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THE EFFECT OF DIETARY CRUDE FIBER ON DANDARAWI LAYING HENS PERFORMANCE, BLOOD SERUM, AND YOLK CHOLESTEROL CONCENTRATIONS

(With 4 Tables)

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تأثير الألياف الخام فى العليقة على الأداء الإنتاجى وتركيز الكوليسترول فى سيرم الدم وصفار البيض لدجاج الدندراوى البياض

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أجريت هذه التجربة لدراسة تأثير زيادة مستوى الأياف الخام فى العليقة على الأداء الإنتاجى ومستوى الكوليسترول فى سيرم الدم وصفار البيض لدجاج الدندراوى البياض. أستخدم ١٢٠ طائر لهذه الدراسة وزعت عشوائيا على أربع معاملات غذائية بكل معاملة ٣٠ طائر وأحتوت كل معاملة على ٣ مكررات بكل مكررة ١٠ دجاجات. تم تكوين العلائق لتحتوى على ٣,٠١, ٤,٤٢, ٦,٥٢ و ٨,٤٦% ألياف خام. أوضحت النتائج المتحصل عليها أن زيادة مستوى الأياف الخام فى العليقة أدى إلى إنخفاض معنوى فى إستهلاك العلف وزيادة فى الكفاءة الغذائية ولم يظهر التأثير العالى للألياف أى فروق معنوية فى وزن البيضة, كتلة البيض , انتاج البيض, وزن البياض أو الصفاربينما أدت المستويات العالية من الألياف إلى إنخفاض معنوى فى وزن القشرة وسمكها. مستوى الكوليسترول إنخفض فى صفار البيض بنسبة ٥,٠٦, ٨,٦٢ و ٩,٧% للدجاجات المغذاة على علائق إحتوت على ٤,٤٢, ٦,٥٢ و ٨,٤٦% ألياف خام على التوالى. كان أكبر إنخفاض فى كوليسترول سيرم الدم للدجاجات التى غذيت على عليقة بها ٨,٤٦% ألياف خام. البيانات المتحصل عليها من هذه الدراسة لخصت أن التغذية على مستويات عالية من الألياف بإستخدام دريس البرسيم كمصدر للألياف لم يؤثرسلبيا على الأداء الإنتاجى لدجاج الدندراوى وأدى إلى تحسين الكفاءة الغذائية وإنخفاض مستوى الكوليسترول فى صفار البيض وسيرم الدم.

SUMMARY

A trial was performed to study the effect of increasing dietary crude fiber level on the performance, blood serum and yolk cholesterol concentrations of Dandarawi laying hens. A total of one hundred twenty, 32 weeks old Dandarawi laying hens were randomly assigned to four dietary treatments of 30 hens each (three replicate of 10 hens each). Diets were formulated to have 3.01, 4.42, 6.52, and 8.46% crude fiber (CF). The experiment prolonged for 3 months results indicated that increasing dietary CF significantly increased feed efficiency while feed

consumption was decreased. Dietary CF levels had no significant effect on weight gain; egg mass, egg production, albumen and yolk weight. Shell weight, percent and thickness were significantly decreased as dietary CF increased. Milligrams yolk cholesterol per g of yolk decreased as hens were fed increasing dietary CF levels. Total cholesterol per yolk decreased by 5.06, 8.62 and 9.7 % at feeding CF levels of 4.42, 6.52 and 8.46%, respectively; as compared to the control diet (3.01CF). Serum cholesterol was significantly decreased when the dietary CF was increased; the lowest reduction (29%) of cholesterol in serum was found in hens fed diet contained 8.46% CF. In conclusion, data reported in this study indicated that yolk and serum cholesterol was reduced by increasing levels of CF. Furthermore, feeding clover hay as fiber source in diet of Dandarawi laying hens reduced yolk cholesterol without adversely affecting either egg production or egg mass furthermore, feed efficiency was significantly improved.

