

**Title:** Fate of Lysine and Phytate During the Bioprocess of Making DDGS—NPB #09-119

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## Part A

### Scientific abstract

Among all the indispensable amino acids in dried distiller's grains with solubles (DDGS), lysine is the most variable amino acid and has the lowest digestibility in swine feeds. The culprit was suggested to be heat damage that occurs during DDGS production. The sensitivity of lysine to heat is known in food due to a temperature dependent reaction between reducing sugars and lysine, known as the Maillard reaction, however, the fate of lysine through unit operations and processes used to make DDGS is unknown. In this study, we measured the changes in the levels of lysine and furosine, a known indicator for heat damage of lysine in food, in intermediate products and DDGS, and found out that the three unit operations, liquefaction, evaporation and drying, are the main processes contributing to the heat damage to lysine in DDGS.

We learned that the heat damage to lysine in DDGS can be caused by the combination of high temperatures, long reaction times and high glucose levels during the corn to DDGS production. With the lysine level in corn about 0.27%, the lysine levels in the DDGS generated from this study varied from 0.52% to 1.1%, responding to different processing conditions, and the estimate of lysine bioavailability varied from 70% to 98%.

We have confirmed that the furosine to lysine ratio of DDGS can be a good indicator for heat damage to lysine. The DDGS with good quality lysine produced from this study contained F/L (percentage of furosine in lysine) lower than 10%, while the DDGS with damaged lysine contained F/L as high as 40%. Besides F/L, the L/CP can be a good estimate for lysine quality if the L/CP of the corn (as the feedstock) is known. The lower the L/CP of DDGS compared with that of corn, the more damage to lysine caused by heat. Color of DDGS is not a very good indicator for heat damage to lysine.

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## **Part B**

### **Scientific Abstract**

More than 80% of phosphorus (P) in corn is in phytate P form, which is not bioavailable. As a result, it is common to include inorganic phosphate and phytase in swine diets to help to improve phosphorus digestibility and reduce environmental impact caused by high phosphate concentrations in manure. The yeast used in fermentation during the bioprocess of making distiller's dried grains with solubles (DDGS) is likely to be able to produce phytase, but how much of the phytate P can be converted to bioavailable P during fermentation is not clear, and whether any other unit operations of the bioprocess of making DDGS have any impact on the change of P speciation is unknown. In this study, we measured the changes in the levels of total P, phytate P and inorganic P in intermediate products and DDGS produced from four different pilot plant runs with various combinations of processing parameters. We learned that the fermentation process was the only unit operation contributing to the phytate P degradation to inorganic P. Our study showed that the percentage of phytate P in total P went from 80% in corn to 40% in DDGS generated from complete fermentation, and to 50% in DDGS generated from incomplete fermentation. The intermediates generated in the back end, such as wet cake and thin stillage, contained different levels of total P and phytate P from DDGS, but the percentage of phytate P in total P was similar to that of DDGS. The key to generate DDGS with high bioavailable P is to grow healthy yeast during fermentation process.