Distillers Grains Feeding Recommendations

POULTRY

Summary of Distillers Grains Feeding Recommendations for Poultry

- "Corn distillers dried grains with solubles can contribute energy, protein and phosphorous to poultry diets."
- "Maximum dietary inclusion levels: broilers, 10%; turkeys (grow-finish), 15%; chicken layers, 15%. Higher levels may be used but may require more careful adjustment of amino acid and energy levels."

— Dr. Sally Noll, University of Minnesota, *Corn Distillers Dried Grains with Solubles for Poultry*, prepared for Minnesota Corn Growers Association, 2005

- "Distillers dried grains plus solubles proved to be a successful feed ingredient when used up to 15% in commercial laying hen diets."

— B.S. Lumpkins, A.B. Batal and N.M. Dale, University of Georgia, *The Use of Distillers Dried Grains Plus Solubles (DDGS) for Laying Hens,* 2005 Journal of Applied Poultry Research 14:25-31

- Based on trial diets of 6, 12 and 18% DDGS, "the 'new generation' DDGS evaluated is a highly acceptable feed ingredient for broiler chickens."

— B.S. Lumpkins, A.B. Batal and N.M. Dale, University of Georgia, *Evaluation of Distiller's Dried Grains with Solubles as a Feed Ingredient for Broilers,* presented at Southern Poultry Science Meeting, 2003

- "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 re used."

— Kevin D. Robertson, Michigan State University, *Use of Dried Distillers' Grains with Solubles in Growing-finishing Diets of Turkey Hens,* International Journal of Poultry Science 2 (6): 389-393, 2003

Corn Distiller Dried Grains with Solubles for Poultry

-An economical addition to poultry diets

Corn Distiller Dried Grains with Solubles (CDDGs) can contribute energy, protein and phosphorus to poultry diets. Least cost formulation will allow up to 20% CDDGs when the product is priced between $75 to 110 per ton depending on cost of other ingredients – corn, SBM, supplemental fat, supplemental lysine and dicalcium phosphorus

-High quality product is available

As a source of protein:
Current research indicates that the nutrient quality of CDDGS is much improved over past nutrient listings. Digestible lysine content can be as high as 83% as compared to NRC (Nutrient Requirements for Poultry, 1994) value of 65%.[1]

As a source of phosphorus:
CDDGs is quite high in phosphorus (.65-.78%) and research indicates that the phosphorus is at least 65% bioavailable. [2]

As a source of energy:
Recent research has found a value of 1283 kcal/lb of "true metabolizable energy" (TME) for both turkeys and chickens and an apparent metabolizable energy (AME) content of 1250 kcal/lb. Values of 1300 kcal/lb have been used in feeding trials with turkeys without effect on feed conversion[3] and values of 1350 kcal/lb in chicken layer and broiler studies[4]. A minimum suggested metabolizable energy (ME) value of 1250 kcal/lb should be used in feed formulation.

As a source of xanthophylls:
CDDGS contributes to pigmentation of egg yolk and chicken carcasses. Feeding of 10% CDDGS darkened egg yolks within one month of feeding in corn-soybean meal based diets.

-Maximum dietary inclusion levels

Broilers – 10%
Turkeys (grow/finish) – 15%
Chicken Layers – 15%

Higher levels may be used but may require more careful adjustment of amino acid and energy levels

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[1] University of Minnesota and University of Illinois
[2] University of Illinois
[3] University of Minnesota and Michigan State University
[4] University of Georgia

-Keys to CDDGs use in poultry diets

Obtain current analytical information from the source of the material as plants are producing a relative consistent product.

Formulate diets considering amino acid digestibility especially for lysine, cystine, and threonine

Formulate diets using minimums for tryptophan and arginine in addition to lysine, TSAA, and threonine, due to the potentially limiting nature of these amino acids in corn DDGs protein

Lower levels of inclusion should be used in diets of young poultry or when first introduced into the diet.

Consider using a higher ME value than that currently recommended by NRC (1994) which lists a ME value of 1130 kcal/lb for DDGs. As most corn DDGs has a fat content which exceeds 9%, ME for CDDGs should be higher, at least in the range of 1200-1250 kcal/lb.

For more information on DDGS research and utilization of DDGs in poultry diets, visit the University of Minnesota website on DDGs at www.ddgs.umn.edu

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DISTILLERS GRAINS IN POULTRY DIETS

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Anticipation of increased supplies of distiller's dried grains with solubles (DDGS) in the Midwest has rekindled the interest in utilization of this by-product in animal feeds. In the Midwest US, corn is the primary feed stock although other grains can be processed as well. With increasing numbers of chicken layers and a large turkey industry in the Midwest, use of DDGS in poultry diets appears to have potential. Unfortunately, there is limited recent research for this ingredient with modern strains of poultry.

