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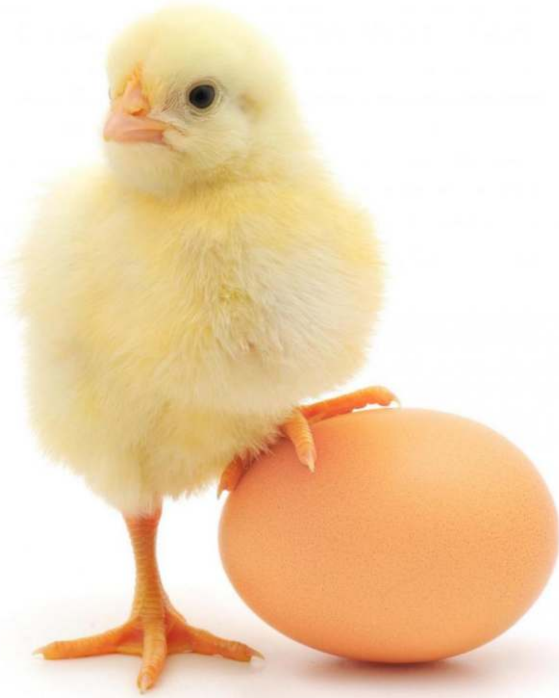

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ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Use of Dried Distillers' Grains with Solubles in Growing-finishing Diets of Turkey Hens

Kevin D. Roberson
2209 Anthony Hall, Department of Animal Science, Michigan State University,
East Lansing, MI 48824, USA
E-mail: robers22@msu.edu

Abstract: Two experiments were conducted with Large White female turkeys to evaluate the effect of dried distillers' grains with solubles (DDGS) derived from ethanol production on growth performance from about 8 to 15 wk of age. Experiment 1 consisted of inclusion levels of 0, 9, 18 or 27% DDGS to a corn-soybean meal based diet and the treatment diets were formulated with a metabolizable energy value of 2870 kcal/kg for DDGS and on a digestible amino acid basis. The grower diet was fed from 56 to 77 d of age and the finisher diet was fed from 77 to 105 d of age. Body weight was linearly decreased at 105 d as % DDGS increased in the diet. Feed conversion was increased at p = 0.100 from 77 to 105 d of age as DDGS inclusion level increased. The incidence of pendulous crops increased when high levels of DDGS were fed. In Experiment 2, dietary treatments consisted of 0, 7, or 10% DDGS in the grower period. Half of the birds fed 10% DDGS in the grower period were fed 7% DDGS in the finisher period. The mash diets were formulated with a metabolizable energy value of 2805 kcal/kg for DDGS and on a total amino acid basis. There were no significant effects on body weight or feed conversion in Experiment 2. Results indicate that ethanol-derived DDGS can be effectively included at 10% in growing/finishing diets for turkey hens if proper formulation matrix values for all nutrients are used.

Key words: Distillers' grains with solubles, metabolizable energy, turkey

Introduction

Distiller's grains with solubles (DDGS) has been used for many years in poultry diets in the United States. Most DDGS in the past had been marketed as a by-product of the liquor industry. Early use of DDGS was due the thought that there might be "unidentified growth factors" in DDGS that would enhance production performance of livestock and poultry. Use of DDGS in poultry diets has been limited to about 5% inclusion in most cases due to concerns about high fiber content, nutrient variability and digestibility, and in some regions, transportation costs may be excessive due to limited local supply. Couch *et al.* (1957) reported that inclusion of 5% DDGS would improve turkey growth rate. Potter (1966) found that DDGS could be fed to turkeys at levels up to 20% with no detrimental effects on body weight or feed conversion if lysine and metabolizable energy (ME) values were formulated properly. Waldroup *et al.* (1981) reported that up to 25% DDGS could support optimal growth performance of broilers when energy and lysine was balanced appropriately. However, greater than 15% inclusion was detrimental to pellet quality due to the high level of fat required to meet the ME requirement specified for the birds. Parsons *et al.* (1983) concluded that DDGS could replace up to 40% of soybean meal protein with no effect on chick body weight if lysine was adjusted.

