Egypt. Poult. Sci. Vol (37)(II): (545-558)(2017) (1717)

Egyptian Poultry Science Journal

http://www.epsaegypt.com

ISSN: 1110-5623 (Print) – 2090-0570 (Online)

UTILIZATION OF DIFFERENT LEVELS OF DISTILLERS DRIED GRAINS WITH SOLUBLES (DDGS) IN LOCAL LAYING HEN DIETS

Youssef A. Attia[1,2], R.A. Hassan[3], A. E. Abd-El-Hamid[1] and W. S. Selim[1]

[1]Anim. and Poult. Prod. Dep., Fac. of Agric., Damanhour Univ., Egypt,
[2]Arid.Land Agric. Dep., Fac. of Meteorology, Envir. and Arid Land Agric., King Abdulaziz Univ., Jeddah, Saudi Arabia. [1]Anim. Prod. Res. Inst., Agric. Res. Center, Egypt
Corresponding author: Youssef A. Attia:Email:attia0103753095@gmail.com

Received:05/04/2017 Accepted:21/05/2017

ABSTRACT: This study aimed to investigate the effect of inclusion of distillers dried grains with solubles (DDGS) in the laying hens' diets on productive and reproductive performance, some egg quality traits, nutrients digestibility and some blood parameters. A total number of 90 Inshas hens and nine Inshas cocks, 28 week-old were randomly distributed into three groups and fed the experimental diets contained 0.0, 10 and 20% DDGS. The results showed that DDGS inclusion in the diet insignificant impact on rate of laying and egg mass, egg weight, feed consumption and feed conversion ratio as compared to the control group during the whole experimental period (28-48 wks of age). Egg quality traits were insignificantly affected due to feeding DDGS, whereas yolk color was significantly increased by feeding 20% DDGS diet as compared to the control. Nutrients digestibility were not affected by feeding 10% DDGS in the diet. Plasma constituents including plasma protein, indices of liver and renal function, uric acid, lipid metabolites and phosphorus were not significantly affected by feeding different levels of DDGS in the diet, but plasma calcium significantly decreased when 20% DDGS was fed and this concurred with a reduction in eggshell quality (relative weight of shell and shell-thickness).
In conclusion, the present results showed that the use of DDGS can be successfully fed up to 20 % in Inshas laying hen diets without any adverse effect on laying hen performance, nutrients digestibility, egg quality and plasma constituents and economical efficiency.

Key words: DDGS, laying hens, egg production, digestibility, egg quality, plasma constituents.

INTRODUCTION

Poultry production plays a major role in bridging the protein gap in producing countries where average daily consumption is far below than the recommended daily allowance (Onyimonyi and Onu, 2009). Feed is the main expensive component of poultry production and often accounts for 60-65% of total costs.

Distillers dried grain with solubles (DDGS) is a by-product of ethanol production. Corn is the key grain utilized in the fuel ethanol industry due to high content of readily fermentable starch. During fermentation, approximately equal portions of ethanol, carbon dioxide (CO_2) and DDGS are formed (Lumpkins *et al.*, 2005). Production of ethanol from 100 kg of corn produces approximately 34.4 kg of ethanol, 34.0 kg of CO_2 and 31.6 kg of DDGS (Renewable Fuels Association, 2005). In Egypt, DDGS imports have grown in last decade being ,81000 tons in 2010, and could reach to 350000 tons by 2020 (U.S. Grains Council, 2011).On the other side, DDGS are higher in Non Starch Polysaccharides (NSP) than the parent materials. However, mono-gasterics such as poultry do not break down successfully feedstuffs which include high NSP content. As a result, the metabolizable energy (ME) of DDGS was lower than in corn (2820 vs. 3350 kcal/kg, NRC, 1994). Previous research has shown that dried distillers grains with solubles (DDGS) is an acceptable ingredient in laying hen diets. DDGS can contribute as much as one third of the protein needed in the laying hen (Roberson *et al.,* 2005). Roberson *et al.* (2005), Lumpkins *et al.* (2005), and Świątkiewicz and Koreleski (2006) , all recommend a usage rate of up to 15% DDGS in laying hen diets to maintain egg production. The objective of the present study was to investigate the inclusion levels of DDGS higher than 15% in laying hen diets and the effect of such inclusion on productive and reproductive performances of laying hens, some egg quality traits, nutrients digestibility; and some blood plasma parameters of local laying hens.

MATERIALS AND METHODS

This study was carried at Sakha Animal Production Research Station, Animal Production Research Institute (APRI) .

A total number of 90 Inshas laying hens and 9 Inshas cocks, 28-week old were weighed and randomly distributed among three experimental groups, each group contained three replicates (10 hens &1 cock). Birds of each replicate were housed in floor pens (280 cm long x 220 cm wide) and received additional artificial light to provide 16h light and 8h dark daily. Chickens in all treatments were reared under similar managerial conditions. Hens were fed three different dietary treatments with three DDGS levels (0, 10 and 20%). Throughout the experimental period (28-48 wks), which were lasted 20 weeks, feed and fresh water were offered *ad libtium*.

