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EFFECT OF ADDING DRY YEAST OR *ASPERGILLUS AWAMORI* AS NATURAL ANTIOXIDANTS TO DIETS CONTAINING OXIDIZED PALM OIL ON THE PERFORMANCE OF GIMMIZAH LAYING HENS

A. M. H. Abou–Ashour, G. A. Zanaty and Esraa Y. F. Ata Alah
Department of Poultry and Fish production, Faculty of Agriculture, Menoufia University, Shibin El – Kom, Egypt.

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ABSTRACT: In this study, one hundred and eighty (180), 28 weeks old Gimmizah laying hens were used to study the effects of adding a probiotic (dry yeast or Aspergillus awamori) as natural antioxidant agents to diets containing oxidized palm oil on the productive performance, egg quality traits, some blood components, economic efficiency and relative economic efficiency of Gimmizah laying hens. Hens were distributed at random into 6 similar treatment groups. Each treatment group was divided into 3 replicates of 10 layers each in a completely randomized design. Layers were housed in individual cages. The first group was fed a basal diet contains 16.41% crude protein, 2748 ME kcal/ kg diet (positive control). The second group was fed basal diet contained 2% oxidized dietary palm oil supplementation (negative control). Other groups three and four were fed negative control supplemented with 0.5% and 1% dry yeast (*Saccharomyces cervices),* respectively. While, five and six groups were fed the negative control with 0.5% and 1% *Aspergillus awamori,* respectively. Results obtained; the addition of 1% *Aspergillus awamori* to the negative control group containing 2% of the oxidized palm oil improved: Hen-day egg production percentage, egg weight, egg number and egg mass. Feed conversion ratio was significantly (P ≤ 0.05) improved by adding 0.5% or 1% of both dry yeast and *Aspergillus awamori* to the negative control diet. A significant increase in the amount of feed intake was observed compared to the negative or positive control. The 6th birds which feeding of the negative control diet + 1%*Aspergillus awamori* significantly recorded the highest improvement in egg shell quality (weight, percentage and thickness) also the highest value of egg shape index at the age of 40 weeks. Some of the qualities of albumen, yolk and Haugh units were also improved. The addition of 1% *Aspergillus awamori* to the negative control diets (the basal diet + 2% oxidized palm oil) resulted in a significant improvement in some traits of blood plasma (total protein, albumin, globulin and AST enzyme in comparison with the positive and the negative control diets. A significant decrease was observed in the level of total cholesterol and triglyceride concentration as well as LDL, while HDL was significantly increased (P ≤ 0.05) in the blood plasma by increasing the levels of probiotics (dry yeast or *Aspergillus awamori*) added to negative control. The best economic efficiency and relative economic efficiency for the sixth treatments were observed at the level of 1% *Aspergillus awamori* compared to other treatments.

Conclusion: The obtained results in the present study encouraging and indicated that adding 1% of probiotics (dry yeast or *Aspergillus awamori*) as antioxidant agents to the basal diet containing 2% of oxidized palm oil led to a significant improvement in productive performance, egg quality traits, some blood traits, economic efficiency and relative economic efficiency of Gimmizah laying hens under experimental conditions.

Key words: **Oxidized palm oil, *Saccharomyces cervices, Aspergillus awamori,* egg production, egg quality traits, Plasma blood parameters, blood lipid profile and laying hens.**

INTRODUCTION

Poultry production is a business which like any other business seeks to generate profit, one of the objectives of any poultry producer is to keep the balance between low coast diets with the least coast and obtain the maximum productivity (Ahiwe, *et al.,* 2018). Oils are added into poultry diets to supply energy and essential fatty acids, as a vitamin vehicle, and to alleviated acute heat stress (Mujahid *et al.,* 2009). Vegetable oils contain large amounts of polyunsaturated fatty acid, such as palm oil, which is susceptible to peroxidation (Liu *et al.,* 2014).

Heated oils contain various amounts of peroxidation products (Zhang *et al.,* 2012), such as 4-hydroxynonenal, hydroperoxide, malondialdehyde, and 2,4-heptadienal (Choe and Min, 2007), which influence oil odor, palatability, and quality (Smyk, 2015).

Several studies reported that the consumption of oxidized fats affects metabolism in several ways (Skufca, *et al.,* 2003), in multiple animal species (Ehr *et al.,* 2015), oxidized oils decrease feed intake, depress growth, and even cause disease. Feeding oxidized oils impaired the growth performance and induced oxidative stress in broiler and laying hens (Wang *et al.,* 2015). Feeding oxidized soybean oil impaired growth broilers and antioxidant activities (Tan *et al.,* 2018). In poultry, oxidative stress may occur due to several factors such as: a) feed (high concentration of polyunsaturated fatty acids [PUFA], contamination with fungal toxins, prolonged storage and antioxidant deficiency) (Chung, *et al.,* 2005), b) environmental (heat, high stocking density, transportation, and vaccination) (Panda, *et al.,* 2008), c) Pathological conditions (ascites, fatty liver haemmorrhagic disease syndrome arthritis and coccidiosis) (Iqbal, *et al.,* 2002).

Therefore, in recent years, different studies have been attempted to find nutrition-based on health strategies and natural alternatives instead of antibiotics and suggested that probiotics, prebiotics, organic acids or natural feed additives can replace the growth-promoting antibiotics and antioxidant properties (Abudabos *et al.,* 2017).

Among these feed additives, probiotics have drawn great attention. FAO/WHO (2001) describes probiotics as "live micro-organisms which" when administered in adequate amounts, confer a health benefit on the host. Probiotics are live microbial culture, such as bacteria, yeast and fungi, which influence the health and nutrition of the host by improving its intestinal microbial balance (Zarei *et al.,* 2018).

***Aspergillus awamori*, a variant of *Aspergillus niger*, is one of the fungi had long been used for processing foods because it safe, produce enzymes such as amylase, protease, pectinase and lipase, and thus enhances the digestion of carbohydrates, proteins and lipids. Also, feasible yeast feedstuffs are normally included into poultry diets as probiotic. Also, *Saccharomyces cerevisiae* has biologically valuable proteins, vitamin B-complex, mannan oligosaccharide, important trace minerals and several unidentified growths promoting factors. Yeast contains digestible proteins especially in the form of free amino acids and peptides, functional nucleic acids and natural immune enhancer such as β-glucan and mannan oligosaccharides.**

Inclusion of probiotic in the diet has been found to improve egg production and feed conversion ratio (Chung *et al.*, 2015). Furthermore, giving probiotics to laying hens has been found to improve

eggshell quality and feed efficiency (Sobczak and Kozłowski, 2015).

Therefore, this study was conducted to investigate the effects of adding probiotic (dry yeast or *Aspergillus awamori*) as antioxidant agents to diets containing oxidized palm oil on the productive performance, egg quality traits, some blood components, economic efficiency and relative economic efficiency of Gimmizah laying hens.

