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Effects of Yellow Grease Addition to Tom Turkey Rations Containing DDGS with Different Fat Contents

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Abstract: In the recent past, fat levels in Dried Distillers Grain with Solubles (DDGS) have changed due to the extraction of corn oil during the ethanol production process as the value of the oil has been seen as a profitable addition to the process. Due to the price of DDGS and the huge quantities available, continued and possibly increased use of DDGS is foreseen; however, the lowered fat content of the new products makes their use more difficult giventhe already reduced energy diets currently being fed due to the high cost of fat addition. The objective of this study was to determine if utilization of a rendered fat (yellow grease) could be used as a replacement for the fat removed from these products. The experiment was conducted on Nicholas 500 tom turkeys using three treatments. The three treatments included low fat DDGS, low fat DDGS+fat addition (yellow grease) to match a high fat DDGS and high fat DDGS at 10 and 20% inclusion rate (starter and grow-finish diets). The low fat DDGS treatment without fat addition acted as the negative control and was fed as a direct replacement for the high fat DDGS to demonstrate any loss in performance. In the following study these treatments were replicated 16 times with 10 turkeys per pen to 19 weeks of age. There was no difference in weight gain between the treatments. Feed efficiency was significantly improved in the low fat DDGS+yellow grease treatment when compared to the low fat DDGS treatment. Feed efficiency was better in all cases with the high fat DDGS, but was not statistically different. Fat pad increased slightly in the yellow grease fed turkeys as well and chilled carcass was also larger. In conclusion, while it is difficult to pick up statistical differences with such small changes in energy when feeding high fat versus low fat DDGS (60 kcal differences), it would appear that the replacement of the lost oil with yellow grease does restore feed efficiency in tom turkeys.

Key words: Turkeys, energy, fat addition

INTRODUCTION

The rendering industry annually produces significant quantities of feed grade quality rendered fats, providing a relatively inexpensive source of energy. The addition of concentrated fat sources to broiler rations is often economically beneficial due to increased rates of gain, decreased feed intake and results in improved feed efficiency. Furthermore, numerous studies have been conducted comparing a variety of available fat sources, both animal and vegetable origin, included in turkey rations. Based on these experiments, variations in the ME levels occur between as well as within fat sources, but do not correlate to a difference in growth or carcass yield. Therefore, price should be the major determinate when selecting a fat source (Firman *et al*., 2008). Yellow grease is widely available and, in many cases, the cheapest fat source for animal feeding.

Dried distillers' grains with solubles (DDGS) are a corn co-product that results from ethanol production. A good deal of research has been conducted concerning the use of DDGS for poultry rations, although concern does exist over ingredient quality and variability. In the dry-grind ethanol production process industry, an effort to utilize more of the energy found in corn is growing in popularity. Ethanol plants are installing corn oil extraction systems that remove crude corn oil from the thin stillage, a product of the centrifuge step following fermentation and distillation, but prior to the drying step. Corn oil removal alters the nutritional profile of the DDGS, reducing the fat and energy content and concentrating the available amino acids (Rochelle *et al*., 2011). This creates the potential to add a fat source when feeding the oil extracted DDGS to increase energy levels fed in turkey rations.

While plant to plant product variation appears to be greater than within-plant variation, nutrient variability within plant can occur due to the drying process (Applegate and Adeola, 2006; Noll *et al*., 2007). For example, the grain drying process can affect metabolizable energy values and result in damaged proteins that reduce amino acid digestibility (Parsons *et al*., 2006). DDGS also tend to contain higher levels of oil than corn grain (Applegate and Adeola, 2006) and sources may vary in fat content. Samples collected from

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four ethanol processors in Minnesota in 2002 ranged in fat content from 8.9-11.4%, with the NRC (1994) estimating 9.0% (Noll *et al*., 2003). More recently, the fat content of US corn DDGS exported to Korea from 2006-2009 was reported with a minimum value of 7.80%, a maximum value of 12.17% and a mean value to 10.67% (Salim *et al*., 2010).

The objective of this study was to determine the effect of fat addition to diets containing low fat DDGS in turkeys when compared to high fat DDGS.

