IMPROVEMENT OF FAYOUMI LAYING HENS PERFORMANCE UNDER HOT CLIMATE CONDITIONS 1- PROBIOTIC AND PREBIOTIC

By

A. A. H. Tollba, A. Z. Wagdy and S. A. M. Shabaan

Animal Prod. Inst. Agric. Res. Center, Ministry of Agric, Giza, Egypt.

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Abstract: *On the 20th wk of age, hundred eighty Fayoumi hens were randomly selected and divided into six equal groups, 30 birds of each, in three replicates, 10 birds of each. Birds in the 1st group were left as a control. While those in the 2nd group were fed a diet supplemented with (Bio-vet) as a probiotic by 1 g/kg feed contains Lactobacillus gassari, and Bifidobacterium longum 10^8 cfu/g. The 3rd group was given a diet with (Bactocell) as a probiotic by 1 g/kg feed contains Pediococcus acidolactici $10x10^9$ cfu/g. The 4th group was fed a diet containing fructooligosaccorids (FOS) as a prebiotic by 1 g/kg feed. The 5th group was fed on diet with synbiotic I (1/2 g/kg feed commercial probiotic Bio-vet and 1/2 g/kg feed FOS). The 6th group was fed a diet supplemented with synbiotic II (1/2 g/kg feed Bactocell and 1/2 g/kg feed FOS). The study was performed to evaluate the effects of probiotic, prebiotic and their combination (synbiotic) as preventive against harmful of hot climate on Fayoumi hens performance.*

The feeding of both probiotics, prebiotic and both synbiotics for 12 and 16 wks to laying hens under hot climate, improved ($P<0.05$) live body weight, egg production, egg mass, feed conversion, and mortality rate as compared to the control flock. However, there were no significant differences in egg weight and feed consumption among the treatments. Interestingly, interior and exterior egg qualities were not impaired during both periods of supplementation. Plasma biochemical parameters such as T_3, total plasma proteins as well as albumin and globulin of layers fed supplemental diets for 16 weeks under hot climate condition were ($P<0.05$) increased. The same trend was observed with blood indices (hemoglobin and hematocrit), lymphoid organs (relative weights of thymus and spleen) and immune response (HI titter) compared to corresponding control. Inversely, the plasma cholesterol, total lipids and A/G ratio were ($P<0.05$) reduced. However, creatinine, GPT and GOT enzymes were not affected. Moreover, there were ($P<0.05$) reduction in pH values and total count of some pathogenic bacteria (E. coli, Salmonella Pullorum and Clostridium *perfringens) of intestine (Dudenum, Jejunum, Ilium and Caecum). In conclusions, feeding of both probiotics forms, prebiotic and both synbiotics forms for 12 or 16 weeks under hot climate condition can improve (P<0.05) the performance of Fayoumi layers without impairing egg quality or any physiological injury.*

INTRODUCTION

Average temperature in Egypt is around 30ºC during 6 months in the year. Under these conditions, heat stress is particularly a great problem when hens are kept in convention naturally ventilated houses, which have proven ineffective in many regions of the country. It is generally known that hot climate always negatively affects poultry performance such as feed intake, egg production and egg weight (Peguri and Coon, 1991) and eggshell quality (Grizzle *et al*., 1992). Dietary manipulations are normally applied to alleviate the negative effects of hot climate on performance of laying hens, instead of the high cost of cooling poultry buildings.

Recent definition of Probiotic is “a live microbial feed supplement (bacteria, yeast and fungi or substances, "nonantibiotics") which beneficially affects the host animal by improving its intestinal microbial balance” (Fuller, 1989). Also, prebiotic has been defined as “non-digestible food that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon” (Gibson and Roberfroid, 1995). Probiotics enable the host animal to return to normal through increasing normal gut flora on the expense of pathogenic organisms (Jin *et al*., 1997). The improvements attributed to probiotics could be due to decreasing proliferation of pathogenic bacteria (Miles, 1993), and prevent diarrhea (Makled, 1991). Furthermore, probiotics produce lactic acid which alter the pH of chicken gut making it improper media for harmful bacteria such as salmonella and pathogenic species of E. coli (Leesson and Major, 1990), improve nutrient availability and absorption (Sellars, 1991), produce digestive enzymes (Lee and Lee, 1990), and improve intestinal microbial balance (Fuller, 1989). Properties of prebiotic are that they selectively stimulate the growth of bifidobacteria, lactobacilli, and certain butyrate producing bacteria (Hold *et al*., 2003). At the same time, they suppress the growth of proteolytioc bacteria such as the Clostridium perfringens group (Gibson *et al*., 1995). These properties (non-digestibility and selective interaction with intestinal bacteria) are considered to be at the basis of their use in animal feed. Abd El-Rahman (1988) found that the addition of probiotic in the diet of laying hens had positive effect on egg production, egg mass and feed conversion. Similar trend was obtained by Mohen Kumar and Christopher (1988); Haddadin *et al*., (1996); Osman (2003) and Sayed *et al*., (2003). Similar results were found with adding oligofructose and inulin as prebiotic (Chen, *et al.*, 2005). These beneficial effects might be more profound if birds were under stressful environmental conditions. Therefore, the goal of this investigation was to throw a light on the effects of using the microbial probiotics (Lactobacillus or Pediococcus) and prebiotic (fructooligosaccorids) under stressful environmental condition (hot climate) on performance of Fayoumi laying hens.

