

Effect of Natural Antioxidants Supplementation as Feed Ingredients in Laying Hen Diet

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ABSTRACT

This study was conducted to elucidate the effect of two types of antioxidants containing compounds on some physiological components of laying hens for 8 weeks as well as egg quality with special reference to egg yolk cholesterol concentration. Ninety six adult Shaver White laying hens were randomly divided into six groups ,each contained sixteen birds , control group, two garlic groups (fed on basal diet plus 1g or 3g/kg), two yeast groups (fed on basal diet plus 2g or 4g /kg), and the last group received basal diet plus a mixture of 3g garlic and 4g yeast /kg. Feed intake significantly increased in groups received garlic (3g/kg) and that received garlic and yeast together, while egg weight , Haugh unit and egg mass, were not significantly affected but egg production percent significantly improved . Egg yolk cholesterol significantly declined in all treated groups, especially in that given both garlic and yeast. serum total lipids, triglycerides, cholesterol as well as LDL-C significantly declined in most treated groups while serum HDL-C significantly increased in the groups receiving garlic (3g/kg) or both garlic and yeast. Also serum total protein and albumin levels increased in the group supplemented with both garlic and yeast. Serum levels of estrogen and progesterone significantly increased in the group receiving both garlic and yeast. In conclusion dietary garlic and yeast powder can be used for laying hens to increase egg quality , since, they have a cholesterol-lowering effect.

Keywords: Garlic, Yeast, Production performance, Lipid profile Estrogen and progesterone hormones, Laying hens.

INTRODUCTION

Chickens kept for egg production are called layers, but that raised for meat production are known as broilers (Zaheer, 2015). Chicken eggs are one of the main consumed foods. Although chicken eggs are an excellent source of protein, unsaturated fat, vitamins and minerals, some peoples donot prefer egg consumption because of their high cholesterol content (Zeidler, 2002).

Zeisel *et al.* (2003) reported that egg has high choline content and it is an important source of lecithin, the latter is valuable for biological membrane structure. A 50g egg contains 186-213 mg cholesterol, the higher cholesterol contents reflect excessive fat deposition (Tewe and Bokanga, 2001) which increased risk for cardiovascular disease (Krauss *et al.*, 1996).

Rossi *et al.* (2013) showed that eggs have compounds with antimicrobial, antioxidant, anti-carcinogenic as well as immuno-modulator characteristics. Feed additives as probiotics (fungi, yeast) or natural antioxidants are usually used in poultry industry to enhance performance, egg production and quality or to decline mortality rate (El Nagar 2013).

Garlic (*Allium Sativum*) was previously known to be used as a therapeutic agent (Amagase *et al.* 2001) and has hypocholesterolemic effect in human (Silagy and Neil 1994). Ibrahim (2006) mentioned that addition of garlic extract at the levels of 0.2% or 0.4% decreased plasma glucose level in hens at the 6th week of age. Yalcin *et al.* (2008) found that dietary supplementation of yeast (*Saccharomyces cerevisiae*) increased body weight gain, egg weight, and serum uric acid, but significantly declined egg cholesterol.

Sim and Bragg (1977) showed that egg yolk cholesterol level is mainly influenced by the dietary cholesterol.

In laying hens tissue cholesterol contents are mostly regulated by synthetic origin and not by cholesterol absorption of dietary origin for meeting egg yolk formation, Sim *et al.* (1984).

Sutton *et al.* (1984) mentioned that most yolk cholesterol is synthesized in the liver of the hen which is transported by the blood in the form of lipoproteins and deposited in developing follicles. However, plasma cholesterol is not closely associated with the yolk cholesterol concentration. Dizaji and Pirmohammadi (2009) observed in yeast supplemented laying hens a significant improvement in feed conversion concomitant with a significant decline in egg weight.

The present study aimed to investigate the effect of dietary garlic powder (1or 3 g/kg diet), yeast (2 or 4 g/kg diet) or combination of garlic (3g/kg) and yeast (4g/kg) on laying performance, egg quality and egg yolk cholesterol level as well as serum lipid profile, total protein, albumin, estrogen and progesterone levels. The experiment lasted 8 weeks.