MATERIALS AND METHODS

Seven hundred day-old tom poults were sourced from a commercial hatchery. Upon arrival, 600 poults were placed in 4' x 8' floor pens in a curtain sided environmentally controlled house that is similar to industry curtain houses. From day zero to day seven the poults had *ad libitum* access to a basal diet and water; mortalities were removed during the period. On day seven the remaining 591 birds were collected, wing banded in the right wing and weighed. The data were then entered into a proprietary sorting program (McGill and Firman, 2014) which sorts the weights in order. The 93 smallest and 18 largest birds were removed. Using this program we were able to sort the remaining 480 birds into 48 pens containing ten birds each. The sorting minimized average bird weight variance among pens to 2.41 g between the largest and smallest pens. Block randomizing was done for each set of treatments, resulting in 16 randomly assigned three treatment groups. In each pen, water and feed were provided *ad libitum* via Plasson waterers and a hanging feeder. Birds were placed on used litter that had the cake removed. Throughout the study, turkeys were exposed to continuous fluorescent lighting. On day zero, building temperature was set to 87°F and in each pen an infrared heat lamp was used as well. The temperature was reduced by five degrees per week and heat lamps were removed after the birds feathered. The trial was conducted in accordance with University of Missouri standard operating procedures and following Animal Care and Use Committee guidelines.

The treatments included high fat DDGS containing 11% corn oil, low fat DDGS with 4% corn oil and low fat DDGS+yellow grease addition equalizing the fat level to the high fat DDGS. The inclusion rate of DDGS in the starter diets 0-3 weeks was 10% (Table 1); that level increased to 20% for the grow and finish period diets, 3-6 weeks (Table 2), 6-9 weeks (Table 3), 9-12 weeks (Table 4), 12-15 weeks (Table 5), 15-18 weeks (Table 6) and 18-19 weeks (Table 7), respectively. The positive control treatment diet containing high fat DDGS was first formulated to meet or exceed the National Research Council's required levels regardless of intake. The negative control was then formulated by replacing the high fat DDGS in the diet with low fat DDGS. Because the low fat DDGS was fed as a direct replacement, differences in performance can be assumed to be due to the 7% difference in DDGS fat levels (Table 8). In the low fat DDGS+yellow grease treatment, the dietary fat level was raised to the same level as the high fat DDGS diet via addition of yellow grease. Soy hulls were used as filler in both diets to make room for the yellow grease addition treatment. The 0.7% (starter diet) or 1.4% (grow-finish diets) addition of yellow grease replaced the fat lost from feeding the low fat DDGS. Therefore, any improvement in performance compared to negative control can be assumed to be due to the yellow grease inclusion. Once the diets were formulated, a premix was made for each treatment in each period which was then used to make the complete feed. The DDGS were sourced from two local POET Ag ethanol production facilities; their plant in Laddonia, Missouri provided the high fat DDGS, while the low fat came from their Macon, Missouri facility. The yellow grease was provided by Darling International Incorporated in National Stockyards, IL.

Table 1: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 0-3 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	31.694	31.694	31.694
Soybean meal	42.150	42.150	42.150
Porkmeal	7.000	7.000	7.000
Soy hulls	2.000	2.000	1.300
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.060	0.060	0.060
Copper sulfate	0.002	0.002	0.002
Dicalcium phosphate	1.089	1.089	1.089
DL-methionine	0.166	0.166	0.166
Yellow grease	0.000	0.000	0.700
Salt	0.200	0.200	0.200
Sodium bicarbonate	0.150	0.150	0.150
Vitamin premix[3]	0.100	0.100	0.100
Limestone	1.088	1.088	1.088
Lysine HCl	0.117	0.117	0.117
Threonine	0.000	0.000	0.000
Avatec 20	0.050	0.050	0.050
DDGS (HF)	10.000	0.000	0.000
DDGS (LF)	0.000	10.000	10.000
Lard	4.035	4.035	4.035
ME	3000	2965	3000
CP	29.200	29.45	29.45
Fat (%)	7.461	6.76	7.461
Lysine	1.760	1.768	1.768
Met+Cys	1.200	1.208	1.208
Threonine	1.054	1.061	1.061
Ca	1.500	1.500	1.500
P	0.700	0.700	0.700

