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USE OF DISTILLERS DRIED GRAINS WITH SOLUBLES (DDGS) AS RAPLACEMENT FOR YELLOW CORN IN LAYING HEN DIETS.

By

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Abstract: *A total number of 288 Bovans Brown laying hens 37 weeks of age was used in this study. Hens were randomly distributed into 8 treatments, each containing 36 hens in 3 replicates of 12 hens each. Four levels of distillers dried grains with solubles (DDGS) and two levels of enzyme preparation were used in a 4 x 2 factorial arrangement. The distillers dried grains with solubles levels were 0, 20, 40 and 60 % as replacement for yellow corn. A commercial enzyme preparation (Polytec Binder Plus®) was added at 0 and 500 g/ ton of the diet. Each gram contained 1500 IU Xylanase, 1500 IU Beta- glucanase, 1500 IU Protease, and 1500 IU Amylase. Water and feed in mash form were offered ad-libitum, under a total of 16 hours light /day regimen during the experimental period (20 weeks, 5 periods of 4 weeks each) from 37 to 57 weeks of age.*

The overall results showed that feeding laying hens on diets containing more than 20 % DDGS replacement significantly (P<0.05) decreased the average values of egg production, egg mass and feed intake. Also, there were improvement on egg production, egg mass and feed conversion values due to feeding laying hens on diets supplemented with enzyme mixture. While, there were no significant differences in egg weight values due to either different levels of DDGS or enzyme supplementation. The interaction between DDGS level and enzyme supplementation showed that the best findings of egg mass and feed conversion were obtained by layers fed diets supplemented with enzyme mixture and contained 20 % and 40 % DDGS as replacement for yollow corn, respectively. Data showed that there were no significant (P<0.05) differences in the average values of egg quality as measured by Haugh units, shell weight, egg shape, yolk color and yolk index due to feeding laying hens on diets containing either different levels of DDGS or supplemented enzyme as well as their interaction. While, there was a significant decreasing in egg shell thickness value with increasing dietary DDGS levels.

The results showed that there were no significant differences in digestion coefficient values of crude protein (CP). While, there were significant differences in organic matter (OM), ether extract (EE), crude fiber (CF) and nitrogen free extract (NFE) digestibility values without clear trend, except for ether extract, which was improved due to increasing DDGS levels. Results showed an improvement in average values of net revenue, economical efficiency and relative economical efficiency due to feeding laying hens on diets containing graded levels of DDGS and supplemented with enzyme preparation. In conclusion, the present results showed that the use of DDGS can be successfully fed at levels up to 40 % as replacement for yellow corn or 24% of laying hen diet supplemented with enzyme supplemented without adverse effect on laying hen performance, egg quality and economical efficiency.

INTRODUCTION

Distiller's Dried Grains with Soluble (DDGS) is a coproduct of dry mill ethanol plants and is a source of protein/amino acids, energy and available phosphorus for poultry. Corn contains about 62 % starch, 3.8 % oil, 8.0 % protein, 11.2 % fiber and 15 % moisture. Because most of the starch is converted to ethanol during fermentation, the resulting nutrient fractions (protein, oil and fiber) are 2 to 3 times more concentrated in DDGS compared to corn. Accordingly, the DDGS content of the corresponding nutrients are on average 8.12 % ash, 10.67 % fat, 27.15 % protein, 6.21 % fiber and 11.10 % moisture ***(Babcock et al., 2008)***. Moreover, ***Roberson et al. (2005)*** determined the metabolizable energy value for laying hens of a single DDGS sample to be 2770 kcal /kg, however, the ME value of DDGS vary due to its content of oil and protein ***(Batal and Dale, 2006)***, as well as method of estimation. In addition, the degree of lightness due to the processing conditions may affect the nutritive value of DDGS ***(Fastinger et al., 2006)***. In this connection, ***Parson et al. (1992)*** suggested that excessive heat applied during the drying process may cause maillard reaction between the lysine residues and carbohydrate moieties, subsequently a reduction in lysine availability. The DDGS from modern ethanol plants may be an attractive alternative ingredient for layer diets ***(Creswell, 2006)***.

