Executive Summary of KySGGA 2019-2020 Funding

Project Title: Use of LED lights to optimize barley malt diastatic (fermentation) power and bioactive compounds for food production.

Executive Summary: Barley is the traditional grain for producing malt because it is naturally endowed with the complete hydrolytic enzymes needed to break down complex compounds into simple ones needed by yeast during fermentation processes. Malt is a major ingredient in the production processes of several alcoholic (brewing and distilling) beverages and confectionery products. It is important in the alcoholic beverage industry because it contains important hydrolytic enzymes that are needed for breaking down the big molecules in grains, and it is also a source of important nutrients needed for yeast activities like protein and carbohydrates. A measure of malt quality is the quantity of enzymes synthesized and accumulated during the malting processing, specifically, during the germination phase of malting. Our starting hypothesis was that the application of external stress like photon (light) energy from a low-cost light-emitting diode (LED) can instigate a quick accumulation of these enzymes thereby shortening the germination day. We set out to test the effect of LED light at different light intensities on diastatic power (enzyme activity levels), beta (β)-glucan, and bioactive compound content of malted barley. The results we obtained show that germination time can be reduced to three/four days depending on the level of photon energy exposure, instead of five days typical for the conventional barley malting process. We also determined that Red LED light has a better impact on germination acceleration vis-a-vis DP level optimization. It was also determined that gamma amino-butyric acid (GABA), a limiting bioactive compound level also increased compared to the control. These findings are major discoveries for the barley (possibly, other seeds) malting process in terms of increased production, higher nutrient value and more return to the industries (brewing, distilling and confectionary) they support. However, beta-glucan level was unusually high in almost all samples except the control. Beta-glucans are not desirable in brewed products malt are used for but constitute no problem for distillers and other food applications, where it is considered an antioxidant. Aside from the unique outcome of the completed study, one post-doc and two undergraduate student researchers were trained on the project. One provisional patent was filled by of Office of Technology Commercialization at the University of Kentucky.

LED light barley germination setup used and green barley malt (Okeke and Adedeji, 2020)

Recommendations for future work include the application of other types of photon energy sources to achieve quicker (a few seconds) treatment than LED; also experimenting with steeping and germination temperatures to reduce the level of β-glucan is a major goal for future work. The short duration of such photon source will increase the potential of automation which will address the concern about space needed in a LED-based system. We appreciate KySGGA for funding significant aspect of this project. We hope for their support in the future.

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