In the United States, a recent interest and increase in ethanol production from corn has resulted in many new ethanol plants being constructed, especially in the Midwestern states commonly referred to as the "Corn Belt". This new technology includes a more gentle drying process and the possibility that DDGS derived from ethanol production may have a better nutrient profile than the traditional commodity traded DDGS produced as a by-product of the liquor industry. Noll *et al.* (2002) reported that toms fed DDGS derived from ethanol production at 12% in the starter period and 8% in later stages of growth did not result in detrimental growth performance or breast meat yield. A ME value of 2870 kcal/kg was used in that study as predetermined in energy digestibility studies by the same primary author. Lumpkins *et al.* (2003) reported that broilers could be fed 12% DDGS derived from ethanol production with no effect on growth performance or carcass yield.

Due to the construction of an ethanol plant in Michigan, there is an interest among poultry producers in the state to evaluate the effectiveness of DDGS inclusion in poultry diets. The purpose of this study was to determine levels of inclusion of DDGS produced from engineering technology available at the ethanol plant in Michigan that could be effectively used in turkey diets. Due to the availability of hens at the research farm and the lack of data published for feeding turkey hens, the study was conducted to evaluate levels of DDGS that can be fed in turkey hen diets.

Materials and Methods

For both experiments, Hybrid Converter hens were delivered after hatching by a commercial hatchery[1]

[1]Cold Springs Farm Ltd., Thamesford, ON NOM 2MO

Table 1: Composition of female turkey grower diets with dried distillers' grains with solubles (DDGS)

	Experiment 1				Experiment 2		
Ingredient	Percent of diet						
Ground yellow corn	54.10	50.25	46.40	42.55	56.55	52.60	50.90
Soybean meal (48%)	35.50	30.55	25.60	20.65	33.47	30.22	28.82
DDGS	0.00	9.00	18.00	27.00	0.00	7.00	10.00
Choice white grease	5.80	5.63	5.46	5.30	5.50	5.66	5.74
Dicalcium phosphate	2.35	2.07	1.82	1.54	2.50	2.42	2.38
Limestone	1.18	1.29	1.42	1.53	0.83	0.90	0.94
Salt	0.34	0.28	0.21	0.17	0.37	0.34	0.32
Sodium bicarbonate	0.05	0.10	0.15	0.20	0.05	0.05	0.05
L-Lysine-HCl	0.26	0.39	0.49	0.60	0.27	0.35	0.39
DL-methionine	0.14	0.14	0.14	0.14	0.21	0.21	0.21
L-threonine	0.03	0.05	0.06	0.07	0.00	0.00	0.00
Vitamin premix[1]	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Trace mineral premix[2]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Calculated nutrient content							
Crude protein, %	21.00				21.00		
ME, kcal/kg	3200				3200		
Lysine, %	1.50				1.43		

[1]Vitamin premix provided per kilogram of diet during 6-9 wk phase: vitamin A (all-trans-retinyl acetate), 11,000 IU; cholecalciferol, 5,000 ICU; vitamin E (all-rac-α-tocopheryl acetate), 35 IU; menadione (as menadione sodium bisulfite), 2.75 mg; riboflavin, 10 mg; Ca pantothenate, 20 mg; nicotinic acid, 80 mg; vitamin B_{12}, 0.025 mg; vitamin B_6, 4.3 mg; thiamin (as thiamin mononitrate), 2.9 mg; folic acid, 2.2 mg; biotin, 0.2 mg; vitamin C, 0.10 g; selenium, 0.275 mg; and ethoxyquin, 125 mg. [2]Mineral premix supplied per kilogram of diet: manganese, 100 mg; zinc, 100 mg; iron, 50 mg; copper, 10 mg; iodine, 1 mg.

