

# Degradation of Soybean Meal Anti-Nutritional Factors via Fermentation with *A. oryzae* and *B. subtilis*

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## Summary of Research

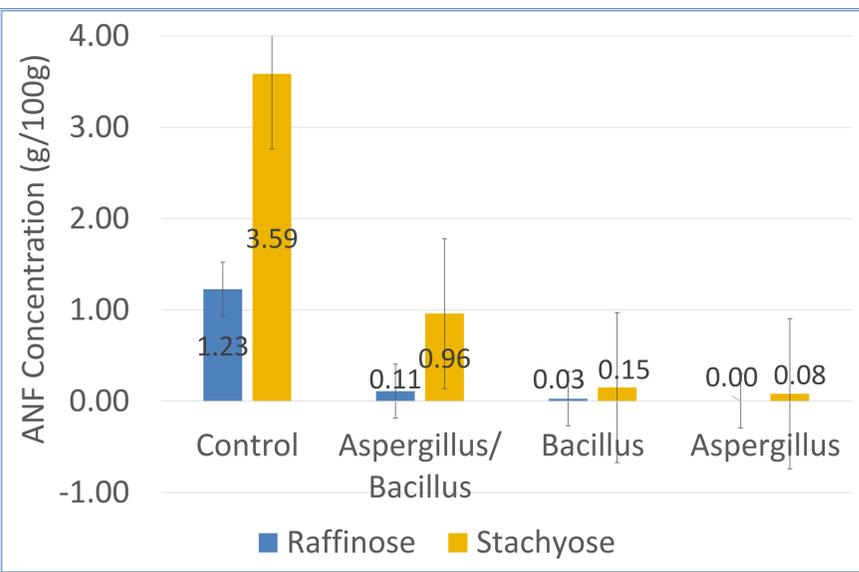
- Soybean meal (SBM) is a co-product in the production of soy oil and a commonly used feed product in swine and poultry diets.
- SBM contains antigenic proteins and anti-nutritional factors (ANFs) which create an undesirable intestinal immune response and negate its digestibility in young animals (Mukherjee et al. 2016).
- Major storage proteins glycinin and beta-conglycinin make up a majority of the antigenic properties found in soybean meal (Chunjiang et al. 2007).
- Oligosaccharides raffinose and stachyose are two significant anti-nutritional factors within SBM.

## Objective

- Significantly reduce the anti-nutritional and antigenic factors in SBM by fermenting with *A. oryzae* and/or *B. subtilis*

## Findings

Figure 1: Fermented SBM Raffinose and Stachyose (g/100g)



Results are mean±SE (n=3)

Fig 1. A single-factor ANOVA test was used to conduct statistical analysis.

- There was a statistically significant reduction in raffinose and stachyose levels between the control and all experimental groups.

Fig 1. *A. oryzae*, *B. subtilis* and the combination of both strains effectively reduced raffinose and stachyose.

- Aspergillus provided the largest degradation of the sugars.

## Materials and Methods



### SDS Protein PAGE:

- BIO-RAD Mini-PROTEAN TGX gel
- 80V- 30 minutes
- 120V-75 minutes
- 5 min- stain
- 20 min- destain

### Part 2: Soybean Meal Fermentation

- Ten grams of SBM, twelve beakers, autoclaved
  - 10<sup>6</sup> CFU/g, 40% sub. moisture, 48-hr, 30°C ferm
  - Control- No inoculate used**
  - Exp. Grp 1- 24 hr. ferm AO, 24 hr. ferm BS**
  - Exp. Grp 2- 48 hr. fermentation with *B. subtilis***
  - Exp. Grp 3- 48 hr. fermentation with *A. oryzae***
- ### Part 3: Fermented SBM Protein Extraction
- 0.1MM glass disruption beads, 3min vortex
  - 0.22 μm extract filtration

### Part 1: Strain Propagation and Harvest

- A. oryzae*
- PDA media, Aerobic Plate Count
- B. subtilis*
- MRS broth, O.D. standard (600nm)