MATERIALS AND METHODS

The experiment was performed at a private farm in Tanta, Gharbia Governorate, Egypt, during the period from December 2017 to February 2018. This experiment was conducted to investigate the effects of adding probiotics (dry yeast or *Aspergillus awamori*) as antioxidant agents to diets containing oxidized palm oil on the productive performance, egg quality traits, some blood components, economic efficiency and relative economic efficiency of Gimmizah laying hens.

1- Birds:

One hundred and eighty (180), 28 weeks old Gimmizah laying hens were used in this experiment. Hens were distributed at random into 6 similar treatment groups and divided into 3 replicates of 10 layers each in a completely randomized design. Layers were housed in individual cages with a size of 44 H × 30 W × 45cm L and were equipped with nipple drinkers and trough feeders.

2- Feeds and feeding:

The composition of the basal diet (T_1; positive control) is given in Table 1. The first group was fed a basal diet contains 16.41% crude protein, 2748 ME kcal/ kg diet (positive control). The second group was fed basal diet contained 2% oxidized dietary palm oil supplementation (negative control). Other groups three and four were fed negative control supplemented with 0.5% and 1% dry yeast (*Saccharomyces cervices*), respectively. While, five and six groups were fed the negative control with 0.5% and 1% *Aspergillus awamori,* respectively. Oxidized palm oil, (200 mEq of peroxide number/ kg oil) was prepared at laboratories of Agriculture research center, Ministry of Agriculture, by aeration the refind palm oil at 145C^{o} for 24 hours (Dror *et al.,* 1976).

The peroxide value was calculated as follow:

Peroxide number (mEq/ kg oil) = Volume of thiosulphate × Standard (0.01) × 1000 ÷ Weight of sample.

While, the probiotic microbial strains used in this study were obtained from Microbiological Research Center (Cairo, Egypt). The probiotic consists of *Aspergillus awamori* spores was about 25 x 10^4 g. Also, dried active yeast *S.cerevisia* factory strain, used in this study, was provided by a commercial company (The Egyptian Company for Starch, Yeast and Detergents, Co., Ltd.; Alexandria, Egypt). The number of saccharomyces cervices F- 7 visiae factory strain 27 spores was CFU 2 x10^{10} g. Probiotic and dry yeast were in dried powder form and were thoroughly mixed in the negative diet.

Mixing of oxidized palm oil supplemented diets was done weekly and nutrient requirements were calculated recommend by the National Research Council (NRC, 1994). Feed and water were provided *ad libitum* during the experimental period. Artificial light was used beside the normal day light to provide 16 hour photo period from 06 am to 10 pm. The laying hens were kept in optimal and standard bio – climatic and welfare conditions and average

temperature was 26.0 ± 3.0 C° during the experimental period.

Table 1. Composition and chemical analysis of the experimental laying diets.

Ingerdiets	Positive control (%)	Negative controle (%)
Ground yellow corn (8.5%).	64.98	58.30
Soybean meal (44%).	24.68	24.19
Wheat bran (15%).	0.21	5.38
Oxidized palm oil.	-	2.00
Limestone ground.	7.49	7.49
Di-calcium phosphate.	1.95	1.95
Vitamin and mineralmi mixture[1].	0.30	0.30
Dl-Methionine[2].	0.06	0.06
Sodium cholorid (salt).	0.33	0.33
Total	100	100
Caculated values[3]:		
Crude protien, CP (%).	16.41	16.41
ME, kcal/ kg diet.	2748	2735
C/ p ratio.	167	167
Lysine, %.	0.83	0.83
Methionine, %.	0.33	0.33
Calcium, %.	3.38	3.38
Av. Phosphorus, %.	0.52	0.52
Determined values:		
Dry matter, %.	90.27	90.11
Crude proteine, %.	16.44	16.40
Ether extract, %.	2.29	3.01
Crude fiber, %.	3.12	3.46
Calcium, %.	3.44	3.40
Av. phosphorus, %.	0.50	0.51

[1]Vitamin and Mineral mixture at 0.30% of the diet supplies the following per kilogram of the diet: Vitamin A 12,000 IU, vitamin D_3 3,000 IU, vitamin E 40 mg, vitamin K_3 3 mg, vitamin B_1 2 mg, vitamin B_2 6 mg, vitamin B_6 5 mg, vitamin B_{12} 0.02 mg, niacin 45 mg, biotin 0.075 mg, folic acid 2 mg, pantothenic acid 12 mg, manganese 100 mg, zinc 600 mg, iron 30 mg, copper 10 mg, iodine 1 mg, selenium 0.2 mg, cobalt 0.1 mg.

[2]DL – Methionine: 98% feed grade (98 % Methionine).

[3]Calculate according to NRC (1994).

3. Parameters were measured and obtained:

3.1. Egg number, egg weight and egg mass.

Daily egg production for each dietary treatment group and individual egg

weight were recorded. Means of egg weight as well as egg mass of each treatment group were determined. Egg production performance was also considered during experimental period.

3.2. Feed intake and feed conversion ratio for egg production.

Total Feed intake/ dietary treatment group/ day was recorded and expressed as feed (g)/ bird/day. Feedconversion ratio was determined as feed (g)/ egg mass (g).

3.3. Egg quality traits.

Nine eggs (9) were randomly collected from each dietary treatment groups were at 40 weeks of age for the determination of the following egg quality traits:

3.3.1. External egg quality measures.

a. Egg shape index (ESI) (%):

Egg shape index were calculated from length and width, measure by digital a tripod micro meter according to Romanoff and Romanoff (1949) as follows: Egg shape index= width (mm)/ length (mm) ×100.

b. Eggshell quality.

- Eggshell thickness (ST), without its membranes, was determined according to Brant and Shrader (1952) by using micrometer (to the nearest 0.01 mm) at the broad, narrow and the middle ends. Average of shell thickness for all three regions were calculated.
- Eggshell weight and eggshell percent were calculated as follows:

Eggshell percent = eggshell weight,g/ egg weight,g ×100.

3.3.2. Internal egg quality measures.

Eggs were individually weighted, then broken on a flat glass plat and thick albumen and yolk heights were measured to the nearest (mm) with a tripod micro meter, yolk diameter was also recorded to the nearest (mm) with a digital caliper according to Funk (1948) and Romanoff and Romanoff (1949), these data used to estimate the yolk index value:

a. Egg yolk index (%).

It was estimated as a ratio between yolk height (mm) and its widths (mm.) as follows:

Yolk index (YI, %) = yolk height (mm)/ yolk width (mm) ×100.

b. Egg yolk visual color.

The egg yolk visual color was determined by matching the yolk with one of the 15 bands. The Roche yolk color fan-an instrument for measuring yolk color by (Rauch, 1961).

c. Egg albumen index (%).

It was calculated from albumen (A) height (mm) and width (mm) that were measured with a tripod micrometer according to Romanoff and Romanoff (1949) as follows:

Albumen index (AI, %) = albumen height (mm)/ albumen width (mm) × 100.

d. Haugh unit.

It was applied from a special chart using egg weight and albumen height which was measured using a tripod micro - meter according to Haugh (1937), Eisen *et al.* (1962) and Kotaiah and Mohapatra (1974) as follows:

Haugh unit = $100 \log (H + 7.57 - 1.7 w^{0.37})$

Where: H = albumen height (mm)

w = egg weight (g).

