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EVALUATION OF FRESH GARLIC AS NATURAL FEED ADDITIVE IN LAYER DIETS VARYING IN ENERGY CONTENT

By

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ABSTRACT: *A total number of 90 Bovans White laying hens 25 weeks old were used in this study to evaluate fresh garlic as a natural feed additive in layer diets varying in their metabolizable energy content. The hens were randomly distributed into 6 groups of 15 birds each and assigned randomly for one of the experimental diets. Two experimental diets were formulated to be isonitrogenous (18.5% CP) but varying in their energy content. The first experimental diet contained low energy level (2700 Kcal/Kg diet) and was considered as negative control (E1), while the second experimental diet contained 2900 Kcal/Kg diet (E2), according to the strain catalog recommendation. Fresh garlic was used to substitute 0, 1.5 or 3% of the total feed mixture of each of the experimental diets. Accordingly, a total of 6 experimental diets were used in (2X3) factorial design.*

The proximate analysis showed that garlic (on fresh basis) contained 80.87% moisture, 17.80% organic matter (OM), 3.79% crude protein (CP), 0.30% ether extract (EE), 1.86% crude fiber (CF), 1.33% ash and 11.85% nitrogen free extract (NFE) indicating its nutritious value in addition to its active medicinal substances. Regardless of dietary energy level, fresh garlic at 3%, decreased ($P \leq 0.05$) feed intake. Feed conversion ratio, insignificantly, improved due to feeding diets containing fresh garlic, when compared with the control. Average egg weight was improved, while egg production decreased ($P \leq 0.05$) due to feeding 3% fresh garlic diet. There was no significant difference ($P \leq 0.05$) between E1 and E2. Best feed conversion values were for E2 at 1.5% fresh garlic, followed by E1 at 3% fresh garlic, last treatment gave better economical efficiency (EEf) and relative economical efficiency (relative EEf), than control group (E2 without garlic supplementation). Addition of 1.5 or 3% fresh garlic, insignificantly, decreased total yolk lipids (mg/g yolk), than control by 13.9 or 7.7%, respectively. Fresh garlic had no significant effect on egg quality, except yolk color, Haugh unit score and yolk index. Addition of fresh garlic *to low energy diets improved digestion coefficients of the nutrients, while decreased the value of EE digestibility.*

Therefore, it is recommended to add 1.5% fresh garlic to the diets containing the recommended energy, while 3% fresh garlic was effective in low energy diets to improve egg laying performance, bird viability, economic efficiency and to reduce total egg yolk lipids

INTRODUCTION

The possibility of developing resistant populations of bacteria and the side effects of using antibiotics as growth promoters in farm animals has led to the recent European Union (EU) ban on the use of several antibiotics as growth promoters in poultry diets. Therefore, there is an intensive search for alternatives such as herbs. These products were considered to play an important role in strengthening the animal defense system by improving the physical conditions of gut ecosystem and enhancing functions of the immune system of chickens **(Guo, 2003). Craig (1999)** reported that garlic (*Allium sativum*) has been used effectively as feed and medicine for many centuries. The compound that produces much of the activity of garlic is allicin, which is released when intact cells of a clove are cut or crushed. Allicin inhibits a wide variety of bacteria, molds, yeasts (including *Candida*) and viruses. The report of the same author indicated that garlic preparations have been found to exert an immunopotentiating effect by stimulating natural killer cell activity. The author added that dried garlic is less effective than fresh garlic or is not active at all. Research **(Craig, 1999)** has suggested that garlic protects against cardiovascular disease. Regular use of garlic can be effective in reducing the risk of heart attack and stroke because it lowers total and LDL cholesterol and triacylglycerol concentrations without affecting HDL cholesterol concentrations. Blood lipid concentrations are also favorably altered in normocholesterolemic subjects taking garlic. The preceding studies showed that garlic has a therapeutic action and it can reduce the activity of pathogens, thus eliminating the competitive bacteria for host nutrients. Also, a connection between diet energy utilization and garlic administration was confirmed by **Oi *et al.* (1995)** who suggested that garlic supplementation enhances the triglyceride catabolism and growth of interscapular brown adipose tissue by increasing norepinephrine secretion. Therefore, the aim of this study was to evaluate fresh garlic as a feed additive in layer diets varying in their metabolizable energy content.