Lumpkins et al. (2005) suggested a maximal inclusion rate of 10-12% DDGS in diets for laying hens. In addition, ***Roberson et al. (2005)*** reported that the use of 15 % DDGS did not adversely affect performance of laying hens but suggested that lower levels of DDGS was preferred when introduced into the diet. Also, ***Swiatkiwicz and Koreleski (2006)*** reported that DDGS could be used in layer diets up to15 % while, inclusion of 20 % negatively affected laying rate and egg weight. ***Roberts et al. (2007)*** found that using 10 % DDGS in laying hen diets had no negative effects on egg production or egg quality parameters. . ***Scheideler et al. (2008)*** showed that egg production, feed consumption, and body weight gain were not affected by the dietary DDGS inclusion up to 25 % in laying hen diets. The same authors also found that egg weights were lowered when the diets contained 20 % or 25 % of DDGS, due to amino acid deficiency. ***Pineda et al. (2008)*** conducted an experiment to investigate whether egg production and egg quality would be affected by very high inclusion levels of DDGS. In their experiment, graded levels between 0 and 69 % DDGS were fed to white leghorn-type laying hens fifty-three weeks of age for eight weeks after a four-week transition period, during which the dietary DDGS contents were gradually changed in steps of about 12 percentage points per week. Egg production decreased linearly during the eight-week experimental period, countered by an increase in egg weight. As a result, egg mass was unaffected by the dietary DDGS inclusion. Feed consumption increased with increasing dietary DDGS content, but feed utilization was unaffected. Egg quality measured as Haugh units, egg composition, and specific gravity was not affected by the DDGS inclusion.

The use of enzyme in poultry nutrition is well documented across different types of poultry diets, amylase ***(Jiang et al., 2008)***, protease ***(Wang et al., 2008)***, xylanase ***(Cowieson et al., 2005)***, beta-glucanase ***(Mathlouth et al., 2002)*** , mixes of two or more of the aforementioned enzymes ***(Cowieson and Ravindran, 2008)*** are among the many that can be found in the scientific literature.

Although, most of the starch in the grain is converted to ethanol during the fermentation process and only a small amount of starch is left in DDGS, however, the fiber content especially, NDF and ADF is not converted to ethanol, and as a result DDGS contains approximately 35 % insoluble and 6 % soluble dietary fiber (***Stein and Shurson, 2009)***. Therefore, such case need the use of enzyme when formulating diets containing DDGS for poultry ***(Adeola and Ileleji, 2009)***. In this connection, ***Ward et al. (2008)*** noted that arabinoxylans and cellulose were the predominant NSP (Non-starch polysaccharide) in DDGS from modern ethanol plants. ***Shalash et al. (2010)*** fed laying hen diets containing different levels of DDGS being 0, 5, 10, 15 or 20. They found that inclusion of 5% DDGS in laying hen diets significantly increased egg production, while it significantly decreased with 15 % or 20 % DDGS.

The objective of this experiment was to study the effect of increasing dietary levels of DDGS on laying hen performance and egg quality. Moreover, the possibility of improving the nutritional value of diets with high levels of DDGS using enzymes supplementation was also investigated.

MATERIALS AND METHODS

The experimental work of the present study was carried out at the Poultry Nutrition unit Faculty of Agriculture, Cairo University, from January to May, 2008. The analytical part of study was performed at the laboratories of Animal Production Department (Animal Nutrition), Faculty of Agriculture, Cairo University. This experiment was conducted to study the effect of using different levels of Distillers Dried Grains with Solubles (DDGS) either with or without enzyme supplementation on laying hen performance, egg quality, nutrients digestibility and economical efficiency of egg production.

The product was purchased from Dakahlia Poultry. The chemical composition of the DDGS as reported by the company was as fellows:

27 % CP, 0.49 % available P, 0.33 % Ca, 0.84 % Lys, 1.15 % Meth+ Cys, and 9% CF. a total number of 288 Bovans Brown laying hens 37 weeks of age were used in this study. Hens were randomly distributed into 8 treatments, each containing 36 hens in 3 replicates of 12 hens each. Laying hens were kept in cleaned and fumigated cages of wire floored batteries in an open system house under similar conditions of management. Water and feed in mash form were offered *ad-Libitum*, under a total of 16 hours light /day regimen during the experimental period (20 weeks, 5 periods of 4 weeks each) from 37 to 57 weeks of age.

