Project FY22-FR-003: Natural Photosensitizer for Decontamination of Mycotoxin in Sprouted Cereal Grains

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1. **What are the major goals and objectives of the research project?**

   Major goal and objective one: Screening natural photosensitizers (PS), designing and characterizing the natural PS loaded delivery system;
   Major goal and objective two: Antifungal and mycotoxin inhibitory activity of PS loaded delivery system in vitro;
   Major goal and objective three: Antifungal and mycotoxin inhibitory efficacy of PS in cereal grains and sprouted cereal grains.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   Major activities in goal three:

   - The antifungal activity of Menadione sodium bisulfite (MSB), coumarin and curcumin in fusarium contaminated wheat grains have been tested under the greenhouse condition and in the field in 2025. In general, the susceptible wheaton cultivars were planted in 20 rows following a randomized complete block design (RCBD) with five blocks. During the flowering stage, the wheaton cultivars were point inoculated with a mixture of Fusarium spp. and the application of photosensitizers (curcumin, MSB, and coumarin) was applied at morning of a day after one day of point inoculation based on our preliminary experiment result in 2024. The FHB scoring data was recorded after 21 days of infection.
     - The FHB scoring have shown the promising results by applying curcumin and MSB. The percentage of FHB severity were significantly decreased as compared to control sample under green house and field trial conditions.
     - In addition, FHB scoring data was correlated with the mycotoxin data. For example, DON has shown significant lower level at $p<0.05$ for curcumin and MSB treated wheat as compared to control under green house and field conditions. whereas no significant reduction was observed in the coumarin treated samples, consistent with the FHB severity results

   - The effectiveness of several natural photosensitizers (PSs) for decontaminating Fusarium head blight (FHB) infected wheat grains and sprouted wheat grains including curcumin, coumarin, and menadione sodium bisulfite (MSB). Initially, the specific fungal species contaminating FHB infected wheat were identified through sequencing and subsequently confirmed by comparing the sequences against the NCBI gene database using Basic Local Alignment Search Tool (BLAST). Afterwards, the three aforementioned natural PSs were evaluated for their ability to decontaminate wheat seed surfaces by counting surviving fungal colonies on 100 FHB infected wheat seeds
     - The results showed that the fungi present on FHB infected wheat included *Arthrinium sp., Aspergillus sp., Fusarium graminearum, Alternaria alternata, and Cladosporium sp*.
     - The antifungal results indicated that curcumin and coumarin, combined with light treatment, completely inhibited fungal colony growth at concentrations of

3 mM and 4 mM, respectively. By contrast, 4 mM of MSB significantly inhibited fungal growth as compared to control, but less effective than that of curcumin and coumarin.

- In wheat seeds and sprouted wheat seeds, all three natural photosensitizers ($p < 0.05$) significantly reduced overall mycotoxin production. Among them, MSB effectively reduced all tested mycotoxins (DON, 3-ADON, 15-ADON, Nivalenol, T-2, and Zearalenone), while curcumin and coumarin only significantly reduced DON, Nivalenol, T-2, and Zearalenone.

3. What opportunities for training and professional development has the project provided?

This project provided an opportunity for one Ph.D. student to enhance their fundamental knowledge and expertise in cereal science, food science, physicochemical properties, and statistical analysis. One Ph.D. student graduated under this award in summer 2026.

4. How have the results been disseminated to communities of interest?

The result has been submitted in peer review journals and some of results has been presented in 2025 FHB annual meeting.

5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Summarize the data and submit the research findings for publication in a peer-reviewed journal.