3.4. Blood parameters and blood lipid profile:

At the end of the experiment (40 weeks of age), blood samples were taken from the wing vein from 3 laying hens / treatment. Blood samples were collected in sterile heparinized centrifuge tubes. Plasma samples were separated by centrifugation at 3000 rpm. for 15 min and then stored frozen at – 20C° for the

determination of total protein, albumin, and glucose and liver enzymes as (ALT and AST) and (lipid profile (triglycerides, total protein, HDL and LDL).

a. **Total protein concentration (TP):** It was quantitatively measured as (g /dl) based on colorimetric determination as described by Henry *et al.* (1974).
b. **Albumin concentration (Alb):** It was determined as (g/ dl) by using special kits delivered from sentinel CH. Milano, Italy according to the method of Doumas *et al.* (1977).
c. **Globulin concentration:** It was calculated by subtracting the values of the albumin from total protein values.
d. **Glucose concentration (Glu.):** It was measured as (mg/ dl) by the method of Trinder (1969) using commercial kits delivered from Linear chemicals Cromatest, Barcelona (Spain) by means of spectrophotometer.
e. **Liver function:** The transaminase enzymes activities of serum alanine aminotransferase (ALT) and plasma asparate amino transferase (AST), were determined by calorimetric method of Reitman and Frankel (1957).
f. **Blood lipid profile:** Total triglyceride, total cholesterol, high–density lipoprotein (HDL) and low–density lipoprotein (LDL) were determined in plasma blood Gimmizah hens.

f.1. Total triglyceride concentration (TG): It was determined as (mg/ dl) depending on the method of Allain *et al.* (1974).

f.2. Total cholesterol concentration (Cho): It was determined as (mg/ dl) on individual base using the specific kits according to the recommendation of Bogin and Keller (1987). High–density lipoprotein (HDL) and low–density lipoprotein (LDL) were detwrmined, using an ultraviolet spectophotomater UV 4802 (Unico, Dayton, US) and commercially available kits (Biosystem S.A, Costa Brava,30, Barcelone, Spain).

3.5. Chemical analysis of feed samples:

The composition of the experimental basal diets were based in tabulated values for feed stuffs NRC (1994). Feed samples of the experimental basal diets were taken for proximate analysis. Moisture, crude protein, ether extracet, crude fiber and ash were determind according to the official methods of AOAC (2005).

3.6. Economic efficiency.

Economic efficiency for egg production was calculated from the input – output analysis (Heady and Jensen, 1954), according to the price of the experimental diets and egg production. Values of economic efficiency were calculated as the net revenue per unit of total costs (Soliman and Abdo, 2005).

3.7. Statistical analyses.

The experiment was conducted using a completely randomized design using SPSS (2011) program and the difference among treatment means were determined using Duncan's multiple range test (Duncan, 1955). Percentages were transformed to the corresponding arcsine values before performing statically analysis.

Statically model:

$$Yij = \mu + \alpha i + Eij.$$

Where:
Yij = observed traits,
μ = overall mean,
αi = effect of treatment (i = 1, 2, 3,…..6).
Eij = experimental random error.

RESULTS AND DISCUSSION

Effect of dietary oxidized palm oil and probiotic on the productive performance of laying hens.

1- Egg production traits.

1.1. Egg number.

Data in Table (2) indicated that egg number/ hen was significantly increased. Egg number values were 50.20, 50.94, 51.00 and 52.05eggs/ hen for 0.5 and 1% *Saccharomyces cerevisia* and 0.5 and 1% *Aspergillus awamori,* respectively. Average of 41.73 eggs/ hen was obtained for the negative control diet (basal diet with 2% oxidized palm oil) compared to 47.70 eggs/ hen for the positive control (basal diet). The findings reported by different authors concerning that egg number indicate wide variability with respect to the effect of dietary dry yeast and probiotic Maziar *et al.* (2007), similarly to the results obtained in this experiment, Saleh *et al.* (2017) and Kaiaty *et al.* (2019) reported a significant improvement in performance and egg number in hens fed diet supplemented with a product containing *Aspergillus awamori* and dry yeast. The presented data are dis agree with those of Elnagar (2013) who reported that yeast supplementation at levels of 3 or 6g/ kg diet significantly decreased egg number.

1.2. Egg weight.

Experimental results indicated that egg weight was increases with dry yeast and probiotic supplementation (Table 2). Means of egg weight were 52.45, 52.86, 53.98, 54.01 and 54.33g for the positive control, 0.5 and 1% *Saccharomyces cerevisia* and 0.5 and 1% *Aspergillus awamori* supplemented diets, respectively. The highest value of average egg weight noted when laying hens fed 1% *Aspergillus awamori*, (T_6, 54.33g) compared to 52.00g in the negative control diet which recorded the lowest value. These results are in agreement with those of Chumpawadee *et al.* (2009) who found a significant difference were observed in egg weigh by addition of Cassava yeast as probiotic source. Similar significant results in egg weight were also obtained in hens fed diets supplemented with a mixture of probiotic content *Lactobacillus* cultures (Kalavathy *et al.,* 2009 and Saleh *et al.,* 2017).

In contrast, our results are opposite to the results of Gül *et al.* (2013); Sacakli *et al.* (2013); Yalçin *et al.* (2014) and Tapingkae *et al.* (2018) who stated that, egg weight was not affected by adding yeast into diet.

1.3. Egg mass.

Diets supplemented with oxidized palm oil and probiotic, generally, resulted in a higher egg mass (Table 2) during the different experimental periods. Egg mass was significantly increased ($P \leq 0.05$) with increasing dry yeast and probiotic levels (0.5 and 1%) being 31.59, 32.74, 32.79 and 33.67g/ hen for T_3, T_4, T_5 and T_6, respectively compared to those fed positive and negative control diets (29.78 and 25.83g/ hen, respectively). Results reported herein are in harmony with these obtained by others researchers reported that egg mass was increased by the dietary supplementation of yeast, yeast products and *Aspergillus awamori* (Yalcin *et al.,* 2010 and Saleh *et al.,* 2017). The high inclusion of yeast level has an adverse effect on nutrient digestibility (Romashko, 1999).

1.4. Egg production, %:

Experimental results on the effect of dietary oxidized palm oil and probiotic (*Saccharomyces cerevisia* and *Aspergillus awamori*) supplementation on egg production percentage at 40 wk of age are shown in Table (2). It observed that percentage of egg production was significantly increased ($P \leq 0.05$). Average of 49.68 % was obtained for the negative control diet (basal diet with 2% oxidized palm oil) in comparison with 57.03% for the positive control (basal

diet). In general, greater improvement 61.91% for egg production was obtained at level of 1% *Aspergillus awamori*, T_6 compared to other treatments (59.23, 60.43 and 60.65%) for T_3, T_4 and T_5, respectively.