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

Table 2: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 3-6 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	29.101	29.101	29.101
Soybean meal	33.448	33.448	33.448
Porkmeal	9.278	9.278	9.278
Soy hulls	2.000	2.000	0.600
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.081	0.081	0.081
DL-methionine	0.111	0.111	0.111
Yellow grease	0.000	0.000	1.400
Salt	0.250	0.250	0.250
Sodium bicarbonate	0.200	0.200	0.200
Vitamin premix[3]	0.100	0.100	0.100
Limestone	1.095	1.095	1.095
Lysine HCl	0.287	0.287	0.287
Avatec 20[4]	0.050	0.050	0.050
DDGS (HF)[5]	20.000	0.000	0.000
DDGS (LF)[6]	0.000	20.000	20.000
Lard	3.898	3.898	3.898
ME	3000	2930	3000
CP	29.000	29.492	29.492
Fat (%)	8.467	7.067	8.467
Lysine	1.760	1.776	1.776
Met+Cys	1.200	1.216	1.216
Threonine	1.008	1.022	1.022
Ca	1.450	1.450	1.450
P	0.660	0.660	0.660

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

Table 3: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 6-9 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	38.077	38.077	38.077
Soybean meal	25.005	25.005	25.005
Porkmeal	7.000	7.000	7.000
Soy hulls	2.000	2.000	0.600
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.085	0.085	0.085
Dicalcium phosphate	0.225	0.225	0.225
DL-methionine	0.085	0.085	0.085
Yellow grease	0.000	0.000	1.400
Salt	0.200	0.200	0.200
Sodium bicarbonate	0.150	0.150	0.150
Vitamin premix[3]	0.100	0.100	0.100
Limestone	1.134	1.134	1.134
Lysine HCl	0.314	0.314	0.314
Avatec 20[4]	0.050	0.050	0.050
DDGS (HF)[5]	20.000	0.000	0.000
DDGS (LF)[6]	0.000	20.000	20.000
Lard	5.475	5.475	5.475
ME	3140	3070	3140
CP	24.500	24.99	24.99
Fat (%)	10.07	8.67	10.07
Lysine	1.480	1.496	1.496
Met+Cys	1.050	1.066	1.066
Threonine	0.838	0.852	0.852
Ca	1.270	1.270	1.270
P	0.600	0.600	0.600

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

During the first ten days, feed pans were placed on the floor of each pen to provide easy feed access for poults. Diets were changed at 3, 6, 9, 12, 15 and 18 weeks; birds and feed were weighed in order to determine weight gain, feed intake and feed conversion. Feed:gain was adjusted for mortality by adding mortality weight to the pen weight for each period.

On day 134, three average weight birds were selected from each pen, wing banded in the left wing and transported to the abattoir. The following day all 144 were slaughtered, eviscerated and then chilled in an ice water bath. Chilled carcass weight as well as fat pad weight were measured and recorded. The major and minor pectoralis muscles, wings, thighs and legs were removed from the carcass and individually weighed. The weight of each part divided by the chilled carcass weight provided the percent yield for each part. The total weight of the parts was then divided by the chilled carcass weight to determine the overall carcass yield.

Mortality, bird weight, feed intake and feed efficiency were measured at each period and for the entire trial. Analysis of the collected data was performed using Minitab statistical analysis software. Each pen served as an experimental unit; the data underwent an Analysis of Variance (ANOVA) using the general linear model. Means were separated with Least Significant Difference test. Level of statistical significance was defined as $p<0.05$.

RESULTS

Table 9a displays the growth performance data recorded at 3, 6 and 9 weeks of age. Table 9b displays the growth performance data recorded at 12, 15 and 18 weeks of age and table 9c shows the growth performance data recorded through the termination of the trial at week 19. Turkey performance data analysis, a one way ANOVA test, was run on the data in order to detect a difference between treatment groups. The growth performance values analyzed include average feed intake per bird, feed to gain ratio, average weight gain per bird and average weight per bird.

In week 1-3 there was no statistically significant difference between treatment groups for feed intake/bird and feed: gain ratio; however, the birds fed the low fat distillers grain plus yellow grease (LF+YG) ration were