## Findings

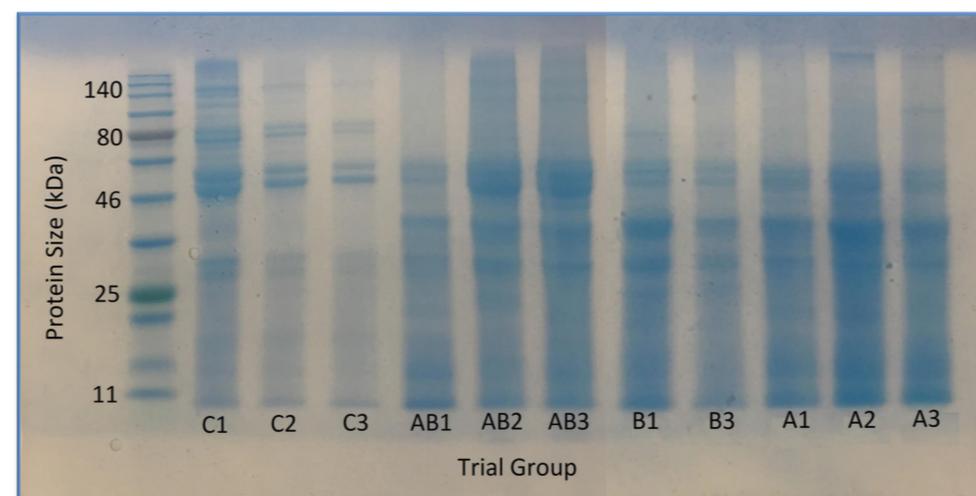
Fig 2. All experimental groups had significant proteolysis.

- A. oryzae* and *B. subtilis* provided the most protein digestion.

Fig 2. Beta-conglycinin has a molecular weight of 140-180kDa (Besler, n.d.).

- A thick protein band at 140kDa in the control and a reduced band in the experimental groups suggests that all experimental groups had a decrease in beta-conglycinin.

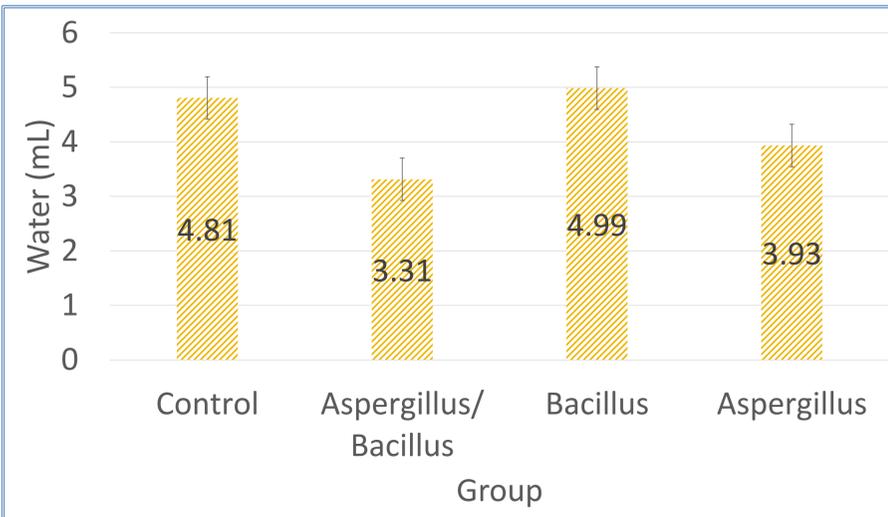
Figure 2: SDS Protein PAGE



C- Control, AB- *A. oryzae*/*B. subtilis*, A- *A. oryzae*

## Implications/Future Directions

Figure 3: Water Added to Obtain a Substrate Moisture of 40%



Results are mean±SE (n=3).

Fig 3. Trends in supplemented H<sub>2</sub>O correlate to the relative effectiveness in raffinose and stachyose degradation

- This suggests that H<sub>2</sub>O was a limiting factor in the fermentation process.

- Additional research should test procedures in a pilot scale solid state fermentation process and include additional fermentation parameters such as moisture.
- These parameters become limiting factors in the scale-up procedure.

## Student Mini-Biography

Luke is a senior in animal sciences. He is from Forrest, IL where his family owns a commercial feed mill and grain elevator. His strong background in feed milling makes him very passionate about feed production and animal nutrition. After completing his bachelor's in animal science Luke plans to pursue a Ph.D. in swine nutrition under Dr. Ryan Dilger in the University of Illinois's Department of Animal Sciences.

## Acknowledgement

This project was supported by the College of ACES Undergraduate Research Scholarship Program.