The differences between the results of the present study and those of previous studies may be due to the species and age of the birds, dietary nutrient composition, type, dosage and composition of yeast and probiotic in the diets and environmental conditions. *Saccharomyces spp* supplementation

Table 2. Effect of dietary oxidized palm oil and probiotic on the productive performance of Gimmizah hens (Means ± S. E).

Items	Dietary treatments[1]						Sig.
	T_1	T_2	T_3	T_4	T_5	T_6	
Egg number (per hen /28-40 wks).	$47.70^{b} \pm 0.40$	$41.73^{c} \pm 0.28$	$50.20^{ab} \pm 0.41$	$50.94^{a} \pm 0.37$	$51.00^{a} \pm 0.41$	$52.05^{a} \pm 0.39$	*
egg weight (g).	$52.45^{c} \pm 0.29$	$52.00^{d} \pm 0.13$	$52.86^{c} \pm 0.16$	$53.98^{b} \pm 0.23$	$54.01^{b} \pm 0.18$	$54.33^{a} \pm 0.35$	*
Egg mass (g/ h/ d).	$29.78^{c} \pm 0.75$	$25.83^{d} \pm 0.54$	$31.59^{bc} \pm 0.80$	$32.74^{ab} \pm 0.78$	$32.79^{b} \pm 0.86$	$33.67^{a} \pm 0.79$	*
Egg production, % (hen-day).	$57.03^{d} \pm 1.32$	$49.68^{e} \pm 0.94$	$59.23^{c} \pm 1.38$	$60.43^{b} \pm 1.24$	$60.65^{b} \pm 1.62$	$61.91^{a} \pm 1.28$	*
Feed intake (g/ hen/d)	$111.07^{c} \pm 0.87$	$105.33^{e} \pm 1.62$	$113.71^{c} \pm 0.70$	$115.19^{ab} \pm 0.50$	$115.09^{b} \pm 0.50$	$116.68^{a} \pm 0.54$	*
Feed conversion ratio (g feed/ g egg mass)	$3.73^{c} \pm 0.07$	$4.08^{a} \pm 0.09$	$3.60^{b} \pm 0.11$	$3.52^{d} \pm 0.08$	$3.51^{d} \pm 0.09$	$3.46^{e} \pm 0.07$	*

T_1: Positive control. T_2: Negative control (Positive control + 2% oxidized palm oil), T_3: Negative control + 0.5% dry yeast, T_4: Negative control + 1% dry yeast. T_5: Negative control + 0.5% *Aspergillus awamori* and T_6: Negative control + 1 % *Aspergillus awamori*.

[2] means ± SE of 3 replicates / treatment.

[3]a, b…… Means the same raw (for treatments) with different super scripts are significantly different ($P \leq 0.05$).

increased egg production and its total weight, this may be due to the fact that the present of probiotic in the digestive tract of poultry may improve digestibility of nutrients, particularly of protein and minerals (Bidura *et al.,* 2012). The improvement in egg production due to low level of yeast inclusion is in agreement with the result of Yörük *et al.* (2004) and Shareef and Al-Dabbagh (2009) who observed higher percentage of egg production for hens fed yeast and probiotic supplemented diets than the control hens. Maziar *et al.* (2007) indicated that dietary supplementation of probiotics, yeast, vitamin E and vitamin C during heat stress caused higher egg production than control group. Similar results have also been obtained by some researcher Chumpawadee *et al.* (2009) reported considerable improvement in egg production in poultry fed dry yeast. Also, the improvement in egg production in layers might be explained that the dry yeast reduces the pathogenic bacteria load in the intestine and then the nutrients in the diets are efficiently diverted toward production in poultry fed yeast, which might improve egg production in layers (Spring *et al.,* 2000). Raka *et al.* (2014) reported that the highest hen day production was in layers fed diet supplemented with Liquid Probiotics Mixed Culture (LPMC) containing two types of microorganisms, *Lactobacillus* and *Bacillus* species. Bidura and Partama (2016) noticed that layers having probiotic supplementation (0.20, 0.40, and 0.60 g of *Saccharomyces* spp. SB-6/ kg of diet) had a significant increase ($P \leq 0.05$) in egg production (hen-day production) compared to control birds, Saleh *et al*. (2017) reported that feeding *Aspergillus awamori* (AA) significantly increased egg production. Özsoy *et al.* (2018) obtained an increase in egg production by feeding laying hen's diet supplemented with 0.2% yeast/ kg diet. Instead Daneshyar *et al.* (2009) reported that the addition of probiotics did not have significant effect on egg production and egg mass. Sacakli *et al.* (2013) and Tapingkae *et al.* (2018) recorded that dietary supplementation of yeast did not significantly affect hen day egg production of laying hens.

2- Feed intake and feed conversion ratio.

2.1. Feed intake.

Results in Table (2), showed that feed intake, FI, (g/ hen/ day) was significantly increased by adding dry yeast or *Aspergillus awamori* compared to the positive and negative control group. Highest value of feed intake was (116.68g/ h/ d) in; hens fed 1% *Aspergillus awamori* in comparsion with other treatments. The beneficial effect of *Saccharomyces cerevisiae* is attributed to the fact that it is a naturally rich source of proteins, minerals and B complex. Elnagar, (2013); Zhang and Kim (2014) and Hussein and Selim (2018) reported an increase in feed intake in chicken fed with multi strain probiotics and yeast addition to the diet. On the other hands, Kim *et al.* (2002) stated that, feed intake values were not statistically different among yeast feeding groups and control. Previous study reported by some research workers for laying hens (e.g. Wibawa *et al.,* 2014 and Bidura and Partama, 2016) and for broilers (Chumpawadee *et al.,* 2009). They studied the effect of yeasts inclusion in the diet and noted that feed intake was not affected by the supplementation. The obtained results are compatible with Bansalyz *et al.* (2011) and Yalcin *et al.* (2012) who found that the feed intake of broilers and laying hens fed diet supplemented with *Saccharomyces cerevisiae* were remarkably decreased than that of the control. studies indicated that dietary yeast supplementation didn't affect feed intake in laying hens (Asli *et al.,* 2007 and

Sacakli *et al.,* 2013), laying quail (Önol *et al.,* 2003), and in broiler turkeys (Özsoy and Yalcin, 2011). Also, Saleh *et al*. (2017) reported that feed intake was decreased by the combination of *Aspergillus awamori* (0.05% AA) and lactic acid bacteria (0.10% LAB). El-Kaiaty *et al.* (2019) found that feed intake for yeast-treated hens was significantly ($P \leq 0.05$) lowered than that of the control group, the lowest feed intake value was recorded for 0.6% yeast supplemental group.