MATERIALS AND METHODS

The present work was carried out with ninety six Shaver White laying hens (36 weeks old). Garlic bulbs were sliced and thinly spread finely ground after sun-drying to make it in the form of powder and mixed with basal diet at levels of 1g or 3g /kg. Dried yeast was purchased from local market and added to the basal diet at two levels (2 or 4 g/kg). Chickens were randomly assigned into 6 groups, each with 16 birds, and were kept in wire cage of 40 × 50 × 40 cm. The basal diet (2866 metabolizable energy (ME) , Kcal/kg, 19.15% crude protein (CP) , 4.26% calcium ,0.47% non-phytate P, 0.492% methionine, 0.829% methione + cysteine and 1.05% lysine) was formulated to meet the need of layers as mentioned in the National Research Council (NRC, 1994).

During the last week of study, eggs were collected for chemical analysis (6 eggs/treatment), their yolks were separated, pooled and homogenized, and freezed at (-20°C) till analysis.

At the end of the experiment (44 weeks of age), blood samples were withdrawn in non-heparinized tubes from wing veins, sera were collected to determine levels

of total lipids, total cholesterol, LDL-C, HDL-C, triglycerides, total protein and albumin as well as the concentrations of progesterone and estrogen in blood serum. Egg quality parameters were estimated (6 eggs / treatment). Including egg weigh, egg mass, egg shell weight, egg production and Haugh unit.

Obtained data were analyzed using a statistical software program (SPSS) 1.2 for windows. Significant differences among means of variables were evaluated using one way analysis of variance (ANOVA). Data expressed as mean ± SE, P ≤ 0.05 considered significant.

RESULTS AND DISCUSSION

Feed additive are generally used for different purposes as for example to improve food intake, increase layers performance as well as feed efficiency. Garlic is well known as herbal medicine for prevention of many diseases. In addition, yeast supplementation plays an important role in decreasing egg cholesterol content. In the present study increases in egg production, feed efficiency in yeast - supplemented laying hens are in accordance with the findings of Yalcin *et al.* (2008). The increased egg production in garlic supplemented hens is in agreement with Bollengier-lee *et al.* (1998) who reported that the improvement in egg production may be due to the presence of vitamins A and E as well as a group of B vitamins and selenium.

In addition obtained increase in egg production and the improvement in feed conversion in garlic - supplemented hens may be as a result of the presence of vitamin A or it may be attributed to the important role of pituitary ovary axis which stimulates the release of FSH and LH and thus increasing the activity of ovary in terms of formation, growth and release of egg (Fletcher, 1971).

The observed increase in feed consumption, especially with garlic treated group, at a dose of 3g/kg is in parallel with previous study of Kim *et al.* (2009) who noted increased feed consumption in laying hens supplemented with increasing dietary garlic levels. The

improvement of egg production in yeast supplemented group is in agreement with the findings of Liu and Yoon (2002) and may be attributed to yeast role in increasing feed consumption as reported by Dizaji and Pirmohammedi (2009).

Certain natural antioxidants such as vitamin C, vitamin E and selenium being beneficial to albumin quality by its antioxidant property (Keshavarz, 1996; Sahin *et al.* 2003). Rabinokov *et al.* (2000) reported that allicin in garlic is converted into various disulfide derivative exerting the anti-oxidative activity by reaction with sulfur containing compound.

The non-significant effect noted in egg mass in yeast supplemented hens may be partially due to unchanged egg weight as mentioned by Hewida *et al.* (2011).

The decline in egg yolk cholesterol content reflect the decrease in fat deposition as reported by Tewe and Bokanga (2001). This decline in hens serum and egg cholesterol in garlic - received hens are in accordance with the results (Kim *et al.* 2009).

Obtained decline in egg yolk cholesterol content in garlic or yeast - supplemented hens is in accordance with the findings of Lim *et al.* (2006) and may be attributed to the effect of glutathione which regulates its biosynthesis through the lowering of 3-hydroxy-3-methyl glutaryl coenzyme A reductase activity as well as the activity of cholesterol 7- α -hydroxylase as reported by Konjufca *et al.* (1997).

Also, the excretion of steroid in faeces may lead to decrease in cholesterol pool and hence decline cholesterol content in plasma and yolk, such an explanation is in accordance with Francis *et al.* (2002). The presence of antioxidants in garlic and yeast may play a role in fat catabolism and hence can decrease fat and cholesterol contents (Issa and Abo Omar, 2012).