MATERIALS AND METHODS

The study was performed at El- Fayoum Poultry Research Station, Animal Production Research Institute, Ministry of Agriculture. A hundred eighty Fayoumi hens at 20 wks of age having nearly equal live body weights were divided into six groups of thirty birds in three replicates of ten birds each, till the age of 36 wks. The tested probiotics containing naturally occurring microorganisms were Biovit (Lactobacillus gassari and Bifidobacterium longum 10^8 cfu/g) or Bactocell (Pediococcus acidolactici $10x10^9$ cfu/g)). Prebiotic was fructooligosaccarids (FOS). Birds were assigned to each of the following dietary treatments: 1) Basal diet (Table1) served as a control. 2) Basal diet supplemented with 1 g/kg feed commercial probiotic (Biovet). 3) Basal diet inclusive 1 g/kg feed commercial probiotic (Bactocell). 4) Basal diet containing 1 g/kg feed commercial prebiotic of fructooligosaccarids (FOS). 5) Basal diet enriched with synbiotic I (1/2 g/kg feed commercial probiotic (Biovet) and 1/2 g/kg feed FOS). 6) Basal diet enriched with synbiotic II (1/2 g/kg feed commercial probiotic (Bactocell) and 1/2 g/kg feed FOS). All groups were put under observation for 12 or 16 weeks from 20 to 36 weeks of age. All birds were kept under local conditions of Fayoum region in metallic layers batteries, where temperature ranged between 38°C and 30°C with 75 % relative humidity throughout the experimental period.. Water and experimental diets were offered *ad libitum*. Pullets were weighted at 20 wks of age and then at intervals of 4 weeks. At the age of 24 weeks (sexual maturity), egg number, egg weight and mortality rate were recorded daily from 24 to 36 wks of age. Feed consumption was recorded weekly and then feed conversion was determined. At the age of 30 weeks, hemagglutination-inhibittion (HI) test was applied for determination of antibody response on serum samples according to Laver (1969) after 15 days of immunized the flock by vaccine Lasota against Newcastle Disease Virus (NDV). Egg quality was measured after 12 and 16 weeks of feeding trial. Ten eggs from each replicate were collected, weighed, broken and separated into shells, yolks and albumens. The weights of yolk, albumen and shell (with membranes) were recorded and calculated as percentages of egg weight. At the end of the experiment, 2 birds from each replicate were sacrificed for slaughtering, and their lymphoid organs were weighed (mg/100 g body weight) then pH of intestine contents were determined directly by pH-meter and pathogenic bacteria were counted as the procedure of A.O.A.C. (1998). Blood samples were collected then hemoglobin (g/dl) was determined by hemoglobinometer and hematocrit (%) by centrifuged heparinized microhematocrite tubes. Remaining blood was centrifuged and plasma separated then stored at – 20 °C until analyzed. Plasma total protein (g/dl) albumin (g/dl), T_3 (ng/dl), cholesterol (mg/dl), Total lipids (mg/dl), creatinine (mg/dl), glutamic pyruvic transaminase (GPT) (U/L) and glutamic oxalacetic transaminase (GOT) (U/L) were calorimetrically determined using commercial kits following the recommendations of manufactures. Data were subjected to ANOVA using the GLM procedure of the SAS Institute, Inc. (1996). The percentage values were transferred to percentage angle using arcsine equation before examined statistically.

RESULTS AND DISCUSSION

1 – Productive performance:

A – Live body weight and mortality rate:

Pullets provided with probiotics, prebiotic or synbiotics had higher ($P<0.05$) live body weight comparing to those fed the control diet at 8, 12 or 16 weeks of feeding trial. Moreover, No mortality was registered among probiotics and synbiotics treatments while, in prebiotic was 5% comparing to 15% in control diet at 16 wks of feeding trial (Table, 2). Similarly, Sayed *et al*., (2003) with Gimmizah and Mamourh strains, Yeo and Kim (1997)**,** and Zulkifli *et al*., (2000) found that growth performance and immune response of two commercial broiler strains fed probiotics culture under heat stress conditions were improved significantly ($P<0.05$). Chapman (1988) concluded that microbial probiotics not only reduce symptoms of stress and decrease mortality rate but also prevent them and act as natural growth promoters.

B – Egg production and egg mass:

Supplementing layer diets with probiotics, either by lactobacillus or pediococcus for 12 wks increased ($P<0.05$) egg production by 17.1 or 18.6% respectively when compared with the respective control. Meanwhile, the same supplementation for 16 wks increased egg production ($P<0.05$) by 11.1 and 12.7%, respectively (Table, 3). Similar ($P<0.05$) effects were observed with the prebiotic (FOS) supplemented group for 12 or 16 wks by 11.8 or 8.7% when compared with the control. Also, feeding either synbiotic I or II for 12 wks produced ($P<0.05$) 14.6 and 16.7%, respectively more eggs than the control diet. Meanwhile, the same supplementation for 16 wks increased egg production (P<0.05) by 8.6 and 9.8%, respectively (Table, 3).