DDGS was obtained from Cairo Poultry Company and proximate chemical analysis including the moisture, crude fat, crude protein, crude ash, and crude fiber of DDGS were determined using AOAC (1995) before formulating the experimental diets. The energy content of distilled dried grains with solubles was calculated according to the following formulation reported by Meloche (2013):

$$ME\ (kcal/kg) = 3673 - (121.35 \times CF) + (51.29 \times EE) - 121.08 \times ash$$

The experimental diets were formulated to be isonitrogenous (~ 16% CP) and isocaloric (~ 2700 kcal ME/kg diet) and to at least satisfy the nutrient requirements according to Agriculture Ministry Decree (1996).Body weights were recorded at the beginning and at the end of the study , accordingly, body weight changes and percentage change in body weight were easily calculated. Egg number, egg weight and feed consumption (g/laying hen) were recorded daily and accordingly, the rate of laying (%), egg mass (g/laying hen/d) and feed conversion ratio were calculated.

Three batches of eggs (No= 100 egg / treatment) were collected from the 9 replicate pens during the 44, 46, and 48th wk of age and incubated at Chick Master hatchery to measure the rate of hatchability. Moreover, fertility was determined by candling at 18 day of incubated period. Five eggs from each replicate were collected at the end of the experimental period (48 wk of age) in order to determine egg quality traits including shape index and yolk index which were determined according to Romanoff and Romanoff (1949), eggshell thickness using a micrometer at the equator, Haugh unit score which was determined by special chart using egg weight and albumin height, the later was assessed using a micrometer according to Haugh (1937), and Eisen *et al.* (1962).

The egg yolk color was determined by yolk color fan. Haugh units were measured (15 eggs/treatment) after storage at room temperature for 0, 1, 2 and 3 weeks to better understand the effect of DDGS inclusion on albumen quality of an egg.

Three eggs per treatment group were used for chemical analysis. Edible parts of eggs (albumen + yolk) were dried at 105^{o} C until constant weight, ashed at 600^{o}C for hours in a forced drought oven, ground and stored to chemical analysis. Proximate analysis was carried out according to the official methods (AOAC, 1995).

At the end of experimental period, 9 cocks (one from each replicate), was utilized for evaluation of the digestibility of nutrients for all experimental diets. Each experimental diet was fed to 3 cocks for four days as a preliminary period, followed by three days collection period, where excreta were quantitatively collected. Simultaneously, records for daily feed consumption for each cock were maintained. The daily excreta voided from each cock were collected and thoroughly mixed. Then, representative excreta samples were taken and dried immediately for chemical analysis (AOAC, 1995). The procedure described by Jakobsen *et al.* (1960) was used for separating fecal protein from excreta samples. Urinary organic matter was determined according to Abou-Raya and Galal (1971).

By the end of the experimental period, 3 blood samples were taken from each group for analysis. The concentrations of plasma total protein and albumin were estimated (Dumas *et al.*, 1971), total cholesterol (Allain *et al*., 1974), total lipids (Fringa and Dunn, 1970), Ca++ ,inorganic P, creatinine (Bartles *et al*., 1972), AST and ALT were determined calorimetrically by using the suitable commercial kits (Diamond Company, Stabio laboratory pasties lab., Diagnostic and Biodiaquastic company). The Globulin values were obtained by subtracting the albumin values from the corresponding total protein values.

Data from all the response variables were subjected to one-way analysis of variance (SAS, 2004) using the replicate as the experimental unit. All percentages values were transformed to arcsine before analyses. The statistical model used was : $Y_{ij} = M + T_i + e_{ij}$.

Where,

Y_{ij} = Any observation. M = Over all mean.

T_i = Treatments (i = 1, 2 and 3). e_{ij} = Experimental error.

Variables having a significant F-test ($P \leq 0.05$) were compared using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

1. **Chemical analysis of DDGS:**

The chemical composition of corn DDGS used in the experiment showed the presence of 27.15% crude protein, 10.03% ether extract, 9.30% crude fiber, 4.30% ash, 0.84% lysine, 0.54% methionine, 0.60% cystine and 1.14% methionine and cystine. It is obvious that crude protein value of DDGS was higher than that recorded by Choi *et al.* (2008) being 26.53% and lower than that recorded by Spiehs *et al*. (2002) being 30%. The value of EE in DDGS being 9.30% is less than that recorded by Spiehs *et al.* (2002), Waldroup *et al.* (2007) and Ghazalah *et al.* (2011). Previous studies have investigated that crude protein content of dried distillers grains with solubles (DDGS) ranging between 23-32% (Spiehs *et al*., 2002 ; Batal and Dale, 2006; Fastinger *et al*., 2006). This wide spectrum could be due to the removal of the germ and pericarp fiber, where the germ contains a lower concentration of protein and a higher concentration of excess fat than the endosperm (Shukla and Cheryan, 2001). In addition, to differences in fermentation process used for production of DDGS (Bregndahl, 2008; Shalash *et al*., 2009). In this regard, Babcock *et al.* (2008) reported that the DDGS content of nutrients were on average 27.15% for CP, 10.67% for EE, 26.21% for CF and 28.12% for ash.

The calculated apparent metabolizable energy (AME) of DDGS used in the present study was 2538 kcal/kg (as fed) being lower than that of yellow corn (3350 kcal/kg), but somewhat greater than the related value of soybean meal (SBM) (2240 kcal/kg). The higher ME of DDGS (2538 kcal/kg) compared to SBM can be attributed mainly to the increase in the EE (10.03%) in DDGS compared with 1.5% for SBM. In this respect, Batal and Dale (2006) reported that the true metabolizable energy value of DDGS ranged between 2490-3190 kcal/kg and had a mean of 2810 kcal/kg. They added that the metabolizable energy of DDGS may differ because of its content of oil and protein, as well as method of evaluation. In addition, color of DDGS varied with the processing conditions and reflected on the nutritive value with darker color showed lower values than lighter ones (Fastinger *et al*., 2006). Therefore, nutritionists should be cautious of the energy variability of DDGS when formulating diets for poultry (Adeola and Ieleji, 2009).

