Corn Dried Distillers Grains with Solubles for Laying Hens – They're Great

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Introduction

Dried distillers grains with solubles (DDGS) has been available as a feedstuff for poultry for many decades. Early use of DDGS showed growth performance benefits in various species of poultry and was often associated with "unidentified growth factors". Research published in the 1940's showed that DDGS was a good source of riboflavin and thiamine. Use of DDGS in poultry diets has historically been about 5% due to limitations such as variability in nutrient content and digestibility and pricing of the product due to transportation costs.

Matterson et al. (1966) reported that DDGS could be fed in laying hen diets at 10 to 20% without affecting egg production with no supplementation of lysine. The inclusion of DDGS in the ration accounted for one-third of the protein provided to the birds. Harms et al. (1969) reported that 10% DDGS in a layer ration did not affect egg production or egg weight. Jensen et al. (1974) observed that DDGS had a positive effect on egg interior quality (increased Haugh units), although this was not a consistent response. This study was focused on wheat-soybean meal diets in which less soybean meal was included in the diet as levels of DDGS were fed relative to feeding corn due to the higher protein content of wheat. When wheat was the primary energy source in the ration, supplemental lysine was needed to maintain egg production when 10% DDGS was fed compared to the control group. Others have shown that levels of 20-25% DDGS can be fed to meat-type birds with no effect on gain or feed conversion as long as metabolizable energy and lysine values are appropriate in the formulation of the diet (Potter, 1966, Waldroup et al., 1981).

The recent increase in construction of ethanol plants in the Midwestern U.S. has resulted in much higher production of DDGS. This by-product of ethanol production is considered a "co-product" by companies producing ethanol since each bushel of corn results in approximately equal portions of ethanol, DDGS and CO_2. The ethanol plant in Caro, MI (Michigan Ethanol, LLC) produces an estimated 125,000 tons of DDGS annually. Since new plants are continuously being built (including Michigan), corn growers are interested in the use of DDGS as a feedstuff for several areas of animal production.

Lumpkins et al. (2003) reported on the use of DDGS in laying hens diets fed DDGS from "New Generation" plants. This "new" process involves a gentler drying process and is proposed to result in a better nutrient profile than traditional commodity DDGS. In this study at the University of Georgia, laying hens were fed DDGS up to 15% starting at 40 weeks of age. The researchers found no detrimental effect on egg production or quality of the egg or shell due to feeding 15% DDGS in the ration. Color of the egg yolk was measured directly on the intact yolk with a Minolta chromameter. However, no effects on egg yolk color were observed.

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The DDGS used for laying hen studies at Michigan State University were procured from Michigan Ethanol, LLC and is identified commercially as Dakota Gold Plus. The product used for Experiment 1 was a goldenrod color while the DDGS used in experiment 2 was a more traditional brown color. Measurement of xanthophyll content at a commercial laboratory verified that there was a large difference between the two samples.

The birds used in the study (Hy-Line W36) had previously been used for another study in which some of the birds had been fed a very low level of available phosphorus. After a four-week recovery period, the birds were allocated to levels of 0, 5, 10 or 15% DDGS making sure that birds were evenly distributed among treatments relative to treatments in the previous trial in case there were long-term carryover effects as well as on the basis of egg production levels the week prior to commencement of the study. The ME value used for DDGS in the study was 2750 kcal/kg (1250 kcal/lb) which is 13.5% higher than the "book" value for DDGS which is commonly used in formulations by industry nutritionists. The diets were formulated according to Hy-Line recommendations for 95 gram/day consumption in experiment 1 and 100 grams/day in experiment 2. The birds were 47 weeks old at the beginning of experiment 1 and had an average hen-day egg production of 85% the week before the trial began. The diets were mixed at the Michigan State University feed mill and fed for approximately 5 weeks per batch mix. Sufficient corn and soybean meal were available in storage at the feed mill so that these feedstuffs would not come from different sources during the study. There were 6 rows of 40 birds each at the beginning of the study. Each row contained 10 cages of 4 birds each and cage size was 16" X 20" to provide 80 square inches per bird. This cage density level was necessary to meet animal care standards at the University which require that all birds have at least 72 square inches of cage space. Feed was provided by hand feeding each day and birds in two adjoining cages shared a cup waterer. Manure was scraped from beneath the cages each day and removed from the house. Eggs were collected daily each morning. Room temperature was maintained at 67 degrees F. Mortality was checked daily. Between experiments, all birds were fed the control corn-soybean meal diet for 9 days. Treatments were reallocated so that the same row of birds were not fed the same treatment in experiment 2 as in experiment 1 and egg production levels among treatments were equal. There were 38 birds per row in experiment 2 (2 cages with 3 birds per row) and the experiment was conducted similarly to experiment 1.