Also, the results showed (P<0.05) an increase in egg mass for hens fed diets supplemented with either probiotics, prebiotic or both synbiotics when compared with those of counterpart control hens after 12 or 16 wks of feeding trial. The increase percentages were 17.0; 18.1; 11.9; 14.8% and 17.1 at 12 week feeding trial. While at 16th week were 10.4; 12.4; 8.1; 8.5 and 9.9%, respectively (Table, 3). Egg mass expressed as the total cumulative egg weight per treatments.

Supplementing layers with Lactobacillus-type probiotics has been reported to improve layer performance. Mohen Kumar and Christopher (1988); Abd El-Rahman (1988), Haddadin *et al*., (1996), Abdularahim *et al*., (1996), Osman, (2003) and Sayed *et al*., (2003) reported that an improvement in egg production, egg mass and feed conversion were observed when a liquid culture of Lactobacillus acidophilus was fed to the laying hens. Also, Chen *et al*., (2005) reported that dietary oligofructose and inulin as prebiotics increase (P<0.05) egg production and feed efficiency of layers without impairing egg quality. Prebiotics, such as inulin or oligofructose, have been shown to change the intestinal microflora and suppress the undesirable bacteria (Bailey, 1991; Gibson *et al*., 1995), and stimulate mineral absorption, mainly calcium and magnesium (Scholz-Ahrens and Schrezenmeir, 2002). Gibson and Roberfroid (1995) indicated that a prebiotic can beneficially affect the host by selectively stimulating the growth and/or activity of healthy bacteria in the colon. However, it is of interest to note that there are few reports available related to the effects of prebiotics on egg-laying performance. On the basis of our results, significant improvements in egg production, egg mass and disappear mortality rate might be due to healthier birds whose feed efficiency and mineral absorption have been improved by two forms of probiotics (Pediococcus Lactobacillus), prebiotic (FOS) and two forms of synbiotics.

C – Feed consumption and conversation ratio:

No differences (P<0.05) of feed consumption among treatments with respect to the whole periods of the experiment was found (Table 2). But, more eggs were produced in treated groups than the control group. Therefore, addition of either probiotics**,** prebiotic or both synbiotics improved (P<0.05) the feed conversion ratio when compared with those of control (Table 2). The improvement were 12.9%; 14.9 10.4; 11.6 and 12.4% at 12 week feeding trial**.** While at 16 week were 11.5; 13.6; 9.4; 10.5 and 10.5%. Several studies have reported that the change of microbial ecology in layers intestine might enhance their health and improve feed efficiency by the use of feeding probiotics (Krueger *et al*., 1977; Abd El-Rahman 1988; Haddadin *et al*., 1996; Abdularahim *et al*., 1996 and Sayed *et al*., 2003) or prebiotics Chen *et al*., (2005). Prebiotics belong to a group of indigestible dietary carbohydrates that exert significant biological effects by selective stimulation of growth or bioactivity of beneficial microorganisms in the intestine (Tomasik and Tomasik, 2003). Hence, we speculated that both probiotics or prebiotic could change the microflora in the layers hens intestine, which would have effects on its development and absorptive capacity with, as a consequence and the observation of an improved feed conversion ratio.

2 – Egg quality:

No ($P<0.05$) differences in average egg weight (Table 3), interior or exterior egg qualities (Table 4) were observed among treatments. Although either probiotics**,** prebiotic or both synbiotics supplementations improved ($P<0.05$) egg production, they did not retard the decline of egg quality. The fact that eggshell thickness and eggshell weight reduces with increase in egg size (Roland, 1988; Jackson *et al*., 1987) were observed in this case**.** However, no reports were available for effects of pediococcus as a probiotic or both synbiotics on egg quality. As stated above, we can indicate that adding either probiotics**,** prebiotic or both synbiotics can improve layer performance without sacrificing egg size or qualities. Miles *et al*., (1981) and Abd El-Rahman (1988) reported that the egg quality traits or egg weight were not affected by adding probiotic in low protein diet. Sayed *et al*., (2003) with Gimmizah and Mamourh strains indicated that no significant differences were found among the primalac inclusion in exterior egg quality. Osman (2003) stated that probiotic did not significantly affect shell thickness, specific gravity, yolk weight and Haugh unit scores. Also, Chen *et al*., (2005) using dietary oligofructose and inulin as prebiotic did not affect egg quality.

3 – Blood biochemical parameters:

There is an increase ($P<0.05$) in plasma total protein as well as albumin and globulin fractions and T_3 values when added either probiotics, prebiotic or both synbiotics to layers diets comparing to counterpart control (Table 5). Ratio of A/G was decreased ($P<0.05$) as a result of the changes in globulin with the addition of either probiotics, prebiotic or both synbiotics. The increases in the previous blood parameters may indicate that an enhancement of immunity occurred corresponding to feeding either probiotics, prebiotic or both synbiotics as a result of improving feed conversation, absorption and utilization of nutrients. Similarly, Sayed *et al.*, (2003) with Gimmizah and Mamourh strains and Abd El-Azeem *et al.***,** (2001) with Japanese quail reported that addition of microbial probiotic caused (P<0.05) higher level of plasma total protein as well as albumin and globulin fractions than those of control group.