Four levels of distillers dried grains with solubles (DDGS) and two levels of compound enzymes were used in a 4 x 2 factorial arrangement. The distillers dried grains with solubles levels were 0, 20, 40 and 60 % as replacement for corn. A commercial enzyme preparation (Polytec Binder Plus®) was added at 0 and 500 g/ ton of the diet. Each gram contained 1500 IU Xylanase, 1500 IU Beta- glucanase, 1500 IU Protease, and 1500 IU Amylase.

Accordingly, there were 8 experimental treatments as follows:

T1: containing 0 % DDGS without enzyme (control diet)

T2: containing 0 % DDGS with enzyme preparation

T3: containing 20 % DDGS without enzyme preparation

T4: containing 20 % DDGS with enzyme preparation

T5: containing 40 % DDGS without enzyme preparation

T6: containing 40 % DDGS with enzyme preparation

T7: containing 60 % DDGS without enzyme preparation

T8: containing 60 % DDGS with enzyme preparation

Each of the eight groups of the experimental birds were given one of the 8 iso nitrogenous (17 %) and iso caloric (2750 kcal/kg) diets for 20 weeks experimental period. All diets were formulated by using linear programming to contain the tested levels of both DDGS and enzyme preparation. The experimental diets and their chemical composition are presented in Table (1).

During the experimental period, feed intake (FI), egg production (EP) and egg weight (EW) were recorded daily, while, feed conversion (g feed consumption/g egg mass) was calculated. Egg shell thickness was measured using a digital dial pipe gauge to the nearest 0.01 mm. Haugh units were calculated using the HU formula according to ***Eisen et al. (1962)*** based on the height of albumen and egg weight. Egg yolk color score was measured by matching the yolk with one of the 15 bands of a 1961 Roche Improved Yolk Color Fan.

The analyses of feed and dried excreta were done according the official methods ***(A. O. A. C, 1990)***. Nitrogen – free extract (NFE) was calculated according to ***Abou- Raya and Galal (1971)***. The data obtained were statistically examined using ***SAS Institute (2004)***. Means were separated by Duncan Multiple Range Test ***(Duncan, 1955)***.

The statistical model was

$$Y_{ijk} = \mu + T_i + E_j + T_iE_j + e_{ijk}$$

Y_{ijk}: observation measured

μ: overall mean

T_i: effect of DDGS (i= 1,......4)

E_j: effect of Enzyme (j=1,2)

T_iE_j: effect of DDGS x Enzyme interaction (ij= 1, ...8)

E_{ijk}: experimental error

Finally, all the experimental treatments were economically evaluated by calculating the net revenue per unit of feed cost.

RESULTS AND DISCUSSION

Laying hen performance:

The effect of experimental treatments on laying hen performance is presented in Table (2). Results showed that there were significant differences in egg production, where the best values were for laying hen fed diets containing 0 and 20% DDGS replacement (73.71 and 74.57 %, respectively). While, feeding diets containing 60% DDGS recorded the lowest value of egg production (67.7 %). Data showed that there were significant differences in egg production for laying hens fed diets supplemented with enzyme (74.71 %) compared with those fed diets without enzyme (68.35 %). The effect of interaction between DDSG and enzyme showed that the best value of egg production (77.21) was recorded by treatment number 2, which fed diet containing 0% DDGS with enzyme supplementation. While, the lowest value (64.85) was recorded by treatment number 7 which fed diet containing 60% DDGS without enzyme supplementation. This may be due to decreasing the amount of feed intake with increasing the different levels of DDGS in laying hen diets. There were no significant differences in egg weight values due to different levels of DDGS. However, egg mass values were significantly ($P<0.05$) decreased with feeding laying hens diets containing high levels of DDGS (40 or 60 % replacement). This may be due to decreasing egg production values. Egg mass values were improved significantly with adding enzyme. Results showed significant differences in feed intake values due to the use of different levels of DDGS. The highest value of feed intake was recorded for diets containing 0 % DDGS and the lowest value was recorded for birds fed diets containing 60% DDGS, which amounted to 110 and 94.1g/hen/day, respectively. This may be due to unpalatability of DDGS, specially with adding high levels of DDGS in laying hen diets. Data showed that when laying hens were fed diets supplemented with enzyme, feed intake decreased significantly ($P<0.05$). Results presented in Table (2) showed that there was an improvement in average values of feed conversion due to using both graded levels of DDGS and enzyme supplementation. Data showed that the best value of feed conversion (2.11) was recorded with laying hens fed diet number 6 which is containing 40% DDGS and supplemented with enzyme. These results are in agreement with those reported by ***Lumpkins et al. (2005) and Roberts et al. (2007) who*** found that using 10 or 15% DDGS in laying hens diets had no effects on egg production values. While, inclusion of 20% DDGS in laying hen diets negatively affected egg production, egg weight, egg mass and feed conversion as reported by ***Swiatkiwicz and Koreleski (2006).*** On the other hand, the results disagree with those reported by ***Scheideler et al. (2008)*** who found that increasing graded levels of DDGS from 0 to 25 % of the diet for White Leghorn-type hens (24 wks) had no negative effect on egg production, feed intake and body weight gain. The decreased egg weight, egg production %, egg number and egg mass values with high level of DDGS (15 and 20 %) may be due to the high percentage of crude fiber and unpalatable DDGS ***(Pineda et al., 2008)*** as well as low lysine digestibility ***(Sherr et al., 1989).*** Also, ***Hansen and Millington (1979)*** reported that the low lysine digestibility may be due to the maillard reaction which reduce the availability of lysine by competing with absorption of lysine or inhibition of carboxy peptidases responsible for protein utilization. Furthermore, the diet with the highest content of DDGS (20%) contained low level of starch because most of the starch is converted to ethanol during fermentation ***(Creswell, 2006),*** that the hens relied solely on converting part of dietary amino acids to glucose through the gluconeogenesis pathway to maintain normal glucose concentrations in the blood.

Egg quality:

The effect of experimental treatments on egg quality is presented in Table (3). The results showed that there were no significant differences in the Haugh units values due to using DDGS (up to 60% replacement). Also, there were no significant ($P<0.05$) differences in the average values of shell weight, egg shape and yolk index values due to different treatments. Results showed that when laying hens were fed diets containing graded levels of DDGS, the average values of yolk color were improved but not significantly compared to control group. Results presented in Table (3) showed that there were no significant differences in shell thickness values due to DDGS levels till 40 % or enzyme supplementation, while 60 % declined ($P<0.05$) shell thickness. Data showed that the lowest value of shell thickness (0.304) was recorded by laying hens fed diet containing 60 % DDGS without supplemented enzyme. While, the best values (0.37) were recorded with control diet (T_1) and diet containing 20 % DDGS with supplemented enzyme. These results are in agreement with those reported by ***Lumpkins et al. (2005) and Roberts et al. (2007)*** who showed that egg quality parameters were not affected by feeding White Leghorn-type laying hens (23 to 58 wks of age) on diets containing 10 % DDGS. Moreover, ***Pineda et al. (2008)*** reported that egg quality was not affected by the DDGS inclusion in laying hen diets. While, increasing DDGS to 15 or 20 % in laying hen diets significantly increased yolk color. This observation was expected, because corn contains relatively high contents of xanthophylls. ***Roberson et al. (2005)*** showed that egg yolk is visually changed within one month when 10 % or higher of a lightly colored DDGS was fed and by two months with 5 % DDGS. Regarding egg shell thickness, ***Pineda et al. (2008)*** indicated that reducing egg shell quality by the DDGS inclusion in laying hen diets was due to sulfur content of DDGS, which may interfere with absorption of dietary calcium from the small intestines.