Table 4: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 9-12 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	38.992	38.992	38.992
Soybean meal	22.905	22.905	22.905
Porkmeal	6.160	6.160	6.160
Soy hulls	2.000	2.000	0.600
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.060	0.060	0.060
Copper sulfate	0.002	0.002	0.002
DL-methionine	0.038	0.038	0.038
Yellow grease	0.000	0.000	1.400
Salt	0.200	0.200	0.200
Sodium bicarbonate	0.150	0.150	0.150
Vitamin premix[3]	0.100	0.100	0.100
Limestone	0.906	0.906	0.906
Lysine HCl	0.197	0.197	0.197
Avatec 20[4]	0.050	0.050	0.050
DDGS (HF)[5]	20.000	0.000	0.000
DDGS (LF)[6]	0.000	20.000	20.000
Lard	8.139	8.139	8.139
ME	3300	3230	3300
CP	23.000	23.492	23.492
Fat (%)	12.666	11.266	12.666
Lysine	1.300	1.316	1.316
Met+Cys	0.963	0.979	0.979
Threonine	0.787	0.801	0.801
Ca	1.04	1.04	1.04
P	0.52	0.52	0.52

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

Table 5: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 12-15 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	48.213	48.213	48.213
Soybean meal	14.319	14.319	14.319
Porkmeal	5.448	5.448	5.448
Soy hulls	2.000	2.000	0.600
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.058	0.058	0.058
DL-methionine	0.106	0.106	0.106
Yellow grease	0.000	0.000	1.400
Salt	0.200	0.200	0.200
Sodium bicarbonate	0.150	0.150	0.150
Vitamin premix[3]	0.100	0.100	0.100
Limestone	0.913	0.913	0.913
Lysine HCl	0.335	0.335	0.335
Threonine	0.060	0.060	0.060
Avatec 20[4]	0.050	0.050	0.050
DDGS (HF)[5]	20.000	0.000	0.000
DDGS (LF)[6]	0.000	20.000	20.000
Lard	7.949	7.949	7.949
ME	3350	3280	3350
CP	19.50	19.992	19.992
Fat (%)	12.669	11.269	12.669
Lysine	1.150	1.166	1.166
Met+Cys	0.928	0.944	0.944
Threonine	0.705	0.719	0.719
Ca	0.95	0.95	0.95
P	0.48	0.48	0.48

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

statistically higher in average weight gain/bird, as well as average weight/bird. In both categories the LF+YG mean was almost 0.02 kg greater than the high fat (HF) and low fat (LF) rations. During weeks 3-6, there was a statistically significant difference for feed intake/bird between LF+YG treatment mean and both HF and LF treatment means. As for feed:gain for weeks 3-6, LF+YG was significantly different from LF, but the HF was not significantly different from either treatment. There was no significant difference between treatment groups for average weight gain/bird and average bird weight. Weeks 6-9 average feed intake/bird was statistically higher for LF compared to HF; however, the LF+YG was statistically similar to both HF and LF treatments. There was no statistically significant difference between the three treatment groups for feed:gain ratio. The average weight gain/bird as well as average bird weight was statistically greater for LF+YG compared to HF, while the LF treatment was statistically similar to the HF and LF+YG treatments. In weeks 9-12 there was no statistically significant difference between all three treatment groups in average feed intake/bird, feed: gain ratio, average feed intake/bird and average bird weight. During weeks 12-15, the LF treatment toms consumed statistically greater amount of feed/bird compared to the HF treatment toms, but the LF+YG treatment was not statistically different from either group; however, feed:gain ratio, average weight gain/bird and average bird weights were not statistically different between all three treatment groups. In weeks 15-18, the average feed intake/bird was statistically higher for the LF treatment compared to the LF+YG treatment. The HF treatment's average feed intake/bird was statistically similar to both LF and LF+YG treatments. The three treatment groups were statistically similar for feed:gain, average weight gain/bird and average weight per bird. From week 18-19 there was no significant difference between the three treatment groups for average feed intake/bird, feed:gain and average bird weight; however, for average weight gain/bird the LF treatment gained statistically more weight than the HF treatment, while the LF+YG treatment had no statistical difference compared to the LF and HF treatments.

