Marshall Wood

End of Summer FURSCA Report

Introduction:

My research this summer focused on analyzing the efficiency of alcohol production using various substrates; malt, sorghum, and grape extracts. In addition, the antimicrobial potential of each of these substrates was investigated. This research aimed to ascertain the most efficient substrate available in the testing groups and assess the antimicrobial potential in each environment. I was able to simulate multiple anaerobic environments and I collected data daily and weekly to investigate each of the substrate's antimicrobial potential. Before starting the experimentation run, I hypothesized that the substrate displaying the most anti-microbial capabilities will also be the most efficient at producing ethanol (Natalia et al. 2019 & Bartkiene 2018).

There will be a little bit of terminology thrown around in the results section so I shall lay out the basics right here. **ABV** is alcohol by volume, a measurement of how much ethanol is in the system. This is determined by comparing the **specific gravity** of the system. In the most simple terms, this is how much sugar is in the system, and comparing results we can determine how much of that sugar has been consumed by the yeast and transformed into alcohol.

Results

Over the 10-week summer research program, 3 trials were run, a preliminary, trial 1, and trial 2. The goal of the preliminary trial was to get comfortable using the research facilities, and the equipment needed for data collection, and to ensure that the methods devised would be appropriate for the rest of the experimentation run. The results of the

preliminary trial surprised me, as adjustments were made after the preliminary trial that would set forth the experimentation for the rest of the summer. Trials 1 and 2 ran successfully with the modified protocol from the preliminary trial which now included a shorter turn-over time from brewing pot to the anaerobic environment, daily measurements, and a modified brewing receipt.

The alcohol efficacy investigation portion of this research leads to some incredibly surprising results. Figures 1 and 2 demonstrate the data collection performed and the average ethanol content in each substrate. As is clear by the graphed results, the Grape extract had the quickest turn around reaching the max alcohol content possible for the given specific gravity in just 4 days while the other substrates are lagging. In figure 1 specifically, it is apparent how after that day 4 marker for most other substrates seemed to have hit a slowing point in the brewing process, which is seen repeated in figure 2's day 4-14. However, figure 2 also depicts that on the last data measurement, day 21, both substrates that previously saw a complete stall, rose in alcohol content. The grape has proven itself to be the most efficient out of the lot, but with trial 2's results, long-term fermentation will still yield ethanol, future trails may be run to determine how long these substrates may take for a complete substrate to ethanol conversion, however, the stated goal of efficacy has been found.

The testing for anti-microbial potential yielded no difference across the board. This was a great learning experience, using methods such as the Kirby Bauer method of determining if there were any limiting growth factors in each of the substrates. The results of this testing showed that there weren't any apparent differences in each of the substrates with extraction times going up to 96 hours. This discovery leads me to

believe that all of these substrates wouldn't inhibit the growth of microbes including the yeast used to ferment the product. With this in mind, all of these substrates were on an even "playing field" allowing for the microbes to do their work. Looking at this unique problem we opted to further test the anti-microbial potential of each of the substrates, the plan was to take the finished research products and subject them to a GC-MS. The results of which showed no real significant chemical structures in the final product, which provides further evidence for the idea of an even microbial "playing field".

Conclusion

This work of summer has been extremely enlightening, learning invaluable lab skills and experimental design. This summer work has pushed me into looking at graduate school opportunities for a future in microbiology, specifically industrial or food microbiology.. Moving forward I'll be looking forward to completing my thesis for the work completed this summer and applying to graduate schools all around the world.

In the fall I will be working on a departmental thesis for Biology with my thesis department. Turning the work performed this summer into a thesis and a possible later publication.

To the Bruce A. ‘53 and Peggy Kresge ‘53 Endowed Science Fellows:

Thank you for giving me the opportunity to participate in Albion’s FURSCA program this summer. This look into lab work truly showed me what I would like to do. This summer provided many benefits that will greatly influence my future education and research endeavors. Thank you!

References

Bartkiene, Elena. “Influence of Microbial and Chemical Contaminants on the Yield and Quality of Ethanol from Wheat Grains.” Journal of the science of food and agriculture. 99.5 (2019): 2348–2355. Web.

Maia, Corrêa, J. A. F., Rigotti, R. T., da Silva Junior, A. A., & Luciano, F. B. (2019). Combination of natural antimicrobials for contamination control in ethanol production. World Journal of Microbiology & Biotechnology, 35(10), 158–159. https://doi.org/10.1007/s11274-019-2734-6