2- Productive performance:

Results in Table (2) showed that increasing DDGS level from 0 – 20% had no significant effect on laying hens' performance compared with control group, suggesting that DDGS up to 20% in local laying hen diets had no negative effects on productive performance of laying hens. These results agree with Lumpkins *et al*. (2005) and Roberts *et al.* (2007) who suggested that feeding laying hens on diet contained 10-12% DDGS had no significant effects on laying performance, and 15% as reported by Roberson *et al.* (2005) and Swiatkiwicz and Korelwski (2006), and 20% as suggested by Swiakwicz and Koreleski (2006) and Cheon *et al.* (2008). On the other hand, Shalash *et al.* (2010) observed that increasing DDGS to 15 or 20 % in laying hen diets significantly decreased egg production % and egg weight, while had no adverse effect on feed consumption compared to the other levels of DDGS (0, 5 and 10%). In addition, Schideler *et al*. (2008) concluded that inclusion of up to 20% and 25% 25% DDGS decreased egg weight because of amino acid deficiency, high percentage of crude fiber and sulfur content (between 0.3 – 1.9%) and decrease in palatability (Pineda *et al.*, 2008). Moreover, lysine deficiency as results of mallard reaction decreases the digestibility of lysine by competing with absorption of lysine or inhibition of carboxy peptidases (Hansen and Millington, 1997 and Sherr *et al.*, 1998). Furthermore, high levels of DDGS resulted in low level of starch as most of the starch is converted to ethanol during fermentation (Creswell, 2006). This indicates that the hens relied solely on converting part of dietary amino acids to glucose through the gluconeogenesis path-way to maintain normal glucose concentration in the blood and relying increasingly on fatty acid oxidation to provide energy. The DDGS diets contained relatively high amount of protein, fiber and fat,. which differ widely in their energy losses as heat increment.

Results in Table (2) indicate that no significant effect on fertility %, hatchability % and body weight of chicks at hatch by inclusion of DDGS in laying hen diets. These results are in agreement with those reported by Shalash *et al.* (2010) who found that no significant effect on semen quality, fertility, hatchability and body weight of chicks at hatch by inclusion of DDGS at 0-20%.

3. Egg quality traits:

Data of components and quality measurements of egg produced by laying hens fed diets contained different DDGS levels at 48 wk– old are presented in Table (3).No significant differences were observed among the experimental groups in all egg components and quality measurements except of shell percentage and shell thickness which were decreased by feeding diet contained 20 % DDGS, whereas, yolk color was increased by increasing DDGS levels. The decrease in eggshell quality was concurred with a decrease in plasma Ca (Table 6). This may be due to that DDGS contain sulfur, which may interfere with absorption of dietary calcium from the gut (Pineda *et al.*, 2008). These results agree with Lumpkins et al. (2005) and Roberts *et al.* (2007) who mentioned that egg quality parameters were not affected by feeding White Leghorn-type laying hens (23 to 58 wks of age) diets containing 10% DDGS. Moreover, Pineda et al. (2008) observed that egg quality traits were not impacted by inclusion of the DDGS in the laying diet.

Increasing DDGS to 20% in laying hen diets (Table 3) increased yolk color (favorable effect) compared to those of the groups fed control diet and 10% DDGS. These results are in agreement with those reported by Pineda *et al.* (2008). This observation was expected because corn contains relatively high content of xanthophyll's, which are a primary contributor of yolk pigmentation, NRC (1994). Similarly, adding DDGS between 5-25% in the laying hen' diets significantly increased egg yolk color (Shalsh *et al.*, 2010; Masadeh *et al*., 2011; Cuevasa *et al*. 2012). This means that xanthophylls in the DDGS were more available. DDGS had higher xanthophylls than corn with about 34 mg/kg (Sauvant and Tran, 2004), which is 3 times the xanthophylls content (10.62 mg/kg) in corn (NRC, 1994). On the other hand, no effect on egg yolk color of laying hens fed diets containing 10-15% DDGS were observed by Lumpkins *et al*., 2005; Roberts *et al.*, 2007 and Deniz *et al*., 2013.

3.1. Haugh units at storage times:

There were no differences among the DDGS treatments at all storage times on the quality of egg albumen when eggs stored for different times (Table 4). On the other hand, Haugh units decreased with storage time in all DDGS treatments. These results agree with Swiatkiwicz and Korleski (2006) who found no differences in Haugh units of egg from hens fed diets containing 0,5,10,15 and 20% DDGS. In this connection, Pineda *et al.* (2008) reported no distinctions in Haugh units when high amounts of DDGS were fed. Additional researchers also reported that Haugh units were not afflicted by DDGS use in hens' diets (Roberson et al., 2005). Nevertheless, Lilburn and Jensen (1984) observed increase in Haugh unit score with the addition of 20 % DDGS and Jensen *et al.* (1978) also reported increased Haugh units with 10% DDGS treatments.