Table 6: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 15-18 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	54.360	54.360	54.360
Soybean meal	7.150	7.150	7.150
Porkmeal	5.720	5.720	5.720
Soy hulls	2.000	2.000	0.600
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.087	0.087	0.087
DL-methionine	0.031	0.031	0.031
Yellow grease	0.000	0.000	1.400
Salt	0.200	0.200	0.200
Sodium bicarbonate	0.150	0.150	0.150
Vitamin premix[3]	0.100	0.100	0.100
Limestone	0.889	0.889	0.889
Lysine HCl	0.293	0.293	0.293
Threonine	0.060	0.060	0.060
Avatec 20[4]	0.050	0.050	0.050
DDGS (HF)[5]	20.000	0.000	0.000
DDGS (LF)[6]	0.000	20.000	20.000
Lard	8.810	8.810	8.810
ME	3430	3360	3430
CP	16.600	17.092	17.092
Fat (%)	13.720	12.320	13.720
Lysine	0.920	0.936	0.936
Met+Cys	0.776	0.792	0.792
Threonine	0.598	0.612	0.612
Ca	0.95	0.95	0.95
P	0.48	0.48	0.48

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

Table 7: Ingredient composition of Tom turkey rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) from 18-19 weeks of age

Treatments	HF DDGS	LF DDGS	LF DDGS+YG
Ingredients			
Corn	57.357	57.357	57.357
Soybean meal	7.153	7.153	7.153
Porkmeal	2.159	2.159	2.159
Soy hulls	2.000	2.000	0.600
Trace mineral premix[2]	0.100	0.100	0.100
Choline Cl	0.059	0.059	0.059
DL-methionine	0.011	0.011	0.011
Yellow grease	0.000	0.000	1.400
Salt	0.200	0.200	0.200
Sodium bicarbonate	0.150	0.150	0.150
Vitamin premix[3]	0.100	0.100	0.100
Limestone	1.035	1.035	1.035
Lysine HCl	0.323	0.323	0.323
Threonine	0.060	0.060	0.060
Avatec 20[4]	0.050	0.050	0.050
DDGS (HF)[5]	20.000	0.000	0.000
DDGS (LF)[6]	0.000	20.000	20.000
Lard	9.243	9.243	9.243
ME	3480	3410	3480
CP	15.000	15.492	15.492
Fat (%)	13.910	12.510	13.910
Lysine	0.850	0.866	0.866
Met+Cys	0.715	0.731	0.731
Threonine	0.540	0.554	0.554
Ca	0.65	0.65	0.65
P	0.34	0.34	0.34

[1]Trace mineral premix provided per kilogram: Mn 160,000 mg, Zn 150,000 mg, Fe 10,000 mg, Se 240 mg, Mg 2%

[2]Yellow Grease analysis: Total fatty acids, min. 90.0%; Moisture, max. 1.0%; Insoluble impurities, max. 0.5%; Unsaponifiable matter, max. 1.0%; Total M.I.U., max. 2.0%; Free fatty acids, max. 15.0%

[3]Vitamin premix provided per kilogram: Vitamin A 7,138,658 IU, B-12 14,000 mcg, D 3,569,720 ICU, E 71,386 mg, K 4,015 mg; Biotin 156 mg; Folate 2,677 mg; Pantothenic 13,385 mg; Niacin 62,463 mg; Riboflavin 7,139 mg

After analyzing the data from weeks 1-6, the feed:gain as well as the average weight gain/bird was not statistically different between the three treatment groups; however, the LF+YG treatment group had a statistically greater average feed intake/bird than both HF and LF treatments. During weeks 1-9 the LF+YG treatment showed a statistically higher average feed intake/bird and average weight gain/bird compared to the HF treatment. Yet, the LF treatment was statistically similar to both the LF+YG and HF treatments. There was no significant difference in feed: gain between the three treatment groups during this period. Through week 12 of the trial, the three treatment groups showed no statistically significant difference in feed:gain or average weight gain/bird. As for average feed intake/bird, the LF and LF+YG treatments consumed statistically more feed on average/bird than the HF treatment. After week 15, all three treatment groups showed no statically significant difference in feed: gain and average weight gain/bird. Though, the LF+YG had a statistically higher average feed intake/bird compared to the HF treatment, while the LF treatment was statistically similar to both treatments. Through week 18, the LF treatment had a statistical higher average feed intake/bird, compared to the HF treatment group, but the LF+YG was not statistically different from either HF or LF treatments; however, there was no statistically significant difference between the three treatments in feed:gain and average weight gain/bird. At the completion of the trial on week 19, there was no statistically significant difference between the three treatment groups for feed:gain as well as average weight gain/bird; however, the average feed intake/bird was statistically greater for the LF treatment when compared to the HF and LF+YG treatments.