Digestibility coefficient:

The effect of dietary treatments on nutrient digestibility is summarized in Table (4). Crude protein digestibility values were not significantly affected by either dietary DDGS levels or enzyme supplementation or their interaction. While, there were significant differences in average values of organic matter (OM) ether extract (EE), crude fiber (CF) and nitrogen free extract (NFE) digestibility without clear trend, except for ether extract, which was improved due to increasing DDGS levels. These results are in non-agreement with those reported by ***Shalash et al.(2010)*** who fed laying hen diets containing different levels of DDGS (0, 5, 10, 15 or 20 %), each without or with two enzyme supplementation, and did not find significant effects on nutrients digestibility. While, ***Shalash et al. (2009a,b)*** who fed cockers on diets containing 100% DDGS, found that EE digestibility was reduced to 69.3% compared to 82.37 for those fed 50% DDGS diet.

Economical efficiency

The effect of different levels of DDGS, enzyme preparation and their interaction on economical efficiency of egg production is presented in Table (5). Egg production (egg number/ hen) and feeding cost are generally among the most important factors involved in the achievement of maximum efficiency of egg production. The economical efficiency values were calculated according to the prevailing market (selling) price of both diets and egg, which was 0.50 LE on average during the experimental period. Results showed an improvement in average values of net revenue, economical efficiency and relative economical efficiency due to feeding laying hens the diets containing 20 ,40, or 60% DDGS replaced .for yellow corn compared to control group, which recorded the lowest values of net revenue and economical efficiency. This finding is in agreement with ***Lumpkins et al.(2005)*** who found that the net revenue was improved with using different levels of DDGS in laying hen diets and might be advantageous to nutritionists in formulating a laying hen diet at a lower cost.

According to these results, it could be concluded that laying hens can tolerate diets containing 40% DDGS as replacement of corn (or 24 % of the diet) with supplemental enzymes, without adverse effect on laying hen performance, egg quality and economical efficiency.

Table 1. Composition and calculated analysis of the experimental diets

Ingredients	DDGS replacement levels (%)							
	0		20		40		60	
	E0 T1	E1 T2	E0 T3	E1 T4	E0 T5	E1 T6	E0 T7	E1 T8
Yellow corn	60.00	60.00	48.00	48.00	36.00	36.00	24.00	24.00
Soybean meal 44%	26.50	26.50	19.79	19.79	12.50	12.50	6.27	6.27
Wheat bran	1.30	1.25	6.42	6.37	12.02	11.97	16.64	16.59
DDGS	0.00	0.00	12.00	12.00	24.00	24.00	36.00	36.00
Vegetable oil	1.50	1.50	3.18	3.18	4.94	4.94	6.57	6.57
Enzyme preparation	-	0.05	-	0.05	-	0.05	-	0.05
Di – Ca – Phos	1.70	1.70	1.47	1.47	1.20	1.20	0.97	0.97
Limestone	8.11	8.11	8.23	8.23	8.37	8.37	8.53	8.53
Vit. – min. Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
NaCl.	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
DL – Methionine	0.20	0.20	0.17	0.17	0.15	0.15	0.13	0.13
L-lysine HCL	0.04	0.04	0.09	0.09	0.17	0.17	0.24	0.24
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis**								
CP%	17	17	17	17	17	17	17	17
ME kcal/kg	2750	2750	2750	2750	2750	2750	2750	2750
CF %	3.32	3.32	4.23	4.23	5.15	5.15	6.04	6.04
Ca%	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Avail. P%	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Lysine.%	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Methionine. %	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Methionine+ Cysteine. %	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Price/Ton (LE)***	2173.5	2176	2116.9	2119.4	2068.9	2071.4	2023.8	2026.3

*supplied per kg diet : Vit.A, 12000 IU; Vit.D_3,2200 IU; Vit.E,10 mg; Vit.k_3,2mg; Vit.B_1,1mg; Vit.B_2,5mg; Vit.B_6,1.5mg; Vit.B_{12},10ug; Nicotinic acid 30mg; Folic acid,1mg; pantothenic acid, 10mg; Biotin 50ug; Choline chloride, 250mg; Copper, 10 mg; Iron, 30mg; Manganese,60mg; Zinc, 50mg; Iodine, 1mg; Selenium, 0.1mg; and Cobalt, 0.1mg

** According to NRC (1994)

*** According to prices of the used ingredients at the experimental time (2008).

Table 2. Effect of different levels of DDGS and enzyme on laying hen performance.

