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EFFECT OF DIETARY YEAST SUPPLEMENTATION ON PRODUCTIVE PERFORMANCE, EGGSHELL QUALITY AND LIPID PROFILE OF LAYING HENS

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ABSTRACT: One hundred and eighty Isa Brown layers, 40 weeks old, were used to study the role of dietary yeast supplementation on productive performance and cholesterol levels in laying hens. All hens were equally classified into four groups. The 1st group, hens were fed the basal diet without any supplementation (control), while those in the 2nd, 3rd and 4th groups were fed the basal diet supplemented with yeast at levels of 0.2, 0.4, and 0.6%, respectively. Feed consumption, feed conversion, egg production and eggshell traits, serum total lipids, cholesterol, triglycerides concentrations as well as yolk and liver contents of cholesterol were measured.

The obtained findings indicated that feed consumption for hens of yeast- supplemented groups was significantly lowered compared with control. The lowest amount of feed consumption was recorded for 0.6% yeast-treatment group. On the other hand, each of egg production, egg weight and feed conversion were not significantly influenced. The means of eggshell (weight, thickness, and breaking strength) for hens supplemented with 0.6% yeast were significantly improved compared with the other yeast-treated and control groups. Dietary yeast supplementation significantly reduced egg yolk and liver tissues cholesterol content comparing with control group. However, the lowest ($P \leq 0.05$) values were recorded for hens supplemented with yeast at 0.6%. Similarly, serum total lipids, and cholesterol as well as triglycerides levels were significantly lowered in yeast-treated groups than the control group.

From the previous results, it could be recommended to use 0.6 % yeast in laying hen diets especially at late age to improve eggshell quality and produce low-cholesterol eggs.

Keywords: Cholesterol contents-egg traits-laying hens-performance-yeast.

INTRODUCTION

During six decades, the poultry industry has paid its attention on several aspects, such as genetics, nutrition and management to improve growth and egg production. However, as recent raising awareness about "healthy consumption products," it must focus on dealing with public concern for environment and food safety (Ghasemian and Jahanian, 2016). It is well established that chicken eggs are good source of protein and essential nutrients contents for humans (López-Fandiño *et al*., 2007). However, eggs have been identified as main dietary cholesterol source, which contain an approximately of 180–250 mg/egg (Elkin, 2009). It was recommended to consume less than 300 mg of cholesterol per day to prevent elevation blood cholesterol and reduce risk of coronary heart disease (Weggemans *et al*., 2001). Antibiotics affect microflora by altering the metabolism of gut microbiota and inhibiting their growth. However, antibiotics can diffuse into the egg via the blood flow and accumulate in the yolk (Ghasemian and Jahanian, 2016). Therefore, a friendly approach with the use of natural products to reduce the cholesterol content in egg yolk and as alternative sources of antibiotics should be developed (Zhao *et al*., 2013). Previous studies revealed that probiotics as *Saccharomyces cerevisiae* reduced the level of cholesterol in broilers (Khani and Hosseini, 2008). The results of Panda *et al*. (2003) indicated that *Saccharomyces cerevisiae* caused a reduction in the cholesterol levels for serum and egg yolk as well as increasing egg production. Similarly, Özsoy *et al*. (2018) found that yeast autolysate supplementation at 2, 3 and 4 g/kg diet decreased egg yolk and serum cholesterol and triglycerides concentrations.

Yeast products have been recently gained great attention in poultry industry as a feed additive (Yalcin *et al*., 2015). Yeasts have great amounts of enzymes, vitamins and other nutrients have been demonstrated to improve the digestibility, growth rate, feed conversion, egg production and reproduction (Yalcin *et al*.,2008), reduce abdominal fat content, improve internal egg quality and increase organic phosphorus utilization in laying hens (Wang *et al*., 2015).

In the same trend, the findings of Hassanein and Soliman (2010) indicated that the *Saccharomyces cerevisiae* supplementation in the diet of laying hens significantly improved egg production, and feed efficiency. On the other hand, Gürbüz *et al*. (2011) found that using of 0.5% yeast in laying hen diets slightly increased egg production, while egg weight and feed conversion were not affected. Yalcin *et al*. (2010) reported that dietary yeast at 1, 2, 3 and 4 g/kg diet didn't significantly affect body weight and feed intake as well as egg quality traits. Also, Yalcin *et al*. (2014) found that egg production and egg weight were significantly increased for hens supplemented with yeast. While, the cholesterol level for egg yolk and serum as well as triglycerides were significantly decreased by yeast supplementation.