Plasma cholesterol were decreased (P<0.05) for groups fed either probiotics, prebiotic or both synbiotics as compared with control group by about 32.3, 43.23, 15.7, 29.4 and 40.7%, respectively. The same trend was observed with total lipids and the decrements were 14.9; 19.6%; 9.9%; 14% and 10.6%, respectively (Table 5). This reduction may be explained as mentioned by Tortuero *et al*., (1975) who attributed that to these bacteria may assimilate or degrade the cholesterol to bile acids followed by deconjugation to prevent resynthesis. Also, Li *et al*., (1995) observed a significant decrease in plasma cholesterol of type hypercholesterolmic rabbits given live bacteria (Eubacterium coprostanolignes) and presume that, this type of bacteria convert feed cholesterol to coprostanol, which is absorbed poorly by gastrointestinal tract. However, some lactobacilli have a direct effect on cholesterol levels by assimilation and removal from the growth medium (Fuller, 1989). Also, Similar trend was obtained by Sayed *et al* (2003) with Gimmizah and Mamourh strains and Abd El-Azeem *et al*., (2001) who reported that a significant decrease (P<0.05) in total cholesterol and insignificant decrease in total lipids at 6 weeks of age with adding lacto sacc and yea sacc in Japanese quail diet. Haddadin *et al*., (1996) found that the addition of Lactobacillus acidophilus culture significantly reduced the levels of serum cholesterol.

No (P<0.05) differences in GOT and GPT enzymes activity and creatinine were observed among treatments (Table 5). The similitude of enzyme activity and creatinine concentration in supplemented or not groups is exhibit healthy, non-pathological or non-toxic effects of either probiotics, prebiotic or both synbiotics on live or kidney functions. Similarly, Abd El-Azeem *et al*., (2001) concluded that broiler chicks fed microbial probiotic recorded insignificant affects on GOT, GPT enzyme activity and creatinine levels.

4 – Blood indices:

Supplementing layer diets with probiotics, prebiotic or both synbiotics for 16 wks increased (P<0.05) hemoglobin and hematocrit values when compared with that of control diet (Table 6). The most likely explanation are the improvement of bioavailability of essential nutrients **(**Haddadin *et al*., 1996), and enhancing vitamin B absorption resulted from increased small intestinal absorption or bacterial synthesis (Jenkins *et al*., 1999).

5– Some lymphoid organs and immune response:

Significant (P<0.05) increases were detected in HI antibody titter as immune response to NDV and relative weighs of thymus and spleen in all treated groups compared with the control ones (Table 6). The increases in weights of thymus, spleen and globulin value probably are due to the immunostimulate as affected by feeding of probiotics, prebiotic or synbiotics. Concomitant were the results of Zulkifli, *et al*., (2000) who found that birds fed lactobacillus culture had higher antibodies production after Newcastle disease vaccine compared with those fed on the control diet.

6 – Intestinal pH:

Addition of either probiotics, prebiotic or both synbiotics to layers diet decreased (P<0.01) the values of pH of duodenum, jejunum, ileum and caecum when compared with those fed on counterpart control diet (Table 7). Similarly, Leesson and Major, (1990) reported that probiotics bacteria produces lactic acid which alter the pH of chicken gut. Lactobacillus Spp. is capable of producing large amounts of lactate from simple carbohydrates (Jernigan *et al*., 1984). Probiotics alter microbial metabolism and decrease intestinal pH (Makled, 1991; Miles and Bootwella, 1991), produce organic acids and decrease ileum pH (Kahraman *et al*., 1997).

7 – Intestinal bacteria:

Adding either probiotics, prebiotic or both synbiotics to layers diet significantly (P<0.05) suppressed the counts of pathogenic intestinal bacteria where, severe decreases in counts of E. coli, Salmonella pullorum and Clostridium perfringens of duodenum, jejunum, ileum and caecum compared to those in respective control diet (Table 8). Similarly, Line *et al*., (1998) reported that yeast culture was reduced the frequency of salmonela colonization significantly. Probiotics decreased proliferation of pathogenic bacteria (Miles, 1993). This type of bacteria produces antimicrobial compound in the gut (Fuller, 1989), or bactericidal substances like bacteriocin, organic acids and hydrogen peroxide (Joerger and Klaenhammer, 1986), or lactic acid which alter the pH of chicken gut making it improper media for harmful bacteria such as salmonella and pathogenic species of E. coli. (Leesson and Major, 1990).

It's strongly recommend that, the addition of microbial probiotics (lactobacilli or pediococcus), prebiotic (fructooligosaccorids) or synbiotic (mixture of probiotic and prebiotic) to layers diet in order to improve its performance, livability, immunostimulant, and to alleviate the negative effects of hot climate.

Table (1): Composition and calculated analysis of the basal diet fed to experimental birds.