MATERIALS AND METHODS

A total number of 90 Bovans White laying hens 25 weeks old were reared under the same management conditions in egg production batteries. The hens were randomly distributed into 6 groups of 15 birds each. Each group was subdivided into five replicates (3 hens/ replicate) and assigned randomly for one of the experimental diets. Two experimental diets were formulated using linear programming to be isonitrogenous (18.5% CP) but varying in their metabolizable energy content. The first experimental diet contained low energy level (2700 Kcal/Kg diet) and was considered as negative control (E1), while the second experimental diet contained 2900 Kcal/Kg diet, according to the strain catalog recommendation (E2). Fresh garlic was used to substitute 0, 1.5 or 3% of the total feed mixture of each of the experimental diets. Accordingly, a total of 6 experimental diets were used in (2X3) factorial design.

The composition and chemical analyses of the control diets are shown in Table1. Fresh garlic was purchased from local market, it contained 80.87% moisture, 3.79% CP, 0.30% EE, 1.86% CF, 1.33% ash and 11.85% NFE (on fresh basis). Mixing the control diets with well minced fresh garlic bulbs was carried out once a week. All diets were formulated to satisfy nutrient requirements of laying hens according to the strain catalog recommendation. Artificial light was used beside the normal day light to provide 16-hour day photoperiod. Feed and water were provided *ad libitum.* The experiment lasted for three months.

Data on egg production (EP), egg weight (EW) and feed conversion (FC) were recorded during the experimental period at the Poultry Farm, Faculty of Agriculture, Cairo University, Giza, Egypt. Representative egg samples (5 eggs) from each treatment were collected monthly throughout the experimental period in order to determine egg and shell quality. Shape index and yolk index were determined according to **Romanoff and Romanoff (1949)** as follows:

Shape index (%) = (width / length) X 100

Yolk index (%) = (height / diameter) X 100

Egg shell thickness, including shell membranes, was measured using a micrometer at the equator. Haugh unit score was applied from a special chart using egg weight and albumin height which was measured by using a micrometer according to **Haugh (1937), Kotaiah and Mohapatra (1974)** and **Eisen *et al.* (1962).** The egg yolk visual color score was determined by matching the yolk with one of the 15 bands of the “1961, Roche Improved

Yolk Color Fan". At the end of the experimental period two egg yolk samples from each treatment were separated from the broken eggs, calculated and extracted according to **Folch *et al.* (1957)**. Yolk total lipids were colorimetrically determined using commercial kits, following the same steps as described by manufacture (Biodiagnostic Egypt).

At the end of the experimental period, a digestion trial was conducted using six birds from each treatment to determine digestion coefficients of nutrients. Proximate analyses of tested fresh garlic, feed and excreta were carried out following **A.O.A.C (1990).** Chemical analyses were carried out at Animal Production Research Institute Laboratories, ARC, Ministry of Agriculture, Dokki, Giza, Egypt.

Economical efficiency of egg production was calculated from the input-output analysis which was calculated according to the price of the experimental diets and egg produced. The values of economical efficiency were calculated as the net revenue per unit of total cost.

Data from all response variables were subjected to a (2x3) factorial analysis using **SAS (1990).** Variables having significant differences were compared using Duncan's multiple range test **(Duncan, 1955).**

Model:

$X_{ij} = \mu + D_i + G_j + (DG)_{ij} + E_{ij}$

Where: X_{ij} = Any observation.

μ =Over all mean.

D_i = Diets energy (i=1and 2).

G_j = Garlic levels (j=1, 2 and 3).

$(DG)_{ij}$= Interaction between diets energy and garlic levels.

E_{ij}= Experimental error.

RESULTS AND DISCUSSION

Chemical Composition of Tested Fresh Garlic

The proximate analysis showed that garlic contained, on fresh basis, 80.87% moisture, 19.13% dry matter (DM), 17.80% organic matter (OM), 3.79% crude protein (CP), 0.30% ether extract (EE), 1.86% crude fiber (CF), 1.33% ash and 11.85% nitrogen free extract (NFE) (Table 2). The values, are within the ranges reported by **Soliman *et al.* (1999)** The chemical composition indicates the nutritious value of tested fresh garlic in addition to its active medicinal substances.

