Nutrient Digestibility of High Protein Corn Distillers Dried Grains and Corn Germ

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ABSTRACT

Sectors of the ethanol industry are starting to use a new bio-refining production technology which separates the corn into three fractions: fiber, germ, and meal. Studies were conducted to determine the nutritional parameters of these new co-products. A chick experiment was conducted to determine the phosphorus (P) bioavailability based on tibia ash. In addition, conventional and cecotomized precision-fed rooster assays were conducted to determine TME, and amino acid digestibility. For the chick assay, a P-deficient corn-soybean meal basal diet with 0.13% non-phytate P was supplemented with 0, 0.05, 0.10, and 0.15% from KH2PO4, 0.05% P from KH2PO4 or 0.10% P from KH2PO4. The chicks were fed a starter diet for 7 days to 8 days of age. The chicks were fasted overnight and at 8 days of age 8 replications of 8 chicks were each fed the experimental diets. Dietary treatments were: 1) Corn-soybean meal basal with 0.13% available phosphorus, 2) Basal + 0.05% P from KH2PO4, 3) Basal + 0.10% P from KH2PO4, 4) Basal + 0.15% P from KH2PO4, 5) Basal + 0.15% P from KH2PO4 5) Basal + 7% HP-DDG, 6) Basal + 14% HP-DDG, 7) Basal + 14% DDGS, 8) Basal + 15% DDGS, 9) Basal + 7% corn germ, and 10) Basal + 14% corn germ. The basal diet was adequate in all nutrients except P and HP-DDG and corn germ were fed at the expense of cornstarch. The chicks were fed the experimental diets from 6 to 28 days of age. At the end of the experiment tibiae were collected from each chick. The tibiae were dried and mineralized. The ash % tibia ash was calculated and multiple regression was used to determine the relative P bioavailability.

SUMMARY

1. The metabolizable energy (TME) of HP-DDG ranged from 2,667 to 3,282 kcal/kg, with a mean of 2,846 kcal/kg.
   a. This is not dramatically different than the average TME of DDGs (2,800 kcal/kg), but it is surprising since the fat level is almost a third lower.

2. The metabolizable energy (TME) of corn germ ranged from 2,911 – 3,681 kcal/kg, with a mean of 3,204 kcal/kg.
   a. Corn germ is a good source of energy.

3. The total lysine concentration, amino acid digestibility coefficient of DDGS, HP-DDG, and corn germ was 0.94 (74%), 1.16 (74.3%), and 0.83% (85.7%), respectively.

4. The phosphorus relative bio-availability of DDGS, HP-DDG, and corn germ was 60.4, 46.9, and 31.5, respectively.

CONCLUSIONS

1. Due to increased emphasis on ethanol production, there has and will continue to be significant amounts of by-products from ethanol production available to the feed industry.

2. Due to the variation in the nutrient content of the various by-products it is important that analytical information be conducted prior to utilizing these new co-products of ethanol production.

INTRODUCTION

In recent years, policies for increased production of ethanol have stimulated an enormous increase in the production of distiller’s dried grain with solubles (DDGS). Until recently, the majority of the dry-grind ethanol plants used unmilled corn or a few other grains to produce ethanol and some type of distillers dried grains (DDG). However, many plants are implementing a modified dry milled process in their facilities. The whole corn is milled into several fractions: corn germ, bran and the endosperm which is used for ethanol fermentation. Ethanol facilities are implementing this modified dry milling process because it increases ethanol yield. However, what is not so obvious is how these changes affect the nutrient quality of the resultant co-products. The high protein restant products are corn germ and a high protein distillers dried grains (HP-DDG), which is the product after the fermentation of the endosperm to ethanol. The corn germ fraction is high in fat and phosphorus, and has a more desirable amino acid profile. The DDG product has a very high protein level which is why it is often called high protein DDG and is used in feed applications. DDG is a feed ingredient because it does not contain the syrup that would normally be added back to the DDG. When considering the potential use of a feed ingredient such as HP-DDG and DDG, corn germ, primary emphasis is placed on obtaining accurate information regarding metabolizable energy, phosphorus availability and amino acid composition and digestibility. As these by-products from ethanol plant processes become increasingly available, more research should be conducted to determine the TME, phosphorus availability and amino acid digestibility of these new co-products of the ethanol process and corn germ products currently available to the feed industry.

MATERIALS AND METHODS

Distillers dried grains with solubles (DDGS), high protein distillers dried grains (HP-DDG) and corn germ samples were obtained from at least seven different fuel ethanol plants in the Midwest from 2005 to 2007. Each sample was analyzed for TME, amino acid digestibility by the "precision-fed rooster assay" as described by Sibbald (1970, 1979). Ten conventional and six cecotomized Single Comb White Leghorn roosters were fed for 24 h and then crop intubated with 35 g of each sample. Feces were collected for a 48 h period, dried, and weighed. The dired samples were then ground and sent for analysis.

An experiment was conducted to assess the bioavailability of phosphorus in DDGS, HP-DDG, and corn germ. Chicks were fed a starter diet for 7 days to 8 days of age. The chicks were fasted overnight and at 8 days of age 8 replications of 8 chicks were each fed the experimental diets. Dietary treatments were: 1) Corn-soybean meal basal with 0.13% available phosphorus, 2) Basal + 0.05% P from KH2PO4, 3) Basal + 0.10% P from KH2PO4, 4) Basal + 0.10% P from KH2PO4. The dired samples were then ground and sent for analysis.

Average total and amino acid (AA) digestibility coefficients (% of dietary distiller’s dried grains with solubles (DDGS), high protein distillers dried grains (HP-DDG), and corn germ (as-fed basis)