Correlation Between Fermentation Rates and Protein Production

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Abstract

This study investigated if yeast fermentation rates correlate with protein production across different substrates. Yeast was incubated for 60 minutes with sucrose, distilled water, and whole wheat, spelt, and dark rye flours. Fermentation was determined by CO2 production, and protein concentration was measured via a Bradford assay. Results in showed sucrose fermented fastest (0.233 ml CO2/min), while whole wheat yielded the highest protein (1.400 mol/L). Dark rye performed lowest among flours in both metrics (0.018 ml CO2/min; 1.005 mol/L). The hypothesis was not supported, demonstrating that total protein density does not predict yeast fermentation speed.

Introduction

In the Bradford Assay Lab, we measured the protein concentration of different sugar types. We also previously had looked at the fermentation rates of different sugars This lab made us curious about seeing if there was a correlation between protein concentration and fermentation rates in other variables which in turn brought us to our research question: Is there a correlation between fermentation rates and protein production in different types of flour? Our purpose was to see if different types of flour such as dark rye, whole wheat, spelt flour would have some sort of correlation from fermentation rates to protein concentration. We used even sucrose and distilled water as our control variables. Specifically, we decided to focus on dark rye where we came up with our hypothesis: If there is a correlation between high fermentation rate and high protein production then, dark rye will have the highest.

Methods

Materials & Location

The experiment was conducted in a classroom lab using standard lab equipment. Materials included a packet of yeast, five fermentation tubes, distilled water, 20% sucrose solution, and flours (spelt, dark rye, and whole wheat), along with a vortex mixer, spectrophotometer, and spectral analysis software.

Procedure

A yeast suspension was made by mixing one packet of yeast with 50ml of water. Adding 10ml of this suspension into five labeled fermentation tubes, followed by 10ml of sucrose, spelt, dark rye, whole wheat, and distilled water. We inverted the tubes to remove air bubbles and incubate for 45 minutes. After incubation, we measured, and recorded CO2 production. For protein analysis, we took 1.0 ml of the yeast samples and transferred into labeled microcentrifuge tubes. Vortex all samples for one minute. Wearing gloves and goggles, we pipetted 100ul of yeast samples into labeled PBS tubes. Then add 900ul of Bradford reagent into a cuvette, followed by 100ul of the PBS yeast samples. Allowing to sit for 2-3 minutes then measuring the absorbance using the spectrophotometer and spectral analysis software.

Average Numbers of Fermentation and Protein Concentration

Substrates	Fermentation Rate (ml CO2/min)	Protein Concentration (mol/L)
Whole Wheat	0.075	1.400
Spelt Flour	0.080	1.254
Dark Rye	0.018	1.005
Sucrose	0.233	0.783
Distilled H2O	0.000	0.446

Table 1. The chart above shows the different fermentation rates and protein concentrations of the variables. All substrates fermented over a 45 minute period

Relationship Between Fermenation Rates and Protien

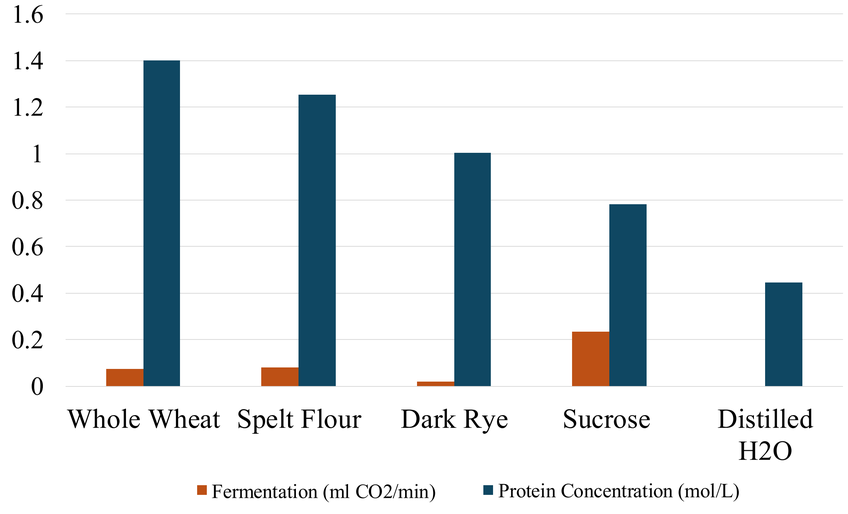

Figure 2. shows the rate of fermentation alongside protein production showing that there is no clear correlation between to the two.

Discussion

The results of our experiment did not support our hypothesis. We hypothesized that if a higher fermentation rate correlates with higher protein production, then dark rye flour would have the highest values for both. However, our data showed no such pattern. According to our data, whole wheat flour yielded the highest protein concentration at 1.400 mol/L, followed by spelt at 1.254 mol/L, and dark rye at 1.005 mol/L. For fermentation, spelt had the highest rate among the flours at 0.080 ml CO2 /min, followed closely by whole wheat at 0.075 ml CO2 /min, while dark rye was the lowest of all tested substrates at just 0.018 ml CO2 /min. Because dark rye performed the poorest in both categories and the other flours did not appear to show a correlation, we concluded that higher protein concentration does not automatically mean a higher fermentation rate.

Our results suggest that a flour's total protein content and how well yeast can ferment it are two independent traits. Our protein readings align well with outside research. A study comparing fermentation gas production across flour types found dark rye flour to contain approximately 8.02% protein while fine stone-ground whole wheat flour contained 14.47% protein which closely mirrors the gap we observed (Rizzello). Additionally, spelt consistently maintains high protein, explaining why it was a close second in our study (Geisslitz). Dark rye's low fermentation rate is likely due to its complex starches, which require more time and specific enzymes to break down into the simple sugars that the yeast can actually digests (Number Analytics). Our 45 minute trial was too short for the yeast to access these complex nutrients. Other research found that active fermentation can actually reduce protein levels over time, meaning these two factors often work against each other rather than together (Noorlaila). Aside from the short timeframe, our study was limited by classroom conditions, including minor temperature fluctuations and slight variations in the consistency of our yeast suspensions.

This experiment helped resolve our original question by showing that us that there is no direct correlation between fermentation rates and protein concentration among the substrates we tested. To build on these findings, future studies should look at what simple sugars helps these flours ferment. It is also recommended that researchers extend the incubation window past 45 minutes so that slower-acting, complex grains like dark rye have enough time to properly ferment and develop protein.

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