2.2. Feed conversion ratio.

Data on the effects of dietary supplementation on feed conversion ratio are presented in Table (2). Feed conversion ratio (FCR) was significantly ($P \leq 0.05$) improved due to probiotic (*Saccharomyces cerevisia* or *Aspergillus awamori*) supplementation at levels of 0.5 and 1%; being 3.60, 3.52,3.51 and 3.46g feed/ g egg mass for T_3, T_4, T_5, and T_6, respectively. In the absence of probiotic, feed conversion ratios were 4.08 and 3.73g feed/ g egg mass for negative control, T_2 (basal diet + 2% oxidized palm oil) and T_1, positive control treatments, respectively. The improvement in feed conversion ratio due to feeding *Aspergillus* may be due to that *Aspergillus* could improve the nutritional value of the soybean meal because the trypsin inhibitor contained in soybean could be degraded by *Aspergillus* (Hong *et al.*, 2004). Birds do not produce enzymes such as cellulase and xylanase, which are required for the digestion of soluble non – starch polysaccharides (NSP). Because *Aspergillus* produces these enzymes, it improves digestion, resulting in an increase in the metabolic energy of diets (Mohan *et al.*, 1996). These may be the major reason for the more efficient feed utilization in *Aspergillus* feeding. The improvement in feed conversion ratio due to feeding *Aspergillus* was in agreement with the results of previous studies (Saleh *et al.,* 2011 and Saleh *et al*., 2017). *Aspergillus* may also affect the activities of these enzymes in liver and adipose tissues and influence fat metabolism (Shen *et al.,* 1991 and Mersmann, 1998).

Results reported herein are in agreement with those obtained by Zhang *et al.* (2005) who observed an improvement in feed conversion ratio of laying hens fed yeast supplemented diets and Hussein and Selim (2018) showed an improvement in feed conversion ratio of broiler chickens fed dried yeast or probiotic. The improvement in feed conversion ratio may be attributed to the improvement in nutrients absorption and utilization associated with adding yeast which reduces the proliferation of enteric harmful bacteria that responsible of mal-absorption. Bradley and Savag (1995) observed an improvement in energy utilization due to feeding dietary yeast. Yalcin *et al.* (2010) reported that feed efficiency was improved with yeast autolysate supplementation at the level of 2, 3 and 4 g/ kg ($P \leq 0.05$). Some studies showed that probiotic supplementation on feed led to improvement in feed conversion ratio of broilers and layer hens as reported by Puspani *et al.* (2014) and Umiarti and Bidura (2014). El-Kaiaty *et al.* (2019) noticed that feed conversion ratio for yeast-treated hens was insignificantly improved compared to the control group. On the contrary, Sacakli *et al.* (2013) and Sakine *et al.* (2014) found that yeast and probiotic supplementation had no effect on feed conversion ratio in laying hens, which might be related to the strain of bacteria, concentration and the form of bacteria used (viability, dryness or their products).

3- Egg quality traits.

3.1. Egg shape index.

Effect of supplementation of probiotic

and oxidized dietary palm oil to layer diet on egg shape index during different periods of production (40 weeks of age) are shown in Table (3). Probiotic (*Saccharomyces cerevisia* and *Aspergillus awamori*) supplementation significantly improved egg shape index being values were 79.82, 80.16, 80.67 and 81.26% for 0.5 and 1% dry yeast (T_3 and T_4) and 0.5 and 1% *Aspergillus awamori* (T_5 and T_6) at 40 wks of age, respectively. No significance difference between treatment 5 and 6 were noted during 40 weeks of age. Chickens consuming the positive control (basal diet) had on egg shape values of 76.23% than those consumed the negative control (basal diet with 2% oxidized palm oil), had egg shape being 75.01%, respectively.

These results are dis agree with with Sakine *et al. (*2014) who reported that yeast cell wall; YCW supplementation had no significant effect on the mean values of egg shape index and the percentages of egg parts. Similarly yeast culture and yeast autolysate (Yalcin *et al.,* 2010) supplementation did not significantly affect interior and exterior egg quality characteristics.

3.2. Eggshell weight.

Findings on the effect of dietary probiotic supplementation on eggshell weight was presented in Table (3). Dietary probiotic supplementation significantly improved eggshell weight at 40 weeks of age. The best values for eggshell weights were 7.81g for treatment 6 (negative control + 1% *Aspergillus awamori*) compared to the negative and the positive controls of age (5.86 and 6.11g), respectively. Whereas, values of eggshell weights were 6.54, 7.28 and 7.62 g for T_3, T_4 and T_5, respectively at 40 wks of age. Ayanwale *et al.* (2006) observed that egg shell weight was higher in laying hens fed diets having 7.5 g/ kg dried yeast. Similar significant results in eggshell quality were also obtained in hens fed diets with a mixture of probiotic contains *Lactobacillus* cultures (Kalavathy *et al.* 2009 and Salah *et al.,* 2017). On the other hand, Özsoy *et al.* (2018) reported that dietary yeast culture supplementation had no significant effect on eggshell weight.

3.3. Eggshell thickness.

Supplementation of probiotic as dry yeast and *Aspergillus* significantly improved ($P \leq 0.05$) eggshell thickness at 40 weeks of age, high average value of eggshell thickness was 0.423 mm in the addition of 1% *Aspergillus awamori* with negative control diet (T_6) and levels of 1% dry yeast and 0.5% *Aspergillus* supplementation had no significant effect between T_4 (0.389 mm) and T_5, (0.398 mm) (Table 3), respectively.

The improvement in eggshell weight and egg shell thickness may be attributed to the enhancement of calcium absorption and retention associated with adding yeast into the diet (Tangendjaja and Yoon, 2002). Park *et al.* (2001) reported that, hens fed diets with yeast produced less soft shell and broken egg than control group. This results of (Chumpawadee *et al*. (2009); Elnagar, (2013) and El-Kaiaty *et al.* (2019) who recorded that eggshell thickness values were significantly higher by *saccharomyces cerevisia* and probiotic supplementation. In contrast, Sakine *et al. (*2014) reported that yeast supplementation had no significant effect on the mean values of egg shell thickness of laying hens.

3.4. Yolk quality.

Significantly improved yolk quality (weight, color and yolk index) was observed with the addition of *saccharomyces cerevisia* or *Aspergillus awamori*, Table (3). The corresponding values of yolk weight at 40 wks were

Table 3. Effect of dietary oxidized palm oil and probiotic on egg quality traits of Gimmizah hens at 40 weeks of age of the experimental period (Means ± S. E).