Eggs are among the maligned products that have suffered because of a public perception that eggs have high cholesterol content (Sun *et al*., 2011). Therefore, many natural products have been tested to reduce egg yolk cholesterol for market requirement.

However, this study aimed to investigate the effect of the different dietary levels of yeast (*Saccharomyces cerevisiae*)

supplementation on laying hen's performance and cholesterol levels in serum, egg yolk, and liver tissues.

MATERIALS AND METHODS

The present study was carried out at the Faculty of Agriculture, Cairo University to study the effect of dietary yeast supplementation on productive performance, eggshell quality and lipid profile of laying hens.

A total of 180 Isa Brown laying hens, 40 weeks old, were randomly divided into four equal groups (4 groups × 3 replicates × 15 hens). The 1st group, hens were fed the basal diet without any supplementation and considered as control, while those in the 2nd, 3rd and 4th groups were fed the basal diet supplemented with yeast at levels of 0.2, 0.4, and 0.6%, respectively.

All hens were housed in individual cages (30 cm L×44 cm W×44 cm H) and exposed to 16 lighting hours per day. The feed and cleaned water were offered *at libtium* during the whole experiment period (8 successive weeks). The basal diet was formulated according the produced company (Isa Brown book). The ingredients of the basal diet and calculated analysis are presented in Table 1.

Feed consumption (FC) for hens was biweekly recorded, while feed conversion ratio was calculated as g feed / g egg. Eggs number and weight were recorded daily.

At the end of experiment at 47 and 48 weeks of age, 120 freshly eggs (4 groups × 5 eggs × 3 replicates × 2 times) were used to determine eggshell traits (weight (EW), thickness (ET) and breaking strength).

Eggshell breaking strength for each egg was measured using an egg-breaking tester (static compression device, Dr.-Ing. Georg Wazau Mess- + Pr ¨ uftechnick, Berlin, Germany). The eggshell thickness was measured by using a micrometer (Mitutoya No. 1044N, 0.01–5 mm, Kawasaki, Japan) at upper, lower ends and middle part.

The yolk of each egg was blended with 10 ml isopropyl alcohol per g yolk, then the extract was used to determine cholesterol content according to the method of Washburn and Nix (1974). The cholesterol level in the egg yolk was calculated and expressed as mg per g yolk.

At the end of experiment, 60 hens (4 groups × 5 hens × 3 replicates) were slaughtered, then blood samples (4 groups × 5 hens × 3 replicates) were separately collected, and centrifuged at 3000 rpm for 10 minutes to obtain the blood serum. The blood serum was stored at −20°C until analysis for total lipids, triglycerides and cholesterol levels which were determined by using colorimetric kits (Stanbio Laboratory LP, Boerne, USA).

Livers were removed from slaughtered hens, washed in ice cold saline and blotted individually on filter paper. Then the tissues homogenized separately in phosphate buffer with 7.4 pH, and the extract was kept at -20°C for cholesterol determination (De Hoff *et al*., 1978).

Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS, 2006). Significant effects of dietary treatments were evaluated with the Duncan's Multiple range test (Duncan, 1955). Statements of statistical significance were based on a probability of $P<0.05$.

Results and Discussions:

The results in Table 2, showed that feed consumption for yeast-treated hens was significantly ($P\leq0.05$) lowered than that

of the control group. However, the lowest feed consumption value was recorded for 0.6% yeast supplemental group. While the highest was recorded for hens of control group. On the other hand, the results of Table 2 showed that the feed conversion ratio for yeast-treated hens was insignificantly improved compared with the control group. The beneficial effect of yeast (*Saccharomyces cerevisiae)* may be attributed to the fact that it is a naturally rich source of proteins, minerals, and B complex vitamins. Also, the decrease in feed consumption and the slight improvement in feed conversion in yeast-treated groups may be attributed to improvement in nutrients absorption and utilization due to yeast supplementation, which plays an important role in reducing the proliferation of enteric harmful bacteria responsible of mal-absorption (Shareef and Dabbagh, 2009). In addition, Tapingkae *et al*. (2016) found that dietary yeast supplementation increased duodenal villus height in laying hens which may be increase nutrient absorption leading to improve feed convertion. The obtained results are compatible with Bansal *et al*. (2011) and Yalçın *et al*. (2012) who found that the feed consumption of broilers and laying hens fed diet supplemented with *Saccharomyces cerevisiae* were remarkably decreased than that of the control. On contrary, some studies indicated that dietary yeast supplementation didn't affect each of feed consumption and feed conversion in laying hens (Nursoy *et al*., 2004; Asli *et al*., 2007; Hassanein and Soliman, 2010 and Sacakli *et al*., 2013), in laying quail (Önol *et al*., 2003), and in broiler turkeys (Özsoy and Yalçın, 2011). Also, Yousefi and karkoodi (2007) found that different levels of dietary yeast (0.05, 0.1, and 0.15%) were not affected feed consumption and feed conversion ratio of laying hens. Additionally, Kim *et al*. (2002) stated that, feed consumption values were not statistically different among yeast feeding groups and control.