Thirty eggs per row were collected at 2, 4, 6 and 8 weeks into the study in experiment 1 and at 3, 6 and 9 weeks into experiment 2 for measurement of egg weight and specific gravity. Ten eggs from each row were chosen at random for yolk color measurement. In experiment 1, a Roche color fan (1967) was used to subjectively measure yolk color on a glass plate with white paper placed underneath the glass. In experiment 2, egg yolks were separated from albumen and placed into clear plastic Petri dishes with white paper placed underneath. A Minolta Chromameter (Model 310) was used to measure lightness (L*), redness (a*) and yellowness (b*) every three weeks. The Roche fan was also used at 6 and 9 weeks for comparison of the two methods. The Roche fan was used on intact yolks and then the yolks were scrambled for objective analysis with chromameter. It was difficult to measure the egg yolks at the same place each time due to placement of the germinal disk on top of the yolk at various spots on different yolks. The fact that egg yolks are formed in layers and can have different coloration in concentric layers provided another reason to scramble the yolks to get the most consistent measurement.

The results showed that in experiment 1, there were no effects on egg production in 8 of the 9 weeks of the trial. Average egg production throughout experiment 1 (48 to 57 weeks of age) was 84%. During week 5, there was a linear decrease in egg production as DDGS was fed at increasing levels of inclusion in the diet. Shell quality was not affected at weeks 2, 6 or 8. However, specific gravity was higher (1.082) compared to the DDGS treatments (1.080) at week 4. Egg weight was not affected during experiment 1. Case weight was about 50 lb/case at the beginning of the study and 51 lb/case at the end of experiment 1. Yolk color was increased by 10 or 15% DDGS throughout the trial. The inclusion of 5% DDGS began to impact yolk color during the second half of experiment 1 and resulted in significantly darker egg yolks after 8 weeks.

Egg production was never decreased by DDGS levels compared to the corn-soybean meal control diet and average egg production from 58 to 67 weeks of age was 81% in experiment 2. Egg weight was decreased linearly by DDGS levels at the 6 weeks into the trial, but was not affected at 3 or 9 weeks. Specific gravity was not affected by treatments in experiment 2. Redness (a*) was increased by inclusion of 5% DDGS throughout the trial and was typically further increased by inclusion of 10% DDGS. However, it was difficult to detect darker yolks with the Roche color fan from all rows in which birds were fed DDGS. At 9 weeks into the trial, there was a clear stepwise increase in redness of the yolks as DDGS levels increased. Lightness (L*) of the yolk was clearly decreased at the end of the trial by feeding DDGS at any level. This observation could also be detected easily with the Roche color fan.

Conclusions

- The results show that DDGS can be successfully fed at levels as high as 15% in post-peak diet using an ME value higher than the traditional value without having a detrimental effect on egg production or shell quality. Digestibility studies have confirmed that the ME value used in these studies is adequate for laying hens.
- Yolk color can be enhanced quickly with a ration containing 10% DDGS and will be darker after about two months when 5% DDGS is fed to birds previously fed a corn-soybean meal diet with no additional pigments. This can be a cost effective means to darken yolks for the shell egg market in other countries such as Mexico and in the breaker market in the U.S. for production of products such as noodles and cake mixes.
- Digestibility of lysine is a variable that needs to be monitored as it can be quite variable especially when color is different. If a light ("golden") color is maintained, digestibility of lysine will likely not be a serious issue for the inclusion of DDGS at 15% or below. Recent research has shown that digestibility of lysine can be over 80% when the color of DDGS is light ((Ergul et al., 2003). Feed intake in the current study was 108 grams/day in experiment 1 and 113 grams/day in experiment 2 with no effect of treatment of feed intake or conversion. According to the results, the level of digestible lysine available to the birds was generally adequate in the study.

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Experiment 1 – % Egg Production
48 to 52 woa

DDGS	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5
0 %	83.0	90.2	83.8	85.3	86.9
5 %	80.5	89.1	82.9	83.6	86.7
10 %	81.7	88.8	83.0	82.7	86.2
15 %	80.8	89.3	81.7	83.6	85.1
SE	1.1	1.1	1.0	0.9	0.8
Trt,p<	0.448	0.836	0.549	0.255	0.466
linear, p<	0.488	0.577	0.172	0.150	0.121

Experiment 1 – % Egg Production
53 to 56 woa

DDGS	Wk 6	Wk 7	Wk 8	Wk 9
0 %	86.6 [a]	78.6	87.4	82.1
5 %	84.5 [ab]	79.0	87.2	82.6
10 %	82.6 [b]	78.7	87.3	82.6
15 %	83.2 [b]	79.0	86.3	82.8
SE	0.9	1.0	0.9	0.9
Trt, p <	0.024	0.983	0.961	0.961
Linear, p<	0.008	0.989	0.844	0.626

Experiment 1 – Egg Weight (g)

DDGS	Wk 2	Wk 4	Wk 6	Wk 8
0 %	63.6	64.6	64.4	63.8
5 %	63.4	64.5	64.5	64.3
10 %	62.6	63.8	63.8	64.0
15 %	63.0	64.2	64.2	64.2
SE	0.5	0.4	0.4	0.4
Trt, p <	0.482	0.285	0.647	0.882
Linear, p <	0.242	0.098	0.489	0.665