In the dry mill production of ethanol two products are produced – liquid solubles and grain residue. Each could be dried separately but are mixed together to form DDGS as a dry ingredient. Some of the liquid solubles have been fed experimentally with acceptable results (Hunt et al., 1997) but usually the product is fed after drying. DDGS as a feed ingredient has a moderate protein content and energy level similar to soybean meal. As a sole source of protein in diet, Parsons and coworkers (1983) found DDGS to be limiting in tryptophan and arginine after lysine.

An early use of DDGS in poultry diests was primarily as a source of unidentified factors that promote growth and hatchability. Distillers dried solubles (DDS) or DDGS were used in diets at low levels of inclusion usually less than 10%. Couch et al. (1957) found 5% inclusion of DDS variably improved turkey growth rates with the response ranging from 17-32%. Day et al (1972) reported broiler body weight improvements to DDS and DDGS in broiler diets at 2.5 and 5% in one of 3 trials. Improved reproductive performance has also been indicated for turkey breeder hens. Couch et al (1957) found improvements in turkey breeder hatchability during the second half of lay with inclusion of dried alfalfa meal, condensed fish solubles, and DDS. Manley et al (1978) found 3% DDGS improved egg production in hens late in lay and experiencing a low rate of egg production. In diets low in phosphorus DDGS was particularly valuable in improving egg production. However, in a subsequent report, no benefits were observed without low dietary phosphorus (Grizzle et al., 1982). Some have hypothesized that the UGF response may partially be due to alteration of feed palatability. Alenier and Combs (1981) noted chicken layer hens preferred rations containing 10% DDGS or 15% DDS over a corn-soy diet without DDGS. Cantor and Johnson (1983) were unable to document an effect with distillers in corn soy diets for young chicks. With identification of essential nutrients and availability of commercial supplements, UGF sources are often looked upon with skepticism (Leeson and Summers).

Use of DDGS has also been examined at high levels of inclusion. When lysine levels were adjusted in turkey diets, similar body weights were obtained with DDGS inclusion up to 20% of the diet to 8 wks of age; but feed conversion worsened (Potter, 1966). Parsons et al. (1983) found that DDGS could replace up to 40% of soybean meal protein when lysine content was adjusted without an effect on body weight. When energy is also adjusted body weights and feed conversions are not affected by inclusion of distillers to high levels. Waldroup et al (1981) included DDGS to 25% of diet for broilers. When adjusted for lysine and energy level, performance was not affected. Without adjustment for energy, growth was maintained but feed conversion decreased. Caloric intake per gain was similar across all treatments.

Despite the above research results, nutritionists are hesitant to use high inclusion levels in the diet. The lower energy (less starch) and higher fiber content is a concern and high dietary levels may limit intake of high performance meat poultry. Variability in product nutrient content and quality is often cited. Indeed, variability exists in nutrient content and performance response. In the report presented by Cromwell and coworkers (1993), 9 different samples of DDGS were analyzed and tested in chick diets. A large range of lysine contents were noted (.43 to .89%). Chick responses to inclusion of these same samples (20%) in isonitrogenous and isocaloric diets ranged from 63 to 84% of the corn-soy-starch control. Samples higher in lysine tended to perform better but some samples did not follow this pattern.

As distiller grains undergo heating to produce the dried product, concern exists over amino acid digestibility especially for heating of lysine in the presence of sugars. Indeed the limited literature citations indicate poorer availability of lysine. Combs and Bossard (1969) found lysine availability to range from 71-93% by chick growth assay. Parsons et al (1983) found slightly lower availability of 66% by chick growth assay. Lysine digestibility with roosters was found to be 82%. Other sources also assign a low digestibility to DDGS.

With the paucity of research and new developments in production of DDGS, inclusion levels and digestibility should be reconsidered. In the Midwest, a variety of ingredients are available and may be cost effective when considering both ingredient cost and effects on performance. Besides soybean meal, meat and bone meal and canola meal is often available. Along with corn and SBM, these ingredients are often used in market poultry diets. Meat and bone meal is a good source of protein and offers other nutrients such as calcium and phosphorus and contributes energy (fat) to the diet. Canola meal has benefits for pellet quality and mill throughput. Utilization of other ingredients such as DDGS needs to be evaluated in such diets with an emphasis on protein quality or amino acid balance as performance and breast meat yield is greatly impacted by intake of specific amino acids.

Thus a study was designed to examine if significant levels of canola meal and DDGS can be used in market turkey diets and to determine which amino acids (tryptophan, isoleucine, arginine) may limit performance with diets containing canola and DDGS.

Nicholas male poults were placed in starting pens at one day of age and reared to 5 weeks of age. Poults were fed a pre-experimental diet designed for best rate of gain. At 5 weeks of age the birds were randomly distributed into 98 pens with 10 birds per pen. Room temperature at 5 wks was targeted at 70 F. In the other room temperature was gradually decreased to 60 F at 14 wks of age and a minimum of 55 F held for the remaining experimental period.

Starting at 5 wks of age, the toms in each environment (cool and warm temperature environments) were fed one of seven dietary treatments with 7 replicates per treatment.

