



PROGRESS REPORT

PROJECT TITLE: **DDG Food Use**

PROJECT NUMBER: 6080-22DD

REPORTING PERIOD: September 1, 2022 – November 30, 2022

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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD. (*Describe project progress specific to goals, objectives, and deliverables identified in the project work plan.*)

This project includes two phases of work, with Phase Two to proceed ONLY if the results from Phase One indicate a realistic opportunity to develop a human food-grade dried distillers grain (FDDG) product of commercial interest and market relevancy. Project outcomes from Phase One expect to determine if further investment in the commercialization of the proposed production at scale is justified.

The Phase One work plan consists of the following deliverables:

1. Human food ingredient market assessment to compare the most relevant value proposition, volume potential, and value to the existing animal feed market for dried distillers grains (DDGs)
2. Assessment of the current FDDG technology readiness level, proposed by Dr. Padmanaban (Padu) Krishnan and based on multiple washes of the wet cake recovered after separation of thin stillage with a food-grade solvent, such as ethanol or supercritical carbon dioxide, to remove excess oils and undesirable aromas and pigments.

Phase One, Deliverable 1

AURI worked closely with Euromonitor International, the world's leading provider of global business intelligence, market analysis and consumer insights, to prioritize and populate the datasets powering two of the three key deliverables from the market assessment – the *Size of Prize Dashboard* and a series of *Defined Adoption Scenarios*.

1. **Size of Prize Dashboard:** This dashboard will be a dynamic, user-friendly interactive tool that will automatically calculate potential revenue for prioritized ingredient and finished product application options.
2. **Defined Adoption Scenarios:** Euromonitor will build separate adoption scenarios based upon FDDGs marketed as a high protein/fiber commercial flour or as a functional protein concentrate/isolate and/or high nutritional fiber product. The project team will then translate these adoption scenarios into optimistic and pessimistic revenue forecasts for the desired category.

Workstreams during this period consisted of creating technical specifications for realistic fiber and protein ingredient opportunities from DDGs and prioritizing in-market datasets against which the team

could define realistic replacement and/or innovation scenarios for DDG-derived ingredients and finished products. To accomplish these objectives, AURI relied upon its internal food industry experience and expertise, as well as through in-depth discussions with University of Minnesota subject matter experts:

- [Dr. George A. Annor](#), an Assistant Professor of Cereal Chemistry and Technology at the Department of Food Science and Nutrition at the University of Minnesota. He is also the chair for the General Mills Endowed Professorship in Cereal Chemistry and Technology. The focus of discussion was the potential of FDDG as a high fiber, high protein corn powder and development of a specification for a theoretical high fiber isolate/concentrate.
- [Dr. Pam Ismail](#), a Professor at the Department of Food Science and Nutrition, University of Minnesota. She is the founder and director of the [Plant Protein Innovation Center](#). The focus of discussion was on the potential for an FDDG derived high protein isolate/concentrate and development of a theoretical specification. Interestingly, much of this discussion focused on the form of the DDG protein as free peptides following ethanol fermentation, which led the market analysis team to specifically include “peptides” as a market category for further exploration.

Early returns from these exercises indicate that DDG-derived ingredients hold marketplace promise for replacing whole meal flours and emerging protein concentrates, and thus worth further investigation. Finished product categories that hold interest for DDG-derived ingredients include Sports Nutrition, Snack Bars, and “Free from Allergens” products. Most of these ingredients and finished product categories would require additional product processing beyond what is currently available at ethanol plants today, however, a significant market opportunity may justify additional investigation.

The project team expects to conduct an initial review of the market analysis output in mid-December 2022, with final project deliverables expected approximately Jan. 31, 2023.

Phase One, Deliverable 2

In Aug. 2022, AURI began working with Dr. Krishnan to reproduce and validate his proposed FDDG process, developed while Dr. Krishnan was a resident at South Dakota State University. This process focused on producing a low color, low odor, high protein and high fiber corn flour for use as an adjunct in baking applications and was enabled by multiple washes of the DDGs with ethanol. However, color and odor were the arbitrary definitions used for the process endpoint rather than via quantified targets or defined food safety standards.

A deeper dive into the literature showcased theoretical opportunities to optimize Dr. Krishnan’s proposed process, though this deliverable focuses on reproducing previous results to transform those theoretical optimization ideas into “commercialization-justified” opportunities. For instance, combining the results of the market analysis with the current process may indicate that the presumed process endpoint (described above) is “too far,” or that the use of ethanol as a washing solvent is not commercially viable.

AURI’s analytical chemist, Dr. Michael Stutelberg, developed a proposed protocol in consultation with Dr. Krishnan and the broader AURI team. This protocol, focused on proximate analysis (using standardized AACCI, AOCS, and AOAC test methodologies) of wet DDGs before and after multiple stages of ethanol washing, will help determine the extent to which DDGs must be processed to achieve a defined endpoint for the desired product. Team members are currently refining the protocol, with lab testing expected to begin in January 2023.

Phase One output will pair the results from the market assessment with the current technology readiness assessment to make a recommendation on proceeding to Phase Two of this project.

2.) IDENTIFY ANY SIGNIFICANT FINDINGS AND RESULTS OF THE PROJECT TO DATE.

In a discussion with Dr. Pam Ismail, Professor at the University of Minnesota and Director of the Plant Protein Innovation Center, AURI recognized the potential opportunity of a corn protein concentrate and/or isolate may not be possible depending on the degree of protein hydrolysis (into constituent peptides) in the DDGs. This fact illustrates that further basic DDG protein chemistry research is necessary prior to pursuing development of any DDG-derived corn protein concentrate or isolate. However, this finding also indicates the potential of DDG-derived corn peptide ingredients and/or finished product opportunities. Because of this, the findings are included in the prioritized consideration set for the market assessment.

3.) CHALLENGES ENCOUNTERED. *(Describe any challenges that you encountered related to project progress specific to goals, objectives, and deliverables identified in the project work plan.)*

None encountered this quarter

4.) FINANCIAL INFORMATION *(Describe any budget challenges and provide specific reasons for deviations from the projected project spending.)*

The team encountered no budget challenges resulting in a change to the projected project spending.

5.) EDUCATION AND OUTREACH ACTIVITIES. *(Describe any conferences, workshops, field days, etc. attended, number of contacts at each event, and/or publications developed to disseminate project results.)*

No education or outreach activities were identified or attended.