Parameters	Dietary treatments[1]					
	T_1	T_2	T_3	T_4	T_5	T_6
Egg shape index, %.	76.23^{c} ± 0.70	75.01^{d} ± 0.56	79.82^{b} ± 0.69	80.16^{ab} ± 0.70	80.67^{a} ± 076	81.26^{a2,3} ± 0.78
Eggshell weight, g.	6.11^{d} ± 0.33	5.86^{e} ± 0.29	6.54^{c} ± 0.34	7.28^{b}± 0.39	7.62^{a}± 0.31	7.81^{a}± 0.42
Eggshell, %.	11.54^{d} ± 0.63	11.24^{e} ± 0.65	12.11^{c} ± 0.44	13.00^{b} ± 0.69	13.60^{a} ± 0.69	13.65^{a}± 0.62
Eggshell thickness, mm.	0.384^{c} ± 0.0054	0.377^{d} ± 0.0044	0.387^{c} ± 0.0044	0.389^{c} ±0.0058	0.398^{b} ± 0.0044	0.423^{a} ± 0.0044
Yolk weight, g.	14.39^{d} ± 049	13.87^{d} ± 0.81	15.83^{bc} ± 0.76	16.19^{b} ± 1.05	15.55^{c}± 0.78	16.87^{a} ± 0.87
Yolk index, %.	42.32^{c} ± 0.61	41.07^{d} ± 0.65	43.64^{b} ± 0.71	43.71^{b} ± 0.97	45.97^{a} ± 0.97	45.88^{a} ± 0.97
Yolk color.	6.30^{c}± 0.23	6.16^{d} ± 0.15	7.07^{b} ± 0.23	7.17^{a} ± 0.19	7.17^{a}± 0.23	7.04^{b}± 0.26
Albumen weight, g.	32.45^{ab}± 1.04	32.26^{b} ± 1.17	31.63^{c} ± 1.31	32.53^{a} ± 1.96	32.83^{a} ± 1.28	32.52^{a} ± 1.12
Albumen index, %.	8.56^{e} ± 0.69	8.18^{f} ± 0.94	9.81^{c} ± 0.69	9.77^{d} ± 0.97	10.67^{a} ± 0.95	9.98^{b} ± 0.96
Haugh units.	83.76^{e} ± 0.39	81.10^{f} ± 0.39	84.76^{d} ± 0.39	87.85^{b} ± 0.39	86.28^{c} ± 0.39	89.02^{a} ± 0.39

[1] T_1: Positive control, T_2: Negative control (Positive control + 2% oxidized palm oil), T_3: Negative control + 0.5% dry yeast, T_4: Negative control + 1% dry yeast, T_5: Negative control + 0.5% *Aspergillus awamori* and , T_6: Negative control + 1 % *Aspergillus awamori*.

[2] means ± SE of 3 replicates / treatment.

[3] a, b,…etc. Means the same raw (for treatments) with different super scripts are significantly different (P ≤ 0.05).

(2007) did not find any effect on egg yolk of laying 15.83, 16.19, 15.55 and 16.87g for T_3, T_4, T_5 and T_6 and yolk color values were 7.07, 7.17, 7.17 and 7.04 and 43.64, 43.71, 45.97 and 45.88% for yolk index for T_3, T_4, T_5 and T_6, groups, hens fed yeast and probiotic supplemented diet.

3.5. Albumen quality.

The finding on albumen quality (albumen weight, index and Haugh units) are given in Table (3). The highest value of albumen weight noted by supplementation 1% *Aspergillus* (T_6) in diet was 32.52 g compared with the positive and thenegative control (32.45 and 32.26g) at 40 wk. A significant difference was noted in albumen index values between dietary treatments; being 8.56, 8.18, 9.81, 9.77, 10.67 and 9.98% for positive, negative control, 0.5, 1% dry yeast, 0.5 and 1% *Aspergillus,* respectively.

Haugh units (albumen quality factor) were significantly improved with dietary probiotic supplementation. The highest value was obtained for groups fed 1% of *Saccharomyces cerevisia* and *Aspergillus awamori*, T_4 and T_6 being; 87.85 and 89.02, respectively in comparison with positive, negative control and other treatments.

Haugh units, is an indicator of the most widely accepted measure of internal egg quality, tended to decrease according to the elapsed time of storage (Williams, 1992). Surai, 2000 suggested that certain antioxidants such as yeast, and *Asperiglus* being beneficial to albumen quality by it's antioxidant property. It is also suggested that dietary antioxidant nutrients and natural antioxidants are effective in improving the quality of eggs during extended storage. Özek (2012) also found that dietary mannan oligosaccharide (MOS) respectively. Ayanwale *et al.* (2006) recorded that yolk weight was higher in laying hens fed diets having 7.5 g/kg dried yeast. However, Maziar *et al.* supplementation significantly modified albumen height and Haugh units.

Different results were recorded by Chumpawadee *et al.* (2009) who reported that addition of yeast in commercial layer hens diet had not any positive effect on Haugh units. Elnagar, (2013) reported that diets supplemented with live yeast did not influence egg albumin weight and percentages.

4- Plasma blood parameters and blood lipid profile.

The effect of dietary treatments on plasma constituents and plasma blood lipid profile are summarized in Table (4). Data concerning the effect of oxidized palm oil and probiotic on blood plasma constituents at the end of the experimental period 40 weeks of age revealed that dry yeast and *Aspergillus,* (0.5% and 1%; T_3, T_4, T_5 and T_6, respectively) are significantly ($P \leq 0.05$) improved total protein, albumin and globulin compared to the positive and negative controls group.

Globulin is a source of antibody production, so its level in the serum is a good indicator of immune responses and consequently better disease resistance (Griminger and Scances 1986). The results of blood protein and globulin did not agree with those obtained by Wakwak *et al.* (2003) did not find any effect on blood protein or albumin due to adding yeast into growing quail diets. In this study, the concentration of plasma blood glucose was significantly ($P \leq 0.05$) differences between all dietary treatments (250.00, 265.50, 196.00 and 252.50mg/ dl) compared to T_1, un-supplemented and T_2, basal diet with

Table 4. Effect of dietary oxidized palm oil and probiotic on plasma blood parameters and blood lipid profile of Gimmizah hens at 40 weeks of age (Means ±S. E).

Parameters	Dietary treatments[1]					
	T_1	T_2	T_3	T_4	T_5	T_6
Total protein, g/ dl.	$4.45^{c} \pm 0.09$	$3.90^{d} \pm 0.06$	$5.85^{b} \pm 0.09$	$6.40^{a} \pm 0.06$	$6.00^{b} \pm 0.07$	$6.25^{a2,3} \pm 0.03$
Albumin, g/ dl.	$2.30^{c} \pm 0.06$	$1.95^{d} \pm 0.03$	$2.70^{b} \pm 0.12$	$3.05^{a} \pm 0.03$	$3.00^{a} \pm 0.02$	$3.20^{a} \pm 0.06$
Globulin, g/ dl.	$2.15^{c} \pm 0.03$	$1.95^{d} \pm 0.09$	$3.15^{ab} \pm 0.06$	$3.35^{a} \pm 0.09$	$3.00^{b} \pm 0.14$	$3.05^{b} \pm 0.05$
Glucose, mg/ dl.	$217.30^{c} \pm 3.52$	$196.00^{d} \pm 0.58$	$250.00^{b} \pm 2.89$	$265.50^{a} \pm 0.29$	$196.00^{d} \pm 0.58$	$252.50^{b} \pm 1.44$
AST, U/ L.	$49.50^{d} \pm 0.69$	$45.60^{e} \pm 0.35$	$54.05^{c} \pm 0.84$	$57.70^{a} \pm 0.52$	$54.00^{c} \pm 0.35$	$55.90^{b} \pm 0.06$
ALT, U/ L.	$29.75^{a} \pm 0.84$	$30.04^{a} \pm 0.42$	$28.85^{b} \pm 0.39$	$28.37^{c} \pm 0.23$	$29.18^{b} \pm 0.35$	$28.10^{c} \pm 0.36$
Total triglyceride, mg/ dl.	$94.35^{a} \pm 0.37$	$94.50^{a} \pm 0.87$	$83.50^{b} \pm 2.60$	$69.00^{d} \pm 0.58$	$77.00^{c} \pm 1.15$	$69.00^{d} \pm 0.57$
Total cholesterol, mg/ dl.	$97.00^{a} \pm 0.92$	$96.00^{a} \pm 0.57$	$86.50^{b} \pm 0.86$	$80.50^{c} \pm 0.87$	$81.50^{c} \pm 0.86$	$78.80^{d} \pm 0.12$
HDL, mg/ dl.	$24.00^{e} \pm 0.46$	$28.45^{d} \pm 0.32$	$32.50^{c} \pm 0.29$	$34.95^{b} \pm 0.03$	$33.00^{c} \pm 0.58$	$36.65^{a} \pm 0.26$
LDL, mg/ dl.	$52.60^{a} \pm 0.35$	$51.95^{a} \pm 0.61$	$42.55^{b} \pm 0.89$	$36.50^{d} \pm 0.29$	$37.80^{c} \pm 1.04$	$35.20^{e} \pm 0.28$