Referring to egg production, the present results in Table 2 indicated that, laying hens fed 0.6% yeast produced 46 eggs, which was slightly higher than those of control, 0.2 and 0.4% yeast-treated groups (44, 44 and 45 eggs respectively). Although, the differences in egg number and egg weight between yeast-treated hens and control group were not statistically significant a numerical increase was observed. Similar results were reported by Ayanwale *et al*. (2006); Asli *et al*. (2007); Yousefi and Karkoodi (2007); Yalçin *et al*. (2008); Yalçın *et al*. (2012); Gül *et al.* (2013) and Sacakli *et al*. (2013).

Also, the present results are in agreement with those of Nursoy *et al*. (2004), who found that egg production and egg weight were not affected by adding yeast to laying hen diets. Similarly, the results of Liu *et al*. (2002), Gürbüz *et al*. (2011) and Yalçin *et al*. (2014) illustrated that egg production for laying hens supplemented with yeast was slightly increased, while egg weight and feed conversion were not affected. On the other hand, Özsoy *et al*. (2018) obtained a decrease in feed consumption and an increase in egg production by feeding laying hens diet supplemented with 0.2% yeast/kg. Tapingkae *et al*. (2018) found that, no significant differences in feed intake, hen-day egg production, and egg weight between yeast-supplemented groups and control group.

Generally, Hassanein and Soliman (2010) observed an increase in egg production in

laying hens by increasing yeast supplementation levels in their diet (0.4, 0.8, 1.2, and 1.6%).

The obtained results in Table 2 indicated that the eggshell weight and breaking strength values were not significantly differ between control group and yeast-treated groups at levels of 0.2 and 0.4%. While their values were significantly higher in 0.6% yeast-treated group comparing with control and other yeast-treated groups. Also, the results showed no significant difference in eggshell thickness between control and 0.2% yeast-treated group (Table 2). Whereas, eggshell thickness values were significantly higher for both 0.4 and 0.6% yeast-treated groups over than 0.2% and control groups. However, the highest value was recorded for the eggs of o.6% yeast-treated group. The significant improvement in the eggshell weight and thickness in the present study may be due to the enhancement of calcium absorption and retention associated with adding high concentration of yeast into the diets (Tangendjaja and Yoon, 2002). These results are in agreement with Park *et al*. (2001), who reported that hens fed diets supplemented with yeast produced less soft shell and broken egg than the control. Vice versa, Özsoy *et al*. (2018) reported that dietary yeast culture supplementation had no significant effect on eggshell weight.

Furthermore, the yeast protein extract contains nucleotides, which reportedly stimulated development of gastrointestinal tract. Hassanein and Soliman (2010) found that inclusion of 0.4 or 0.8% live yeast into laying hen diets improved the productive performance and nutrient utilization, which may be returned to the inhibitory effect of yeast against pathogenic bacteria.

Present study showed that administrated of yeast in laying hen diets significantly ($P \leq 0.05$) lowered serum total lipids, cholesterol and triglycerides levels compared with unsupplemented control group (Table 3). However, the lowest concentrations of total lipids, cholesterol and triglycerides were recorded for hens fed diet supplemented with 0.6% yeast. Also, egg yolk and liver tissues cholesterol contents were significantly ($P \leq 0.05$) lowered in yeast supplementation hens than control ones (Table 4). The lowest yolk and liver cholesterol values were recorded for 0.6% yeast-treated group. Meanwhile, there were no significant differences in both yolk and liver cholesterol contents between 0.2 and 0.4 yeast-treated groups which took intermedium place between control and the high level of dietary added yeast (0.6%) (Table 4).

Guo and Zhang (2010) reported that, the decrease of blood cholesterol concentrations in yeast-treated hens may be due to the incorporation and assimilating cholesterol into the cellular membrane of the microorganism thus, in turn reduces cholesterol absorption. Also, the decrease of blood cholesterol level could be attributed to bile salts deconjugation, which are less depressed absorbed in the gastro-intestinal tract (Guo and Zhang, 2010). Additionally, the major components of yeast cell wall viz. mannan-oligosaccharides and ß-glucan have been proved to lower the cholesterol concentration in serum and egg yolk in laying hen (Yalcin *et al*., 2010).

