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How the Sugar in Energy Drinks Affect Yeast Fermentation

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Biology 160: General Biology W/ Lab

Abstract

The experiment tested how energy drinks affect yeast fermentation compared to a 20% sucrose control. Yeast was mixed with energy drinks (Monster, Bang, Alani, and Ghost) and sucrose solution. The mixtures were kept at 37°C, and CO_2 production was checked every 5 minutes for 20 minutes. We hypothesized Monster would increase fermentation the most. However, Ghost showed the highest fermentation, surpassing the sucrose control, while Monster, Bang, and Alani produced little gas. These results suggest some energy drinks help fermentation, while others may inhibit it. More research is needed to identify the responsible components.

Introduction

Fermentation means that yeast changes sugars into ethanol and CO_2 without oxygen being present. The rate of CO_2 production can be trusted as a sign of how fast fermentation is taking place. Yeast is able to ferment glucose and sucrose well, so a 20% sucrose solution is usually used as a positive control. A combination of sugars, artificial sweeteners, caffeine, amino acids, preservatives and vitamins in energy drinks may change the rate at which fermentation happens. A few of these ingredients add nutrients, while others help to stop yeast from growing. This experiment was done to compare the effects of four energy drinks (Monster, Bang, Alani and Ghost) on yeast fermentation with those of a 20% sucrose control. Research shows that the ingredients in a substance can either help or harm yeast activity, depending on how they affect the yeast's environment (Hallsworth et al., 2006).

Methods

Materials & Location

- 4 energy drinks (Monster, Bang, Alani, and Ghost)
- 4 containers with lids (for energy drink solution)
- 20% sucrose solution
- 5 fermentation tubes
- 5 graduated cylinders.
- 5 pipettes
- 5 yeast packets
- stopwatch
- distilled water

All experiments and data collection were done in the WCC Biology Lab

Procedure

1. Label five fermentation tubes for each treatment: Monster, Bang, Alani, Ghost, and 20% sucrose (control).
2. Prepare the yeast suspension by adding 5g of active dry yeast to 50 mL of warm water.
3. For each energy drink, mix 80 mL of water with 20 mL of the energy drinks to dilute the treatments.
4. In a different graduated cylinder, combine 10 mL of the yeast suspension with 10 mL of each treatment mixture (energy drink and sucrose solution).
5. Pour each mixture into its labeled fermentation tube. Place all tubes in the incubator and set temperature to 37°C. Record CO_2 gas levels at 5-minute intervals for 20 minutes.
6. Repeat trials to ensure consistent data.
7. Calculate the average fermentation rate for each treatment (mL CO_2/min).

Table 1. The picture above shows the 5 different fermentation tubes used from trial #3 in our study. The control fermentation tube (leftmost in the front) was usually the one with the highest fermentation rate. After multiple trials, Ghost (far right) ended up having higher fermentation rates consistently.