Key words: *Crude fiber, laying hens, cholesterol, performance, Egg quality, Egg production.*

INTRODUCTION

From the consumer's point of view, fat is associated with poor dietetic quality and moreover, consumer awareness of correlation between saturated fat consumption and obesity or coronary heart disease has stimulated the demand for low fat products of animal origins. Laying hens generally are not fed products of animal origin and usually meet their bodies' needs for cholesterol entirely by de novo synthesis. In addition, most of the cholesterol in laying hen plasma resides in the very low-density lipoprotein (VLDV) fraction (Elkin *et al.,* 1999). As stated by Holden *et al.,* (1989), the average cholesterol content of one large egg is 208 mg. Kritchevsky and Kritchevsky (2000) recommended that people should limit the consumption of eggs because of their high cholesterol content. Hence, the cholesterol scare may have created a severe negative influence on consumer's attitude toward eggs. Diets containing high levels of fiber were associated with higher water content in the gastrointestinal tract and it is proposed that this improved welfare (Hocking *et al.,* 2004). Bile acid excretion is the main eliminatory pathway of endogenous cholesterol. Increased bile acid excretion causes a decrease in the cholesterol pool and in blood cholesterol. Eastwood and Boyd (1967) observed in rats that bile salts appear to be bounded to fiber in the small intestine and therefore unavailable for bile salt reabsorption and enterohepatic recirculation. Increasing dietary fiber has been shown to significantly decrease serum cholesterol and/or artery

deposition of plaque in humans (Trowell, 1972), rabbits (Kritchevsky *et al.,* 1954), rat (Tsai, 1976), chicks (Fahrenbach *et al.,* 1966 and Fisher and Griminger, 1967), turkeys (Simpson and Harms, 1969), and laying hens (Menge *et al.*, 1974 and Hussein *et al.*, (1976). Truk and Barnett (1972) found that alfalfa, when added to corn-soy laying hen diet, was most effective of the fiber sources tested for decreasing egg cholesterol with the least loss of egg size, feed efficiency, and egg production, while cellulose only slightly reduced egg cholesterol. Therefore, this experiment was conducted to determine the effect of fiber sources and level on yolk and serum cholesterol and performance of Dandarawi laying hens using natural fiber sources that might be added to practical laying hen diets.

MATERIALS and METHODS

This experiment was carried out at the Poultry Farm, Animal and Poultry Production Department, Faculty of Agriculture, Assiut University. One hundred twenty Dandarawi laying hens were 32 weeks old were divided into four groups of 30 birds each and housed individually in wire cages. A row of 10 cages was considered as one block per treatment. They were fed diets consisting of various levels of fiber (3.01, 4.42, 6.52, and 8.46 CF %) *ad libitum* over a 3 month experimental period. All dietary treatments were isonitrogenous and isoenergetic. All birds subjected to photoperiod of 16 hours light and 8 h dark daily. Feed samples were taken and analyzed according to AOAC methods (1990). The composition of experimental diets used is shown in Table (1).

Egg production, fed consumption, feed efficiency, egg weight, egg quality and survivability were determined periodically throughout the experiment. At the end of 2nd and 3rd month of the experiment blood samples were collected from six randomly selected hens from each treatment. Serum was separated by centrifugation for 10 minutes (300 rpm) and stored in vials at -20ºC for later analyses. Frozen serum was thawed and assayed for cholesterol values by enzymatic colorimetric test (CHOD-PAP) using commercial kits purchased from Bioub (Germany). Yolk cholesterol was determined in eggs laid in the last three days the of second and third month of the experiment. Collected eggs were broken and yolk separated and weighed, then pooled and frozen at -18 ºC until analyzed in duplicate samples. Yolk cholesterol was extracted according to the method of Folich *et al.,* (1956) as modified by Washburn and Nix 91974) and estimated by the method of Zlatkis *et al.* (1953) using a cholesterol diagnostic kit.

Analysis of variance (ANOVA) was performed on the yield data using the general linear model (GLM) of Statistical Analysis System (SAS, 1992). The analysis was carried out according to the following model:

$$Y_{ij} = \mu + L_i + +E_{ij}$$

Where Y_{ij} is the observation of the CF levels, μ is the overall mean, L_i is the effect of CF level, and E_{ij} is the random error. When a significant effect ($P<0.05$) was proved, differences between treatment means were tested for significant by least squares means (LSM) or Duncan's test as explained by Steel and Torrie (1960).