Treatments

1. Control - Corn/soy/animal protein
2. As 1 plus corn DDGS
3. As 1 plus Canola meal
4. As 1 plus DDGS and Canola meal
5. As 4 plus Tryptophan to Trt 1
6. As 4 plus Tryptophan and Isoleucine to Trt 1
7. As 4 plus Tryptophan, Arginine, and Isoleucine to Trt 1

All major diet ingredients were analyzed for nutrient content and digestible amino acids (Table 1). Ingredients were chemically analyzed for protein, minerals and amino acids. Samples of each ingredient were submitted to Dr. Parson at the University of Illinois for determination of digestible amino acids using cecatomized chickens.

Sample diets are shown in Tables 2 and 3 for the respective 5-8 and 17-19 wk periods for Treatments 1 through 4. The control diet (Treatment 1) includes animal protein because of its obvious economic advantage and widespread use. Valine content (as a percent of protein) is similar across ingredients; therefore diet protein in these sample diets was fixed by setting a valine specification. Supplemental lysine, methionine, and threonine were used so that all diets contained adequate amounts of these amino acids. For Treatments 5, 6, and 7 supplements of tryptophan, arginine and isoleucine were used to achieve amino acid levels similar to that of Treatment 1. All diets contained 60 gm Coban and 20gm Stafac from 5-8 wks and 20 gm Stafac per ton alone from 8-19 wks of age. Weights and feed consumption were determined at 8, 11, 14, 17 and 19 wks of age. At 19 weeks, toms were processed and carcass and breast meat yield determined. At this time samples of breast meat representing each treatment and environment were measured for meat quality by obtaining color, pH, and purge loss.

The experimental design was factorial with diet and environment as the main effects. Analyses of variance were conducted to determine the effects of diet, environment and their interaction on gain, feed conversion, and breast meat yield.

Body weight and feed efficiency (feed/gain) were affected primarily by environment temperature. Turkeys grown in the warm temperature environment had less body weight especially at 19 wks of age with somewhat better feed efficiency (Table 4). Inclusion of moderate levels of canola meal and DDGS had no adverse effects on performance in comparison to the control diet in either environment. Both environment and diet (Table 5) affected breast meat yield (amount and percentage). Warm temperatures depressed yield by 1.2 lbs. or 2% of the carcass. Inclusion of either DDGS or canola meal alone had little effect on breast meat yield. However, the inclusion of both into the diet depressed percentage meat yield significantly. Supplementation of the diet with tryptophan restored some of the lost yield in comparison. Isoleucine was without effect, while supplementation with arginine (in combination with tryptophan and isoleucine) restored breast meat yield completely.

In summary, digestible amino acid content of the DDGS used in this project was much better than reported elsewhere. Warm environmental temperatures depressed body weights by 1.8 lbs.

at 19 wks of age and breast meat amount by 1.2 lbs. Inclusion of significant levels of either canola and/or DDGS had no effect on growth performance. Breast meat yield (as a proportion of carcass weight) was sensitive to amino acid quality as reflected by the depression in yield when the combined diet of canola and distiller grains were fed. The amino acids tryptophan and arginine appeared to play a role in restoring yield.

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Table 1. Ingredient Analyses for Turkey Feeding Trial.

	Corn, Ground yellow		Soybean meal, 47%		Distillers Grains Solubles		Canola Meal		Meat & Bone Meal Poultry Blend	
Nutrient (%)	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible
PROTEIN, CRUDE	8.44		46.77		26.39		37.12		58.11	
DRY MATTER	87.13		88.27		90.23		89.32		95.19	
FAT, CRUDE	4.67		2.31		11.51		3.45		11.37	
FIBER, CRUDE	1.7		2.47		6.17		10.15		0.51	
CALCIUM	0.0079		0.24		0.08		0.78		7.77	
PHOSPHORUS, TOTAL	0.24		0.65		0.82		1.18		3.86	
POTASSIUM	0.29		2.11		1.1		1.29		0.61	
SODIUM	0.0008		0.0215		0.17		0.11		0.65	
CHLORIDE	0.04		0.01		0.08		0.05		0.58	
METHIONINE	0.15	0.14	0.66	0.61	0.49	0.43	0.72	0.65	1.07	0.99
CYSTINE	0.17	0.16	0.77	0.65	0.53	0.42	0.97	0.77	0.63	0.53
LYSINE	0.25	0.2	2.94	2.66	0.81	0.64	2.04	1.71	3.32	2.99
ARGININE	0.37	0.33	3.38	3.14	1.11	1.02	2.22	2.05	3.95	3.71
TRYPTOPHAN	0.06	0.05	0.66	0.58	0.24	0.192	0.5	0.45	0.52	0.468
VALINE	0.37	0.32	2.19	1.99	1.36	1.2	1.77	1.48	2.43	2.19
GLYCINE	0.3		1.93		1		1.75		6.41	
HISTIDINE	0.23	0.2	1.29	1.15	0.7	0.61	1.01	0.89	1.16	1.06
PHENYLALANINE	0.41	0.37	2.37	2.19	1.26	1.16	1.44	1.3	2.02	1.87
TYROSINE	0.26		1.63		0.99	0.95	0.99	0.88	1.47	1.36
THREONINE	0.29	0.24	1.78	1.57	1	0.83	1.51	1.23	2.01	1.81
LEUCINE	1.02	0.96	3.59	3.31	3	2.82	2.53	2.28	3.63	3.37
ISOLEUCINE	0.27	0.24	2.05	1.89	0.96	0.86	1.35	1.16	1.88	1.73
SERINE	0.37	0.37	2.09	2.09	1.12	1.01	1.33	1.15	2.22	1.98