located in Canada. The poults were utilized in a 7-wk amino acid study and then placed on a common corn-soybean meal based diet until approximately 8 wk of age. The birds were weighed and sorted to result in equal starting weights across all treatments. The average starting body weight in Experiment 1 was 3.12 kg at 56 d of age and for Experiment 2 the birds weighed 3.58 kg at 57 d of age. There were 42 or 43 birds/pen at the beginning of each study and 7 pens (3.69 X 4.62 m) per treatment. A corn-soybean meal based diet (Table 1 and 2) was fed in the mash form to all treatment groups. In Experiment 1, DDGS was included in the diet at 0, 9, 18 or 27% from 56 to 105 d of age. The DDGS in this trial came from an ethanol plant in Preston, MN and is marketed under the name Dakota Gold Plus[2]. All essential amino acids were formulated to meet or exceed NRC (1994) requirements and were formulated on a digestible basis. Information on amino acid digestibilities for ethanol-derived DDGS was collected (S.Noll, University of Minnesota, personal communication) and used in formulations and NRC (1994) values for corn and soybean meal. Digestibility of lysine in DDGS was assumed to be 78% as reported by Noll *et al*. (2002). The metabolizable energy value used for DDGS was 2870 kcal/kg based upon previous experience feeding toms (S. Noll, University of Minnesota, personal communication). The grower diet was fed for 21 days and the finisher diet was fed the last 28 days. The birds were weighed at the end of each feeding phase and the incidence of pendulous crops was recorded for each pen. Litter samples were taken the day after the birds were removed from the house by taking 8 sub-samples from each pen and blending them together. The composite sample for each pen was dried at 50 ^{o}C for 24 hr in a forced air drying oven to measure litter dry matter. The difference between the wet litter sample taken from the pen and the dry litter removed from oven is reported as litter moisture.

Experiment 2 was conducted the same as Experiment 1 except for differences in inclusion levels of DDGS and formulation strategy. The DDGS used in this trial came from a recently constructed ethanol plant in Michigan manufactured by similar engineering technology used to build the plant in Minnesota from which DDGS was delivered for Experiment 1. Treatments consisted of 0, 7, or 10% DDGS during the grower phase which was fed from 57 to 75 d of age. There were 14 rather than 7 pens of turkeys fed 10% DDGS during this period. From 75 to 103 d of age, half of the birds previously fed 10% DDGS were then fed 7% DDGS. The diets were formulated to provide at least 110% of the NRC (1994) requirements for essential amino acids. Amino acid specifications were formulated on a total amino acid basis due to concern about variability of digestibility of amino acids,

[2]Dakota Commodities, Scotland, SD 57059

Table 2: Composition of female turkey finisher diets with dried distillers' grains with solubles (DDGS)

	Experiment 1				Experiment 2		
Ingredient	Percent of diet						
Ground yellow corn	62.95	59.10	55.25	51.45	60.72	56.62	54.87
Soybean meal (48%)	26.90	21.95	17.00	12.00	26.87	23.63	22.22
DDGS	0.00	9.00	18.00	27.00	0.00	7.00	10.00
Choice white grease	5.95	5.79	5.62	5.45	8.25	8.43	8.51
Dicalcium phosphate	2.13	1.87	1.60	1.34	2.03	1.94	1.90
Limestone	1.10	1.21	1.32	1.44	1.17	1.23	1.27
Salt	0.38	0.32	0.27	0.21	0.37	0.34	0.33
Sodium bicarbonate	0.00	0.05	0.10	0.15	0.05	0.05	0.05
L-Lysine-HCl	0.16	0.27	0.38	0.49	0.13	0.22	0.26
DL-methionine	0.08	0.08	0.08	0.08	0.16	0.15	0.15
L-threonine	0.10	0.11	0.13	0.14	0.00	0.13	0.20
Vitamin premix[1]	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Trace mineral premix[2]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Calculated nutrient content							
Crude protein, %	18.00				18.00		
ME, kcal/kg	3400				3400		
Lysine, %	1.15				1.10		