The obtained hypocholesterolemic effect of garlic or yeast may be in part attributed to excess excretion of cholesterol via the egg to prevent hypercholesterolemia, an explanation which coincides with that of Sutton *et al.* (1984).

Table 1. Effect of dietary dried garlic, yeast or both on laying hens performance

Parameters	Group	C	G _{1g}	G _{3g}	Y _{2g}	Y _{4g}	G _{3g} +Y _{4g}
Initial weight(kg)		1.43±0.01	1.44±0.01	1.44±0.01	1.43±0.01	1.44±0.01	1.43±0.01
Final weight (kg)		1.46±0.006	1.43±0.003	1.45±0.003	1.47±0.001	1.45±0.004	1.51 ±0.001
Feed intake(kg)		0.75±0.003	0.77±0.003	0.83 ±0.06*	0.77±0.01	0.78±0.04	0.94 ±0.003*
Feed conversion ratio (%)		1.81±0.004	1.86±0.003	1.97±0.01 *	1.85±0.005	1.91 ±0.002*	1.99±0.01*

Values expressed as mean ± SE (n=6). *: significant when compared to control group.

C: Control, G_{1g}: 1g garlic, G_{3g}: 3g garlic, Y_{2g}: 2g yeast, Y_{4g}: 4g yeast, G_{3g} + Y_{4g}:3g garlic + 4g yeast.

Table 2. Effect of dietary dried garlic, yeast or both on egg quality traits of laying hens

Parameters	Group	C	G _{1g}	G _{3g}	Y _{2g}	Y _{4g}	G _{3g} +Y _{4g}
Egg weigh (g)		65.6 ±6.40	59.5 ±0.27	60.8 ±0.45	59.1 ±0.32	59.6±0.42	59.8 ±0.49
Egg mass (g)		58.2 ± 0.33	57.8 ±0.64	58.3 ± 0.13	57.1 ± 0.63	56.9 ± 0.38	59.8 ±0.22
Egg shell weight(g)		5.8±0.007	6.2 ±0.24	5.8±0.16	5.4±0.19	5.7±0.21`	6.3 ±0.11
Egg production (%)		83.2 ±0.75	91.4 ±2.21*	93.0 ±2.22*	85.5 ±0.41*	87.8 ±0.62*	96.0 ±1.51*
Haugh unit		10.50± 1.62	10.26± 1.17	10.25 ± 0.65	10.83±3.46	10.67± 0.8	10.97± 0.9
Egg yolk cholesterol (mg/g)		15.6± 0.22	12.8±0.17*	11.3 ± 0.13*	14.0± 0.11*	13.3 ± 0.11*	10.5 ±0.19*

Values expressed as mean ± SE (n=6). *: significant when compared to control group.

C: Control, G_{1g}: 1g garlic, G_{3g}: 3g garlic, Y_{2g}: 2g yeast, Y_{4g}: 4g yeast, G_{3g} + Y_{4g}: 3g garlic + 4g yeast.

Table 3. Effect of dietary dried garlic, yeast or both on serum lipid profile (mg/dl) of laying hens.

Group Parameter (mg/dl)	C	G _{1g}	G _{3g}	Y _{2g}	Y _{4g}	G _{3g} +Y _{4g}
Total Lipid	467.2±6.05	411.5±10.6*	361.5±9.32*	442.0±11.4	404.2±10.4*	315.3±8.06*
Triglyceride	226.7±5.77	201.0±5.26*	175.0±5.09*	210.0±5.77	198.0±5.77*	165.0±5.77*
Total Cholesterol	120.0±1.63	115.0±1.50	109.0±1.39*	111.8±1.62*	108.0±1.15*	100.3±1.11*
LDL-C	38.0±1.15	31.0±0.28*	27.0±0.57*	31.0±0.57*	28.0±0.93*	18.0±0.57*
HDL-C	37.0±0.57	44.0±0.57*	47.0±0.57*	39.0±0.57	41.0±0.57*	49.0±0.57*

Values expressed as mean ± SE (n=6). *: significant when compared to control group.

