Evaluation of a High Protein DDGS Product on Broiler Performance

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Summary and Implications

Dried distiller's grains with solubles (DDGS) are commonly fed at an inclusion of 10% or less in broiler diets with the added benefit of an improved ability to utilize the available nutrients compared to layers fed the same inclusion. Combined with intentional changes to processing to enhance the nutritional quality of DDGS, there is the potential to increase the utilization of DDGS when fed to broilers. The objective of this study was to determine the effects of feeding up to a 20% inclusion of high protein DDGS (HiP DDGS) on broiler performance in straight-run Cobb 500 broiler chickens. Birds fed diets containing 15 and 20% HiP DDGS gained less weight than control ($p < 0.05$) but did not have a different feed intake (FI). Birds fed the 20% HiP DDGS diet had a less efficient FCR than the control. Additional research is needed to further illustrate the value of feeding HiP DDGS in broiler chickens.

Introduction

Co-products from the dry-milling production of ethanol such as DDGS are typically incorporated into broiler diets at an inclusion of less than 10% based on total diet ingredient inclusion. The continued use of DDGS in poultry diets is due to increased availability and the concentration of desirable nutrients such as available phosphate, amino acids, linoleic acid, and other important nutrients. Changes to the conventional methods of processing DDGS can be utilized to enhance certain aspects of the nutrient profile such as crude protein (CP) and metabolizable energy (ME). The high protein DDGS (HiP DDGS) used in this study contained ≥34% CP and 2,627 kcal/kg ME compared to 27% CP and 2,619 kcal/kg ME in conventional DDGS. Typically, these changes to nutrient composition will have more of an impact in broilers as they utilize DDGS better than laying hens fed the same inclusion rate. The objective of this study was to determine the effects of HiP DDGS on performance in broiler chickens.

Materials and Methods

The procedures of this study were approved by the Iowa State University Institutional Animal Care and Use Committee. Cobb 500 broiler chicks were housed in 4ft x 4ft floor pens for 42 days with 13 birds per pen and 8 pen replicates per diet. Each pen was randomly assigned to 1 of 4 dietary treatments that consisted of a control with 5% commercially-available conventional DDGS and 3 test diets containing 10, 15, and 20% HiP DDGS. A 5% HiP DDGS was initially included, but a diet error precluded the inclusion of the diet in the analysis. The 42-day trial was divided into a 14-day starter period, 21-day grower period, and 7-day finisher period. Diets within each period were isonitrogenous and isocaloric. To balance the diet, HiP DDGS were added in increasing levels at the expense of first soybean meal and then corn. This resulted in 21.50% protein and 3,000 kcal ME in the starter period, 19.75% protein and 3,500 kcal ME for grower, and 18.75% protein and 3,200 kcal ME in the finisher period. Mash feed and water were provided *ad libitum* in a round feeder and nipple waterer. All birds in a pen were weighed at the start and end of each period and feeders were weighed before and after filling throughout the study to record feed intake. This information was used to then determine the body weight (BW), gain, feed intake (FI), and feed conversion ratio (FCR) of each pen and then used to calculate the average performance variable per bird.

Performance measurements were analyzed using the GLM procedure in SAS with diet treatment as a fixed effect. The LSmeans statement with the PDIFF option was used to calculate mean values with an α-value of $p<0.05$ to determine significance among means. Means were separated using the MEANS statement with the LINES TUKEY option.

Results and Discussion

There were no significant differences in the body weight of the birds at the start of the study. In the starter period (d0-14), birds fed 15 and 20% HiP DDGS diets had a 10.3 and 5.1% lower BW, respectively, 11.4 and 5.7% reduction in gain, and 11.6 and 7.5% less efficient FCR than birds fed the control diets ($p<0.05$). These varied results during the starter period can partially be explained by caking in the HiP DDGS that was ameliorated by further grinding the HiP DDGS prior to mixing grower period diets. Caking of the HiP DDGS resulted in sorting of feed by the chicks, especially in 15 and 20% inclusion rates, and therefore may have reduced performance unintentionally.

