COOPERATIVE EXTENSION
College of Agriculture, Forestry and Life Sciences

Fermentation: An Analysis of Craft Beverages and Microbiological Impacts on Fermentation

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Abstract

Through Clemson University's USDA-funded Science Influencers program and the Research and Extension Experience for Undergraduates (REEU), I explored fermentation science thoroughly, bridging theoretical concepts with extensive lab work. The program provided a structured framework for investigating microbial fermentation, focusing on factors such as metabolic pathways, microbial dynamics, and environmental impacts on fermentation efficiency. My primary project examined how to build a fermentation lab and experiment with the yeast *Lachancea thermotolerans*, or Philly Sour, developed by the University of the Sciences in Philadelphia, PA. This yeast is widely used in commercial sour beer production due to its low contamination risk and reliable flavor profile. This work required precise control and knowledge of fermentation parameters while also aiding in a fun and engaging project letting me build upon practical skills in strain cultivation, process monitoring, and quality assurance. Clemson Extension also gave me a deeper understanding of how analytical research can drive innovations in the food and beverage industries and the local community. This experience refined my technical abilities and reinforced the role of research in advancing regional and commercial applications of fermentation science.

Introduction and Objectives

- **Constructed a university fermentation lab to support research and brewing optimization.**

The growth of the craft brewing industry has driven an increased demand for innovative and consistent analytical testing, enabling local brewers to assess their products and prevent spoilage confidently. During my summer internship, I worked closely with Dr. Paul Dawson, a professor at Clemson University, and Alex Thompson, a Clemson Extension agent in upstate South Carolina. I focused on establishing a fully functional fermentation lab to support Clemson University's future research and designing a fermentation experiment for Fall 2024. This opportunity allowed me to apply my food science knowledge in a lab setting while contributing to Clemson's research infrastructure and advancing the field of fermentation science. Key objectives of the internship included exploring how fermentation variables—such as temperature, pH, nutrient levels, and wild yeast strains—affect the fermentation process. The internship also prioritized the development of practical skills in microbial cultivation, fermentation monitoring, and data analysis, laying a solid foundation for my future career in food and agricultural science.

- **ServSafe and food safety principles from the National Restaurant Association.**

Another critical area of the internship was gaining insight into ServSafe, a safety training program that covers common foodborne illnesses and essential food safety principles. This included understanding and implementing critical food safety practices such as proper sanitation, temperature control, and safe food handling techniques to minimize contamination risk and ensure food products' safety throughout their lifecycle. By applying these principles, I was able to get certified. I helped establish protocols that help within the laboratory and my future career in production environments, ultimately contributing to the success and reliability of food products.

Methods

Under the guidance of Alex and Dr. Dawson, I could apply this knowledge in developing an experiment that will be further expanded in the Fall 2024 semester at Clemson University. Their expertise significantly enhanced my ability to analyze and apply food science concepts, broadening my scientific understanding. The materials used in the research included custom-milled barley, hops, yeast, and water, all integral to the brewing and fermentation processes.

The equipment used for the experiments consisted of a 5-gallon brew kettle, cylindrical fermentation tanks, thermometers, hydrometers, a scale, and a sanitizer solution StarSan for maintaining cleanliness and preventing contamination. These materials and tools were used often in the day-to-day procedures so that tests being conducted were accurate and provided reputable reliable results after the brewing process.

Results and Discussion

The USDA REEU internship expanded my understanding of the Extension role and deepened my knowledge of fermentation science and commercial brewing especially on a microbiological approach. Throughout the position, I actively achieved our two key objectives: setting up a fermentation lab at Clemson University, which included installing essential equipment for diverse experiments, and preparing a research project with muscadine grapes through a blend of scientific literature, instructional videos, and hands-on experience.

Figure 1 – Hot Side of the Lab and the Various Brewing Kettles.

Figure 2 – Cold Side of the Lab and Cylindrical Fermenters.

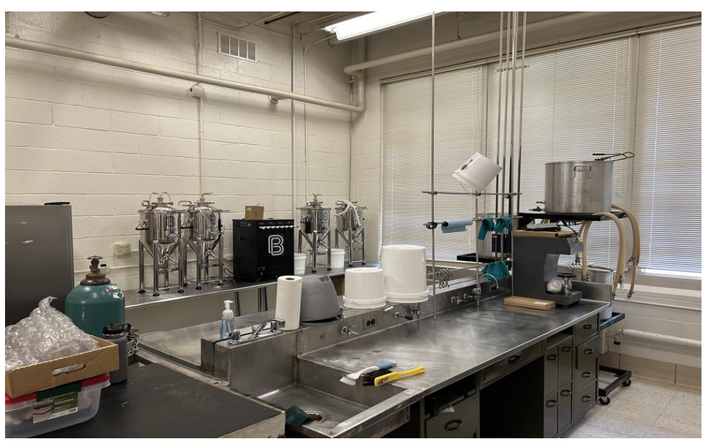

Figure 3: Plate heat exchanger facilitating the transfer of liquid into cylindrical fermenters.

Figure 4: Beer fermentation in a cylindrical fermenter connected to a glycol cooling system for precise temperature control.

Conclusion

The diverse projects I was a part of throughout the summer offered a comprehensive and well-rounded introduction to food science and the Clemson Extension program. A highlight of this experience was successfully producing a high-quality sour beer with each step of the brewing process—from mashing to bottling. This achievement showcased my effective sanitization and fermentation practices and providing the University a full functioning fermentation lab for the future of Clemson University.

References

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