Table 2. Selected Diet Composition 5-8 Wks of Age

	Control (C-S-MBM)		DDGS		Canola		Canola & DDGS	
Ingredient (%)	Trt 1		Trt 2		Trt 3		Trt 4	
Corn	59.95		54.09		54.81		48.95	
SBM 47%	26.78		20.49		18.68		12.39	
Poultry blend (meat&bone)	8		8		8		8	
Distillers grains w/sol	0		12		0		12	
Canola meal	0		0		12		12	
Dicalcium phosphate	1.094		1.005		0.954		0.865	
Calcium carbonate	0.683		0.748		0.567		0.632	
Scarb	0.381		0.366		0.338		0.324	
Salt	0.040		0.004		0.044		0.008	
Potassium carbonate	0.004		0.036		0.060		0.093	
DL-Methionine	0.184		0.179		0.131		0.125	
L-Lysine	0.275		0.405		0.301		0.432	
Threonine	0.077		0.091		0.069		0.082	
MNVIT99	0.22		0.22		0.22		0.22	
MNTM96	0.12		0.12		0.12		0.12	
Choline Chloride 60%	0.125		0.125		0.125		0.125	
Choice White Grease	2.06		2.12		3.57		3.63	
Total	100.0		100.0		100.0		100.0	
Calculated Nutrient Content								
Crude Protein (%)	22.7		22.5		22.9		22.7	
Metabolizable Energy (kcal/kg)	3070		3070		3070		3070	
Crude fat (%)	6.4		7.4		7.9		8.9	
Calcium (%)	1.18		1.18		1.18		1.18	
Phosphorus, total (%)	0.83		0.86		0.88		0.91	
Phosphorus, Inorganic (%)	0.59		0.59		0.59		0.59	
Potassium (%)	0.79		0.79		0.79		0.79	
Sodium (%)	0.19		0.19		0.19		0.19	
Chloride (%)	0.22		0.22		0.22		0.22	
	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total
Met plus cys (%)	0.819	0.905	0.819	0.912	0.819	0.922	0.819	0.929
Lysine (%)	1.287	1.418	1.287	1.418	1.287	1.433	1.287	1.433
Arginine (%)	1.336	1.443	1.241	1.342	1.310	1.417	1.216	1.315
Tryptophan (%)	0.225	0.254	0.208	0.238	0.229	0.258	0.213	0.242
Valine (%)	0.900	1.003	0.900	1.006	0.900	1.019	0.900	1.022
Glycine (%)	1.210	1.21	1.190	1.19	1.248	1.248	1.229	1.229
Histidine (%)	0.513	0.576	0.502	0.566	0.516	0.581	0.505	0.57
Phenylalanine (%)	0.958	1.042	0.938	1.02	0.918	1.002	0.897	0.98
Tyrosine (%)	0.701	0.71	0.697	0.711	0.661	0.683	0.658	0.681
Threonine (%)	0.785	0.887	0.785	0.891	0.785	0.901	0.785	0.905
Leucine (%)	1.732	1.863	1.805	1.938	1.688	1.824	1.762	1.898
Isoleucine (%)	0.788	0.861	0.759	0.832	0.792	0.843	0.732	0.814
Serine (%)	0.940	0.959	0.908	0.94	0.890	0.93	0.858	0.912