Ingredients	%
Yellow corn	63.14
Soybean meal 44 %	27.10
Di-calcium phosphate	1.50
Limestone	7.60
Salt (NaCl)	0.30
DL-Methionine	0.06
Vit. & Min. Mixture *	0.30
Total	100.00
<u>Calculated analysis</u>	
Metabolizable energy (Kcal / Kg)	2722.00
Crude protein %	17.50
Crude fiber %	3.03
Calcium %	3.30
Available phosphate %	0.42
Methionine %	0.36
Met + cyct %	0.68

*Supplied per Kg of diet: Vit. A, 10 000 IU; Vit. D_3, 2 000 IU; Vit. E,10 mg; Vit. K_3,1 mg; Vit. B_1, 1mg; Vit. B_2, 5 mg; Vit. B_6, 1.5 mg; Vit. B_{12}, 10 mcg; Niacin, 30mg; Pantothenic acid, 10mg; Folic acid,1mg; Biotin, 50mcg;Choline,260mg; Copper, 4 mg; Iron, 30mg; Manganese, 60mg; Zinc,50mg; Iodine,1.3mg; Selenium, 0.1mg; Cobalt, 0.1mg;

Table (2): Body weight (g) and mortality rate % of Fayoumi laying hens fed probiotics, prebiotic and synbiotics under hot climate conditions (LSM±S.E).

Treatment / Feeding Period (wks)	Control	Lactobacillus	Pediococcus	FOS	Synbiotic I	Synbiotic II
Body weight (g)						
0	$1231.0^{a}\pm10.2$	$1211.2^{a}\pm15.1$	$1205.5^{a}\pm15.7$	$1223.5^{a}\pm10.2$	$1234.5^{a}\pm23.2$	$1219.5^{a}\pm11.0$
8	$1470.7^{b}\pm7.0$	$1569.8^{a}\pm21.2$	$1577.5^{a}\pm19.2$	$1545.5^{a}\pm19.2$	$1546.5^{a}\pm14.2$	$1558.5^{a}\pm18.9$
12	$1562.4^{b}\pm9.0$	$1685.5^{a}\pm15.8$	$1671.0^{a}\pm21.1$	$1634.5^{a}\pm14.1$	$1662.7^{a}\pm18.5$	$1644.5^{a}\pm20.3$
16	$1634.5^{b}\pm11.3$	$1757.3^{a}\pm20.1$	$1774.1^{a}\pm23.1$	$1730.9^{a}\pm21.7$	$1716.5^{a}\pm19.3$	$1721.2^{a}\pm18.2$
Mortality rate %						
16	15	0	0	5	0	0

Means with differing superscript (a, b) within a row, differ significantly ($P<0.05$)

Table (3): Productive performance of Fayoumi laying hens fed probiotics, prebiotic and synbiotics under hot climate condition (LSM ± S.E.)

Treatment / Feeding Period (wks)	Control	Lactobacillus	Pediococcus	FOS	Synbiotic I	Synbiotic II
Cumulative egg number (egg/hen house/wk)						
12	26.21 ^{b}±0.46	30.68 ^{a}± 0.71	31.09^{a}±0.93	29.31 ^{a}±0.96	30.04 ^{a}±0.97	30.58 ^{a}±0.62
16	43.18 ^{c}±0.82	47.96 ^{a}±0.59	48.65^{a}±0.96	46.95 ^{a}±0.79	46.89 ^{a}±0.54	47.43 ^{a}±0.68
Egg weight (g)						
12	45. 23 ^{a}±0.20	45. 21 ^{a} ±0.19	45.03^{a}±0.41	45.27 ^{a}±0.26	45.33 ^{a} ±0.13	45.39 ^{a}±0.18
16	46.62 ^{a}±1.12	46.36 ^{a}±0.27	46.52^{a}±0.34	46.34 ^{a}±0.24	46.57 ^{a}±0.31	46.65 ^{a}±0.28
Cumulative egg mass (g egg/ hen house/ wk)						
12	1185.5 ^{b}±36.24	1386.88^{a}±39.74	1400.22^{a}±39.94	1326.91 ^{a}±49.71	1361.77 ^{a}±46.18	1387.96 ^{a}±26.20
16	2013.2 ^{c}±62.91	2223.53^{a}±32.89	2263.68^{a}±48.47	2175.67 ^{a}±39.54	2183.51 ^{a}±18.39	2212.53 ^{a}±13.40
Cumulative feed consumption (g feed/hen house /wk)						
12	4682.5 ^{a}±12.00	4770.90^{a}±165.23	4706.50^{a}±48.51	4697.50 ^{a}±215.47	4752.50 ^{a}±225.41	4802.9 ^{a}±230.24
16	7670.9 ^{a}±52.50	7493.50^{a}±276.35	7447.50^{a}±129.99	7506.5 ^{a}±114.75	7445.80 ^{a}±86.54	7550.70 ^{a}±149.73
Feed conversion (g feed / g egg)						
12	3.95 ^{a}±0.13	3.44 ^{bc}±0.04	3.36 ^{c}±0.03	3.54 ^{b}±0.01	3.49 ^{b}±0.06	3.46 ^{b}±0.01
16	3.81 ^{a}±0.11	3.37 ^{bc}±0.07	3.29 ^{c}±0.05	3.45 ^{b}±0.06	3.41 ^{b}±0.02	3.41 ^{b}±0.05