[1]Vitamin premix provided per kilogram of diet during 6-9 wk phase: vitamin A (all-trans-retinyl acetate), 11,000 IU; cholecalciferol, 5,000 ICU; vitamin E (all-rac-α-tocopheryl acetate), 35 IU; menadione (as menadione sodium bisulfite), 2.75 mg; riboflavin, 10 mg; Ca pantothenate, 20 mg; nicotinic acid, 80 mg; vitamin B_{12}, 0.025 mg; vitamin B_6, 4.3 mg; thiamin (as thiamin mononitrate), 2.9 mg; folic acid, 2.2 mg; biotin, 0.2 mg; vitamin C, 0.10 g; selenium, 0.275 mg; and ethoxyquin, 125 mg. [2]Mineral premix supplied per kilogram of diet: manganese, 100 mg; zinc, 100 mg; iron, 50 mg; copper, 10 mg; iodine, 1 mg.

especially lysine. The metabolizable energy value used for DDGS was 2805 kcal/kg in this study. The litter from this experiment was not sampled and was used as a base for a later trial.

All data were analyzed on a pen basis using the General Linear Models procedure of SAS (SAS Institute, 2000). Data in Experiment 1 was subjected to regression analysis to test for linear or quadratic effects. The incidence of pendulous crops was analyzed with actual data as arcsine transformation did not provide any benefit in analysis of the data.

Results and Discussion

There was no significant effect on 77-d body weight in Experiment 1 (Table 3). However, body weight was linearly decreased (p = 0.011) at 105 d as DDGS inclusion in the diet increased. The decrease in body weight was likely due to a need for additional lysine and possibly other amino acids to the diet. The digestibility of lysine in by-products such as DDGS can vary considerably due to processing differences of the grain. Ergul *et al*. (2003) reported that the average lysine digestibility from ethanol-derived DDGS was 71% with a digestible lysine content of 0.53%. However, digestible lysine content varied from 0.38 to 0.65%. Feed conversion (feed:gain) was linearly increased at p = 0.100 by DDGS inclusion during the finisher period (77 to 105 d of age). Higher feed conversion was likely due to an overestimation of the ME value of DDGS (Potter, 1966; Waldroup *et al*., 1981). Energy levels of samples of ethanol-derived DDGS can also vary within and between plant locations (N.Dale, University of Georgia, personal communication).

The incidence of pendulous crops was increased linearly (p = 0.018) as inclusion of DDGS increased. The higher incidence of pendulous crops when 18 to 27% DDGS was fed in Experiment 1 would result in complications at the processing plant as the crop was emptied and feed contamination would result in reprocessing of the birds affected. The incidence of pendulous crops when 9% DDGS was fed was similar to the control fed birds and was a common occurrence observed in the facilities used in this study. Litter moisture was increased quadratically (p = 0.047) by DDGS inclusion due to wetter litter when 27% was fed. Sodium levels were formulated to be the same (0.18%) across all treatments. Dietary potassium decreased by 0.03% for each 9% level of inclusion of DDGS as soybean meal was displaced. However, dietary potassium was above the NRC (1994) requirement for all treatments at all ages. It was not possible to monitor water consumption for each treatment in the facility used.

There were no significant differences in body weight or feed conversion in Experiment 2. (Table 4). This experiment showed that DDGS could be incorporated into female turkey diets at 10% during the entire 8 to 15-wk growing/finishing periods. The results verified that

Table 3: Effect of inclusion of dried distillers' grains with solubles (DDGS) on growth performance, incidence of pendulous crops and litter moisture when fed to Large White female turkeys[1] (Experiment 1)