Table 3. Selected Diets for 17-19 Wks of Age

	Control (C-S-MBM)		DDGS		Canola		Canola & DDGS	
Nutrient (%)	Trt 1		Trt 2		Trt 3		Trt 4	
Corn	74.46		70.55		71.04		67.13	
SBM 47%	12.67		8.48		7.28		3.08	
Poultry blend (meat&bone)	5.00		5.00		5.00		5.00	
Distillers grains w/solubles	0		8		0		8	
Canola meal	0		0		8		8	
Dicalcium phosphate	0.768		0.709		0.674		0.615	
Calcium carbonate	0.563		0.606		0.485		0.529	
Scarb	0.333		0.322		0.304		0.294	
Salt	0.110		0.085		0.112		0.088	
Potassium carbonate	0.011		0.033		0.049		0.070	
DL-Methionine	0.042		0.039		0.006		0.003	
L-Lysine	0.154		0.241		0.171		0.258	
Threonine	0.022		0.031		0.017		0.026	
MNVIT99	0.17		0.17		0.17		0.17	
MNTM96	0.08		0.08		0.08		0.08	
Choline Chloride 60%	0.1		0.1		0.1		0.1	
Choice White Grease	5.51		5.55		6.52		6.56	
Total	100.0		100.0		100.0		100.0	
Nutrient								
Crude Protein (%)	14.6		14.6		14.8		14.7	
Metabolizable Energy (kcal/kg)	3390		3390		3390		3390	
Crude fat (%)	9.9		10.5		10.8		11.5	
Calcium (%)	0.80		0.80		0.80		0.80	
Phosphorus, total (%)	0.60		0.61		0.63		0.65	
Phosphorus, inorganic (%)	0.40		0.40		0.40		0.40	
Potassium (%)	0.52		0.52		0.52		0.52	
Sodium (%)	0.18		0.18		0.18		0.18	
Chloride (%)	0.22		0.22		0.22		0.22	
	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total
Met + Cys (%)	0.495	0.546	0.495	0.552	0.495	0.558	0.495	0.563
Lysine (%)	0.756	0.845	0.756	0.845	0.756	0.855	0.756	0.855
Arginine (%)	0.829	0.901	0.766	0.834	0.812	0.884	0.749	0.816
Tryptophan (%)	0.134	0.154	0.123	0.143	0.137	0.157	0.126	0.146
Valine (%)	0.600	0.675	0.600	0.677	0.600	0.685	0.600	0.688
Glycine (%)	0.789	0.789	0.776	0.776	0.814	0.814	0.801	0.801
Histidine (%)	0.348	0.393	0.340	0.386	0.350	0.396	0.343	0.389
Phenylalanine (%)	0.647	0.707	0.633	0.692	0.620	0.68	0.606	0.665
Tyrosine (%)	0.468	0.474	0.466	0.474	0.442	0.456	0.439	0.457
Threonine (%)	0.490	0.564	0.490	0.567	0.490	0.573	0.490	0.576
Leucine (%)	1.303	1.396	1.352	1.446	1.274	1.37	1.323	1.419
Isoleucine (%)	0.505	0.555	0.485	0.535	0.487	0.543	0.467	0.523
Serine (%)	0.639	0.651	0.618	0.639	0.606	0.632	0.585	0.62

Table 4. Performance of Male Market Turkeys

Diet Number	Description	Body Weight 11 wks	19 wks	Feed Efficiency 5-19 wks
		--------- lbs ---------		feed/gain
1	Control (Corn-Soybean-Animal Protein)	18.9	42.7	2.517
2	As 1 + Distillers Dried Grains	19.0	42.6	2.635
3	As 1 + Canola Meal	19.1	43.1	2.679
4	As 1 + Distillers Dried Grains & Canola Meal	19.1	42.8	2.650
5	As 4 + Tryptophan to Trt #1	19.1	42.6	2.860
6	As 5 + Isoleucine to Trt #1	19.0	43.2	2.592
7	As 6 + Arginine to Trt #1	18.9	42.9	2.619
	Cool Environment	**19.0**	**42.8**	**2.650**
1	Control (Corn-Soybean-Animal Protein)	18.4	40.6	2.515
2	As 1 + Distillers Dried Grains	18.5	41.2	2.536
3	As 1 + Canola Meal	18.7	41.3	2.543
4	As 1 + Distillers Dried Grains & Canola Meal	18.6	40.9	2.522
5	As 4 + Tryptophan to Trt #1	18.9	41.2	2.581
6	As 5 + Isoleucine to Trt #1	18.4	40.2	2.511
7	As 6 + Arginine to Trt #1	18.6	41.5	2.529
	Warm Environment	**18.6**	**41.0**	**2.534**
1	Control (Corn-Soybean-Animal Protein)	18.6	41.6	2.516
2	As 1 + Distillers Dried Grains	18.7	41.9	2.586
3	As 1 + Canola Meal	18.9	42.2	2.611
4	As 1 + Distillers Dried Grains & Canola Meal	18.8	41.8	2.586
5	As 4 + Tryptophan to Trt #1	19.0	41.9	2.721
6	As 5 + Isoleucine to Trt #1	18.7	41.7	2.551
7	As 6 + Arginine to Trt #1	18.8	42.2	2.574
	Average	18.8	41.9	2.592
	P Value			
	Diet	NS	NS	0.0183
	Room	0.0001	0.0001	0.0002
	Diet x Room	NS	NS	NS
	Least Significant Difference (P<.05)			
	Diet	0.3	0.7	0.109
	Room	0.2	0.4	0.059