4- Chemical analysis of egg yolk:

After 20 weeks feeding period, no differences in moisture, protein and fat content of egg yolk among three DDGS treatments was found (Table 4). These results are in agreement with those reported by Sun (2011) who found that fat content of egg yolk of only 50% DDGS group was significantly higher than of the other groups (0, 17, 35%), but protein content was lower, with no differences in moisture content of egg yolk among four treatments.

5-Plasma constituents:

Data of some blood constituents of Inshas laying hens fed the diets contained different levels of DDGS are illustrated in Table (5). Plasma parameters of laying hens, measured in the present study, were estimated to show the metabolic changes of Laying hens and their health condition as affected by feeding DDGS at different levels. Results showed that no significant differences were found among treatments in all blood constituents with the exception of a decrease in plasma Ca when 20% DDGS was fed. These results are agree with Gabr *et al.* (2008) who found that total protein, cholesterol, GOT and GPT were not significantly affected by feeding diets contained 10, 15 and 20% DDGS. In this regard, Awad *et al*. (2011) reported that plasma parameters are not afflicted by using different levels of DDGS (0, 10, 20 and 30%) in Domyati Ducks diets. However, DDGS had no effect on cholesterol, which would be due to the low amount of solubles fiber present in the DDGS diets.

6- Nutrient digestibility:

Percentage of OM, DM, CP , EE, CF and NFE digestibility are illustrated in Table (6). Results showed that no significant effect was found on digestion of nutrients due to feeding diets contained different levels of DDGS. Values of nutrients digestibility were insignificantly improved by feeding diet contained 10% DDGS as compared to control. These results are agree with those found by Shalash *et al.* (2010) who reported that digestibility values of CP, CF, EE and NFE were not significantly affected by dietary DDGS levels (0-20%). The present results indicate that DDGS had high bioavailability of some nutrients, particularly lysine (Cromwell *et al*., 1993 and Shurson, 2003). Also, DDGS is a good source of P that contains 0.72% total P (NRC, 1994) and the bioavailability of P is higher than the 25 to 35% that is typical for most plant ingredients. On the other hand, Swiatkiewicz and Koreleski (2008) found that nutrients digestibility of DDGS is differ and may be afflicted by non-starch polysaccharide content. In addition, Mikhail *et al*. (2013) found that the highest DDGS inclusion level (30%) in quail diets resulted in the lowest CP and CF digestibility. This may be due to high fiber content especially NDF and ADF, not converted to ethanol during the fermentation process (Stein and Shurson, 2004). In this respect, Ghazalah *et al.* (2012) showed that increasing the DDGS level could decrease total digestibility of nutrients due to the unbalanced dietary amino acids and high fiber content.

7- Economical efficiency:-

Calculations were carried out according to the prices of feed ingredients, additives and eggs prevailing during year 2015 (the experimental time) as listed in Table (7). The economical efficiency values of laying hens were improved by 7.04 and 10.70% for the groups fed diets contained 10 and 20 % DDGS as compared to the control, respectively during the studied laying period from 28 to 48 weeks of age. So, increasing inclusion levels of DDGS up to 20% in the diet of laying hens improves net return per hen and economical efficiency compared to those of the control. It may be due to the decreasing of feed consumption and the feed cost. These results are in agreement with those obtained by Choi, *et al*. (2008) who found that the cost of feed decreased as the levels of DDGS increased in broiler diets without adverse effects on the performance.

CONCLUSION

DDGS could be included in of Inshas laying hen diets as non-conventional feedstuff up to 20% without adverse effect on productive and reproductive performance, plasma constituents, nutrients digestibility as well as economic efficiency from 28 to 48 weeks of age if the reduction in eggshell quality could be avoided.

Table (1): Composition and calculated analysis of experimental diets.

Ingredients	**Control Diet**	**10% DDGS**	**20% DDGS**
Yellow corn	64.00	60.69	57.00
Soybean meal (44%)	23.70	18.30	12.76
Wheat bran	1.85	0.70	0.00
DDGS	0.00	10.00	20.00
Limestone	8.0	8.00	8.06
Di-calcium phosphate	1.63	1.53	1.41
Sodium chloride	0.45	0.33	0.21
Vit.& Min. Mixture*	0.30	0.30	0.30
DL-Methionine (99%)	0.07	0.06	0.05
L-lysine HCl (98%)	0.00	0.09	0.21
Total	100	100	100
Calculated analysis[1]			
Crude Protein, %	16.04	16.01	16.01
ME, kcal/kg	2700	2706	2704
Crude Fiber, %	4.64	4.93	5.25
Methionine,%	0.36	0.36	0.37
Meth+Cystine,%	0.62	0.62	0.62
Lysine ,%	0.79	0.79	0.79
Calcium, %	3.46	3.44	3.42
Available Phoshorus, %	0.43	0.43	0.42
Sodium, %	0.19	0.19	0.19
Determined analysis[2], %			
Dry matter	89.80	89.56	89.68
Crude protein	16.10	16.08	16.05
Crude fat	2.70	3.52	4.38
Crude fiber	4.78	4.82	5.00

*Supplied per kg of diet: vit.A, 12000 IU; D_3, 20200 IU; Vit.E, 10mg; Vit.K_3,2mg; vit.B_1, 1mg; vit. B_2, 5mg; vit.B_6, 1.5mg; vit. B_{12}, 10mcg; Niacin, 30mg; Pantothenic acid, 10mg; Folic acid, 1mg; Biotin, 50µg; Choline chloride, 250mg; Copper, 10mg; Iron; 30mg; Manganese, 60mg; Zinc, 50mg; Iodine, 1mg; Selenium, 0.1mg; and Cobalt, 0.1mg.

