stevia does express delayed cell growth in our experiment, however stevia is not fermentable and this growth is likely from the yeast's stored energy. We know that pure stevia extract is non-fermentable, because there is sugar and non-sugar that is bonded, the fungal cells are unable to divide the glycoside bonds to release the sugar, making it unfermentable (Biology Insights, 2025). It is useful to know that fermentation metabolites affect dough properties and the bread characteristics (Timmermans E, et al. 2022).Therefore using sugar in a sourdough starter, our data supports that cane sugar is the best four options, and monk fruit is the best of two low calorie options.

Methods

Materials: pipette, beaker, glass rod, test tube, microscope, yeast packet, hemocytometer, methylene blue, stevia, coconut sugar, monk fruit, cane sugar, water, 10 mL pipette pump

Procedures:

A yeast solution was prepared by mixing water with a yeast packet. Four beakers were prepared containing different sugars: cane sugar (control), stevia, coconut sugar, and monk fruit. Each solution contained 20% sugar and was allowed to react.

Samples from each mixture were placed into test tubes. Methylene blue was then added at a 1:4 ratio of mixture to methylene blue to stain the dead cells. A pipette was used to place a drop of each sample onto a hemocytometer slide.

The slides were observed under a microscope, and both alive and dead yeast cells were counted for each sugar treatment. The experiment was repeated. All variables, such as temperature, yeast concentration, and solution volume were kept constant.

Discussion

The results of this study supported our original hypothesis which was “if we used and alternative sugar to feed the yeast then the yeast cell count would be lower.” In our findings cane sugar(blue line) that represents our control, remained a higher viability percentage most of the way over the three days. Furthermore stevia(yellow line), Monk fruit(red line) and coconut(green line) consistently stayed below cane sugar for majority of our research project. this means that these alternative sugars are less supporting of yeast viability then traditional cane sugar which also leads to a decrease in sourdough rise level.

As mentioned in the introduction by (Timmermans E, et al. 2022) during alcoholic fermentation, yeast likes to convert sugars into carbon dioxide and ethanol and prefers glucose. This connects to our findings as cane sugar is disaccharide made of one glucose molecule and one fructose molecule, which is why the viability of yeast cells stayed higher than the alternative sugars because cane sugar was easily broken down as that's was the fermentation process preferred. This also connects to why the alternative sugars didn't perform as well as cane sugar because monk fruit and stevia are sugars that don't contain glucose and if there's no glucose then there is no fermentation process to even start. This leads to lower viability cells which means lower bread rise in sourdough as shown in the graph above. However, coconut sugar does have glucose but is less refined as coconut sugar has higher concentrations of other sugars.

Overall, without the glucose from cane sugar the fermentation proves cannot take place in sourdough fermentation which would decrease sourdough rise levels. For a future study we could show how different flour interactions interact with sugar to support yeast viability

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Effects of Different Types of Sugars on Yeast Viability Over 3 Days