Experiment 1 – Specific Gravity

DDGS	Wk 2	Wk 4	Wk 6	Wk 8
0 %	1.081	1.082 [a]	1.078	1.078
5 %	1.080	1.080 [b]	1.078	1.078
10 %	1.080	1.080 [b]	1.078	1.078
15 %	1.080	1.080 [b]	1.078	1.078
SE	0.001	0.001	0.001	0.001
Trt, p<	0.489	0.015	0.415	0.700
Linear, p<	0.209	0.010	0.088	0.363

Experiment 1 – Yolk Color (Roche)

DDGS	Wk 2	Wk 4	Wk 6	Wk 8
0 %	7.76 [b]	7.79 [b]	6.81 [b]	7.39 [b]
5 %	7.90 [b]	7.81 [b]	7.17 [b]	7.86 [a]
10 %	8.29 [a]	8.00 [a]	7.60 [a]	7.86 [a]
15 %	8.22 [a]	8.00 [a]	7.89 [a]	8.02 [a]
SE	0.07	0.05	0.13	0.09
Trt, p<	<0.001	0.004	<0.001	0.001
Linear, p<	<0.001	0.001	<0.001	0.001

Experiment 2 – % Egg Production (58 to 62 woa)

DDGS	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5
0 %	80.0	83.6	82.9	78.8 [ab]	80.6
5 %	80.9	86.5	83.2	81.3 [a]	83.5
10 %	81.3	82.9	82.1	77.3 [b]	81.2
15 %	81.2	85.0	82.0	80.2 [ab]	81.1
SE	1.0	1.0	0.8	0.8	1.2
Trt, p<	0.735	0.082	0.602	0.016	0.341
Linear, p<	0.323	0.908	0.249	0.942	0.870

Experiment 2 – % Egg Production (63 to 67 woa)

DDGS	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
0 %	82.8	80.1	78.4	79.0	77.7
5 %	83.1	80.1	79.5	82.3	80.6
10 %	81.3	79.6	76.9	78.9	78.6
15 %	83.6	80.4	80.2	80.9	79.9
SE	1.0	1.2	1.0	1.1	1.6
Trt, p<	0.429	0.977	0.121	0.098	0.562
Linear, p<	0.867	0.957	0.577	0.675	0.511

Experiment 2 – Egg Weight (g)

DDGS	Wk 3	Wk 6	Wk 9
0 %	65.6	66.5	65.4
5 %	64.5	64.8	65.5
10 %	65.0	65.1	64.9
15 %	64.3	64.6	65.8
SE	0.4	0.5	0.4
Trt, p<	0.104	0.060	0.452
Linear, p<	0.075	0.029	0.773

Experiment 2 – Specific Gravity

DDGS	Wk 3	Wk 6	Wk 9
0 %	1.079	1.079	1.078
5 %	1.079	1.078	1.078
10 %	1.078	1.079	1.078
15 %	1.078	1.078	1.078
SE	0.001	0.001	0.001
Trt, p<	0.500	0.469	0.996
Linear, p<	0.444	0.254	0.946

Experiment 2 – Yolk Color (chromometer – 3 wk)

DDGS	L *	a*	b*
0 %	77.3	1.52 [c]	88.2
5 %	76.9	2.62 [b]	88.3
10 %	76.7	3.54 [a]	88.3
15 %	76.6	4.07 [a]	88.1
SE	0.3	0.31	0.3
Trt, p<	0.306	<0.001	0.968
Linear, p<	0.070	<0.001	0.893

Experiment 2 – Yolk Color (chromometer, Roche – 6 wk)

DDGS	L*	a*	b*	Roche
0 %	82.0 [a]	2.84 [b]	93.2 [a]	8.35
5 %	80.6 [ab]	4.36 [a]	92.6 [a]	8.43
10 %	80.3 [ab]	4.39 [a]	91.0 [ab]	8.73
15 %	78.2 [b]	5.27 [a]	86.8 [b]	8.53
SE	0.7	0.29	1.5	0.19
Trt, <p	0.016	<0.001	0.035	0.551
Linear, <p	0.002	<0.001	0.007	0.331

Experiment 2 – Yolk Color (chromometer and Roche – 9 wk)

DDGS	L*	a*	b*	Roche
0 %	77.9 [a]	2.70 [d]	88.1	8.63 [b]
5 %	75.9 [b]	4.19 [c]	86.7	8.98 [a]
10 %	76.2 [b]	4.74 [b]	87.5	9.02 [a]
15 %	75.9 [b]	6.11 [a]	87.7	9.22 [a]
SE	0.4	0.19	0.6	0.08
Trt, p<	0.004	<0.001	0.352	0.001
Linear, p<	0.007	<0.001	0.846	<0.001