Exploring the Feasibility of Artificial Honey

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Abstract

Honey is a very popular product all around the world. It is a sweet and sugary solution which improves the taste of tea and most desserts. It also has a variety of health benefits such as anti-inflammatory and antibacterial properties that improve the lives of people all over the world. Honey is mainly produced by a variety of species of bees, many of which have been domesticated in some form. This domestication has reduced the population of bees in the wild due to inferior genetic fitness. Thus, the purpose of our project and this report was to determine a new and simple way to synthesize honey. This was done by making synthetic nectar at a temperature of 60°C and adding invertase, glucose oxidase, and catalase to it. The mixture was then left to boil at 220°C until a final volume below 70 mL was left. From there, the mixture was analyzed for its water content, its pH, sugar content, and its viscosity. First, as the amount of glucose oxidase increased, the water content in the honey decreased from 21% at its highest to 12.5% at its lowest. Conversely, as more glucose oxidase was added, the amount of glucose, the viscosity and the pH of the honey all increased. As a result of these tests and data, not only can it be concluded that honey can be made synthetically from sugars, but also that glucose oxidase may have a distinct role in the changes of the properties of honey. Finally, it is recommended that future projects provide a taste test of the samples with store-bought honey to test whether taste changes with increased glucose oxidase concentrations.

Background

The motivation of the project and the purpose of creating synthetic honey can comes from the following information:

- The US has experienced a dwindling bee population for many years;
- If honeybees are more regulated due to their population status, the need for an alternative to honey would be needed;
- A lot of people with dietary restrictions cannot enjoy the sweet treat;

Therefore, the project attempted to follow the proposed procedure:

Figure 1: Preliminary idea of honey synthesis

For the synthetic honey production, the major milestones in the synthetic honey development have been related to the following discoveries:

- Bio-enzymatic pathway thanks to *Bacillus subtilis* production of enzymes;
- Development of synthetic stomachs of bees;

Objectives

This project will focus on the possibility of the synthesis of artificial honey and the effects of glucose oxidase in the process of artificial honey. Therefore, the three objectives of this project are:

References

Visuals created with BioRender.com
Zur, Yehonatan, Dor Ben Meir, Mai Dror, Lidya Tannenzapf, Nir Litver, Ofri Warsha, Shira Levi, et al. “Description.” BeeFree: Creating BeeFree Honey By Using A Synthetic Bee Stomach, 2019. https://2019.igem.org/Team:Technion-Israel/Description.
Visuals for the enzymatic pathway were created with images from BioRender, MedChemExpress, American Chemical Society, Florida State University, and Wikipedia.

Enzymatic Pathway

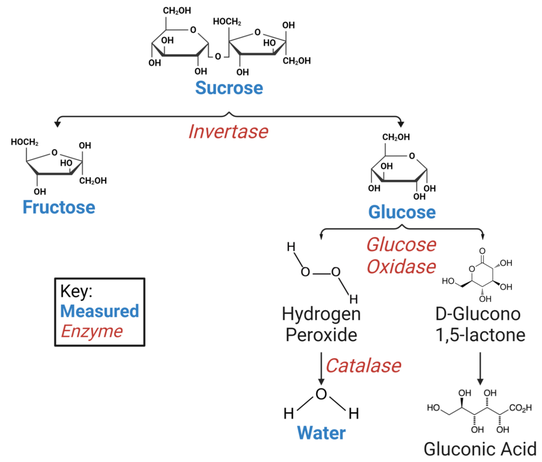

Figure 2: Enzymatic pathway for the production of artificial honey

Methodology

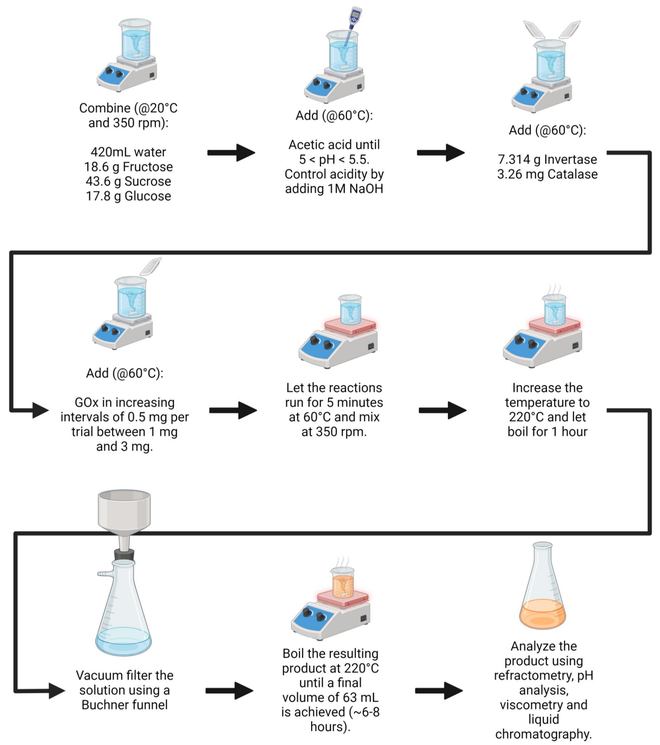

Figure 3: Process flow chart of this project

Synthetic Honey

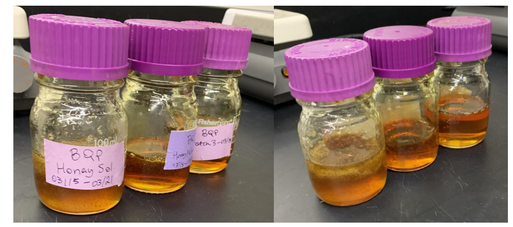

Figure 4: Synthetic honey batches 1 through 3

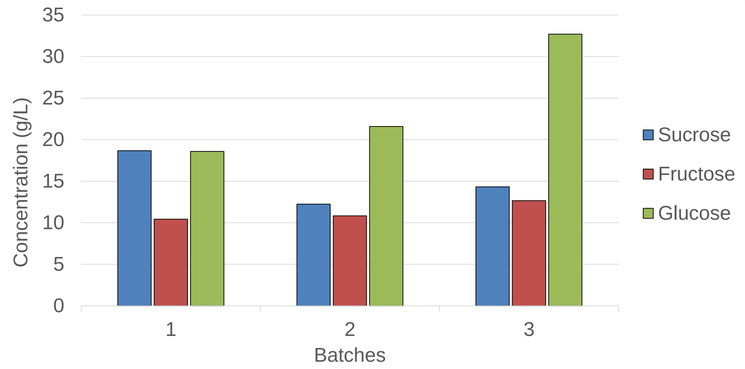

Figure 5: Sugar concentrations of sucrose, fructose and glucose per batch

Results

The following data was collected from the four analytical tests done on the honey batches:

- As glucose oxidase concentration increased, water content in the batches decreased;
- As glucose oxidase concentration increased, glucose concentration, pH, and viscosity increased;
- Fructose concentration remained approximately constant and sucrose content dropped per batch.

Conclusions and Recommendations

From the results of this project, it has been concluded that honey can be made artificially in the lab with only enzymes and that GOx has an impact on this process. For the future, it would be imperative to have more batches done so more data can be accrued and accessed, and the impact of the other two enzymes should be studied.

Acknowledgements

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