Treatments			Item					
No.	DDGS	Enzyme	Egg Production (%)	Egg. No./ hen/day	Egg weight g	Egg mass (g/hen/day)	Feed intake (g/hen/day)	Feed conversion
Main effect:								
DDGS level effect :								
	0		73.71^{a}	0.73	59.3	43.7^{a}	110.0^{a}	2.53^{a}
	20		74.57^{a}	0.74	58.7	43.7^{a}	103.6^{b}	2.38^{b}
	40		69.80^{b}	0.69	58.7	41.0^{b}	95.6^{c}	2.35^{b}
	60		67.70^{c}	0.67	59.4	40.1^{b}	94.1^{c}	2.35^{b}
Enzyme effect :								
		E0	68.35^{b}	0.68	58.8	40.2^{b}	102.9^{a}	2.56^{a}
		E1	74.71^{a}	0.74	59.3	44.0^{a}	98.7^{b}	2.24^{b}
Interaction								
1	0	E0	70.14^{c}	0.70	60.4	42.4^{bc}	110.5^{a}	2.61^{a}
2	0	E1	77.21^{a}	0.77	58.2	44.9^{ab}	109.4^{b}	2.44^{b}
3	20	E0	72.14^{b}	0.72	57.5	41.5^{cd}	106.9^{c}	2.58^{ab}
4	20	E1	76.71^{a}	0.76	59.9	46.0^{a}	100.3^{d}	2.18^{c}
5	40	E0	66.14^{d}	0.66	58.5	38.7^{de}	100^{d}	2.58^{ab}
6	40	E1	73.50^{b}	0.73	58.8	43.2^{bc}	91.3^{f}	2.11^{c}
7	60	E0	64.85^{e}	0.64	58.7	38.0^{e}	94.3^{e}	2.48^{ab}
8	60	E1	70.14^{c}	0.70	60.1	42.2^{c}	93.9^{e}	2.23^{c}

a , b,c…..etc means in same column ,within each factor, with different superscripts are significantly ($P<0.05$) different

Table 3. Effect of different levels of DDGS and enzyme on egg quality

Treatments			Item					
No.	DDGS	Enzyme	Haugh units	Shell weight (%)	Egg shape (%)	Yolk color	Yolk index (%)	Shell thickness (mm)
Main effect:								
DDGS level effect :								
	0		72.81	9.72	79.5	5.25	46.07	0.359^{a}
	20		68.09	9.44	76.8	5.20	46.83	0.353^{a}
	40		71.49	9.71	78.8	5.50	45.91	0339^{a}
	60		64.38	9.32	77.7	6.45	46.66	0.307^{b}
Enzyme effect :								
		E0	68.80	9.47	77.6	5.50	46.77	0.343
		E1	69.58	9.62	78.5	5.71	45.66	0.336
Interaction								
1	0	E0	75.6	9.37	78.3	5.17	45.52	0.372^{a}
2	0	E1	70.01	9.70	80.7	5.33	46.62	0.346^{ab}
3	20	E0	68.23	9.30	76.8	5.17	47.69	0.336^{ab}
4	20	E1	67.74	9.57	76.7	5.25	45.78	0.370^{a}
5	40	E0	70.83	9.17	77.3	5.85	46.67	0.332^{ab}
6	40	E1	72.14	10.24	79.3	5.42	45.16	0.346^{ab}
7	60	E0	66.13	9.66	78.1	6.08	47.19	0.304^{b}
8	60	E1	62.63	8.98	77.4	6.82	44.87	0.309^{b}

a, b, c…..etc means in same column ,within each factor, with different superscripts are significantly ($P<0.05$) different