CO2 Production from Energy Drinks per Min

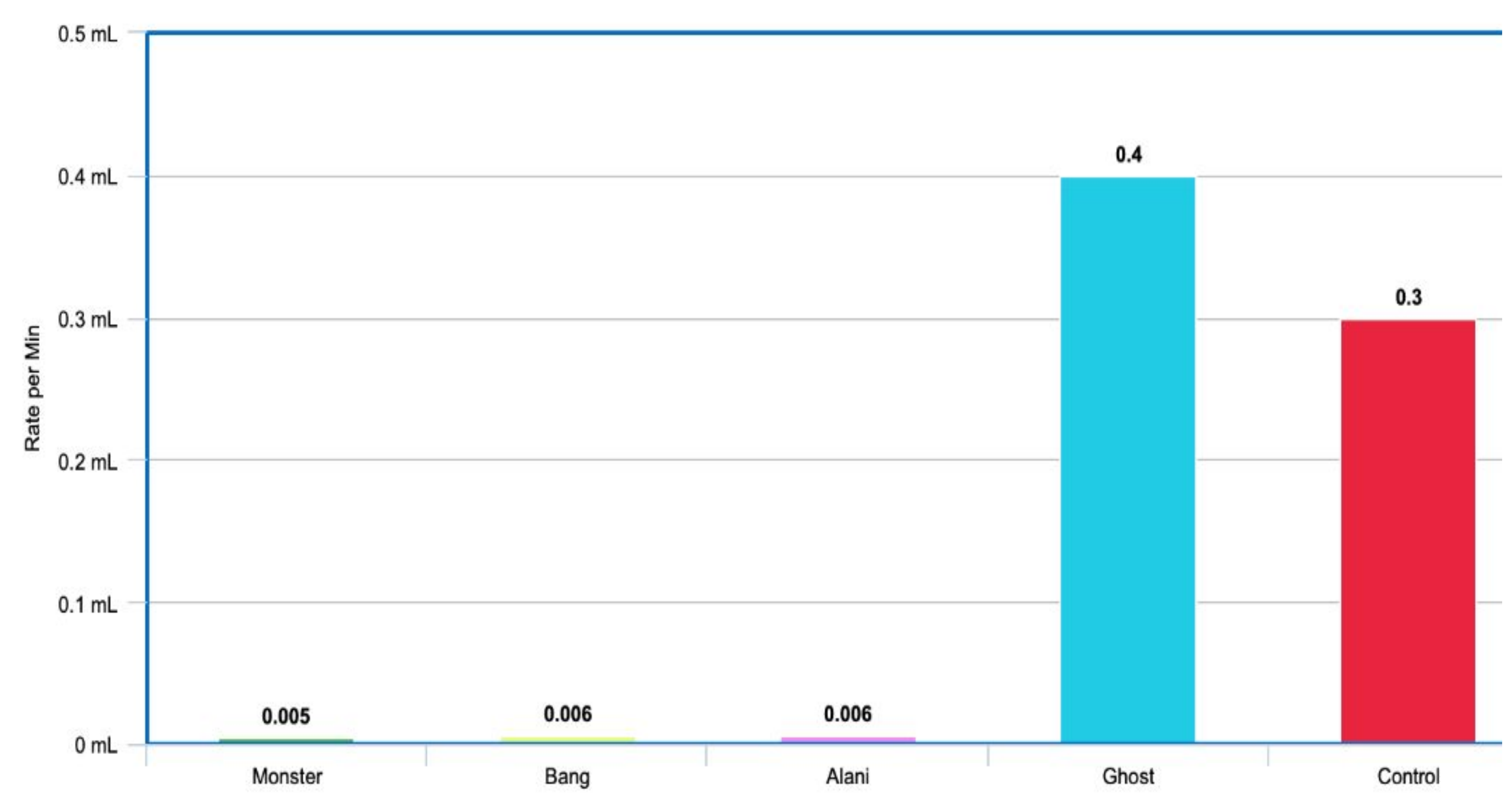

Figure 1. Average fermentation rates per solution (Monster, Bang, Alani, Ghost, and Control). Ghost's CO_2 production measured at 0.4mL/min, while the control's CO_2 production measured at 0.3mL/min.

Discussion

Data indicates that Ghost had the highest average CO_2 production, even more than the 20% sucrose control. Therefore, it seems that Ghost has ingredients that can be fermented by yeast such as sugars, amino acids, or nutrients not in the other drinks. This supports previous findings by Hallsworth et al. (2006), who demonstrated that certain solutes can stress or benefit microorganisms depending on their chemical nature. On the other hand, Monster, Bang and Alani had very low fermentation rates, just like the baseline. Ghost was the only energy drink that produced more CO2 than even the sugar control, suggesting it contains ingredients that significantly enhance yeast activity. Meanwhile, the other drinks showed fermentation levels close to zero, indicated a strong inhibitory effect. Sucralose, sodium benzoate and high levels of caffeine are often found in these drinks and they can stop the yeast from growing. It confirms our hypothesis that artificial ingredients would slow down the process. Using 20% sucrose as a control allowed us to compare other samples with high fermentation ability. Ghost surpassed the benchmark, but the other energy drinks did not even come close, proving there is a big difference in how they affect yeast. One drawback is that the actual concentrations of ingredients or their pH levels are not always known which can influence fermentation. In the future, researchers may study specific compounds (for example, caffeine or sucralose), test more brands of energy drinks, and experiment with different yeast strains to confirm the findings.

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