DISCUSSION

The focus of the study was to determine if a reduction in corn oil levels of dried distillers grains with solubles, as large as seven percent difference in fat level of high-fat vs low-fat DDGS, results in a decrease in growth performance from 0 to 133 days of age in a commercial tom turkey. Additionally, we attempted to study whether any decrease in performance that was observed could be regained through the addition of yellow grease,

Table 8: Chemical amino acid and fat analyses of Dried Distillers Grains with Solubles

ME (Kcal/kg)	--- LF DDGS 2432 ---		---- HF DDGS 2782 ----	
Amino acids (%)	Total	Digestible	Total	Digestible
Aspartic acid	1.95		1.79	
Threonine	1.15	0.82	1.05	0.75
Serine	1.35	0.86	1.22	0.82
Glutamic acid	4.47		3.98	
Glycine	1.33	0.90	1.25	0.87
Alanine	2.20	0.82	1.99	0.78
Cysteine	0.57	0.82	0.53	0.79
Valine	1.56	0.79	1.46	0.72
Methionine	0.64	0.87	0.59	0.82
Isoleucine	1.21	0.82	1.13	0.75
Leucine	3.54	0.90	3.23	0.87
Tyrosine	1.14	0.86	1.04	0.82
Phenylalanine	1.55	0.87	1.43	0.83
Lysine	1.09	0.82	1.06	0.74
Histidine	0.82	0.90	0.76	0.87
Arginine	1.34	0.89	1.23	0.86
Tryptophan	0.23	0.88	0.20	0.82
Fat content (%)	4.3		11.3	

typically the lowest cost source of energy, which is the recommended selection determinate (Firman *et al*., 2008). Multiple studies (Min *et al*., 2012; Wang *et al*., 2007) have shown that high quality DDGS can be included at 15 to 20% of the diet without affecting meat quality or growth performance in the broiler model. Min *et al*. (2012) showed yellowness of muscle color was the only measurement of meat quality that differed significantly between 15 and 20% DDGS inclusion in the diet. In addition, shear force, water holding capacity, pH, as well as lightness and redness were measured as indicators of meat quality and no significant difference was shown between the two inclusion rates. Therefore, it may be assumed that DDGS can safely be added at 20% of the diet without detriment to muscle quality. Furthermore, Wang *et al*. (2007) displayed no significant variation between the control ration and 20% inclusion of DDGS for body weight, feed conversion and feed intake of the broiler from 0-49 days, when fed a high quality DDGS feedstuff.

For the trial a high quality DDGS was sourced locally, high-fat and low-fat products were obtained and samples were sent to the University of Missouri chemical analysis laboratory for proximate and amino acid analysis. Digestibility was determined using the leghorn rooster as a model in order to correctly formulate the basal diet. The high-fat DDGS contained an ether extract level of 11.3% while the low-fat DDGS contained 4.3%, creating a 7% difference. It can be argued that a 7% decrease in fat levels of the DDGS may not be large enough to see a visible difference; however, data collected from a recent broiler trial (Kubas and Firman, 2014) shows that the 7% difference in corn oil can exhibit growth performance differences detectible through statistical analysis. Moreover, when an additional source of energy, yellow grease in this study,

Table 9a: Growth performance for Tom turkeys fed high fat DDGS, low fat DDGS and low fat DDGS plus yellow grease from 7-63 days of age

	1-3 weeks				1-6 weeks				1-9 weeks			
Period	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE
Feed intake	0.607	0.618	0.630	0.0065	3.458	3.423	3.578	0.0162	10.261	10.246	10.326	0.0426
Bird weight	0.514^{A}	0.516^{A}	0.537^{B}	0.0029	2.141	2.160	2.190	0.0095	5.605^{B}	5.684^{AB}	5.768^{A}	0.0213
Adj. feed/gain	1.600	1.615	1.558	0.0207	1.723	1.690	1.742	0.0109	1.876	1.846	1.833	0.0080

^{a,b}Means within a row with no common supscripts differ significantly ($p<0.05$)

Table 9b: Growth performance for Tom turkeys fed high fat DDGS, low fat DDGS and low fat DDGS plus yellow grease from 1-18 weeks of age

	1-12 weeks				1-15 weeks				1-18 weeks			
Period	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE
Feed intake	20.597	20.651	20.689	0.1620	31.889	32.965	32.541	0.2550	44.050^{AB}	46.164^{A}	43.766^{B}	0.403
Bird weight	9.918	9.887	10.015	0.0378	13.572	13.661	13.547	0.0822	17.162	17.419	17.051	0.132
Adj. feed/gain	2.105	2.117	2.095	0.0148	2.373	2.437	2.430	0.0165	2.586	2.672	2.592	0.0141