Table 4. Effect of different levels of DDGS and enzyme on nutrient digestibility

Treatments			Item				
No.	DDGS	Enzyme	OM %	CP %	EE %	CF %	NFE %
Main effect:							
DDGS level effect :							
	0		79.05^{a}	64.83	83.98^{b}	24.23^{bc}	90.83^{a}
	20		76.97^{a}	67.20	84.85^{ab}	22.93^{c}	88.27^{ab}
	40		75.89^{a}	69.013	87.09^{ab}	25.93^{ab}	87.70^{b}
	60		65.18^{b}	65.07	88.09^{a}	28.13^{a}	87.81^{b}
Enzyme effect :							
		E0	73.73^{b}	67.07	86.40^{a}	24.37^{b}	88.64^{a}
		E1	74.82^{a}	65.98	85.93^{b}	26.24^{a}	86.17^{b}
Interaction:							
1	0	E0	80.59^{a}	66.59	86.52^{a}	24.11^{cb}	90.71^{a}
2	0	E1	77.51^{a}	63.06	81.45^{b}	24.35^{cb}	90.95^{a}
3	20	E0	76.05^{a}	66.84	85.27^{ab}	20.61^{c}	90.24^{a}
4	20	E1	77.90^{a}	67.56	84.42^{ab}	25.24^{ab}	86.30^{b}
5	40	E0	75.18^{a}	70.57	84.97^{ab}	25.11^{ab}	90.72^{a}
6	40	E1	76.60^{a}	67.44	89.20^{a}	26.76^{ab}	84.68^{b}
7	60	E0	63.10^{b}	64.26	88.84^{a}	28.59^{a}	82.88^{c}
8	60	E1	67.27^{b}	65.88	88.64^{a}	27.66^{ab}	82.74^{c}

a , b,c….etc means in same column ,within each factor, with different superscripts are significantly ($P<0.05$) different

Table 5.Effect of different levels of DDGS and enzyme on economical efficiency during the experimental period (20 weeks).

Treatments			Item						
No.	DDGS	Enzyme	FI/hen (Kg)	Feed price Kg/(LE)	Feed cost/hen (LE)	Egg. No./hen	revenue (LE) [a]	Net revenue L.E/hen	EEf [b]	Relative EEf [c]
Main effect:										
DDGS level effect :										
	0		15.40	2.174	33.47	103.2	51.60	18.13	0.54	
	20		14.50	2.118	30.71	104.4	52.20	21.49	0.70	
	40		13.38	2.070	27.48	97.8	48.90	21.42	0.77	
	60		13.17	2.025	26.66	94.8	47.40	20.74	0.78	
Enzyme effect :										
		E0	14.40	2.195	31.60	95.7	47.85	16.25	0.51	
		E1	13.81	2.197	30.34	104.6	52.30	21.96	0.72	
Interaction:										
1	0	E0	15.47	2.173	33.61	98.2	49.10	15.49	0.46	100
2	0	E1	15.31	2.176	33.31	108.1	54.05	20.74	0.62	134
3	20	E0	14.96	2.116	31.65	101.0	50.50	18.85	0.57	124
4	20	E1	14.04	2.119	29.75	107.4	53.70	23.95	0.80	174
5	40	E0	14.00	2.068	28.95	92.6	46.30	17.35	0.60	130
6	40	E1	12.78	2.071	26.46	102.9	51.45	24.99	0.94	204
7	60	E0	13.20	2.023	26.70	90.8	45.40	18.70	0.70	152
8	60	E1	13.14	2.025	26.60	98.2	49.10	22.50	0.84	182

a) Assuming that the price of egg = 50 pt
b) Net revenue per unit feed cost.
c) Assuming that the group number 1 represent the cortrol.

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الملخص العربي

استخدام المنتجات العرضيه الجافة لتقطير الحبوب بالسوائل كبديل للأذره الصفراء في علائق دجاج البيض.