C: Control, G_{1g}: 1g garlic, G_{3g}: 3g garlic, Y_{2g}: 2g yeast, Y_{4g}: 4g yeast, G_{3g} + Y_{4g}: 3g garlic + 4g yeast.

Table 4. Effect of dietary dried garlic, yeast or both on total protein ,albumin content as well as estrogen and progesterone level of laying hens.

Group Parameters	C	G _{1g}	G _{3g}	Y _{2g}	Y _{4g}	G _{3g} +Y _{4g}
Total Protein (g/dl)	7.28±0.32	7.60±0.27	7.96±0.21	7.36±0.14	7.40±0.27	8.35±0.22*
Albumin (g/dl)	2.90±0.10	3.00±0.09	3.18±0.06	3.06±0.07	3.16±0.07	3.45±0.08*
Estrogen (ng/ ml)	1.45±0.04	1.56±0.09	1.68±0.07	1.50±0.12	1.60±0.06	1.80±0.06*
Progesterone (ng/ml)	10.80±0.27	11.00±0.15	11.47±0.20	11.07±0.31	11.10±0.16	11.80±0.20*

Values expressed as mean ± SE (n=6). *: significant when compared to control group.

C: Control, G_{1g}: 1g garlic, G_{3g}: 3g garlic, Y_{2g}: 2gyeast, Y_{4g}: 4g yeast, G_{3g} + Y_{4g}: 3g garlic + 4g yeast.

The resulted increase in serum total protein and albumin levels especially in the groups of hens received both garlic and yeast, were not unexpected and may be due to improvement of protein metabolism and the liver function (Gally and - El-latif 2007). An increase in concentrations of estrogen and progesterone was recorded in the group received both garlic and yeast, which may be attributed to antioxidant properties of garlic and yeast in ameliorating health state of the hen's (Hajiun,2014).

In conclusion, dried garlic powder and bakery yeast supplementation to the diet of laying hens could improve their performance and positively affected their metabolic processes and resulted in healthy low cholesterol eggs.

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تأثير اضافة مضادات الاكسدة الطبيعية لمكونات عليقة الدجاج البياض
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اجريت هذه الدراسة لتوضيح تأثير تناول مركبين يحتويان علي مضادات الأكسدة على بعض المكونات الفسيولوجية للدجاج البياض لمدة 8 أسابيع وكذلك جودة البيض و خاصة محتواه من الكوليسترول. تم تقسيم ستة وتسعين من الدجاج البياض إلى ستة مجموعات، كل منها يحتوي على ستة عشر دجاجة: اولا المجموعة الضابطة، واثنين من مجموعات الثوم (تتغذى على العلف المضاف اليه 1 او 3 جرام من الثوم / كج)، و مجموعتي الخميرة (تتغذى على العلف المضاف اليه 2 او 4 جرام من الخميرة / كج)، وتلقت المجموعة الأخيرة العلف بالإضافة إلى خليط من (3 جرام من الثوم و 4 جرام من الخميرة / كج). وقد ازدادت نسبة تناول العلف بشكل ملحوظ في المجموعات التي تلقت الثوم (3 جم / كج) والتي تلقت الثوم والخميرة معا، في حين أن وزن البيض ووحدة هوف وكتلة البيض لم تتأثر بشكل ملحوظ ولكن نسبة إنتاج البيض تحسنت بشكل واضح. كما انخفض الكوليسترول في صفار البيض بشكل ملحوظ في جميع المجموعات المعالجة وخاصة في المجموعة المعالجة بالثوم والخميرة معا. كذلك كان النقص في محتوى مصل الدم من الدهون الكلية والدهون الثلاثية والكوليسترول والبروتينات الدهنية منخفضة الكثافة في معظم المجموعات المعاملة، في حين كانت الزيادة في البروتينات الدهنية عالية الكثافة في المجموعات المعالجة بتركيزات عالية من الثوم او الخميرة او كليهما معا. كما ارتفع البروتين الكلي ومستويات الألبومين وكذلك هرمون الاستروجين والبروجسترون في المجموعة التي تلقت الثوم والخميرة معا. ونستنتج من ذلك ان مسحوق الثوم والخميرة يمكن استخدامهما لزيادة جودة البيض نظرا لتأثيرهما الخافض للكوليسترول