Means with differing superscript (a, b, c) within a row, differ significantly ($P<0.05$)

(4): Some egg quality characteristics of Fayoumi laying hens provided with probiotic, prebiotic and synbiotic under hot climate conditions (LSM±S.E)

Treatment / Item	Feeding Period (wks	Control	Lactobacillus	Pediococcus	FOS	Synbiotic I	Synbiotic II
Exterior egg quality							
Egg weight	12	45. 31^{a}±0.20	45. 27^{a}±0.19	45.14^{a}±0.41	45.38^{a}±0.26	45.41^{a}±0.13	45.48^{a}±0.18
	16	46.77^{a}±1.12	46.55^{a}±0.27	46.63^{a}±0.34	46.42^{a}±0.24	46.69^{a}±0.31	46.79^{a}±0.28
Shell weight %	12	10.31^{a}±0.15	10.24^{a}±0.24	10.13^{a}±0.29	10.25^{a}±0.14	10.32^{a}±0.24	10.21^{a}±0.29
	16	10.05^{a}±0.28	10.10^{a}±0.24	10.09^{a}±0.14	10.06^{a}±0.14	10.10^{a}±0.24	10.10^{a}±0.14
Shell thickness (mm)	12	3.87^{a}±0.07	3.91^{a}±0.04	3.92^{a}±0.01	3.91^{a}±0.06	3.90^{a}±0.09	3.91^{a}±0.07
	16	3.79^{a}±0.09	3.82^{a}±0.04	3.83^{a}±0.05	3.81^{a}±0.09	3.82^{a}±0.05	3.83^{a}±0.06
Egg Shape index	12	74.19^{a}±1.70	74.32^{a}±1.51	74.45^{a}±0.98	74.25^{a}±1.08	74.22^{a}±1.08	74.31^{a}±1.08
	16	76.92^{a}±1.33	77.12^{a}±1.88	77.28^{a}±1.30	77.19^{a}±1.66	76.99^{a}±1.66	77.06^{a}±1.66
Interior egg quality							
Albumin weight%	12	58.57^{a}±0.01	58.37^{a} ±0.01	58.18^{a}±0.01	58.20^{a} ±0.01	58.29^{a}±0.01	58.39^{a}±0.01
	16	58.92^{a}±0.01	58.89^{a}±0.01	58.79^{a}±0.01	58.52^{a}±0.01	58.89^{a}±0.01	58.80^{a}±0.01
Yolk weight%	12	31.12^{a}±0.44	31.39^{a}±0.51	31.70^{a}±0.64	31.55^{a}±0.01	31.39^{a}±0.51	31.40^{a}±0.64
	16	31.03^{a}±0.98	31.01^{a}±0.50	31.12^{a}±0.88	31.42^{a}±0.01	31.01^{a}±0.50	31.10^{a} ±0.88
Yolk index	12	37.50^{a}±5.90	37.71^{a}±.6.33	37.76^{a}±6.86	37.67^{a}±0.01	37.70^{a}±5.91	37.65^{a}±0.01
	16	35.62^{a}±6.21	35.83^{a}±4.53	35.77^{a}±6.81	35.67^{a}±0.01	35.69^{a}±9.44	35.81^{a}±0.01
Haugh unit	12	84.08^{a}±1.96	84.27^{a}±1.96	84.42^{a}±1.96	84.07^{a}±0.01	84.59^{a}±1.96	84.73^{a} ±0.01
	16	80.96^{a}±1.96	81.21^{a}±1.96	81.36^{a}±1.96	81.10^{a}±1.96	81.17^{a}±1.96	81.28^{a}±1.96

Means with differing superscript within a row, differ significantly ($P<0.05$)

Table (5): Blood biochemical parameters of Fayoumi laying hens fed probiotics, prebiotic and synbiotics for 16 wks under hot climate conditions (LSM ± S.E.).

Items / **Treatment**	Control	Lactobacillus	Pediococcus	FOS	Synbiotic I	Synbiotic II
T_3 (ng/dl)	194.12^{c}±10.14	219.37^{b}±13.30	242.51^{a}±18.44	215.43^{b}±26.16	219.43^{b}±12.66	229.37^{ab}±24.41
Total protein (g/dl)	3.22^{d}±0.19	4.12^{c}±0.13	4.55^{a}±0.23	4.10^{c}±0.12	4.21^{c}±0.20	4.32^{b}±0.30
Albumin (A) (g/dl)	2.20^{d}±0.15	2.47^{c}±0.11	2.83^{a}±0.18	2.65^{b}±0.11	2.68^{b}±0.18	2.84^{a}±0.30
Globulin(G) (g/dl)	1.02^{e}±0.10	1.65^{b}±0.10	1.72^{a}±0.02	1.45^{d}±0.10	1.53^{c}±0.04	1.78^{a}±0.20
A/G ratio	2.15^{a}±0.02	1.5^{d}±0.04	1.65^{c}±0.02	1.82^{b}±0.05	1.75^{b}±0.06	1.60^{c}±0.03
Creatinine (mg/dl)	0.46^{a}±0.03	0.43^{a}±0.01	0.46^{a}±0.03	0.45^{a}±0.02	0.44^{a}±0.02	0.46^{a}±0.03
GPT (U/L)	44.16^{a} ±2.13	44.11^{a}±1.94	44.27^{a}±2.20	44.13^{a}±2.50	43.96^{a}±2.20	44.02^{a}±2.21
GOT (U/ML)	20.82^{a}±1.33	21.11^{a}±1.41	21.07^{a}±0.94	21.13^{a}±1.08	21.17^{a}±1.07	21.02^{a}±1.01
Cholesterol (mg/dl)	114.50^{a} ±4.06	77.50^{c}±2.51	65.20^{d}±2.48	96.50^{b}±3.07	80.80^{c}±3.50	67.90^{d}±3.4.1
Total lipids (mg/dl)	178.11^{a} ±3.50	151.61^{bc}±3.66	143.18^{c}±4.53	160.52^{b}±4.80	153.14^{bc}±4.90	159.20^{b}±4.20