[1] T_1: Positive control. T_2: Negative control (Positive control + 2% oxidized palm oil), T_3: Negative control 0.5% dry yeast, T_4: Negative control+ 1% dry yeast, T_5: Negative control + 0.5% *Aspergillus awamori* and , T_6: Negative control + 1 % *Aspergillus awamori*.

[2] means ± SE of 3 replicates / treatment.

[3] a, b,...etc. Means the same raw (for treatments) with different super scripts are significantly different ($P \leq 0.05$).

oxidized dietary palm oil (217.30 and 196.00 mg/ dl, respectively at 40 weeks of age. AST was significantly (P ≤ 0.05) increased, while ALT was significantly (P ≤ 0.05) decreased with adding probiotic (dry yeast or *Aspergillus awamori*) compared to positive or negative control

positive control treatment (29.75 U/L) and the negative control (30.04 U/L). On the contrary, Elnagar (2013) and Sakine *et al.* (2014) noted that, there were no significant differences in the serum levels of total protein, AST and ALT by the addition of yeast culture.

Laying hens fed diets contained *Saccharomyces cerevisia* and *Aspergillus awamori* had significantly (P ≤ 0.05) lower serum total triglyceride being 83.50, 69.00, 77.00 and 69.00 mg/ dl, total cholesterol 86.50, 80.50, 81.50 and 78.80 mg/ dl and Low–density lipoprotein (LDL) 42.55, 36.50, 37.80 and 35.20mg/ dl for T_3, T_4, T_5 and T_6, respectively and significantly (P ≤ 0.05) increased high–density lipoprotein (HDL) at 40 weeks of age (Table 4) at 40 weeks of age when compared to the positive and negative control (94.35 and 94.50mg/ dl for total triglyceride and 97.00 and 96.00 mg/ dl for total cholesterol).

Hens fed the positive and negative control diet had significantly decreased (P ≤ 0.05) HDL (24.00 and 28.45 mg/dl), while values of HDL were significantly improved by the addition levels of 0.5 and 1% of *Saccharomyces cerevisia* and *Aspergillus awamori* in laying hen diets being; 32.50, 34.95, 33.00 and 36.65mg/ dl, respectively (Table 4). The decrease in blood lipid profile may be due to the beneficial role of probiotic in decreasing the microbial intracellular pH. Thus, inhibits the action of important microbial enzymes and forces the bacterial cell to use energy to release the acid protons, leading to an intracellular accumulation of acid anions (Young and Foegeding,

groups. Gimmizah laying hens fed diet supplemented with 0.5% (T_3), 1% (T_4) dry yeast and 0.5% and 1% (T_5 and T_6) *Aspergillus awamori* had the lowest value of ALT (28.85, 28.37, 29.18 and 28.10 U/L), respectively in comparison with the

1993).

Also, probiotic may contribute in the regulation of serum cholesterol concentrations conducted by deconjugated bile acids. As cholesterol is a precursor for bile acid formation and when deconjugated bile acids excretion is enhanced by probiotics supplementation, then more precursor molecules are needed for the recovery of bile acid formation (Ezema and Eze, 2015). Consequently, it may be expected that level of serum cholesterol decreases (Park *et al.,* 2008 and Sutarpa *et al.,* 2011). Moreover, Klaver and Van Der Meer (1993) also suggested that co-precipitation with bile acids may be of importance in decreasing serum cholesterol concentrations. Moreover the observed hyperthroidism associated with dietary probiotic could also explain the observed reduction in serum lipid profile.

In accordance with the present result, Kim *et al.* (2003) also found that *Aspergillus oryzae* at 0·1 % in the diet significantly lowered serum cholesterol in broiler chickens. Mahdavi *et al.* (2005) realized that using the different levels of probiotic caused significant decrease in plasma cholesterol, plasma triglyceride. *Aspergillus* on plasma cholesterol and triacylglyceride, (TAG) could be related to an inhibitor of 3–hydroxy–3–methyl–glutaryl–coenzyme A reductase (HMG - CoA reductase) Hajjaj *et al.,* (2005). Indeed, mRNA of muscle HMG - CoA reeducates was decreased by *Aspergillus awamori* feeding. It is well known that the HMG - CoA

reductase inhibitor (Statin) was extracted from a fungus (Endo, 1985) and Statin is widely used to decrease LDL - cholesterol and TAG and to increase HDL - cholesterol in the plasma. Muscle HMG - CoA reductase may also be responsible for the decrease in fat deposition.

These results indicate that *Aspergillus awamori* produces antioxidative substances. In fact, Kaminishi *et al*. (1999) have found that several strains of *Aspergillus* produce anti oxidative substances. In addition, Salah *et al.* (2017) and Tapingkae *et al.* (2018) reported that, cholesterol and triglyceride in serum and yolk were significantly ($P \leq 0.05$) lowered in the laying hens fed diet administrated with yeast and probiotic compared to the control (untreated hens). The reduction in cholesterol level in serum could be explained by the reduced absorption and/or synthesis of cholesterol in the gastrointestinal tract. Ezema and Eze, (2015) and Bidura *et al.* (2016) stated that the use of probiotic on diet may significantly lowered levels of cholesterol in serum of native local chickens. Moreover, El-Kaiaty *et al.* (2019) found that administrated of yeast in laying hen diets significantly ($P \leq 0.05$) lowered serum total lipids, cholesterol and triglycerides levels compared to un-supplemented control group. However, the lowest concentrations of total lipids, cholesterol and triglycerides were recorded for hens fed diet supplemented with 0.6% yeast.

In contrast, there were no significant differences in the serum levels of total triglyceride and cholesterol by the addition of yeast culture (Yalcin *et al.,* 2010 and Sacakli *et al.,* 2013).

5. Economic efficiency.

The economic efficiency of the experimental treatments are shown in Table (5) and showed that the highest economic efficiency 47.32% and relative economic efficiency (102.56) were obtained with the diet containing 1% *Aspergillus awamori* (T_6). This may be due to the better feed conversion ratio obtained in birds received the experimental diet compared to other diets. While the lowest economic efficiency (36.45%) and relative economic efficiency (79.00) was found in the negative control diet (T_2).