Laying Performance:

The results presented in Table 3 showed that performance of laying hens was not, significantly, affected by energy levels (2700 vs. 2900 Kcal/Kg diet). Regardless of the energy levels, fresh garlic at 1.5% level, insignificantly, improved egg production rate by 1.9%, when compared to the control diets, but egg production rate was, significantly decreased than control by 6.2% when birds fed 3% fresh garlic. Addition of fresh garlic at 3% of the diet significantly ($P \leq 0.05$) increased egg weight, while decreased ($P \leq 0.05$) feed intake as compared to either the control or 1.5% fresh garlic diets.

There was an interaction between energy level and fresh garlic level regarding egg weight, feed intake and feed conversion values. Addition of 1.5% fresh garlic, to low energy diets improved egg weight, insignificantly, but the improvement was significant ($P \leq 0.05$) at 3% fresh garlic, when compared to the control diets.

The 3% fresh garlic supplement improved ($P \leq 0.05$) egg weight of the birds fed the diet containing recommended energy (E2). Insignificant reduction in feed consumption due to addition of 3% fresh garlic to low energy diets was observed, while addition of fresh garlic (1.5 or 3%) to the diet containing recommended energy (E2) decreased feed intake significantly ($P \leq 0.05$), as compared to their controls.

Addition of 3% fresh garlic to low energy diet insignificantly improved feed conversion ratio by 15%, while addition of 1.5% fresh garlic to recommended energy diet improved, significantly, feed conversion ratio by 17.5%, as compared to the control (E2).

Regardless of the garlic treatments, the recommended energy diets scored better viability than low energy diet (96 vs. 91%). Also fresh garlic decreased mortality, especially at 1.5%, as compared to control. Least viability was observed for birds fed on the control of low energy diets and the recommended energy diet supplemented with 3% fresh garlic (73 and 87%, respectively). Fresh garlic at 1.5% improved the viability of both low and recommended energy diet. A suggested mechanism, by which garlic enhance the utilization of diet energy, was explained by Oi et al. (1995) who revealed that diallyldisulfide, a sulfur containing, volatile, pungent compound of garlic, enhances norepinephrine secretion via increasing the activity of the peripheral sympathetic nervous system, but not epinephrine, in contrast to capsaicin. Norepinephrine secretion has been found to control the thermogenesis of interscapular brown adipose tissue (IBAT) via the regulation of uncoupling protein (thermogenin) synthesis in brown adipose tissue (BAT). Published papers have suggested that BAT is important in the regulation of energy balance (Himms-Hagen, 1990).The results of Oi et al. (1995) suggest that increased norepinephrine secre tion accounts for a decrease in plasma concentrations of triglycerides and free fatty acids as a result of increased growth in IBAT by garlic supplementation.

The insignificant increase in egg production due to 1.5% garlic, as compared with the control, was supported by Reddy et al. (1991), while the increase in the egg weight due to 3% fresh garlic was supported by El-Habbak et al. (1989). Alm El-Dein (1999) observed, a positive effect of dietary garlic on egg production, but no effect on feed efficiency was observed. Prasad and Pandey (1995) supported the results of this study as they observed slightly improvement in feed conversion by adding 0.25% powder garlic to the diet of male chickens from poor growth layer strain. The previous results revealed that, regardless of garlic level laying performance was not affected by a reduction of 200 Kcal/Kg diet. Fresh garlic at 1.5% of the diet, regardless of diets energy, improved egg laying performance. Addition of 3% fresh garlic, to laying hen diets, improved, insignificantly, feed conversion value of the low energy diet, while 1.5% fresh garlic was enough to improve, significantly, feed conversion value of recommended energy diet.

Egg Quality:

External Egg Quality:

External egg quality was not affected, significantly by diet energy, fresh garlic level or the interaction between them (Table 4). However, there was little improvement in shell weight and shell thickness due to addition of 1.5% fresh garlic reached 2.74% and 1.61% from control, respectively. It is worthy to note that addition of 1.5% fresh garlic to low energy diet insignificantly improved shell weight, shell% and shell thickness by 2.70, 1.60 and 6.27% of the recommended control, respectively.