Table 5. Carcass yield of market tom turkeys

Diet Number	Description	Body Wt 19 wks	Carcass	Breast	% of Carcass Breast
		------------- lbs -------------			---- % ---
1	Control (Corn-Soybean-Animal Protein)	42.51	33.41	10.65	31.83
2	As 1 + Distillers Dried Grains	43.14	34.28	10.84	31.59
3	As 1 + Canola Meal	42.93	34.10	10.90	31.90
4	As 1 + Distillers Dried Grains & Canola Meal	42.75	33.65	10.48	31.08
5	As 4 + Tryptophan to Trt #1	42.24	33.25	10.45	31.37
6	As 5 + Isoleucine to Trt #1	42.87	34.05	10.59	31.02
7	As 6 + Arginine to Trt #1	42.92	33.93	10.73	31.54
	Cool Environment	**42.76**	**33.81**	**10.66**	**31.48**
1	Control (Corn-Soybean-Animal Protein)	39.96	31.36	9.32	29.65
2	As 1 + Distillers Dried Grains	40.94	32.14	9.42	29.30
3	As 1 + Canola Meal	41.32	32.50	9.71	29.86
4	As 1 + Distillers Dried Grains & Canola Meal	40.68	31.76	9.15	28.78
5	As 4 + Tryptophan to Trt #1	41.25	32.44	9.57	29.48
6	As 5 + Isoleucine to Trt #1	40.52	31.65	9.17	28.93
7	As 6 + Arginine to Trt #1	41.42	32.57	9.78	30.01
	Warm Environment	**40.87**	**32.06**	**9.45**	**29.43**
1	Control (Corn-Soybean-Animal Protein)	41.23	32.39	9.99	30.74
2	As 1 + Distillers Dried Grains	42.04	33.21	10.13	30.45
3	As 1 + Canola Meal	42.13	33.30	10.30	30.88
4	As 1 + Distillers Dried Grains & Canola Meal	41.72	32.71	9.81	29.93
5	As 4 + Tryptophan to Trt #1	41.74	32.84	10.01	30.43
6	As 5 + Isoleucine to Trt #1	41.69	32.85	9.88	29.98
7	As 6 + Arginine to Trt #1	42.17	33.25	10.25	30.78
	Average	41.82	32.93	10.05	30.45
	P Value				
	Diet	NS	NS	NS	0.0206
	Room	0.0001	0.0001	0.0001	0.0001
	Diet x Room	NS	NS	NS	NS
	Least Significant Difference (P<.05)				
	Diet	0.94	0.86	0.39	0.65
	Room	0.50	0.46	0.21	0.35

Distiller's Grains: Focusing On Quality Control

A tremendous amount of research has been conducted in a short period of time to determine the suitability of distillers dried grains plus solubles (DDGS) for poultry feeds

By Nick Dale and Amy Batal, University of Georgia

During the past several years, distiller's dried grains plus solubles (DDGS) has become a major feed ingredient in North America. Dozens of fermentation plants have been established in the mid-western United States where corn is fermented to produce alcohol to be mixed with petroleum. While it is sometimes debated whether this produces a net gain in fuel, there is no question that millions of tons of fermentation residues are now available to the feed industry. As might be expected, a tremendous amount of research has been conducted in a short period of time to determine the suitability of DDGS for poultry and animal feeds. Much of this research can be found at www.ddgs.umn.edu. In studies conducted at the University of Georgia, it was found that broilers and laying hens can easily utilize 10% DDGS, although somewhat lower levels are recommended for the starter period. There are no inherent problems with DDGS, as might be the case with gossypol in cottonseed meal or trypsin inhibitors in underprocessed soy. Instead, any problems to be encountered with the use of DDGS are probably due to simple variations in quality.

The process by which DDGS is produced is quite easy to understand. First, corn is ground and moistened, and an enzyme is added to convert starch to sugars. The material is then heated to eliminate unwanted microbes, and then a yeast is added to convert the sugars to alcohol. After fermentation, alcohol is removed by distillation and the remaining components are dried. As grain is composed of approximately 2/3 starch, which is consumed during fermentation, the process effectively triples the concentration of oil, fiber, and other minerals. The level of protein in DDGS is slightly more than triple that in the original corn, as the final product also contains yeast residues. Studies on DDGS at the University of Georgia found typical nutrient levels to approximate those in Table 1. Nutritionists and quality control specialists will need to focus on several additional areas to maximize the efficiency of DDGS use in their feeds.

Variations in Proximate Composition

For reasons which are not completely clear, the protein content of DDGS can vary from 24-29%. There can also be significant variations in fiber, while oil content generally is less variable. Thus, whenever receiving a new shipment of DDGS it is highly advisable to evaluate at least the crude protein content prior to incorporating the material into poultry feeds.

Amino Acids

Once crude protein has been determined, the area of amino acid availability is one which should be of prime concern to nutritionists. In general, we have found the availability of amino acids in DDGS to be extremely satisfactory, and only slightly lower than that of corn itself. Some decrease would be expected due to the effect of drying on the availability of amino acids such as lysine. Typical total and available amino acids in DDGS are presented in Table 2. What concerns most nutritionists, however, is the possibility of decreased amino acid availability in samples of darker color. This concern is completely understandable, as lysine availability is sharply reduced in overprocessed soybean meal. Fourteen samples of DDGS have been evaluated for total and available amino acids at this laboratory. In addition, we have attempted to relate the darkness of a sample to its amino acid availability.