Means with differing superscript (a, b, c) within a row, differ significantly ($P<0.05$).

Table (6): Blood indices, HI titter and relative weights of some lymphoid organs (mg/100g B.W.) of Fayoumi laying hens fed probiotics, prebiotic and synbiotics for 16 wks under hot climate conditions (LSM ± S.E.).

Items / Treatment	Control	Lactobacillus	Pediococcus	FOS	SynbioticI	SynbioticII
Hemoglobn (g/dl)	10.22^{b}±0.81	11.54^{a}±0.54	11.82^{a}±0.22	11.45^{a}±0.13	11.26^{a}±0.43	11.58^{a}±0.31
Hematocri **(**%)	26.73^{b}±1.14	28.47^{a}±0.67	28.69^{a}±0.19	28.32^{a}±0.91	28.31^{a}±0.79	28.06^{a}±0.61
HI titter	125.71^{b}±6.25	195.21^{a}±8.31	205.61^{a}±6.98	192.42^{a}±7.24	195.22^{a}±8.44	195.32^{a}±7.11
thymus	66.22^{c}±5.15	74.29^{b}±2.11	83.46^{a}±3.21	72.00^{b}±4.20	72.15^{b}±4.51	74.40^{b}±3.39
spleen	198.67^{c}±8.15	211.92^{b}±13.10	227.04^{a}±10.11	211.04^{b}±9.20	210.39^{b}±8.10	215.91^{b}±10.10

Means with differing superscript (a, b) within a row, differ significantly ($P<0.05$)

Table (7): Intestine pH of laying hens fed on probiotics, prebiotic and synbiotics for 16 wks under hot climate conditions (LSM ± S.E.).

Treatment / Items	Control	Lactobacillus	Pediococcus	FOS	Synbiotic I	SynbioticII
Duodenum	5.7 ^{a} ± 0.15	5.1^{b} ± 0.10	5.1^{b} ± 0.10	5.2 ^{b}± 0.10	5.2^{b} ± 0.10	5.2 ^{b} ±0.10
Jejunum	6.7 ^{a} ± 0.15	6.1 ^{b} ± 0.10	6.1^{b} ± 0.10	6.1 ^{b}± 0.10	6.1^{b} ± 0.10	6.1 ^{b} ±0.10
Ileum	7.1 ^{a} ± 0.15	6.5 ^{b} ± 0.10	6.4^{b} ± 0.10	6.5 ^{b}± 0.20	6.4 ^{b} ± 0.10	6.4 ^{b} ±0.10
Caecum	7.4 ^{a} ± 0.15	6.7 ^{b} ± 0.10	6.6^{b} ± 0.15	6.9 ^{b}± 0.20	6.8 ^{b} ± 0.10	6.7 ^{b} ±0.15
Cloaca	7.9 ^{a} ± 0.15	7.3 ^{b} ± 0.10	7.1^{b} ± 0.10	7.3 ^{b}± 0.10	7.2 ^{b} ± 0.10	7.2 ^{b} ±0.10

Means with differing superscript (a, b) within a row, differ significantly (P<0.05)

Table (8): Counts of some intestinal pathogenic bacteria (x 10^6 CFU / g fluid) of laying hens fed on probiotics, prebiotic and synbiotics for 16 wks under hot climate conditions (LSM ± S.E.).

