How Alternate Sugars Affect Cell Growth and Fermentation

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Abstract

This experiment investigated the effects of alternative sweeteners on yeast fermentation and cell growth. We hypothesized that alternative sweeteners would result in lower fermentation rates and reduced yeast cell growth compared to sucrose. Yeast cultures were exposed to different sweetener treatments, and fermentation was measured by carbon dioxide (CO_2) production while cell growth was measured using a hemocytometer. Results showed that sweetener type influenced both fermentation and cell growth. Sucrose generally supported greater yeast activity, while alternative sweeteners showed lower levels of growth and fermentation. These findings suggest that sweetener type affects yeast metabolism and overall population growth.

Introduction

Artificial sweeteners are commonly used as alternatives to sugar in foods and drinks because they provide sweetness with little to no calories. As the use of sweeteners continues to increase, it is important to understand how they affect living organisms. Yeast is a useful model organism because it grows quickly and relies on sugars for energy through cellular respiration and fermentation. The purpose of this experiment was to decide how different alternative sweeteners affect yeast cell growth and fermentation. We hypothesized that sucrose would have the highest yeast growth and fermentation because it is a metabolized sugar, while alternative sugars would result in reduced growth and lower carbon dioxide production.

Methods

Materials & Location

This experiment was conducted in KUL 110 at Whatcom Community College. Materials included 20% sucrose solution, Monk Fruit sweetener, Stevia sweetener, Zero Cal sweetener, active yeast cultures, fermentation tubes, test tubes, pipettes, a 10 mL pipette pump methylene blue, a hemocytometer, and a microscope.

Procedure

Yeast cultures were exposed to sucrose, Monk Fruit, Stevia, Zero Cal, water, and was monitored over 4 weeks. Fermentation was measured by placing yeast and sweetener solutions into fermentation tubes, placed in an incubator and recording the amount of carbon dioxide produced. To measure cell growth, yeast samples were mixed with methylene blue and water and put into a hemocytometer. Live and dead cells were counted under a microscope. Data was collected weekly and was used to compare the effects of each sweetener on yeas growth and fermentation.

Effect of Alternative Sweeteners Yeast Cell Growth over Four Weeks

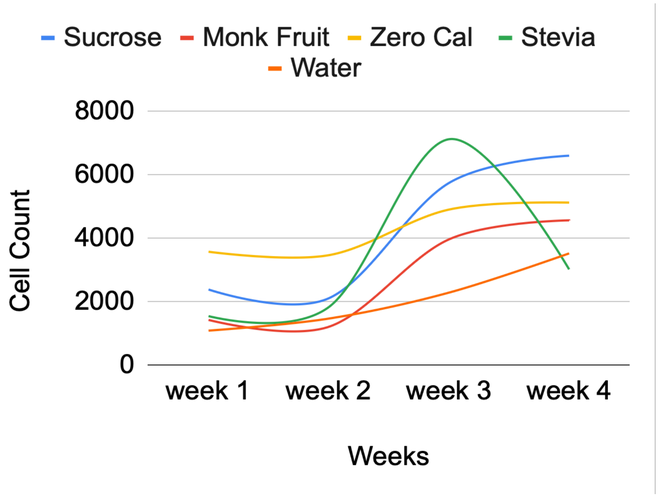

Figure 1. This Graph illustrates the effect of different sweetener treatments (sucrose, monk fruit, zero-calorie sweetener, and stevia) on yeast cell growth over a four-week period. Cell counts were found using a hemocytometer and are reported as cells per milliliter (cell/mL). The x-axis represents time in weeks, and the y-axis represents yeast cell count.

Effect of Different Sweeteners on Yeast Fermentation Rate Measured by $C0_2$ Production Over Four Weeks

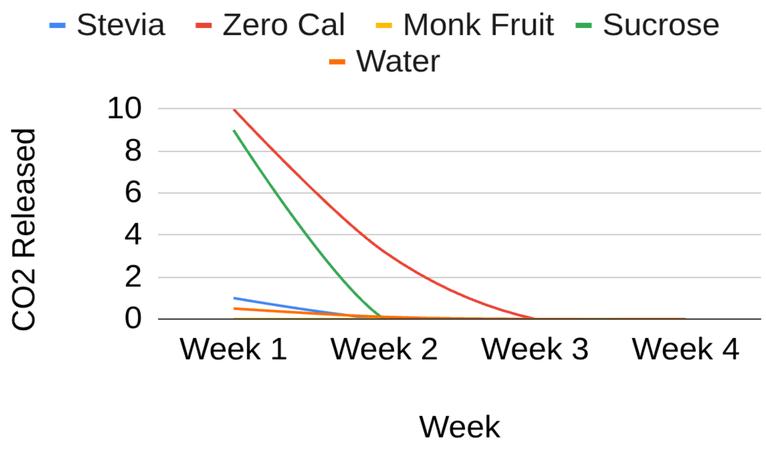

Figure 2. *This graph illustrates the effects of different sweetener treatments (sucrose, monk fruit, zero-calorie sweetener, stevia, and water) on yeast fermentation over a four-week period. Fermentation rate was measured by the amount of carbon dioxide released. The x-axis represents time in weeks, and the y-axis represents CO_2 released (mL).*

Discussion

The main objective of this experiment was to figure out if alternative sugars have an effect on yeast fermentation and cell growth. The results ended up showing that Sucrose had the greatest yeast activity, but all the different sweeteners with yeast had no fermentation happen. These findings slightly contradict our original hypothesis where we thought that they would all be a lower rate but measurable for both yeast cell growth and fermentation rate. The absence of activity with fermentation shows the possibility that something stopped the fermentation entirely.

To interpret what we found, yeast is metabolized in two different ways through either aerobic or anaerobic respiration. From our findings with our fermentation not happening for any of the sugars it is possible that the yeast could have had too much oxygen getting to it to cause aerobic respiration to happen. Because of the cell growth and no fermentation, the aerobic pathway happened to then allow the yeast to metabolize and grow in cell count rather than kick start anaerobic respiration to make fermentation start. Furthermore, the various sugar contents also could have been a factor for only cell growth happening. The yeast possibly focused on the sugars and prioritizing the cell growth over fermentation.

Lastly, these results show the important implications into how the research in the future is affected. For future research we suggest that it is a necessity to make sure no excess oxygen get into the anaerobic pathway. By utilizing more airtight containers, to not shake the various concentrations, and possibly lower all the different sugar concentrations it will help build future research. Implementing these will allow for a more precise look at alternative sugar metabolism and to clarify if these sugar substitutes can be a decent alternative to sugar in fermentation.

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