Our studies clearly indicate that dark DDGS samples have lower amino acid availability than lighter samples. In the photograph, three samples of DDGS are shown. Sample 1 is of light color, typical of that produced by many new DDGS plants. Sample 2 is intermediate, while Sample 3 is dark (all samples were taken from commercial shipments). In Table 2, the light sample (#1) is seen to have satisfactory levels of total and available amino acids. The intermediate sample (#2) had somewhat reduced levels of available amino acids, especially lysine, but this decrease was not severe. However, the dark sample (#3) had extremely low levels of both total lysine and lysine availability. This indicates that a significant amount of the lysine had been destroyed during processing. In addition, we see that much of the lysine that was not destroyed had become biologically unavailable. Thus, the level of available lysine in sample #3 was only 1/3 that in the light colored sample (#1). As is the case with soybean meal, other amino acids were not as severely affected as lysine by the excessive heating.

Metabolizable Energy

Metabolizable energy (ME) has been determined on more than 25 samples of DDGS, using the TME_n assay with Leghorn roosters. While samples with higher fiber content understandably have lower energy, a value of 2800 kcal/kg is appropriate for feed formulation. We have seen no indication that color of sample affects its ME.

Available Phosphorus

Many nutritionists have been surprised by the high level of available phosphorus in DDGS (see Table 1). As with other components, the level of total phosphorus is three times higher in DDGS than in corn. During the fermentation process, it is presumed that modest amounts of phytase are produced by yeast, thus converting phytin phosphorus to more available forms. We have found the phosphorus in DDGS to be approximately 65% available for poultry.

Mycotoxins

Just as levels of nutrients are tripled in DDGS as compared to the original grain, this also applies to concentration of mycotoxins, which are not destroyed by fermentation. However, while mycotoxins may occur, this is considered by the alcohol industry to be relatively unlikely. The profit from corn fermentation is clearly in the efficient production of alcohol. Corn which has been improperly stored and has developed aflatoxin or other mycotoxins may not give the same efficiency of alcohol production as higher quality corn. Thus, while the possibility of mycotoxin contamination of DDGS cannot be ruled out, at present toxin contamination is not considered likely. -- Egg Industry, April 2005

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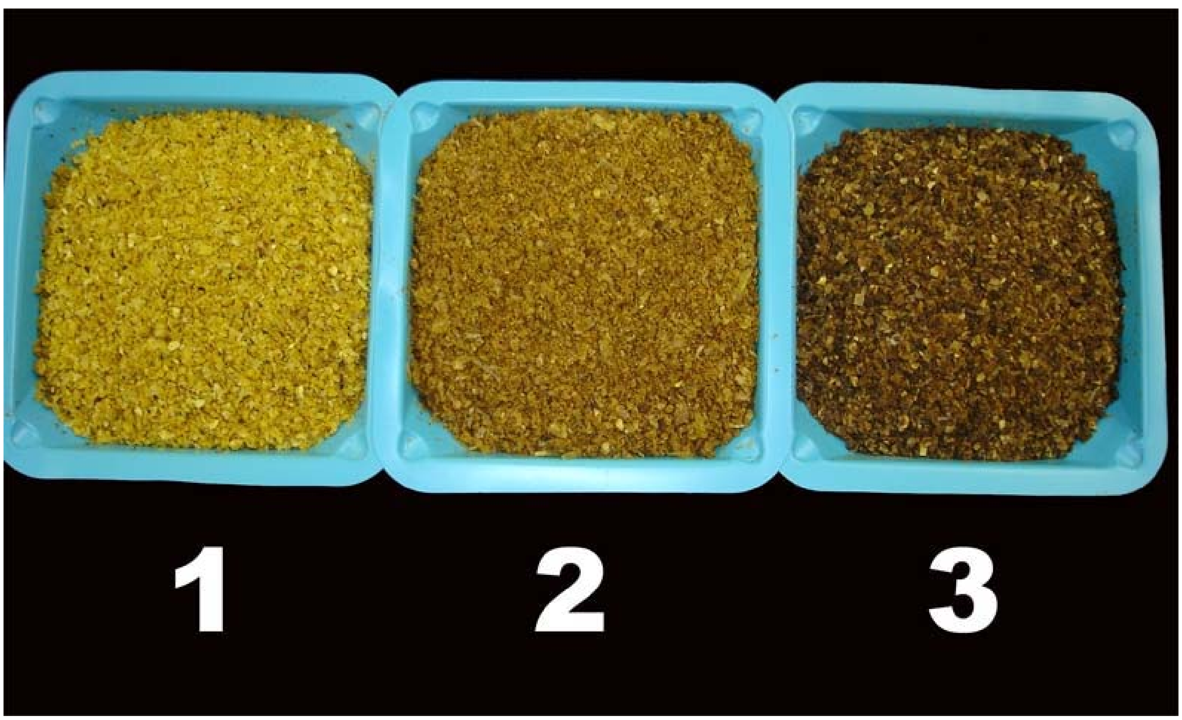
TABLE 1. Nutritional profile of distillers grains plus solubles (90% DM)

Protein (%)	27.0
Oil (%)	9.5
Crude fiber (%)	9.0
Calcium (%)	0.33
Phosphorus, total (%)	0.75
Phosphorus, available (%)	0.49
Sodium (%)	0.10-0.45*
Metabolizable energy (kcal/kg)	2810

*Significant variation seen between suppliers.