The obtained results are in agreement with previous studies on Hyline Brown laying hens (Yalcin *et al*., 2015), Lohmann Brown laying hens (Yalcin *et*

al., 2008) and Brown Nick laying hens (Yalçın *et al*., 2012). Also, the present results are in agreement with those of Yalçin *et al*. (2010 and 2014), who found that dietary yeast supplementation caused a reduction in serum total lipids, cholesterol, and triglycerides concentrations in laying hens. Similary, Panda *et al*. (2003) obtained a reduction in liver tissues and egg yolk cholesterol concentrations by using yeast in laying hen diets. In addition, Tapingkae *et al*. (2018) reported that, the cholesterol and triglyceride of serum and yolk were significantly ($P < .05$) lowered in the laying hens fed diet administrated with yeast compared to the control-untreated hens.

The reduction in cholesterol level in serum and egg yolk could be explained by the reduced absorption and/or synthesis of cholesterol in the gastrointestinal tract. Krasowska *et al*. (2007) revealed that yeast *(Saccharomyces)* strains can remove cholesterol from the growth medium. *Saccharomyces* has been demonstrated to have certain physiological and growth characteristics including evidence that it can assimilate cholesterol. Research and commercial interest surrounds the biotherapeutic properties of different yeasts and those of cholesterol-lowering activity have attracted specific attention. In view of the impetus towards lowering cholesterol through dietary modifications and speculation, yeast could provide a means to lower serum cholesterol (Krasowska *et al*., 2007).

Conclusion

From these results, it could be concluded that supplementation of yeast in laying hens diet significantly reduced feed consumption, blood, liver and egg yolk cholesterol content and improved eggshell (thickness and breaking strength). However, the best results were achieved by using yeast at level of 0.6%.

Table (1): Composition and calculated analysis of the basal diet

Feed Ingredient	Percentage (%)
Yellow corn	59.93
Soybean meal (48%)	24.23
Corn gluten meal	2.0
Calcium carbonate	9.16
di-calcium phosphate	1.84
Oil	2.0
NaCl	0.364
Methionine	0.076
Premix*	0.4
Total	100
Calculated analysis:	
ME (kcal/kg)	2806
Protein (%)	17.39
Calcium (%)	3.97
Av. Phosphorus (%)	0.465
Meth. + Cyst (%)	0.66
Lysine (%)	0.86

*Vitamins and minerals Premix: each 1 kg supplied the following per kilogram of diet;vit. A: 12000 lu,
vit. D3: 3000 lu, vit. E.: 12 mg. vit. B12 0.02 mg, vit. B1 1 mg, Choline chloride 0.16 mg, Copper 3 mg, Iron 30 mg. Manganese 40 mg, Zinc 45 mg and Selenium 3 mg.

Table (2): The effects of dietary yeast supplementation on performance and eggshell traits of laying hens

Treatments / Parameters	Yeast %			
	Control	**0.2**	**0.4**	**0.6**
Feed consumption (g/hen/day)	131.34 ± 10.54^{a}	129.15 ± 9.75^{b}	129.12 ± 10.52^{b}	126.62 ± 9.96^{c}
Feed conversion ratio (g feed/g egg)	2.069±0.10	2.063±0.11	2.061±0.12	2.048 ±0.11
Egg production (No.)	44.0±0.54	44.0±0.61	45.0±0.42	46.0±0.38
Egg weight (g)	61.75±0.42	61.80±0.39	62.12±0.41	62.34±0.33
Eggshell weight (g)	5.76 ± 0.11^{b}	5.75 ± 0.14^{b}	5.82 ± 0.10^{b}	6.00 ± 0.10^{a}
Eggshell thickness (mm)	0.332 ± 0.02^{c}	0.334 ± 0.03^{c}	0.339 ± 0.01^{b}	0.344 ± 0.02^{a}
Eggshell strength (Kg/cm^2)	3.54 ± 0.09^{b}	3.58 ± 0.11^{b}	3.56 ± 0.08^{b}	3.75 ± 0.09^{a}

*Values are expressed as means ± standard error of the mean.
[a, b, c] Means with different superscripts, within row, are significantly differ ($P\leq0.05$).

Table (3): The effect of dietary yeast supplementation on some lipid profile (mg/dl) of laying hens.