REULTS

Table 1: Composition of the experimental diets

Ingredient	Diet1 (Control)	Diet 2	Diet 3	Diet 4
Ground yellow corn(8.5% CP	58.21	51.94	40.60	29.87
Soybean meal(44% CP)	27.70	25.80	24.46	23.00
Clover hay meal	00	6.22	15.60	24.65
Mixed oil	3.05	5.00	8.30	11.44
Dicalcium phosphate	1.74	1.74	1.74	1.74
Limestone	8.50	8.50	8.50	8.50
Salt	0.35	0.35	0.35	0.35
Premix*	0.23	0.23	0.23	0.23
DL-Methionine(99%)	0.22	0.22	0.22	0.22
Total	100	100	100	100
Calculated analysis				
ME, Kcal/Kg	2842	2840	2840	2840
CP%	17.10	17.03	16.94	16.90
Crude fiber	3.01	4.42	6.52	8.46
Ether Extract	5.44	7.30	10.35	13.25
Calcium %	3.54	3.52	3.50	3.50
Available phosphorus %	0.52	0.52	0.52	0.52

Each package of 1 kg contain: 2million IU vit. A; 1.5million IU vit. D; 330 mg vit. K; 830 mg vit. E;20000 mg CholineChloride; 830 mg Nicotinc Acid; 35 mg vit. B6; 330 mg vit. B1; 1000 mg vit. B2; 1.75 mg vit. B12; 35 mg Biotin; 85 mg Folic Acid; 335 mg Panyotheinic Acid6670 mg Mg; 500 mg Cu; 35 mg I; 17 mg Se; 12500 mg Fe5000 mg Mn; 11660 mg Zn; 17 mg Cobalt.

Table 2: Effect of Different Levels of Crude Fiber on Blood Serum and Egg Yolk Cholesterol Levels.

Dietary treatments	Cholesterol values	
	Serum (mg/ 100ml)	Yolk (mg/g)
3.01% CF	137.36±12.2[a]	12.06±0.2 [a]
4.42% CF	118.58±13.1[ab]	11.45±0.0 [a]
6.52% CF	106.41±10.42[a]	11.02±0.1[b]
8.46% CF	97.37±11.7[cb]	10.89±0.4[b]
Significance	*	*

[ab] means within a column within the same character, with different superscripts are significantly different ($P<0.05$)

DISUCSSION

Laying hen's performance: Table (3) summarized the effects of dietary crude fiber on body weight, egg number, egg production, egg mass, feed intake, feed efficiency and survivability. Body weight gain of hens was not significantly ($P<0.05$) affected by increasing dietary crude fiber. This result is in agreement with that of Hammad, (2005), Abdel-Azeem (2005) and Vargas and Naber (1984). Feed intake of birds fed dietary fiber at levels of 5 and 7% was significantly decreased when compared to the control group. Similar findings were reported by Abdel-Azeem (2005); Chaturvedi and Singh (2000); Wess and Scot (1978) and James (1978). However, feed efficiency was significantly increased as CF was increased. Compared with other dietary groups, fed high dietary CF the level of 8.46% crude fiber showed a little improvement in feed efficiency. These results agreed with those of Adeyemi and Familade (2003) and Hetland (2003) who reported that the coarse insoluble fiber could improve feed conversion if poultry fed highly fiber diets. Improvement of feed efficiency is thought to be due partly to increase digestibility of starch and may be due to increase of gizzard activity.

Insignificant decrease was showed in egg mass and egg number per hen when the hens received high fiber diets. These results are in agreement with those obtained by Roth-Maier and Krichgessner (1998), they concluded that maize-cob-mix with up to 7% crude fiber can be used successfully as energy source for laying hens. No significant differences were observed in egg production due to crude fiber levels. The obtained results are in agreement with the findings of Vargas and Naber (1984); Hennig *et al.,* (1990); Piliang (1990), and Hammad (2005). According to survivability, no significance effects were detected among dietary fiber.

Egg quality traits: The results of egg quality measurements as affected by dietary fiber levels are presented in Table (4). No significant differences in albumen, yolk weight, and yolk index were fond due to diets fiber contents variation. Results reported herein are in harmony with those obtained by Abdel-Azeem (2005) and Hammad (2005). However, shell weight and shell thickness significantly decreased as dietary fiber increased in the diet of laying hens. This result was disagreed with those of Roberts (2004); Adeyemi and Familade (2003) and Abdel-Azeem (2005) who found that dietary crude fiber did not influence shell thickness.

In conclusion, the data reported herein indicated that the dietary crude fiber led to a significant increase in feed efficiency, while feed intake and shell thickness were decreased. Dietary crude fiber had no significant effects on weight gain, egg mass, egg production, yolk, albumen weight and yolk index.