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استخدم في هذه الدراسه عدد ٢٨٨ دجاجه بياضة من نوع البوفانز البني عمر ٣٧ اسبوع. قسمت الطيور الى ٨ مجاميع متساويه العدد حيث شملت كل مجموعة ٣٦ دجاجة (وزعت كل مجموعة على ٣ مكررات بكل منها ١٢ طائر) . تم استخدم أربعه مستويات من المنتجات العرضيه الجافة لتقطير الحبوب بالسوائل (DDGS) وهي ٠، ٢٠ ، ٤٠ و ٦٠ % كبديل للذره الصفراء مع إضافه أو بدون إضافة مخلوط انزيمي بمستوى صفر او ٥٠٠ جم / طن من العليقه (كل جرام من المخلوط الانزيمي احتوي على ١٥٠٠وحده دوليه من الزيلانيز ، ١٥٠٠ وحده دوليه من بيتا جلوكانيز ، ١٥٠٠ وحده دوليه من البروتاييز ، ١٥٠٠ وحده دوليه من الأميليز. تم تقديم المياه والعلائق بصوره حره مع توفير إضاءه مقدارها ١٦ ساعه / يوم خلال فترة التجربه التي استمرت ٢٠ أسبوعا (٥ فترات ٤ أسابيع لكل منهما) من عمر ٣٧ اسبوع إلى٥٧ أسبوع من العمر.

أظهرت النتائج أن تغذية دجاج البيض على علائق تحتوي على مستويات أعلى من ٢٠% أحلال من المنتجات العرضيه الجافة لتقطير الحبوب بالسوائل أدى الى انخفاض في متوسط كلا من انتاج البيض و كتلة البيض واستهلاك العلف كما تحسن انتاج البيض وكتلة البيض ومعامل التحويل الغذائي مع اضافة مخلوط الانزيمات الى العليقه في حين لم يكن هناك اختلاف كبيرا في وزن البيض نتيجة لاضافة المنتجات العرضيه الجافه لتقطير الحبوب بالسوائل أو مخلوط الانزيمات . أظهر التداخل بين مستوى المنتجات العرضيه لتقطير الحبوب وإضافة الأنزيم تسجيل أفضل نتائج كتلة البيض ومعدل التحويل الغذائي بالتغذية على علائق مضافا اليها المخلوط الإنزيمي مع استبدال الذره الصفراء بمعدل ٢٠ % ، ٤٠ % من المنتجات العرضيه لتقطير الحبوب على التوالي. اظهرت النتائج أيضا عدم وجود فروق معنويه في قياسات جودة البيضه (وحدات هاو ، وزن القشره ، شكل البيضة ، لون الصفار) نتيجة تغذية دجاج البيض على علائق تحتوي على مستويات مختلفه من المنتجات العرضيه الجافة لتقطير الحبوب بالسوائل ومخلوط الانزيمات، في حين كان هناك انخفاض في سمك القشره مع زيادة مستوى المنتجات العرضيه لتقطير الحبوب بالسوائل في العليقه.

أوضحت النتائج عدم وجود فروق معنويه في معامل هضم البروتين الخام ، بينما كان هناك اختلافات معنويه في معامل هضم كل من المادة العضويه ، مستخلص الأثير ، الألياف الخام ، المستخلص الخالي من الازوت بدون اتجاه واضح الا في حالة مستخلص الايثر الذي تحسن نتيجة زيادة نسب المنتجات العرضية لتقطير الحبوب الجافة بالسوائل ومخلوط الانزيمات في علائق دجاج البيض. واظهرت النتائج تحسنا في متوسط قيمة صافي الايرادات والكفاءه الاقتصاديه عند تغذية دجاج البيض على مستويات مختلفه من المنتجات العرضيه الجافة لتقطير الحبوب بالسوائل مع اضافة مخلوط الانزيمات.

ومن خلال النتائج المتحصل عليها يمكن التوصيه باستخدام المنتجات العرضيه الجافة لتقطير الحبوب بالسوائل حتى مستوى ٤٠ % بديلا للذره الصفراء (أو ٢٤% من العليقة) في علائق الدجاج البياض مع اضافة انزيمات دون تأثير سلبي على الاداء الانتاجي وجودة البيض والكفاءة الاقتصاديه لإنتاج البيض.