Internal Egg Quality:

Table 4 shows that, diet energy did not affect yolk index or yolk percentage, while low energy diets (E1) resulted in higher ($P\leq0.05$) haugh unit, yolk color and insignificant lower total yolk lipids (mg/g yolk) as compared with recommended energy diets (E2). Addition of fresh garlic at either 1.5 or 3% significantly ($P\leq0.05$) decreased Haugh unit score, yolk index % and total yolk lipids, but had no effect on yolk %. Fresh garlic at 1.5% improved ($P\leq0.05$) yolk color. There was no significant interaction between energy level and fresh garlic level on internal egg quality, however

1.5% fresh garlic of low energy diet resulted in least total yolk lipids (11.61% less than the control of low energy diets, E1, and 16.85% than the control of recommended energy diets, E2). The insignificant effect of different treatments on egg quality was supported by **Alm El-Dein (1999)**. The results presented by **Alm El-Dein (1999)** and **El-Kaiaty *et al.* (2002)** confirmed the reduction in yolk total lipids due to garlic supplementation.

Digestion Trials:

Dietary energy had no effect on digestion coefficient of nutrients values, except OM which was improved by low energy diet (Table 5). Addition of fresh garlic at 1.5%, significantly ($P \leq 0.05$) improved digestion coefficients of DM, OM and CP and insignificantly improved CF, NFE and nitrogen balance (NB), while it significantly decreased the values of EE digestibility (Table 5). Addition of 3% fresh garlic resulted in increasing CP and decreasing EE digestibilities. However, DM, OM, CF, NFE and nitrogen balance insignificantly recorded same improvements. Addition of 1.5% fresh garlic to low energy diet significantly improved the digestion coefficients of DM and OM and insignificantly improved CF, CP and NFE by 2.43, 4.03, 27.06, 1.06 and 6.82% of the recommended control, respectively. On the other hand, it decreased digestion coefficient of EE by 6.95%. **Ghazalah and Ibrahim (1996)** supported the results of this study, as they stated that Mascovi ducks fed either olive or garlic oils (1.25 mg /100 gm body weight) had the higher values of nutrients digestibility and nitrogen balance percentages. Also, **Abdo (1998)** found that 3% fresh garlic of broiler diet, improved OM digestibility and decreased digestion coefficient of EE, insignificantly when compared to the control diet (without garlic supplementation).

Economical Efficiency:

Table 6 showed the economical efficiency (EEf) and the relative economical efficiency (relative EEf) values. The values ranged between 0.40-0.73 and 100-183% for the recommended control diet, without supplementation, and the low energy diet, supplemented with 3% fresh garlic, respectively. Regardless of the energy level, 1.5% fresh garlic gave the best relative EEf value (158 vs. 133). The most economical treatment was obtained when 3% fresh garlic added to the diet containing low energy level (E1), or 1.5% to the diet containing the recommended energy, where they gave the best EEf (0.73 and 0.70 vs.0.4) and relative EEf (183 and 175 vs.100 for recommended control).Therefore, it is recommended to add 1.5% fresh garlic to the diets containing the recommended energy, while 3% fresh garlic was effective in improving the economic efficiency of low energy diets. **Soliman *et al.* (1999)** indicated that best economic efficiency values were obtained by feeding diets containing 3% fresh garlic with either low corn oil or low poultry fat level (2.5% of the diet) as compared to the corresponding values of the unsupplemented diet.

Table (1) The composition and chemical analysis of the control diets

Ingredients	**Control (E1)**	**Control (E2)**
Yellow corn		
Soybean meal (44%)	56.13	51.20
Limestone	30.98	31.85
Bone meal	7.80	7.80
Corn oil	2.84	2.84
Salt	1.45	5.50
Premix[1]	0.31	0.31
Methionine	0.30	0.30
	0.19	0.20
Total	**100**	**100**
Calculated analysis:		
Crude protein %	18.5	18.5
Metabolizable energy (ME Kcal/Kg diet)	2700	2900
Available P%	0.48	0.48
Calcium %	3.91	3.91
Lysine %	0.98	0.99
Methionine %	0.48	0.49
Methionine + Cystine %	0.79	0.79

1. Each 3 kg of Vit. & Min. Mixture contains: Vit. A 12000,000 IU, Vit. D_3 2200,000 IU, Vit. E 10,000 mg, Vit. k_3 2000 mg, Vit. B_1 1000 mg, Vit. B_2 5000 mg, Vit. B_6 1500 mg, Vit. B_{12} 10 mg, Pantothenic acid 10,000 mg, Niacin 30,000 mg, Folic acid 1000 mg, Biotin 50 mg, Choline 300,000 mg, Manganese 60,000 mg, Zinc 50,000 mg, Copper 10,000 mg, Iron 30,000, Iodine 1000 mg, Selenium 100 mg, Cobalt 100 mg, Ca CO3 to 3,000 gm.