TABLE 2. Amino acid composition and availability of several distillers grains plus solubles samples differing in color (90% DM)

	Light (#1)		Intermediate (#2)		Dark (#3)	
	Total A.A. (%)	Availability (%)	Total A.A. (%)	Availability (%)	Total A.A. (%)	Availability (%)
Lysine	0.84	75	0.69	65	0.39	46
Methionine	0.55	86	0.53	85	0.46	82
Cystine	0.60	72	0.56	71	0.52	68
Threonine	0.98	74	0.94	70	0.85	69
Tryptophan	0.24	81	0.20	81	0.14	80
Arginine	1.20	80	1.03	81	0.75	73
Isoleucine	1.00	80	0.97	85	0.89	78
Valine	1.40	79	1.27	77	1.24	77
Leucine	3.05	88	3.11	87	2.87	87



Evaluation of Distiller's Dried Grains with Solubles as a Feed Ingredient for Broilers

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Distiller's dried grains with solubles (DDGS), a by-product of the ethanol industry, is becoming available to feed producers in large quantities. The material used in these studies is "new generation" DDGS, derived completely from corn, the solubles fraction being free of by-product streams from other processes, and using drying conditions that are less harsh than in the past. Two experiments were conducted to evaluate the use of DDGS in practical broiler diets. Experiment 1 was a 2 x 2 factorial design with diets containing two levels of DDGS (0 and 15%) and two diet densities (high and low). The high density and low density diets were formulated to contain 23% CP and 3200 Kcal ME/kg and 20% CP and 3000 Kcal ME/kg, respectively. Eight pens of six chicks each were fed each experimental diet from 0 to 18 d of age. Chicks were weighed and feed consumption measured at 7, 14 and 18 d of age. At 18 d of age, body weight and feed efficiency of chicks receiving the high density diet was significantly ($P < 0.05$) better than the chicks fed the low density diet. However, within the two density levels, there was no difference ($P > 0.05$) between chicks receiving diets with 0 or 15 percent DDGS. Experiment 2, a floor pen study was conducted from 0 to 42 d of age, which was randomized into 6 replications of 50 chicks fed one of four dietary treatments. The treatments were formulated to be isocaloric and isonitrogenous and contained 0, 6, 12 or 18% DDGS. There was no observable difference ($P > 0.05$) in productive performance between treatments except for a slight, but significant, depression in body weight gain at the 18% DDGS. Ten birds from each pen were processed to observe carcass yield. No differences were noted between treatments. These studies indicate that the "new generation" DDGS evaluated is a highly acceptable feed ingredient for broiler chickens.

Key words: distiller's dried grains with solubles, DDGS, broilers, feed ingredients, carcass yield

The Use of Distillers Dried Grains Plus Solubles (DDGS) For Laying Hens

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An experiment was designed to examine the effects of “new generation” distiller’s dried grains plus solubles (DDGS) in commercial laying hen diets. Four experimental diets were fed to eight replications of 16 Hy-line W36 laying hens per treatment from 21 to 43 weeks of age. The four dietary treatments consisted of a commercial grade diet (18.5\% CP, 2870 Kcal ME/Kg, 4.0\% Ca and 0.42\% available P) with 0 or 15 percent DDGS and a low density diet (17\% CP, 2800 Kcal ME/Kg, 4.0\% Ca and 0.42\% available P) also with 0 or 15 percent DDGS. Hen body weights and feed consumption were measured periodically throughout the 22 week period. Several tests were performed throughout the experiment to explore all parameters of egg characteristics that may be affected by DDGS. These tests included egg production, egg weight, feed intake, specific gravity, Haugh units, yolk color, and shell breaking strength. No significant differences were observed ($P > 0.05$) in egg production between the two commercial grade diets (0 and 15\% DDGS) and the low density diet with 0\% DDGS. However, there was a slight, but significant, depression ($P < 0.05$) in egg production with the low density diet containing 15% DDGS as compared to the other three dietary treatments. No significant differences ($P > 0.05$) in egg weights were observed among the four dietary treatments. No significant differences were observed ($P > 0.05$) for any of the egg characteristics measured. One might expect to see an increase in feed consumption when hens are fed the low density diet yet no significant differences in feed consumption were observed. Summer temperatures may provide some explanation for the lack of differences in feed consumption. Distiller’s dried grains plus solubles proved to be a successful feed ingredient when used up to 15\% in commercial laying hen diets.

Key words: laying hens, distiller’s dried grains plus solubles, DDGS, low density, feed ingredients

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

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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- -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 °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- -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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