Table 5. Effect of dietary oxidized palm oil and probiotic on economic efficiency of Gimmizah hens during the experiment period.

Items	Dietary treatments[1]					
	T_1	T_2	T_3	T_4	T_5	T_6
Price of Kg feed, (L. E.).	4.52	4.60	4.65	4.71	4.67	4.75
Total feed intake / hen, (Kg).	9.34	8.85	9.55	9.68	9.67	9.80
Total feed cost hen, (L.E.)	42.22	40.71	44.41	45.49	45.16	46.55
Total number of eggs/hen, egg).	47.46	42.73	50.19	51.22	51.00	52.75
Total price of eggs / hen, (L.E.)[3].	61.70	55.55	65.25	66.59	66.30	68.58
Net revenue / hen, (L.E.)[4].	19.48	14.84	20.84	21.00	21.14	22.03
Economic efficiency, (%)[5].	46.14	36.45	46.93	46.06	46.81	47.32

Relative Economical efficiency[6].	**100**	**79.00**	**101.71**	**99.83**	**101.45**	**102.56**

[1] T_1: Positive control, T_2: Negative control (Positive control + 2% oxidized palm oil),
T_3: Negative control 0.5% dry yeast, T_4: Negative control +1% dry yeast,
T_5: Negative control+0.5% *Aspergillus awamori* and, T_6: Negative control + 1% *Aspergillus awamori*.
[2] Assuming the price of one – egg was 1.30L.E. (according to Egyptian market, 2018).
[3] Price of Kg oxidized palm oil, dry yeast and % *Aspergillus awamori* were (4, 11 and 15 L.E.), respectively according to Egyptian market, 2018.
[4] Net revenue / hen, (L.E.) = Total price of eggs – Total feed cost.
[5] Economic efficiency = (Net revenue ÷ Total feed cost) × 100.
[6] Relative economic efficiency of control considered 100.

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تأثير إضافة الخميرة الجافة أو الأسبرجلس أمورى كمضات أكسدة طبيعية إلى العلائق المحتوية على زيت النخيل المؤكسد على أداء دجاج الجميزة البياض

عاطف محمد حسن أبو عاشور، جمال عبد الستار زناتى، إسراء يوسف فتحى عطاالله

قسم إنتاج الدواجن والأسماك – كلية الزراعة – جامعة المنوفية – مصر.

الملخص العربى

استخدم فى هذه الدراسة عدد ١٨٠ دجاجة من سلالة الجميزة البياض عمر ٢٨ أسبوع بهدف دراسة تأثير إضافة البروبيوتيك (الخميرة الجافة أوالأسبرجلس أمورى) كمضادات أكسدة طبيعية إلى العلائق المحتوية على زيت النخيل المؤكسد على الكفاءة الإنتاجية ، صفات جودة البيض، بعض مكونات الدم ، الكفاءة الاقتصادية والكفاءة الإقتصادية النسبية لدجاج الجميزة البياض (Gimmizah). الدجاجات قسمت عشوائيا إلى ست مجموعات تجريبية غذائية، قسمت كل مجموعة إلى ٣ مكررات بكل مكررة ١٠ دجاجات تم تسكينها فى أقفاص فردية. غذيت المجموعة الأولى على العليقة الأساسية (الكنترول الموجب) تحتوى على ١٦.٤١% بروتين خام، ٢٧٤٨ كيلو كالورى طاقة ممثلة/ كجم عليقة. المجموعة الثانية (الكنترول السالب) غذيت على العليقة الأساسية وأضيف اليها ٢% من زيت النخيل المؤكسد. أما المجموعتين الثالثة والرابعة غذيت على عليقة مجموعة الكنترول السالب مضاف إليها الخميرة الجافة بمستوين ٠.٥، ١% على التوالى. بينما غذيت المجموعة الخامسة والسادسة على عليقة مجموعة الكنترول السالب مع إضافة ٠.٥، ١% من فطر الأسبرجلس أمورى على التوالى. وأظهرت النتائج المتحصل عليها أن إضافة ١% أسبرجلس أمورى إلى مجموعة الكنترول السالب المحتوية على ٢% من زيت النخيل المؤكسد أدى إلى تحسن كل من: معدل إنتاج ووزن وعدد وكتلة البيض. تحسن معدل تحويل الغذاء معنوياً بإضافة ٠.٥ أو ١% من الخميرة الجافة أوالأسبرجلس أمورى إلى مجموعة الكنترول السالب – كما لوحظ زيادة معنوية فى كمية الغذاء المأكول مقارنة بمجموعتى الكنترول السالب والموجب. سجلت طيور المجموعة السادسة المغذاة على عليقة الكنترول السالب والمضاف لها الأسبرجلس أمورى بمستوى ١% أعلى تحسن معنوى لصفات جودة قشرة البيض (الوزن، النسبة المئوية وسمك القشرة) وأعلى قيمة لدليل شكل البيضة عند عمر ٤٠ أسبوع. كما تحسنت بعض صفات جودة البياض والصفار ووحدات هوف. أدت إضافة ١% أسبرجلس أمورى إلى عليقة الكنترول السالب (العليقة الأساسية + ٢% زيت نخيل مؤكسد) إلى تحسن معنوى لبعض صفات بلازما الدم (البروتين الكلى، الألبيومين، الجلوبيولين وإنزيم ألانين أسبارتك ترانسفريز (AST) مقارنة بعليقة

الكنترول السالب والموجب. لوحظ انخفاضاً معنوياً فى تركيز كل من الكوليسترول الكلى والدهون الثلاثية الكلية وكذلك البروتين الدهني منخفض الكثافة (LDL) بينما زاد مستوى تركيز البروتين الدهنى عالى الكثافة (HDL) وذلك عند مستوى معنوية ٠.٠٥ فى بلازما الدم بزيادة مستويات البروبيوتك (الخميرة الجافة أو الأسبرجلس أمورى) . لوحظ أفضل كفاءة إقتصادية وكفاءة إقتصادية نسبية لعليقة المعاملة السادسة (١% أسبرجلس أمورى) مقارنة بباقى المعاملات. بصفة عامة وبناءا على النتائج المتحصل عليها من التجربة ودراسة الكفاءة الإقتصادية اتضح أن إضافة ١% من البروبيوتيك (١% أسبرجلس أمورى أو الخميرة الجافة) إلى العليقة الأساسية المحتوية على ٢% من زيت النخيل المؤكسد (الكنترول السالب)، أدت إلى تحسن معنوى فى الأداء الإنتاجى وصفات جودة البيض وبعض صفات الدم والكفاءة الاقتصادية والكفاءة الاقتصادية النسبية لدجاجات الجميزة البياض تحت ظروف التجربة.

أسماء السادة المحكمين

أ.د/ عادل إبراهيم عطيه كلية الزراعة – جامعة الزقازيق

أ.د/ منال كمال أبوالنجا كلية الزراعة – جامعة المنوفية