Table (2) Chemical composition of garlic

	On fresh basis	**On dry matter basis**
Moisture, %	80.87	---
Dry matter (DM), %	19.13	100
Organic matter (OM), %	17.80	93.05
Crude protein (CP), %	3.79	19.81
Ether extract (EE), %	0.30	1.57
Crude fiber (CF), %	1.86	9.72
Ash, %	1.33	6.95
Nitrogen free extract (NFE), %	11.85	61.95

Table (3) Performance (Mean ± SE) of laying hens as affected by different treatments

Treatments			Item					
No	Diets	Garlic levels	Egg production (%)	Average egg weight (g)	Egg mass (g/d)	Feed intake (g/d)	Feed conversion (feed/egg)	Viability %
	E1		90.0±1.38	58.5±0.34	52.7±0.92	112.2±2.93	2.18±0.07	91
	E2		87.5±1.88	59.1±0.34	51.6±1.09	112.4±3.58	2.18±0.09	96
		Control	89.9^{a}±1.49	58.2^{b}±0.45	52.4±1.01	117.6^{a}±4.04	2.28±0.10	87
		1.5%	91.6^{a}±1.68	58.5^{b}±0.37	53.6±1.05	112.1^{a}±3.96	2.16±0.10	100
		3%	84.3^{b}±2.63	59.7^{a}±0.37	50.4±1.59	107.3^{b}±3.78	2.16±0.10	94
1	E1	1	89.4±2.13	57.8^{c}±0.88	51.8±1.62	110.3^{bc}±3.15	2.14^{ab}±0.07	73
2		2	91.0±3.08	58.7^{bc}±0.32	53.4±0.32	118.7^{ab}±6.85	2.35^{ab}±0.16	100
3		3	89.6±1.98	59.0^{b}±0.42	52.9±1.38	107.6^{bc}±4.37	2.04^{ab}±0.09	100
4	E2	4	90.3±2.16	58.6^{bc}±0.30	52.9±1.27	124.8^{a}±6.78	2.40^{a}±0.17	100
5		5	92.3±1.81	57.9^{bc}±0.59	53.5±1.23	105.4^{c}±4.03	1.98^{b}±0.09	100
6		6	79.5±4.26	60.7^{a}±0.55	48.3±2.65	106.9^{bc}±6.01	2.28^{ab}±0.16	87

a, b ....= Means in the same column within each factor differently superscripted are significantly different ($P \leq 0.05$)

Table (4) Means ± S.E. of egg quality as affected by different treatments

Treatments			Items								
			External egg quality:				Internal egg quality:				
No	Diets	Garlic levels	Shell weight (g)	Shell (%)	Shell thickness (mm)	Shape index (%)	Haugh unit score	Yolk color	Yolk index (%)	Yolk (%)	Total lipids (mg/ g yolk)
	E1		7.4±0.1	12.4±0.2	0.378±0.5	76.4±0.5	90.3^{a}±1.0	6.2^{a}±0.2	44.3±0.8	26.3±0.3	280.16±18.7
	E2		7.5±0.1	12.2±0.2	0.370±0.5	77.6±0.8	87.9^{b}±1.3	5.8^{b}±0.1	43.9±0.7	25.8±0.4	289.87±20.8
		Control	7.3±0.2	12.3±0.3	0.373±0.6	76.6±0.7	92.4^{a}±1.0	5.9^{b}±0.2	46.0^{a}±0.8	26.0±0.6	307.09±22.1
		1.5%	7.5±0.1	12.5±0.2	0.379±0.6	77.0±0.6	87.4^{b}±1.8	6.2^{a}±0.2	43.8^{ab}±0.7	26.2±0.3	264.38±5.1
		3%	7.5±0.1	12.0±0.2	0.369±0.6	77.5±1.0	87.5^{b}±1.0	5.9^{b}±0.1	42.5^{b}±0.9	26.0±0.4	283.57±34.0
1	E1	1	7.1±0.3	12.1±0.3	0.380±0.9	77.1±1.0	94.6±1.1	6.2±0.3	46.5±1.1	26.2±0.6	297.71±38.3
2		2	7.6±0.2	12.7±0.3	0.390±0.7	75.8±1.0	87.8±1.6	6.3±0.3	44.0±0.9	26.5±0.4	263.16±4.1
3		3	7.4±0.1	12.2±0.2	0.364±0.9	76.3±0.6	88.7±1.3	6.1±0.1	42.4±1.6	26.2±0.5	279.61±56.0
4	E2	4	7.4±0.2	12.5±0.4	0.367±0.8	76.1±1.1	90.3±1.4	5.7±0.2	45.5±1.2	25.7±1.0	316.47±35.7
5		5	7.5±0.2	12.2±0.3	0.369±0.8	78.2±0.4	87.1±3.4	6.0±0.3	43.6±1.1	25.9±0.4	265.60±11.7
6		6	7.6±0.2	11.8±0.3	0.374±0.9	78.6±1.9	86.4±1.6	5.7±0.2	42.6±1.0	25.9±0.6	287.53±61.3