Serum and egg yolk cholesterol: The effect of various level of fiber upon serum and egg cholesterol values is shown in Table (2). Egg weight were separated into two distinct egg weight 40 ± 2g or 45 ± 2g and egg yolk cholesterol was determined in each group. Eggs of similar weights were taken in order to delete any possible interaction of egg weight and yolk cholesterol. Milligrams yolk cholesterol per g of yolk decreased as hens were fed increasing dietary fiber levels. Total cholesterol per yolk decreased by 5.06, 8.62 and 9.7 % at feeding dietary crude fiber levels of 4.42, 6.52 and 8.46% respectively; as compared to the control diet. Also, serum cholesterol was significantly decreased when the dietary CF was increased, the lowest reduction (29%) in serum was found in hens fed diet contained 8.46% CF. Although dietary fat increased as dietary fiber increased (Table 1), the conclusion reached was that only dietary fiber influenced yolk cholesterol. Miller and Katsoulis (1974) found no significant differences in ether blood serum or egg yolk cholesterol concentration with increasing dietary animal fat. The results obtained from this study are in agreement with those by Weiss and Scott (1979) who reported that the alfalfa meal produced a significant lowering in plasma cholesterol in the hens. Hargis (1988) reported that fiber influences cholesterol, binding with the bile salts in the intestinal tract, shortening intestinal transit time and increasing fecal sterol excretion. Alfalfa meal, when added to corn-soy laying hen diet, was the most effective of fiber sources tested for reducing egg cholesterol with the least loss of egg size, feed efficiency, and egg production (Turk and Barnett, 1972). The results obtained from Story Krtichevsky (1976) indicated that cellulose bound an average of 1.4% of all the bile acids tested, whereas alfalfa bounded 15.9%; thus alfalfa was most successful in reducing bile acid. Data reported in this study indicated that yolk cholesterol was reduced with increasing levels of dietary fiber. Furthermore, feeding alfalfa as fiber source in the diet of Dandarawi laying hens reduced yolk cholesterol without adversely affecting either egg production or egg mass.

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Table 3: Effect of dietary crude fiber on Dandarawi laying hens performance

Dietary treatment	Initial body weight (g)	Final body weight (g)	Body weight gain (g)	Feed intake (g/day)	Egg weight (g)	Egg number / 30 day	Egg mass (g/ 30day)	Egg production (%)	Feed efficiency (g egg/g feed)	Survivability (%)
3.01% CF	1507±54	1901±46[a]	394±42[b]	124.2±1.4[a]	46.86±0.19	17.3±0.7	810.68±28	57.67±1.7	0.22±0.01[a]	100
4.42% CF	1522±49	1924±56	402±54[b]	92.6±1.8 [b]	44.32±0.21	16.9±0.4	749.00±37	56.33±2.4	0.27±0.01[b]	100
6.52% CF	1486±52	1851±53	365±26[a]	85.3±1.9 [b]	42.97±0.36	16.5±0.6	709.00±25	55.00±1.9	0.28±0.03[b]	100
8.46% CF	1502±50	1863±45	361±40	75.2±2.0[c]	41.13±0.45	16.1±0.8	662.19±23	53.67±2.6	0.29±0.01[b]	100
Significance	NS	NS	NS	*	NS	NS	NS	NS	*	NS

[ab] means within a column within the same character, with different superscripts are significantly different(P<0.05)
Statistical significant by analysis of variance, NS = not significant

Table 4: Effect of dietary crude fiber on egg quality traits of Dandarawi laying hens performance

Dietary treatment	Egg weight (g)	Albumen weight (g)	Albumen (%)	Yolk weight (g)	Yolk (%)	Shell weight (g)	Shell (%)	Shell thickness mm	Yolk Index (%)
3.01% CF	46.6±2.2	22.55±0.21	48.39±0.82	15.72±0.29	33.73±0.28	5.96±0.08[a]	12.79±0.45[a]	0.35±0.01[a]	48.77±1.43
4.42% CF	44. 2±2.3	21.92±027	49.59±0.64	14.35±0.32	32.47±0.39	5.14±0.16[a]	11.62±o.37[b]	0.31±0.01[b]	47.95±1.56
6.52% CF	41.3±2.7	19.43±0.12	47.10±0.46	14.33±0.34	34.74±0.36	4.27±0.11[b]	10.35±0.63[b]	0.28±0.0[b]	45.13±1.23
8.46% CF	40.2±1.2	19.82±0.18	49.25±0.97	13.86±0.11	34.44±0.63	4.12±0.05[b]	10.23±0.72[b]	0.24±0.0[c]	45.32±1.22
Significance	NS	NS	NS	NS	NS	*	*	*	NS

[ab] means within a column within the same character, with different superscripts are significantly different(P<0.05)
Statistical significant by analysis of variance, NS = not significant