Whatcom COMMUNITY COLLEGE

The Effect of pH on Yeast's Buffer System

Imelda Oungouramang, Lisa Cummings, Margarita Gonzales
Biology 160: General Biology

Abstract

This study was performed in order to determine how pH levels effect yeast's buffer system. Our hypothesis was the yeast's buffer would slow down the more basic the solution became. The data supported our hypothesis, however we discovered the introduction of acid immediately overcomes the buffer and the pH will not attempt to return to a neutral state. This data collection is important because yeast is a powerful model organism that enables a better understanding of human biology and disease. Furthermore, the data collect could initial research questions such as if these results congruently translate to a human's buffer system.

Introduction

Yeast is something that can be found everywhere. It can be found in your pasta, bread, and even pet food additive. My partners and I pondered on how yeast and PH level affect each other using different solutions. A topic of how buffer reacts in a relatively high concentration (love KR 2018). As well as an article on how the different level of PH can affect the growth of yeast (Alexander, M 1971) which helped narrow down our research. Lastly we found an article that explains why buffer doesn't affect or work with acidic yeast (Dennis B) especially weak acids. In our research we look for information covering why buffer doesn't affect acidic yeast and why does it basically kill the solution by breaking it down. After much reading and contemplating we had come up the question, why does the buffer only work when it comes to basic Ph and not acidic? Our hypothesis was that the yeast's buffer will slow down the closer the pH gets to 14, most basic.

Methods

Materials & Location

The present experiment was conducted on campus in the microbiology lab. Pre-experiment preparations included filling three beakers with 50 mL of water and 5 grams Red Star Premier Blanc Yeast. A 20% solution of sucrose was measured and set aside. We then set up a continuous pH monitor meter to a laptop and calculated the program to collect 1 pH sample every 1 second. Lastly, we set aside a solution of 1.0M NaOH, and of 1.0M HCl, both with identical chemical droppers.

Procedure

Beaker 1: *Step 1* – set yeast solution on top of magnetic stirrer and insert pH probe. *Step 2*: at 20 seconds administer 2 drops of NaOH every 2 minutes. Repeat for 10 minutes. **Beaker 2**: Repeat *Step 1* and *Step 2* except substitute HCl for NaOH. **Beaker 3**: Repeat *Step 1*. Add sucrose to yeast solution. Repeat *step 2* with NaOH.

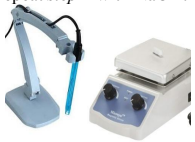

Figure 1. The instrument on the left is a pH meter probe. The instrument on the right is a continuous magnetic stirrer

Table with Yeast pH levels v. Time

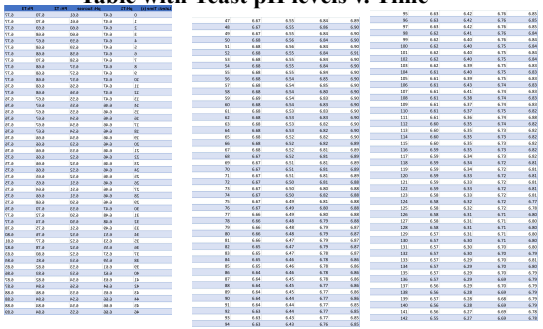

Table 1. Table shows the numeric values of pH level changes when NaOH (a base) is added. The time column is in seconds

Yeast Graphs: pH levels v Time

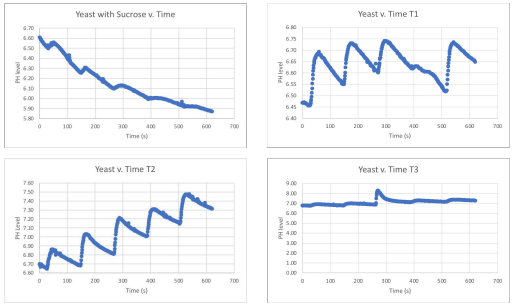

Figure 2. The graphs show the change in pH levels when the NaOH (base) is added. It's easier to see when the buffer is broken because the pH level doesn't drop as for down below. The change is noticeable

Discussion

At the completion of our experiment, we found the data collected supported our hypothesis that the buffer system would actively attempt to return the pH to a neutral state until a large dose of basic solution was present. During our trial experimentation with adding NaOH to the yeast solution in water, there is anomaly around 4 minutes with the pH drastically changing, and then no longer able to return to neutral. However, when acid was introduced to the yeast solution whether via HCl or sucrose the buffer system was almost immediately deactivated.

The results of the experiment are supported by the biological process of ionization or dissociation. In a solution of pure water at neutral pH 7, some water molecules will ionize, or dissociate, into H+ ions and OH- ions. Because the water is pure, there will always be the same number of H+ and OH- ions. However, when a compound that contains H+ ions is introduced into the water, the H+ ion concentration will increase. The greater concentration of H+ ions causes the water to become more acidic, and so the pH drops. Buffers maintain a constant pH because they combine with H+ ions and either remove them from solution or add them back, essentially "soaking up" the acid or base. If enough acid or base is added, it will eventually overcome the buffer and the pH will rise or fall accordingly.

Yeast share many genes with humans, but grow a lot faster. While human cells divide a rate of about once every 12 hours, yeast divides once every two hours or so. Due to the results of experiment, the argument could be made that high acid or basic pH levels have the same effect on our buffer system but perhaps at a slower rate.

Acknowledgements

We would like to give a special thanks to our teacher Lauren Maniatis for helping us navigate this scientific experiment. For not only providing the location and all of the materials needed, but also helping us narrow down a specific research question.

References/ Work Cited

Dennis Bayrock Global Director Fermentation Research Lactrol Phibro Ethanol Performance Group 651.788.0602 dennis.bayrock@pahc.com

Alexander, M. 1971. Microbial ecology. John Wiley & Sons, Inc., London, United Kingdom.

Love KR, Dalvie NC, Love JC. The yeast stands alone: the future of protein biologic production. Curr Opin Biotechnol. 2018;53:50–8.