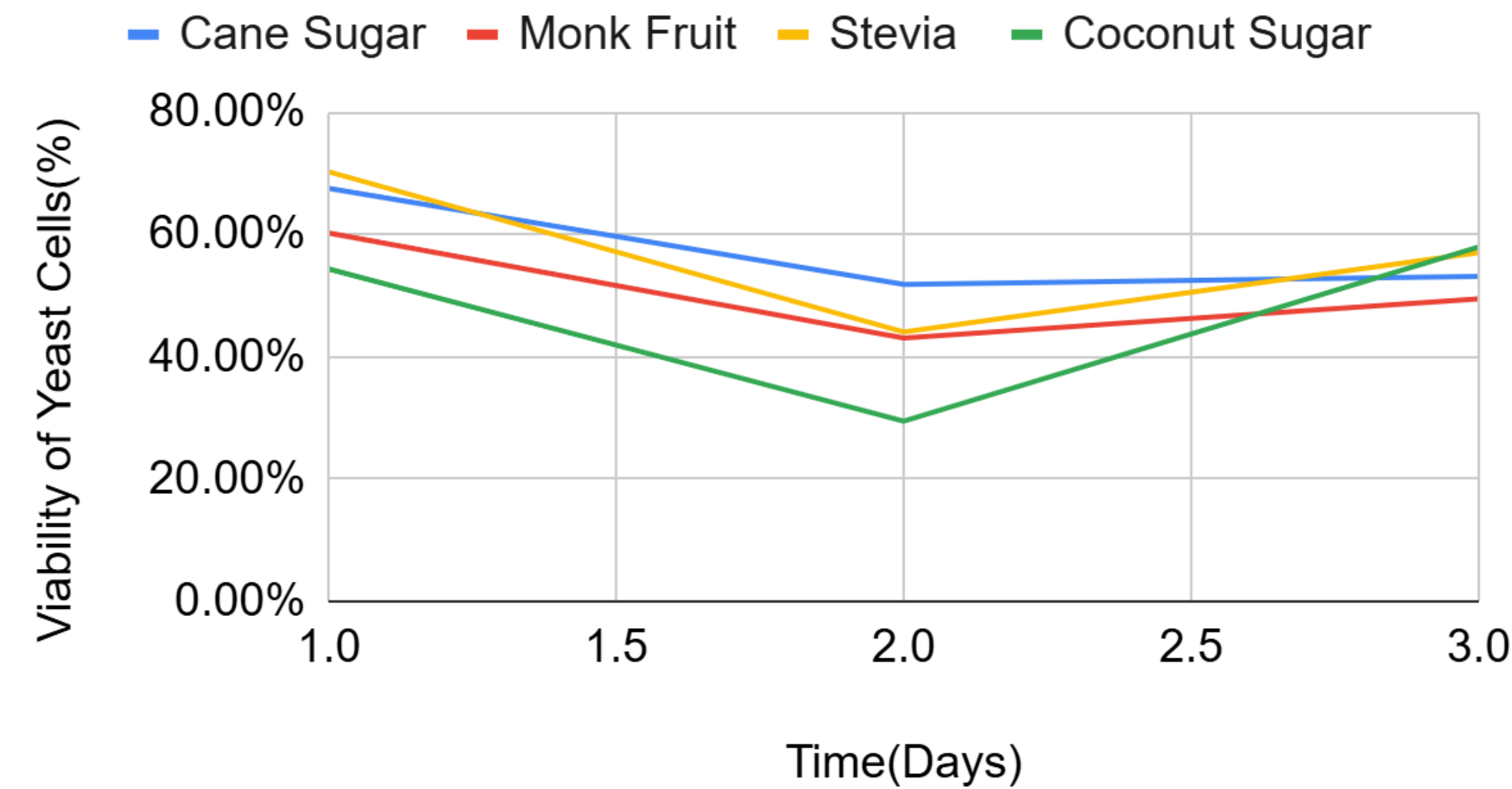


Table 1. Yeast cells were counted once a week over a 3-week period, to determine the effect on Cane Sugar, Monk Fruit, Stevia, and Coconut sugar on yeast viability(%).

Effect Of Different Types of Sugars On Yeast Growth Over 3 Days

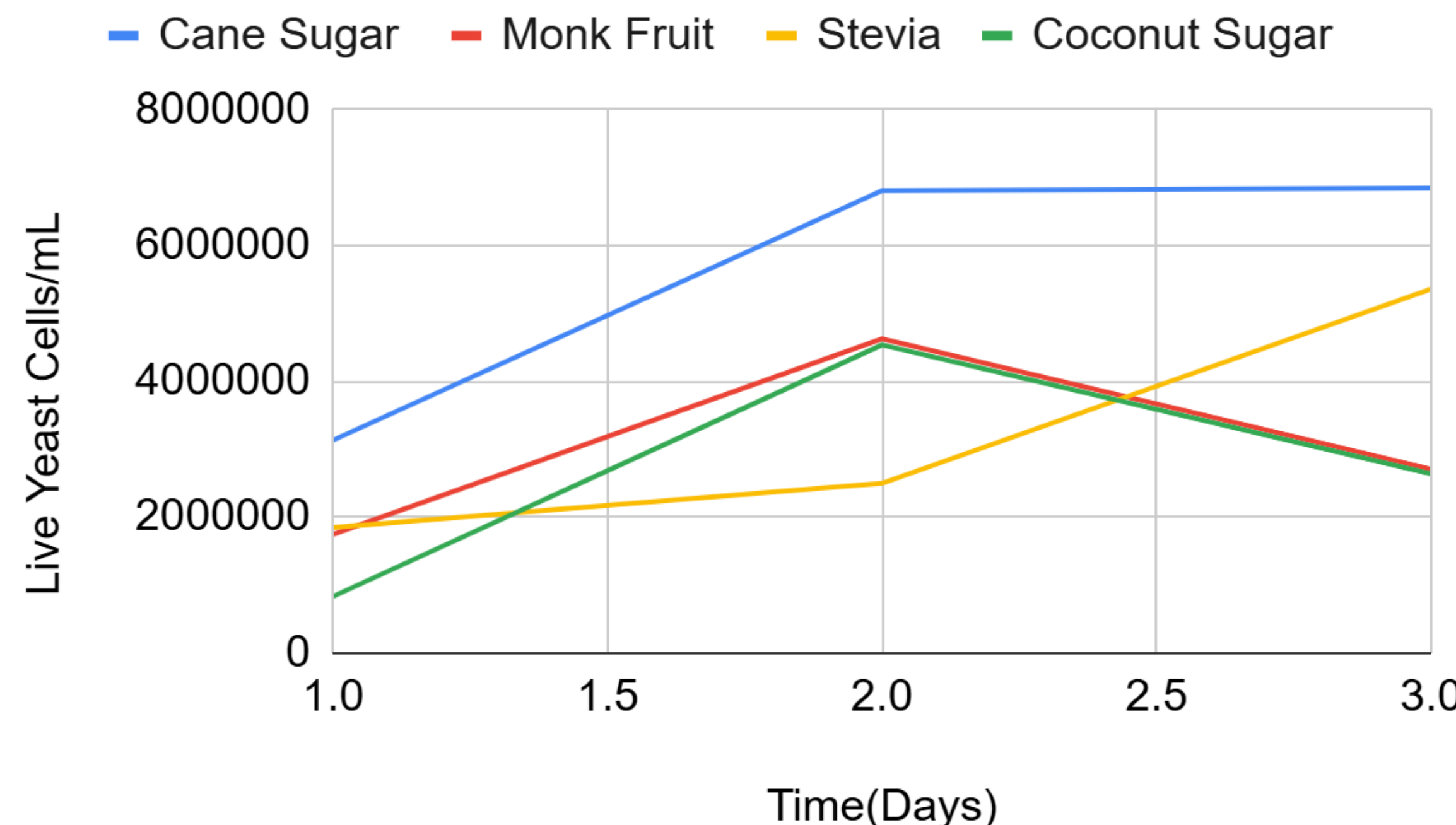


Figure 2. Live yeast cells per mL were recorded once a week over a 3-week period to measure the effect of Cane Sugar, Monk Fruit, Stevia, and Coconut Sugar on yeast cell growth.