In the grower period (d14-35), birds fed 15% HiP DDGS had a 6.5% lower BW compared to control ($p<0.05$); however, the FCR was not different than control or 10% HiP DDGS, indicating that birds fed 15% HiP DDGS may now be catching up from the reduced performance seen in the starter period. Birds fed the 20% HiP DDGS diet had a 6.0% lower BW, 6.8% reduction in gain, and 6.6% less efficient FCR compared to control ($p<0.05$).

In the finisher period (d35-42), birds fed the 15 and 20% HiP DDGS diets had a 7.3% lower BW compared to control ($p<0.05$); however, both gain and FCR were not significantly different between any of the 4 diets, indicating that less feed was required to produce the same amount of gain, and therefore no difference in FCR for the finisher period. Birds fed the 15% HiP DDGS diet had an 8.3% reduced feed intake compared to control ($p<0.05$), while the intake of birds fed 20% HiP DDGS was not different than any other group ($p>0.05$).

For the overall trial d0-42, birds fed the 15 and 20% HiP DDGS diets had a 6.7 and a 6.4% reduced gain, respectively, compared to control ($p<0.05$). While there were differences in BW, gain, and FI throughout the three periods, negative impacts to FCR for the entire 42-day trial were only seen in birds fed the 20% HiP DDGS diet. Birds fed the 20% HiP DDGS diet had a 5.3% less efficient FCR compared to the other treatments ($p<0.05$; Table 1). This could be a carryover from reduced performance during the starter period, where chicks build skeletal structure to handle muscle growth during the grower period, as performance differences due to higher HiP DDGS inclusion rates reduced over time.

All research diets were balanced based on total crude protein and energy for each growth stage and formulated as simply as possible; therefore, the amino acid profiles of the diets changed as higher levels of HiP DDGS displaced soybean meal and corn. Lysine and arginine are two amino acids that are essential in poultry diets. Lysine is usually a limiting amino acid in corn and soybean meal-based diets, whereas arginine is not. The percentage of lysine in soybean meal is 3.023% compared to 1.16, 0.70 and 0.233% found in HiP DDGS, DDGS, and corn, respectively. In contrast, soybean meal, HiP DDGS, DDGS, and corn each contain 3.56, 1.10, 1.10, and 0.86% arginine, respectively. As HiP DDGS concentration in the diets increased, the displaced soybean meal resulted in an overall decrease in lysine and arginine, with an over-representation of the amino acid profile of corn in the diet . The overall effect is that diets with a lower inclusion of DDGS and HiP DDGS had an improved amino acid profile than diets containing a higher concentration of HiP DDGS.

To evaluate the HiP ingredient in a controlled research setting, diets were formulated with as few differences as possible within a growth period; therefore, dietary amino acid supplements were kept constant. NRC guidelines (1994) suggest a range of 1.10- 0.85% for total lysine and 1.25-1.0% total arginine may be acceptable for 0-6wk broilers. Cobb 500 suggests to formulate digestible lysine >1.18% for starter, 1.05 for grower, and 0.95 for finisher, but the 20% HiP DDGS diet was calculated to contain 1.12, 0.96 and 0.86% digestible lysine, respectively. At higher inclusion rates of HiP DDGS (15 and 20%), arginine was affected to a greater degree than lysine because no supplemental arginine was added to the diet. Cobb 500 recommends digestible arginine in starter, grower, and finisher diets to be >1.24, 1.10, and 1.03%, respectively. The 15 and 20% HiP DDGS diets contained 1.08 and 1.01% digestible arginine in the starter period, 0.97 and 0.91% in the grower, and 0.90 and 0.84% in the finisher, respectively. For practical diet formulation with higher inclusion rates of HiP DDGS, single amino acid deficiencies can be easily corrected by adding supplemental lysine and arginine. While the 20% HiP DDGS was the only diet with a significantly lower overall 0-42 day FCR by 5 points, the difference in amino acid profiles may explain the decrease in performance as HiP DDGS in the diet increased (Table 1).