[1]Calculated values (NRC, 1994)

[2]Determined values (AOAC, 1995)

Table (2): Effect of diets with various levels of DDGS on egg production, egg number, egg mass, egg weight, feed intake, feed conversion and body weight change during the 20-week long period

Parameters	**DDGS, %**			**SEM**	**P-value**
	0	**10**	**20**		
Egg production, %	62.0	61.9	61.4	0.149	0.205
Egg weight, g	49.6	49.4	49.4	0.038	0.147
Egg mass, g/h/d	30.7	30.6	30.3	0.081	0.108
Feed intake, g /h/d	94.3	93.3	92.7	0.322	0.119
Feed conversion ratio, g feed/g egg	3.06	3.05	3.05	0.011	0.883
Body weight gain, g	24	24	18	2.10	0.483
Changes of body weight, %	1.61	1.56	1.21	0.136	0.494
Fertility, %	90.3	90.4	89.9	1.248	0.748
Hatchability, %	82.1	82.8	81.5	2.011	0.525
Body weight of chicks at hatch (g)	35.2	35.2	35.1	0.358	0.625

Table (3): Effect of diets with various levels of DDGS on some egg quality traits at 48 weeks of age.

Parameters	**DDGS, %**			**SEM**	**P-value**
	0	**10**	**20**		
Albumen weight, %	54.7	55.0	55.0	0.122	0.562
Yolk weight, %	33.6	33.4	33.6	0.104	0.784
Shell weight, %	11.8^{a}	11.6^{ab}	11.6^{b}	0.037	0.038
Shape index	76.4	77.1	76.7	0.286	0.642
Yolk index	46.0	45.7	45.1	0.276	0.445
Shell thickness, µm	363^{a}	349^{b}	330^{c}	2.1	0.0001
Haugh unit score	80.6	80.8	81.3	2.44	0.615
Yolk color	5.60^{b}	5.80^{b}	6.33^{a}	0.105	0.009

a,b,c: means in the same row bearing different superscripts are significantly different ($p \leq 0.05$).

Table (4): Effect of diets with various levels of DDGS on Haugh unit score at different times of storage and chemical components of egg yolk at 48 weeks of age.

Parameters		DDGS diet (%)			SEM	P-value
		0	10	20		
Haugh units						
Storage period	0 wk	80.6	80.8	81.3	0.77	0.215
	1 wk	78.5	78.9	79.2	0.79	0.355
	2 wk	75.4	75.9	76.8	0.84	0.145
	3 wk	72.5	73.8	74.4	0.83	0.245
Egg yolk						
Chemical composition	Fat,%	32.1	32.2	32.5	0.24	0.165
	Moisture,%	48.5	48.5	48.6	0.08	0.322
	Protein,%	16.9	16.9	17.0	0.09	0.189

Table (5): Effect of diets with various levels of DDGS on some plasma constituents of 48 week-old laying hens.

Parameters	DDGS, %			SEM	P-value
	0	10	20		
Total protein, g/dl	5.39	5.33	5.33	0.022	0.520
Albumin, g/dl	3.43	3.30	3.33	0.058	0.154
Globulin, g/dl	1.96	2.03	2.00	0.052	0.124
Albumin/globulin ratio	1.75	1.63	1.67	0.031	0.145
Aspartate aminotransferase, U/ml	45.7	47.7	48.0	0.433	0.610
Alanine aminotransferase, U/ml l	13.0	13.0	13.6	0.423	0.949
Alkaline phosphatase, U/ml	24.0	24.5	24.6	0.209	0.547
Cholesterol, mg/dl	135.3	135.7	135.0	0.235	0.579
Total Lipids, mg/dl	570	572	569	0.433	9.5
Uric acid, mg/dl	4.43	4.80	4.90	0.096	0.195
Creatinine, mg/dl	0.453	0.486	0.493	0.009	0.155
Calcium, mg/dl	22.9[a]	22.8[ab]	22.4[b]	0.108	0.092
Inorganic phosphorus, mg/dl	5.62	5.68	5.30	0.145	0.245

a,b,c: means in the same row bearing different superscript are significantly different (p≤0.05).

Table (6): Effect of diets with various levels of DDGS on nutrients digestibility at 48 weeks of age.

Items	DDGS (%)			SEM	P-value
	0	10	20		
Dry matter,%	76.17	76.52	76.05	0.485	0.255
Organic matter, %	79.05	80.00	78.85	2.155	0.785
Crude protein, %	78.99	79.56	78.84	1.559	0.916
Crude Fiber, %	21.41	23.08	22.39	2.465	0.934
Ether Extract, %	70.91	71.40	71.73	1.377	0.507
Nitrogen free extract, %	73.10	73.56	72.04	3.427	0.999

Table (7): Effect of diets with various levels of DDGS on economical efficiency of laying hens during 28-48 weeks of age.