a, b ....= Means in the same column within each factor differently superscripted are significantly different ($P \leq 0.05$)

Table (5) Means ± S.E. of digestion coefficients as affected by different treatments

Treatments			Items						
No	Diets	Garlic levels	DM (%)	OM (%)	EE (%)	CF (%)	CP (%)	NFE (%)	NB (%)
	E1		77.9±0.9	78.2^{a}±0.8	80.5±0.6	34.2±1.4	93.5±1.1	94.3±1.2	61.2±1.8
	E2		77.5±0.5	76.6^{b}±0.3	79.4±2.5	32.0±1.1	94.4±0.3	90.6±1.5	65.4±1.9
		Control	76.8^{b}±0.8	76.4^{b}±0.4	82.7^{a}±1.3	30.7±1.2	92.2^{b}±1.3	91.2±1.2	62.0±2.8
		1.5%	79.0^{a}±0.6	78.6^{a}±0.8	80.1^{b}±0.6	35.6±1.7	94.8^{a}±0.4	94.2±2.0	63.4±2.2
		3%	77.3^{b}±0.7	77.2^{b}±0.9	77.1^{c}±3.0	33.1±0.9	94.9^{a}±0.2	91.9±2.4	64.5±2.7
1	E1	1	75.4^{d}±0.1	75.9^{c}±0.7	80.4^{bc}±0.2	31.1±0.8	90.3±1.3	91.5±2.5	59.3±5.6
2		2	80.0^{a}±0.3	80.0^{a}±0.4	79.0^{c}±0.1	38.5±0.2	95.0±1.0	97.1±1.0	61.5±3.1
3		3	78.2^{b}±0.1	78.7^{ab}0.4	82.2^{b}±1.0	33.1±0.1	95.1±0.3	94.3±0.6	62.8±0.0
4	E2	4	78.1^{bc}±0.2	76.9^{c}±0.2	84.9^{a}±0.4	30.3±2.8	94.0±1.1	90.9±1.6	64.7±1.3
5		5	78.0^{bc}±0.2	77.2^{bc}±0.3	81.2^{bc}±0.1	32.8±1.3	94.7±0.1	91.4±2.6	65.4±3.4
6		6	76.3^{cd}±1.2	75.8^{c}±0.6	72.0^{d}±1.2	33.1±2.3	94.7±0.3	89.5±4.7	66.2±6.2

a, b ....= Means in the same column within each factor differently superscripted are significantly different ($P \leq 0.05$)

Table (6) Input output analysis and economical efficiency of different treatments during the experimental period

Items	Control			garlic 1.5%*			garlic 3%*		
	E1	E2	Av.	E1	E2	Av.	E1	E2	Av.
Price/ kg feed (L.E.)	1.20	1.29	1.25	1.20	1.29	1.25	1.20	1.29	1.25
Total feed intake/hen (kg)	9.93	11.23	10.58	10.68	9.49	10.09	9.68	9.62	9.65
Total feed cost/hen (L.E)	11.92	14.49	13.23	12.82	12.24	12.61	11.62	12.41	12.06
Total number of eggs/hen	80.46	81.27	80.91	81.90	83.07	82.44	80.64	71.55	75.87
Total price of eggs /hen (L.E.)[1]	20.12	20.32	20.23	20.48	20.77	20.61	20.16	17.88	18.97
Net revenue / hen (L.E.)	8.2	5.83	7.00	7.66	8.53	8.00	8.54	5.47	6.91
Economical efficiency (E.E.f)[2]	0.67	0.40	0.53	0.60	0.70	0.63	0.73	0.44	0.57
Relative EEf[3]	168	100	133	150	175	158	183	110	143