Based on these results, HiP DDGS can be fed to broiler chickens up to 10% of the diet without negative impacts on performance during a 42 day grow-out period. Importantly, product quality due to new processing and drying methods must not change the consistency of the product in ways that may cause birds to sort feed (i.e. caking). Producers wishing to add DDGS to their practical diets must take into account diet cost and amino acids tradeoffs with the use of high corn diets due to the reduction of soybean meal in place of HiP DDGS, and the need to balance synthetic amino acids and overall protein content when adding increased inclusion levels of DDGS. Additional research is needed to further illustrate the value of production method of DDGS in relation to predicting feeding value HiP DDGS to broiler chickens.

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Table 1. Performance of Cobb 500 broiler chickens[1] on a per bird basis fed increasing concentrations of HiP DDGS[2] for 42 consecutive days.

	Experimental Diet					
	DDGS Control	10% HiP DDGS	15% HiP DDGS	20% HiP DDGS	SEM	P-Value
Starter 0 d-14 d						
BW (g/bird; 0 d)	38.56	38.08	37.69	37.93	0.0003	>0.05
BW (kg/bird; 14 d)	0.39[a]	0.39[a]	0.35[c]	0.37[b]	0.005	<0.0001
Gain (kg/bird)	0.35[a]	0.35[a]	0.31[c]	0.33[b]	0.004	<0.0001
FI (kg/bird)	0.52	0.53	0.51	0.52	0.007	0.0785
FCR	1.46[c]	1.51[c]	1.63[a]	1.57[b]	0.015	<0.0001
Grower 14 d-35 d						
BW (kg/bird; 35 d)	2.01[a]	2.03[a]	1.88[b]	1.89[b]	0.028	0.001
Gain (kg/bird)	1.62[ab]	1.64[a]	1.54[bc]	1.51[c]	0.026	0.0045
FI (kg/bird)	2.69[ab]	2.75[a]	2.61[b]	2.67[ab]	0.035	0.0647
FCR	1.67[b]	1.68[b]	1.71[b]	1.78[a]	0.013	<0.0001
Finisher 35 d-42 d						
BW (kg/bird; 42 d)	2.73[a]	2.73[a]	2.53[b]	2.53[b]	0.040	0.0004
Gain (kg/bird)	0.70	0.71	0.65	0.65	0.017	0.0364
FI (kg/bird)	1.33[a]	1.31[a]	1.22[b]	1.26[ab]	0.018	0.0028
FCR	1.90	1.86	1.88	1.95	0.032	0.2706
Total 0 d-42 d						
Gain (kg/bird)	2.67[a]	2.69[a]	2.49[b]	2.50[b]	0.042	0.0014
FI (kg/bird)	4.54[ab]	4.58[a]	4.34[b]	4.46[ab]	0.055	0.0194
FCR	1.70[b]	1.70[b]	1.74[b]	1.79[a]	0.011	<0.0001

[1]Experimental diets were divided into a starter phase (14 days), grower phase (21 days) and finisher phase (7 days) for a total of 42 consecutive days. Broilers were fed a control diet (no HiP DDGS) and four different test diets with increasing concentration of HiP DDGS (5%, 10%, 15%, and 20%). Control and dietary treatments contained 104 broilers total, with 8 replicate experimental units and 13 birds/experimental unit.

[2] HiP DDGS= High Protein DDGS; crude protein=34.1% as fed

[3] Model significant (P<0.0001)

[4] Least square means with differing superscripts are significantly different within a row (P<0.05)

[5] Abbreviations: BW= body weight; FI= feed intake; FCR= feed conversion ratio (kg intake/kg gain)