Parameters	**DDGS (%)**		
	0	**10**	**20**
Average feed consumption kg per hen during overall period	13.195	13.066	12.972
Cost /kg feed, L.E[1]	3.905	3.826	3.769
Total feed cost, L.E[2]	51.53	50.00	48.89
Number of egg produced / hen	86.66	86.52	85.82
Price of one egg, L.E[3]	1	1	1
Total return / hen, LE	86.66	86.52	85.82
Net return / hen, LE	35.13	36.52	36.93
Economic efficiency[4]	0.682	0.730	0.755
Relative economic efficiency[5]	100	107.04	110.70

1-L.E = Egyptian pound.
2-According to price of different ingredients available in Egypt at the experimental time.
3- According to local price at the experimental time.
4-Economic efficiency =(Net return LE / Total feed cost LE) .
5- Relative economic efficiency = assuming EEF of the control equals 100 %.

REFERENCES

Abou-Raya, A.K. and Galal, A. G. H., 1971. Evaluation of poultry feeds in digestion trials with performance to some factors involved. Egypt J. Anim. Prod., 11: 207-221.

Adeola, O. and Ileleji, K.E., 2009. Comparison of two diet types in the determination of metabolizable energy content of corn distillers dried grains with solubles for broiler chickens by the regression method. Poult. Sci., 88: 579-585.

Agriculture Ministry Decree, 1996. The standard properties for ingredients, feed additives and feed manufactured for animal and poultry. El-Wakaee El-Masria, Amirria Press, Cairo, Egypt. No. 192, 1997., pp: 95.

Allain, C.A., Poon, L. S., Chan, C.G.S., Richmons, W. and Fu, P.C., 1974. Enzymatic determination of total serum cholesterol. Clin. Chem., 20:470-475.

AOAC. 1995. Official Methods of Analysis. 16th edition. 5th revision. AOAC International, Gaithersburg, MD. Calcium (927.02), Phosphorus (965.17), Protein (CP) Kjeldahl Method (988.05), and Crude fate (Ether Extract) (920.39).

Awad, A. L., Hussein, M.A.A., Ghonim, A.I.A. and Kasim, M.G., 2011. Effect of dietary inclusion level of distillers dried grains with solubles on growth performance of domyati ducklings. Egypt. Poult. Sci. J., 31:65-75.

Babcock, B.A., HAYS, D.J. and Lawrence, J.D., 2008. Using Distillers Grains in the U.S. and international livestock and poultry industry. Midwest agribusiness Trade Research and Information Center. First edition, (Ames, Iowa, USA).

Batal, A.B. and Dale, N.M. 2006. True Metabolizable Energy and Amino Acid Digestibility of Distillers Dried Grains with solubles. J. of Appl. Poult. Res., 15: 89-93.

Bregendahl, K., Roberts, S.A., Kerr, B. and Hoehler, D. 2008. Ideal Ratios of Isoleucine, Methionine, Methionine plus Cystine, Threonine, Tryptophan, and Valine Relative to Lysine for White Leghorn-Type Laying Hens of Twenty-

Eight to Thirty-Four Weeks of Age. Poult. Sci., 87:744-758.

Cheon, Y.J., H.L. Lee, M.H. Shin, A. Jang and S.K. Lee et al., 2008. Effects of corn distiller's dried grains with solubles on production and egg quality in laying hens Asian-Aust. J. Anim. Sci., 21:1318-1323.

Choi, H.S., Lee, H.L., Shin, M.H., Cheorun, J., Lee, S.K. and Lee, B.D. 2008. Nutritive and economic values of corn Distiller's Dried Grains with solubles in broiler diets. Asian-Aust. J. of Anim. Sci., 21: 414-419.

Creswell, D.C., 2006. DDGS Benefits and Limitation. Asian Poult. Mag., pp: 22-24.

Cromwell, G. L., K. L. Herkelman, and T. S. Stahly, 1993. Physical, chemical, and nutritional characteristics of distillers dried grains with solubles for chicks and pigs. J. Anim. Sci., 71:679-686.

Cuevasa, A.C., Carrillob, C.A.E., Elizaldea, G.S., Iriartea, J.M., Roac, M.O. and Gonzaleza, E.A. 2012. Use of distillers dried grains with solubles (DDGS) on sorghum-soybean meal diets for broilers and laying hens. Rev. Mex. Cienc. Pecu., 3: 331-341.

Deniz, G., Gencoglu, H., Gezen, S. S., Turkmen, I. I., Orman, A. and Kara, C. 2013. Effects of feeding corn distiller's dried grains with solubles with and without enzyme cocktail supplementation to laying hens on performance, egg quality, selected manure parameters, and feed cost. Livestock Sci., 152:174-181.

Dumas, B., Wabson, W. and Biggs, H., 1971. Albumin standards and measurements of serum with bromocresol green. Clin. Chem. Acta, 31:87.

Duncan, D.B., 1955. Multiple range and multiple F-tests. Biometrics, 11:1-42.

Eisen, E. J., B.B. Bohren and Mckean, K. E., 1962. The Haugh unit as a measure of egg albumen quality. Poult. Sci., 41: 1461-1468.

Fastinger, N.D., Latshaw, J.D. and Mahan, D.C., 2006. Amino Acid Availability and True Metabolizable Energy Content of Corn Distillers Dried Grains with solubles in Adult Cecectomized Roosters. Poult. Sci., 85:1212-1216.

Frings, C.S. and Dunn, R.T., 1970. A colorimetric method for determination of total serum lipids based on the sulfo-pohspho vanillin reaction. Amer. J. Clin. Pathol., 53: 552-555.