* The price of fresh garlic was 1 LE/Kg, the final prices of the diets were not changed after substituting equal percentage of the diet by fresh garlic.
1- The price of the egg = 25 P.T.
2- Net revenue per unit of total feed cost.
3- Relative economic efficiency % of the control, assuming that the relative EE of the control (E2) = 100.
E1=2700 Kcal/Kg diet E2=2900 Kcal/Kg diet Av.= Average.

REFERENCES

Abdo Zeinab, M. A. (1998). *The effect of using some natural growth promoter and fats on broiler performance and immunity. Ph. D. Thesis, Faculty of Agriculture, Cairo, University, Giza, Egypt.*

Alm El-Dein, A. K. (1999). *Physiological studies on cholesterol in laying hens. M. Sc. Thesis, Faculty of Agriculture Cairo University, Giza, Egypt.*

Association of Official Analytical Chemists, A. O. A. C. (1990). *Official methods of analysis. 15th Ed. Published by the AOAC., Washington, D. C., USA.*

Craig W. J. (1999). *Health-promoting properties of common herbs. American Journal of Clinical Nutrition,* ***70****: 491S-499S.*

Duncan, D. B. (1955). *Multiple range and multiple F-Test. Biometrics 11:1-42.*

Eisen, E. J.; Bohren, B. B. and Mckean, M. (1962). The Haugh Unit as a measure of egg albumin quality. Poultry Sci. **41**: 1461.

El-Habbak, M. M. E.; Saleh, K.; Arbid, M. S.; Hegazi, A. G. and Sofy, H. (1989). *Influence of garlic (Allium sativum L.) on some biological and biochemical changes in Japanese quail with special reference to its hypocholesterolemic activity. Archiv fur Geflugelkunde.* ***53:*** *73-79.*

El-Kaiaty, A. M.; Soliman, A. Z. and Hassan, M. S. H. (2002). *The physiological and immunological effects of some natural feed additives in layer hen diets. Egypt. Poult. Sci.* ***22****: 175-203.*

Folch, J., Lees, M. and Stanly, S. G. H. (1957). *A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem., 226: 497.*

Ghazalah, A. A. and Ibrahim Faten, A. A. (1996). *The possibility of using some edible and aromatic oils in the nutrition of Muscovi ducks. Egypt. Poult. Sci.* ***16:*** *305-328.*

Guo, F. C. (2003). *Mushroom and herb polysaccharides as alternative for antimicrobial growth promotors in poultry. Thesis, Wageningen Institute of Animal Sciences, Department of Animal Nutrition, Wageningen University, Wageningen, Netherlands.*

Haugh, R. R. (1937). *The Haugh unit for measuring egg quality. US Egg Poultry Mag.* ***43****: 552-555.*

Himms-Hagen, J. (1990). *Brown adipose tissue thermogenesis: interdisciplinary studies. FASEB J.* ***4:*** *2890-2898.*

Kotaiah, T. and Mohapatra, S. C. (1974). *Measurement of albumin quality. India Poult. Ganzette* ***59****: 121.*

Oi, Y.; Kawada, T.; Kitamura, K.; Oyama, F.; Nitta, M.; Kominato, Y.; Nishimura, S. and Iwai, K. (1995). *Garlic supplementation enhances norepinephrine secretion, growth of brown adipose tissue and triglyceride catabolism in rats. Nutritional Biochemistry* ***6:*** *250-255.*

Prasad, J. and Pandey, R. C. (1995). *Effect of different levels of garlic inclusion in the ration of cockerels on their growth rate and feed conversion ratio. Poultry Adviser, (27)* ***6:*** *39-41.*

Reddy, R.; Lightsey, S. F.; and Maurice, D. V. (1991). *Research Note: Effect of feeding garlic oil on performance and egg yolk cholesterol concentration. Poultry Sci., 70: 2006-2009.*

Romanoff, A. L. and Romanoff, A. L. (1949). *The avian egg. John Wiley and Sons, Inc., New York.*