DDGS %		77-d Body Weight (Kg)	56 to 77-d Feed:Gain (Kg):(Kg)	105-d Body Weight (Kg)	77 to 105-d Feed:Gain (Kg):(Kg)	56 to 105-d Feed:Gain (Kg):(Kg)	Pendulous Crops	Litter Moisture
							------------- %	-------------
0		5.44	2.49	8.53	3.36	2.99	0.3	50.6
9		5.42	2.45	8.41	3.52	3.07	0.3	49.5
18		5.32	2.62	8.23	3.68	3.21	1.7	48.1
27		5.26	2.66	8.16	3.68	3.21	3.1	52.3
Mean		5.36	2.55	8.34	3.56	3.11	1.3	50.0
SEM		0.12	0.07	0.13	0.12	0.09	0.8	1.6
Analysis of Variance								
	df	----------------------------			probabilities			----------------------------
DDGS	3	0.733	0.167	0.218	0.217	0.252	0.062	0.152
Regression Analysis								
Linear		0.258	0.143	0.011	0.100	0.124	0.018	0.610
Quadratic		0.839	0.507	0.794	0.234	0.376	0.403	0.047

[1]Average start weight was 3.12 kg at 56 d of age

Table 4: Effect of inclusion of dried distillers' grains with solubles (DDGS) on growth performance of Large White female turkeys[1] (Experiment 2)

Treatment (% DDGS)	75-d Body Weight (kg)	57 to 75-d Feed:Gain (kg:kg)	103-d Body Weight (kg)	75 to 103-d Feed:Gain (kg:kg)	57 to 103-d Feed:Gain (kg:kg)
0	5.56	2.65	8.51	3.44	3.12
7	5.55	2.67	8.46	3.54	3.19
10 / 7[2]	5.48	2.67	8.38	3.48	3.15
10	5.58	2.66	8.50	3.46	3.14
Mean	5.54	2.66	8.46	3.48	3.15
SEM	0.04	0.05	0.12	0.07	0.05
Analysis of variance[3]					
	----------------------------		probabilities		----------------------------
Treatment	0.396	0.993	0.851	0.701	0.787

[1]Average start weight was 3.58 kg at 57 d of age. [2]10% DDGS was fed from 57 to 75 d of age; 7% DDGS was fed from 75 to 103 d of age. [3]df = 2 to 75 d of age; df = 3 to 103 d of age.

the ME value of DDGS for turkey hens should be formulated at less than 2870 kcal/kg. Because the lysine requirement specification was formulated by two different methods in the two experiments, the total amount of lysine in the diets was about 5% lower in Experiment 2. Lysine content of the DDGS used in Experiment 2 was analyzed at 0.64% compared to 0.62% in Experiment 1. However, the DDGS used in Experiment 2 was lighter in color than the DDGS used in Experiment 1 which may indicate better amino acid digestibility. The Maillard, or browning, reaction in which the epsilon amino group of lysine is reduced by a sugar in the heating process is known to reduce digestibility of lysine. Ergul *et al.* (2003) reported that color is a good predictor of lysine, cysteine, and threonine digestibilities in DDGS for poultry.

Noll *et al.* (2002) reported that feeding 12% DDGS with an equal inclusion of canola meal to toms from 5 to 19 wk of age will reduce breast meat yield. The concern over meat yield is that removal of soybean meal by DDGS at the same inclusion rate results in a higher proportion of the dietary amino acids being provided by DDGS compared to earlier phases in which the dietary protein levels are higher. The result is that tryptophan and possibly arginine become limiting and negatively impact breast yield. The hens in both experiments of the current study were processed whole in a commercial plant and yield was not measured by treatment effect.

The results of this study demonstrate that 10% DDGS derived from ethanol production can be fed to turkey hens in the growing-finishing phases with no detrimental effects on growth performance as long as the proper matrix values are used for nutrient levels of DDGS. A value of about 2800 kcal/kg ME for DDGS resulted in adequate feed conversion. Lysine can be formulated on a total amino acid basis without a reduction in body weight as long as the nutrient specification for lysine is 10% over the NRC (1994) requirement for turkeys at each age period and the DDGS fed does not have a dark color.

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