Gabr, A. A., El. Sherif, Kh. and Naeem, A. F., 2008 . Effect of inclusion dried distiller's grains with solubles with enzyme addition in rabbit diets on performance, digestibility, carcass traits and some blood constituents. J. Agric. Sci. Mansoura Univ., 33: 6335 – 6349.

Ghazalah, A.A., Abd- Elsamee, M. O., AbdEl-Hakim, A. S. and Ibrahim, M.M., 2012 . Evaluation of using distillers dried grains with solubles (DDGS) in broiler diets. Egypt. Poult. Sci. J., 32:381-397.

Ghazalah, A.A., Eman M. O. A. E., and Moustafa, S., 2011. Use of Distillers Dried Grains with solubles (DDGS) as Replacement for Soybean Meal in Laying Hen Diets. Int. J. Poult. Sci., 10:505- 513.

Hansen, L.P. and Millington, R. J., 1979. Blockage of protein enzymatic digestion (carboxy peptides-B) by heat stress-induced sugar lysine reactions. J. Food Sci., 44:1173-1177.

Haugh, R. R., 1937. The Haugh units for measuring egg quality. US Egg Poult. Mag., 43:552– 555.

Jakobson, P. E, Gertov, K. and Nielsen, S. H., 1960. Fordojelighedsforsog med fjerKrae. (Digestibility trials with poultry)1. Fordo jelseskanalen hos hons samt metodiske problemer ved gennemforelsen af Fordojelighedsforsog. 322 beretning fra forsoges laboratoriet, kobenhaven.

Jensen, L.S., Chang, C. H. and Wilson, S. P., 1978. Interior egg quality: Improvement by distillers feeds and trace elements. Poult. Sci., 57: 648-654.

Lilburn, M. S. and Jensen, L. S., 1984. Evaluation of corn fermentation solubles as a feed ingredient for laying hens. Poult. Sci., 63:542–547.

Lumpkins, B.S., Batal, A. B. and Dale, N. M., 2005. Use of distillers dried grains plus solubles in laying hen diets. J. Appl. Poult. Res., 14: 25-31.

Masadeh, M. K., Purdum, S. E. and Hanford, K. J., 2011. Dried distillers grains with solubles in laying hen diets. Poult. Sci., 90:1960-1966.

Meloche, K.J., 2013. The development and validation of prediction equations for the apparent metabolizable energy of Distillers Dried Grains with solubles in Broilers. Thesis, Auburn Univ., Alabama, USA.

Mikhail, W. Z., Abd EL-Samee, M. O., Shebl, M. A. and Abo-Atia, A. R. 2013. Using distillers dried grains with solubles (DDGS) supplemented with enzymes in quail diets. Egypt. Poult. Sci. J. 33:805-823.

NRC, 1994. National Research Council. Nutrient Requirements of Poultry. 9th Edn., National Academy of sciences. Washington, DC., USA.

Onyimonyi, A. E. and Onu, E. 2009. An Assessment of Pawpaw Leaf Meal as Protein Ingredient for Finishing Broiler. Int. J. of Poult. Sci., 8: 995-998.

Pineda, L., Roberts, S., Kerr, B., Kwakkel, R., Verstegen, M. and Bregendahl, K. 2008. Maximum dietary content of dried distiller's grains with solubles in diets for laying hens: Effects on nitrogen balance, manure excretion, egg production and egg quality. Iowa State University Animal Industry Report 2008, Iowa State University. (http://www.ans.iastate.edu/report/air/).

Renewable Fuels Association (2005). Homegrown for the homeland: Ethanol industry outlook 2005. http: WWW. Ethanolrfa. Org/objects/pdf/Accessed May 2005

Roberson, K. D., Kalbfleisch, J. L., Pan, W. and Charbeneau, R., 2005. Effect of distiller's dried grains with solubles at various levels on performance of laying hens and egg yolk color. Int. J. Poult. Sci., 4: 44-51.

Roberts, S. A., Xin, H., Kerr, B.J., Russell, J. R. and Bregendahl, K., 2007. Effects of dietary fiber and reduced crude protein on nitrogen balance and egg production in laying hens. Poult. Sci., 86: 1716- 1725.

Romanoff, A. L. and Romanoff, A. J., 1949. Chemical Composition in The Avian Egg, John Wiley & Sons, NY, P311.

SAS Institute, 2004. SAS, DSTAT Users Guide. SAS Institute, Inc. Cary, NC.

Sauvant, D. and Tran, G., 2004. Corn distillers. Page 118 in: Tables of composition and nutritional value of feed materials. D. Sauvant, J.-M. Perez, and G. Tran, ed. Wageningen Academic Publishers, The Netherlands.

Scheideler, S. E., Masadah, M. and Roberson, K., 2008. dried distillers grains with solubles in laying hens ration and notes about mycotoxins in DDGS. In Pre-Show Nutrition Symposium, Midwest Poultry Federation Convention, March 18-20St. Paul, MN.

Shalash, S. M. M., Abou El-Wafa, S., Hassan, R. A., Ramadan, Nehad A., Mohamed, Manal S., El-Gabry, Hoda, E. 2010. Evaluation of Distillers Dried Grains with solubles as Feed Ingredient in Laying Hen Diets. Int. J. Poult. Sci., 9: 537–545.

Shalash, S. M., Sayed, M.A., Hoda El-Gabry, E., Nehad Ramadan, A. and Manal Mohamed, S., 2009. Nutritive value of distillers dried grains with solubles and broiler performance at starter period. Int. J. Poult. Sci., 8: 783-787.