SAS Institute, Inc. (1990). *SAS User's guide: Statistics. SAS Inst. Inc., Cary, NC.*

Soliman A.Z.M.; Ghazalah, A. A.; El-Samra, Somaya H.; Atta, A. M. and Abdo, Zeinab M. A. (1999). *The synergistic effect of either black seed or garlic with fat on broiler performance and immunity. Egyptian J. Nutrition and Feeds 2 (Special Issue): 603-620.*

الملخص العربي

تقييم إضافة الثوم الطازج إلي علائق دجاج البيض المختلفة في محتواها من الطاقة

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أجري هذا البحث بهدف تقييم إضافة الثوم الطازج إلي علائق تطبيقية للدجاج البياض متساوية في محتواها من البروتين (١٨,٥% بروتين خام) و تحتوي علي مستويين من الطاقة القابلة للتمثيل. العليقة الأولي احتوت علي مستوى منخفض (٢٧٠٠ كيلو كالوري / كجم عليقة) بينما احتوت العليقة الثانية على احتياجات السلالة (٢٩٠٠كيلو كالوري / كجم عليقة).تم إضافة الثوم الطازج ليحل محل (صفر, ١,٥, ٣%) من المخلوط الكلي لكل من العليقتين. وبالتالي تم استخدام ٦ علائق في تصميم إحصائي متداخل (٢ x ٣).تم اختبار هذه العلائق باستخدام عدد ٩٠ دجاجة بياضة عمر ٢٥ أسبوع من نوع البوفانز الأبيض. تم توزيعها عشوائيا إلي ٦ مجاميع بكل منها ١٥ دجاجة في بطاريات.

أوضحت نتائج هذه الدراسة احتواء الثوم الطازج علي ٨٠,٨٧% رطوبة, ١٩,١٣% مادة جافة, ١٧,٨٠% مادة عضوية, ٣,٧٩% بروتين خام, ٠,٣% دهن خام, ١,٨٦% ألياف خام, ١,٣٣% رماد و١١,٨٥% مستخلص خالي الازوت مما يوضح قيمته الغذائية بالإضافة إلي محتواه من المواد الاخري الفعالة. كما أدت إضافة الثوم الطازج (بغض النظر عن مستوي طاقة العليقة) إلي

انخفاض المأكول و تحسين معامل التحويل الغذائي. لم يكن هناك فروق معنوية في الأداء الإنتاجي للطيور المغذاة على العلائق المحتوية على المستوي الأول أو الثاني من الطاقة. أدت العلائق المحتوية على ٣% ثوم طازج إلي تحسين معنوي في متوسط وزن البيض بينما أدت إلي انخفاض معنوي في معدل إنتاج البيض. أعطت العلائق المحتوية على احتياجات السلالة من الطاقة المضاف إليها الثوم الطازج بمستوي ١,٥% أفضل معامل تحويل غذائي, يليها العلائق المحتوية على الطاقة المنخفضة مضافا إليها ٣% ثوم طازج. كما أدت العلائق الأخيرة إلي الحصول على أفضل كفاءة اقتصادية مقارنة بالعلائق المحتوية على احتياجات السلالة من الطاقة الممثلة بدون إضافة الثوم. أدت إضافة الثوم الطازج بمستوي ١,٥ أو ٣% إلي خفض غير معنوي للدهون الكلية لصفار البيض بمقدار ١٣,٩ أو ٧,٧% على التوالي بالمقارنة بالكنترول (بدون ثوم). إضافة الثوم الطازج إلي العلائق المنخفضة في الطاقة أدت إلي تحسين معاملات هضم العناصر الغذائية بينما أدت إلي خفض قيم معاملات هضم الدهن الخام. أظهرت النتائج العامة لهذا البحث خاصة عند أخذ الجدوى الاقتصادية في الاعتبار أن إضافة الثوم الطازج بنسبة ١,٥% إلي العلائق المحتوية على احتياجات السلالة من الطاقة أو بنسبة ٣% من مخلوط العليقة المحتوية على مستويات منخفضة من الطاقة حسنت الاستفادة من هذه العلائق حيث أدت إلي الحصول على أفضل أداء إنتاجي وحيوية للطيور وكذلك تحسين جودة البيض وخفض محتواه من الدهون الكلية.