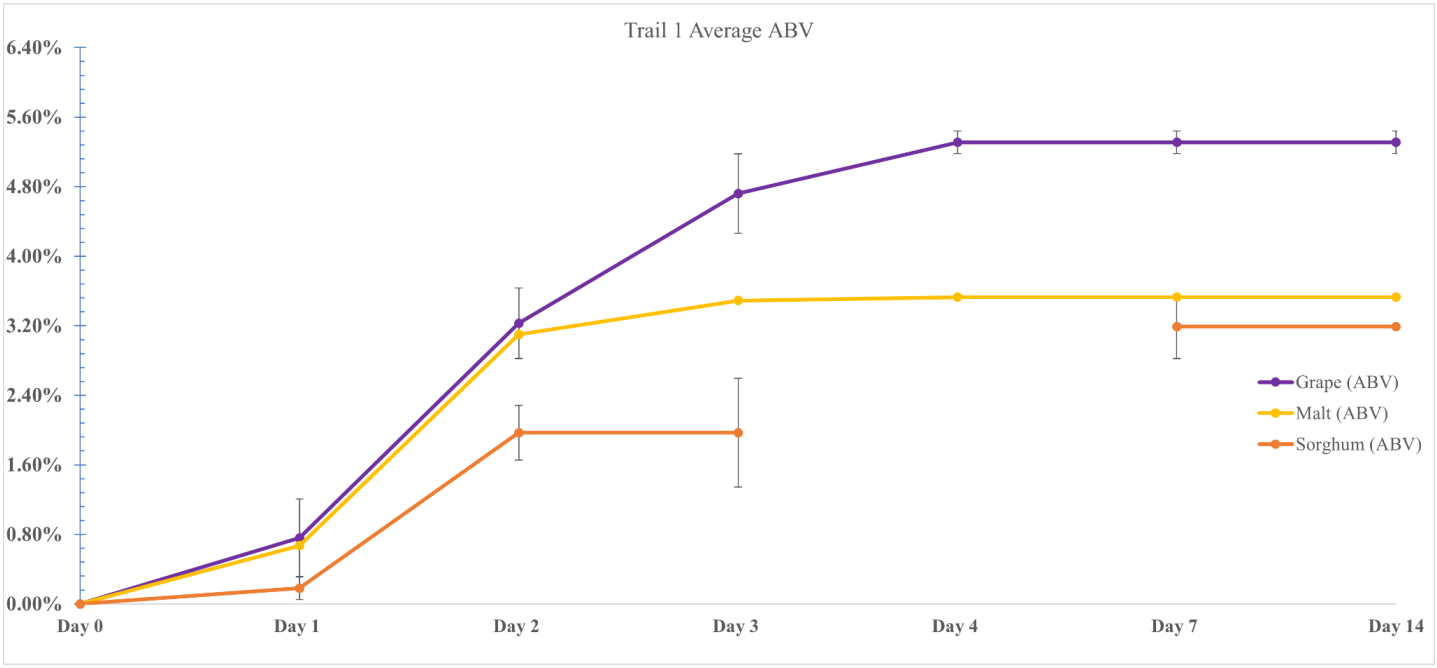

Figure 1 (Trial 1)

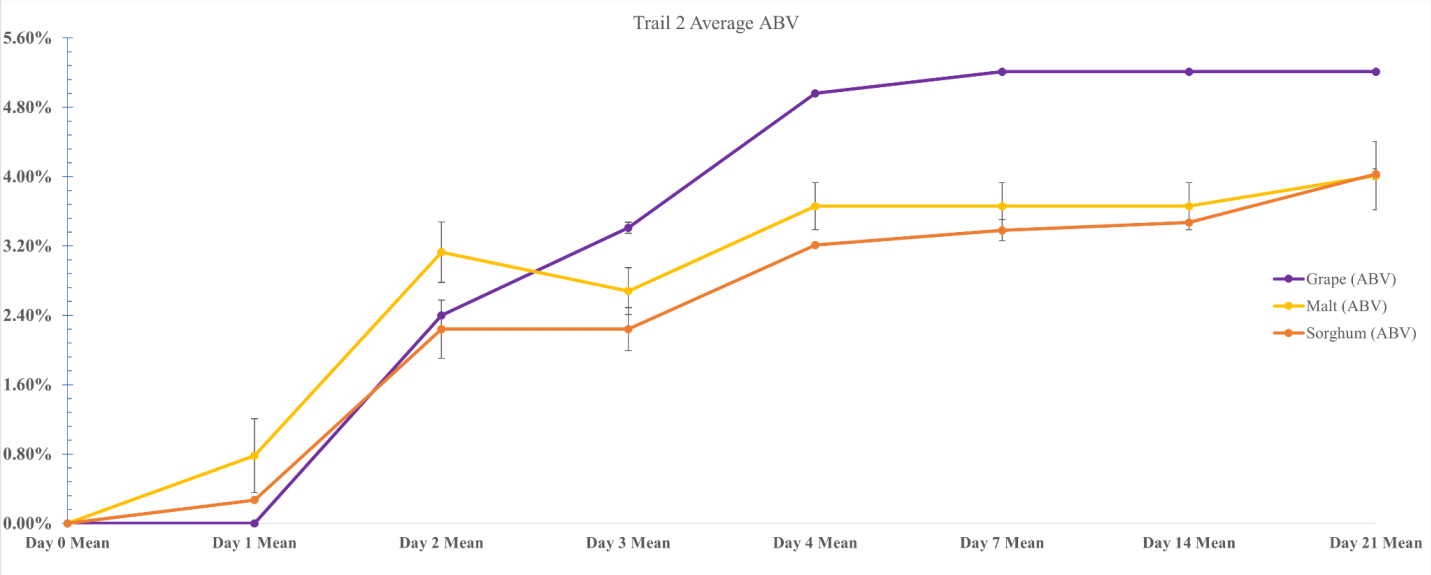

Figure 2 (Trail 2)