Sherr, B., Lee, C. M. and Jelesciewicz, C., 1989. Absorption and metabolism of lysine maillard products in relation to the utilization of-lysine. J. Agric. Food Chem., 37: 119-122.

Shukla, R. and Cheryan, M. 2001. Zein: The industerial protein from corn. Ind. Crops. Prod., 13 : 171- 192.

Shurson, J., 2003. The value and use of distillers dried grains with solubles DDGS) in livestock and poultry ration. http://www.ddgs.umn.edu. Accessed on January 23, 2011.

Spackman, D. H., Stein, W. H. and Moore, S., 1958. Automatic recording apparatus for use in the chromatographay of amino acids. Analyt. Chem., 30: 1190.

Spiehs, M. J., Whitney, M. H. and Shurson, G. C., 2002. Nutrient Database for Distiller's Dried Grains with solubles Produced from New Ethanol Plants in Minnesota and South Dakota. J. of Anim. Sci., 80: 2639-2645.

Stein, H. H. and Shurson, G. C., 2009. The use and application of distillers dried grains with solubles in swine diets. Anim. Sci., 87:1292-1303.

Sun, H., 2011. Effects of increasing concentrations of corn distiller's dried grains with solubles on the egg production, internal quality of eggs, chemical composition and nutrients content of egg yolk. M. Sc. Thesis, Iowa State University.

Świątkiewicz, S. and Koreleski, J., 2006. Effect of maize distillers dried grains with solubles and dietary enzyme supplementation on the performance of laying hens. J. Anim. & Feed Sci., 15:253-260.

Swiatkiewicz, S., and J. Koreleski. 2008. The use of distiller's dried grains with solubles (DDGS) in poultry nutrition. World's Poult. Sci. J., 64:257-266.

U.S. Grains Council, 2011. Egypt's CGM, DDGS purchases rise. Web site: www.grains.org.

Waldroup, P. W., Wang, Z., Coto, C., Cerrate, S. and Yan, F., 2007. Development of a Standardized Nutrient Matrix for Corn Distillers Dried Grains with solubles. Int. J. of Poult. Sci., 6: 478-783.

الملخص العربي

الإستفادة من نواتج التقطير الجافة للحبوب بالسوائل في علائق الدجاج البياض

يوسف عبدالوهاب عطية[1و2]، رضا علي حسن[3]، عبدالحميد السيد عبدالحميد[1]، ولاء سعيد سليم[1]
[1]قسم الإنتاج الحيواني والدواجن- كلية الزراعة -جامعة دمنهور- مصر
[2]قسم زراعة المناطق الجافة، كلية الارصاد والبيئة وزراعة المناطق الجافة-جامعة الملك عبد العزيز-جدة- المملكة العربية السعودية
[3]معهد بحوث الأنتاج الحيوانى - مركز البحوث الزراعية- مصر

يهدف البحث الى دراسة تأثير إستخدام نواتج التقطير الجافة للحبوب بالسوائل فى علائق الدجاج البياض المحلى على الكفاءة الإنتاجية وجودة البيضة ومعامل هضم العناصر الغذائية وبعض مكونات الدم . فى هذة الدراسة أستخدم عدد 90 دجاجة أنشاص و 9 ديوك من نفس سلالة أنشاص عمر 28 أسبوع وتم توزيعها عشوائيا الى 3 مجاميع وتغذت على العلائق التجريبية بإستخدام ثلاث مستويات من نواتج التقطير الجافة للحبوب بالسوائل وهى صفر، 10 ، 20 % .
أوضحت النتائج ان اضافة نواتج التقطير الجافة للحبوب بالسوائل أدت الى تأثير غير معنوى على عدد البيض- معدل انتاج البيض- كتلة البيض- وزن البيض- العلف المستهلك والكفاءة الغذائية بالمقارنة بمجموعة الكنترول خلال الفترة من 28-48 أسبوع من العمر. تأثرت جودة البيض تأثير غير معنوى بأضافة نواتج التقطير الجافة للحبوب بالسوائل فى حين ان لون صفار البيض زاد معنويا عند مستوى 20 % من نواتج التقطير الجافة للحبوب بالسوائل بالمقارنة بمجموعة الكنترول . تحسنت معاملات هضم جميع العناصر الغذائية بالتغذية على 10 % من نواتج التقطير الجافة للحبوب بالسوائل فى العلف. لم تتأثر مكونات الدم من البروتين – وظائف الكبد والكلية وحمض اليوريك والليبدات والفوسفور بالتغذية على المستويات المختلفة من نواتج التقطير الجافة للحبوب بالسوائل بينما إنخفض مستوى الكالسيوم فى الدم معنويا عندما تغذت الطيور على 20 % من نواتج التقطير الجافة للحبوب بالسوائل وإنعكس هذا على إنخفاض جودة قشرة البيضة (الوزن النسبى لقشرة البيضة وسمك القشرة).
ومن خلال النتائج المتحصل عليها يمكن التوصية بأستخدام نواتج التقطير الجافة للحبوب بالسوائل حتى مستوى 20 % فى علائق الدجاج البياض دون تأثير سلبى على الأداء الأنتاجى ومعاملات هضم العناصر الغذائية وجودة البيض ومكونات الدم والكفاءة الأقتصادية لأنتاج البيض.