Correlation Between Fermentation Rate and Protein Content in Different Sugar Solutions

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Abstract

The purpose of this experiment was to investigate and compare protein content in yeast and whether its fermentation rate correlates to its protein content when exposed to different sugar sources. Yeast solutions were incubated with 20% brown sugar, coconut sugar, sucrose, powdered sugar, and stevia. Fermentation rate was measured as an indicator of yeast metabolic activity, while protein content was analyzed to determine which sugar has the highest protein content to fermentation rate.

Introduction

Yeast makes proteins including enzymes that help break down sugars and support growth. Studies have shown that protein levels in yeast change during fermentation, with key enzymes increasing as the yeast becomes more active (Department of Microbiology and Ecologies, University of València). With the growing population, yeast protein is an attractive alternative to traditional protein sources such as plants and meat. Moreover, yeast protein biomass also has trace minerals and vitamins including B-group. Thus, using yeast in the production of protein provides both valuable nutrients and enhances purification of wastes. In conclusion, nutritional yeast protein biomass may be the best option for human and animal nutrition with a low environmental footprint. In this experiment, over a three-week period, we looked at whether yeast that ferments faster also has a higher protein rate when exposed to different sugar types. We predicted that yeast with lower fermentation rate would also have a higher protein content because faster metabolism should support faster growth and reproduction.

Methods

Materials & Procedure

Fermentation Lab

We began by labeling five clean test tubes (1-5). Next, we mixed one packet of yeast with 50mL of water. Using a pipette, 10 mL of this yeast mixture was added to each test tube. Next, 10 mL of a 20% sugar solution was added to each tube. A new pipette was used for transferring to prevent cross-contamination. The sugar solutions tested were brown sugar, coconut sugar, sucrose, powdered sugar, and stevia, with each one assigned to a different test tube. Each mixture was then transferred into a correspondingly labeled fermentation tube, ensuring that there were no air bubbles. The fermentation tubes were placed in a 37°C incubator for 20 minutes. After incubation, fermentation rates were measured and recorded.

Descriptive Title for your Table

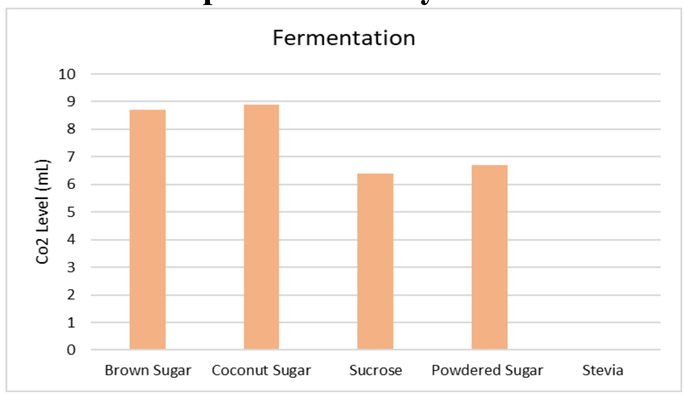

Table 1. A brief description of what this title illustrates, include the types of methods, the titles and appropriate units

Descriptive Title for your Graph

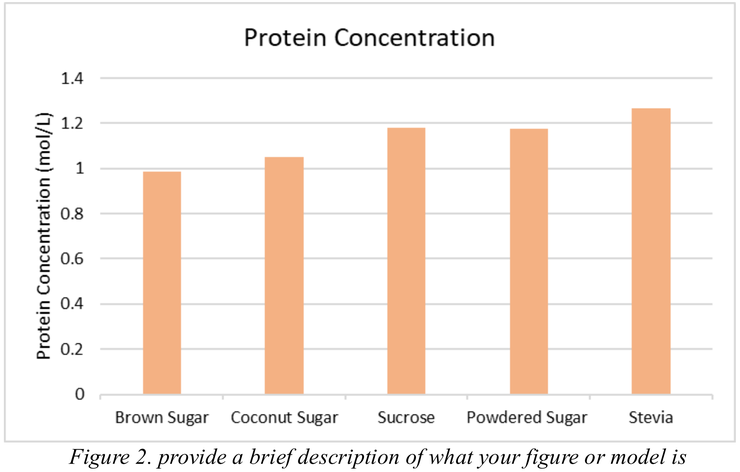

Figure 2. provide a brief description of what your figure or model is illustrating. It should help to build the case of the outcomes of your research.

Bradford Assay

Using a P-1000 micropipette, 1mL of each sample was transferred into five separate 2.0mL clear microcentrifuge tubes containing glass beads. The samples were then vortexed for 1 minute to lyse the yeast cells and release intracellular proteins. Next, 20µL from each lysed sample was transferred, using a P-20 micropipette, into five new microcentrifuge tubes containing phosphate-buffered saline (PBS). For the protein assay, 900µL of Bradford reagent was added to six clean cuvettes. Then, 20µL of each yeast sample (in PBS) was added to five of the cuvettes. The remaining cuvette, containing only Bradford reagent, was used as a blank to calibrate the spectrophotometer at an absorbance of 595nm. After calibration, the absorbance of each sample was measured, and the data were recorded.

Discussion

We hypothesized that the sugar which causes the least amount of fermentation would result in the highest protein content. Stevia caused the least amount of fermentation, producing an average of 0mL even after the 20 minutes of incubation. Stevia's average protein content was 1.260mol/L, the highest average protein content out of all the sugars. This supports our hypothesis.

Two students that did a similar experiment were Heather Edeen and Viktoriya Melnk. In their experiment studying the correlation between fermentation rate and protein content in yeast, they achieved results that supported our hypothesis. The two test tubes that showed the least fermentation, water and sucrose, resulted in a higher protein content that any of their other test tubes. However, their results were affected by mold that grew in their sweetener solutions. A potential error that could have affected our findings was the amount of sugar solution and yeast solution added to each test tube. In two of our trials, we added the solutions 10mL at a time. For the other two, we added the solutions 5mL at a time. This gives room for potential differences in measurement. Another potential error was the wait time between measuring the protein content of the samples. Although we moved through the process in a timely manner, minor differences in fermentation time could have affected our results.

Although the results did not show perfect correlation, there does appear to be a trend between lower fermentation and higher protein content. As we stated, yeast protein is a possible alternative for traditional proteins, with additional nutritional benefits. Studying which sugars interact with yeast to produce the highest protein content would be valuable knowledge for further research of alternative nutrients. Future research would benefit from collecting data from a wider range of sugars. Additionally, these studies should be sure to change the order of solutions as they are measured for protein content each trial, to ensure that the results are not affected by these timing differences.

References/ Work Cited

https://pmc.ncbi.nlm.nih.gov/articles/PMC7466055/
https://pmc.ncbi.nlm.nih.gov/articles/PMC8780597/