^{a,b}Means within a row with no common supscripts differ significantly ($p<0.05$)

Table 9c: Growth performance for Tom turkeys fed high fat DDGS, low fat DDGS and low fat DDGS plus yellow grease from 1-19 weeks of age

	1-19 weeks			
Period	HF DDGS	LF DDGS	LF DDGS+YG	Pooled SE
Feed Intake	47.800^{B}	50.294^{A}	47.526^{B}	0.311
Bird weight	17.976	18.520	18.007	0.123
Adj. Feed/Gain	2.678	2.737	2.663	0.0108

$^{a-b}$Means within a row with no common supscripts differ significantly ($p<0.05$)

Table 10: Processing yield of broilers fed rations containing high fat distillers grains (HF DDGS), low fat distillers grains (LF DDGS) and low fat distillers grains+yellow grease (LF DDGS+YG) at 133 days of age, after 12 h fasting

	HF DDGS	LF DDGS	LF DDGS+YG	Pooled St Err
Chilled carcass[1]	82.167	81.629	81.685	0.2130
Fat pad[2]	2.130^{B}	2.230^{AB}	2.609^{A}	0.0689
Major breast[2]	23.077	24.154	23.469	0.2160
Minor breast[2]	4.941	4.857	4.968	0.0438
Leg[2]	13.065	12.530	12.802	0.1450
Thigh[2]	14.379	14.214	14.226	0.1050
Wing[2]	12.554	11.872	12.187	0.1000
Total cutout[2]	70.146	69.857	70.260	0.2600

$^{a-b}$Means within a row with no common supscripts differ significantly ($p<0.05$)

[1]Chilled Carcass yield expressed as a percent of live weight

[2]Yields expressed as a percentage of the chilled carcass weight

is added to the low-fat DDGS diet at a level matching the 7% corn oil lost, feed conversion was improved significantly. The two DDGS were included at 10% of the starter and 20% of the grower rations and the total ration ether extract level decreased by 0.7 and 1.4% respectively.

The 60 kcal reductions between HF and LF rations represents at most a 2% difference in energy and any variation in growth performance for the tom turkey is slight at best. At three weeks of age the LF+YG treatment birds weighed significantly more compared to the LF and HF treatments which were similar statistically. No differences were detected for feed intake and feed conversion ratio in the period. After six weeks, all treatments were statistically similar for feed intake, bird weight and feed conversion. At week 9 the LF+YG treatment birds were significantly heavier compared to the HF treatment birds, while the LF treatments weights were statistically similar to both treatments. Yet feed intake and conversion ratio were similar among the treatment groups. Through weeks 12 and 15 bodyweight, feed intake and conversion rate were comparable between the three treatments. At 18 weeks of age, turkeys in the LF+YG treatment showed a significant decrease in feed consumption when compared with the LF treatment turkeys, while the HF treatment turkeys consumed an amount that was similar to both treatment groups. Bodyweight as well as feed conversion rate were again similar between the three treatments. The final week of the trial showed the LF treatment birds consuming statistically greater amount of feed compared to the HF and LF+YG treatments. Again, bodyweight and feed conversion were not statistically different between the treatments.

Overall, little differences were observed when comparing processing yields. It appeared the added fat produced greater percent carcass yield when compared to the high-fat DDGS treatment, but this was somewhat unexpected and would need to be repeated before any confidence was placed in the results.

The data shows if sourcing LF DDGS and yellow grease is a least cost option when compared to HF DDGS, the substitution will not decrease growth performance over a 19 week growth period in a commercial tom turkey. These results reflect similar findings of Lumpkins *et al.* (2004), who found significant reduction in feed efficiency and body weight for 0-18 day old chicks fed a low density DDGS versus a 50 kcals/kg greater high density DDGS when fed at 15% inclusion rate to the diet.

Conclusion: Use of the lower fat DDGS does result in increased feed intake when compared to the higher fat product or the low fat+yellow grease in tom turkeys. The increased feed intake translated into reduced overall feed efficiency at market weight. The addition of yellow grease reversed this and improved feed efficiency when added to the low fat DDGS diets.

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