Treatments / Parameters	Yeast %			
	Control	**0.2**	**0.4**	**0.6**
Total lipids	335.60±5.22[a]	314.40±6.17[b]	290.4±3.89[c]	275.8±3.86[d]
Total cholesterol	135.8±3.85[a]	129.01±4.12[b]	125.1±3.77[b]	114.6±3.54[c]
Triglycerides	199.8±4.10[a]	187.40±4.72[b]	161.4±4.12[c]	150.2±4.17[d]

*Values are expressed as means ± standard error of the mean.
[a, b, c] Means with different superscripts, within row significantly differ (P < 0.05).
N = 15 per treatment.

Table (4): The effects of dietary yeast supplementation on egg yolk and liver cholesterol contents

Treatments / Parameters	Yeast %			
	Control	**0.2**	**0.4**	**0.6**
Yolk cholesterol (mg/g of yolk)	12.96 ± 0.91[a]	10.95±0.81[b]	10.56± 0.52[b]	8.17 ± 0.61[c]
Liver cholesterol (mg/g tissue)	4.40 ± 0.11[a]	3.92 ± 0.12[b]	3.76 ± 0.10[b]	3.12 ± 0.09[c]

*Values are expressed as means ± standard error of the mean.
[a, b, c] Means with different superscripts, within row significantly differ (P < 0.05).
N = 15 per treatment.

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الملخص العربي
تأثير اضافة الخميرة للعلائق علي الاداء الانتاجى و جودة قشرة البيضة و مستوى الليبيدات فى الدجاج البياض

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اشتملت هذه الدراسة علي 180 دجاجة بياضة من سلالة الايزابراون ، عمر 40 اسبوع لدراسة تأثير اضافة الخميرة للعلف علي الاداء الانتاجى و مستوى الكوليسترول فى الدم و البيض للدجاج البياض. قسمت الدجاجات الي اربع مجموعات متساوية بكل منها 3 مكررات و كل مكرر 15 دجاجة. غذيت المجموعة الاولي على عليقة اساسية بدون اضافات واعتبرت مجموعة المقارنة ، بينما تغذت مثيلاتها بالمجموعات الثانية و الثالثة والرابعة على نفس العليقة الأساسية مضافا اليها الخميرة بمستوي 0,2 ، 0,4 و 0,6 % علي التوالي لمدة ثمانية اسابيع. تم تغذية جميع الدجاجات على العلائق المختلفة لحد الشبع ، وعرضت لـ 16 ساعة اضاءة يومياً طوال فترة التجربة.

تم قياس كل من استهلاك العليقة و معدل التحويل الغذائي للبيض، عدد و وزن البيض ، سمك و وزن قشرة البيضة و قوة تحمل القشرة للكسر (معامل الكسر)، محتوي سيرم الدم من كل من الدهون الكلية و الكوليسترول و الجليسريدات الثلاثية و محتوي صفار البيض و انسجة الكبد من الكوليستيرول.

اوضحت النتائج وجود انخفاض معنوي في كمية الغذاء المستهلك للدجاجات المعاملة بالخميرة و قد سجلت المجموعة الرابعة (0.6% خميرة) اقل كمية غذاء مستهلك مقارنة بباقي المجموعات بينما لم تتحسن الصفات الانتاجية الاخري باضافة الخميرة للعليقة. تحسنت معنوياً صفات قشرة البيضة (وزن القشرة وسمكها وقوة تحملها للكسر) فى المجموعة المغذاة علي عليقة مضاف اليها الخميرة بمستوى 0.6% مقارنة بمجموعة المقارنة و باقي المجموعات المعاملة.

كما اظهرت النتائج انخفاض معنوي بمحتوي سيرم الدم من الدهون الكلية و مستوي كل من الكوليسترول و الجليسريدات الثلاثية و محتوى صفار البيض و انسجة الكبد من الكوليسترول لجميع معاملات الخميرة مقارنة بمجموعة المقارنة و قد تحققت افضل النتائج بإضافة الخميرة للعليقة بمستوي 0.6%.

من هذة الدراسة يمكن استنتاج ان اضافة الخميرة لعلائق الدجاج البياض ادى الي خفض كمية الغذاء المستهلك كما ادى الي تحسن صفات قشرة البيضة بالاضافة الي خفض محتوى الدم و الكبد و صفار البيض من الكوليستيرول و قد تحققت افضل النتائج باضافة الخميرة بمستوى 0.6%.

الكلمات الدالة: الخميرة ، الدجاج البياض، الاداء ، جودة البيض ، الكوليسترول