pathogenic bacteria	Control	Lactobacillus	Pediococcus	FOS	Synbiotic I	Synbiotic II
Duodenum						
E. coli	3.8^{a} ±0.10	2.7^{c}±0.10	2.5^{d}±0.20	3.1^{b}±0.20	2.9^{bc}±0.10	2.7^{c}±0.20
Salmonella	2.6^{a} ±0.10	1.9^{b}±0.10	1.6^{c}±0.10	2.1^{d}±0.20	2.0^{d}±0.10	1.9^{d}±0.20
Clostridium	4.7^{a} ±0.10	3.5^{c} ±0.10	3.3^{c} ±0.20	3.9^{b}±0.20	3.7^{bc}±0.20	3.7^{bc}±0.20
Jejunum						
E. coli	4.6^{a} ±0.20	3.1^{c}±0.10	2.8^{d}±0.10	3.4^{bc}±0.2	3.6^{b}±0.20	2.5^{d} ±0.20
Salmonella	3.1^{a} ±0.10	1.7^{c}±0.10	1.5^{c}±0.10	2.1^{bc}±0.2	1.9^{bc}±0.10	1.8^{b} ±0.10
Clostridium	4.3^{a} ±0.20	3.1^{b}±0.20	3.0^{b}±0.10	3.6^{b}±0.20	3.4^{b}±0.10	3.2^{b} ±0.10
Ileum						
E. coli	4.9^{a} ±0.20	2.8^{bc}±0.10	2.5^{c}±0.10	3.2^{b}±0.10	3.0^{b}±0.10	2.7^{bc} ±0.10
Salmonella	3.3^{a} ±0.20	1.1^{b}±0.10	1.0^{b}±0.10	1.3^{b}±0.10	1.1^{b}±0.10	1.0^{b} ±0.10
Clostridium	4.1^{a} ±0.10	3.2^{b}±0.20	2.9^{b}±0.10	3.5^{b}±0.20	3.2^{b}±0.20	3.2^{b} ±0.20
Caecum						
E. coli	3.1^{a} ±0.20	2.2^{b}±0.10	2.1^{b}±0.10	2.7^{b}±0.10	2.4^{b}±0.10	2.3^{b} ±0.10
Salmonella	2.8^{a} ±0.10	0.5^{b}±0.10	0.4^{b}±0.10	0.9^{b}±0.10	0.6^{b}±0.10	0.6^{b} ±0.10
Clostridium	4.0^{a} ±0.10	2.9^{b}±0.20	3.0^{b}±0.10	3.3^{b}±0.20	3.1^{b}±0.20	3.0^{b} ±0.20

Means with differing superscript (a, b, c) within a row, differ significantly (P<0.05)

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الملخص العربى

تحسين الأداء الانتاجي للدجاج الفيومي البياض تحت ظروف المناخ الحار
1 - مركز البكتريا الحيوية و بادئات البكتريا الحيوية

أحمد عباس حسين طلبة و سيد أحمد محمد شعبان و وجدي ذكريا علي

معهد بحوث الإنتاج الحيواني – مركز البحوث الزراعية - وزارة الزراعة – الجيزة –ج.م.ع.

أجريت هذه الدراسة لمعرفة تأثير نوعين من البكتيريا الحيوية Probiotic النوع الأول المعروف في المستحضر التجاري (Biovit) فية البكتريا (Lactobacillus gassari and Bifidobacterium longum 10^8 cfu/gm) والنوع الثاني الجديد فية البكتريا (Pediococcus acidolactici $10x10^9$ cfu/gm) الموجودة في المستحضر التجاري (Bactocell) أو يادئات البكتريا الحيوية Prebiotic المستحضر fructooligosaccorids (FOS) أو مخاليطهما لتحسين بعض الصفات الإنتاجية والفسيولوجية للدجاج الفيومي البياض تحت ظروف المناخ الحار. وقد تم استخدام 180 دجاجة فيومي عمر 20 اسبوع تم توزيعهم عشوائيا إلى ستة مجموعات متساوية كلا منها 30 دجاجة في 3 مكررات كل منها 10 دجاجات وتم تربيتهم تحت ظروف متماثلة . المجموعة الأولي عليقة المقارنة والثانية تم إضافة مستحضر البكتيريا Biovit (Probiotic) بمعدل 1جم / كجم عليقه . والثالثة تم إضافة مستحضر البكتيريا Bactocell (Probiotic) بمعدل 1جم / كجم عليقه . والرابعة تم إضافة مستحضر { fructooligosaccorids (FOS) } (Prebiotic) بمعدل 1جم / كجم عليقه. والخامسة تم إضافة مستحضر البكتيريا (Biovit) مع مستحضر (FOS) بمعدل 1/2جم / كجم عليقه لكل من

المستحضرين (Synbiotic I). والسادسة تم إضافة مستحضر البكتيريا (Bactocell) مع مستحضر (FOS) بمعدل 1/2جم / كجم عليقه لكل من المستحضرين (Synbiotic II). وذلك من عمر 20 اسبوع حتي 36 اسبوع من العمر (مايو إلي أغسطس) أثناء قصل الصيف الحار حيث تتراوح درجة الحرارة بين 28- 38 درجة مئوية مع درجة رطوبة نسبية حوالي 75 % . **وكانت النتائج كالأتي : -**

- هناك تأثير إيجابى معنوي بمستوي (P<0.05) **للميكروبية الحيوية (Probiotics) بنوعيها أوبادئات**

البكتريا الحيوية (Prebiotic) أومخاليطهما (Synbiotics) بنوعيهما عند إضافتها الي عليقة الدجاح

الفيومي البياض لمدة 8 أو 12 أو 16 اسبوع تحت ظروف المناخ الحار علي وزن الجسم الحي ومعدل النفوق بالمقارنة بمجموعة عدم الإضافة.

- كما أدت الإضافات لمدة 12 أو 16 اسبوع تحت ظروف المناخ الحار **إلي** زيادة معنوية أيضا (P<0.05)

في كل من معدل إنتاج البيض وكتلة البيض والكفاءة التحولية تراكميا وذلك بالمقارنة بمجموعة عدم الإضافة .

- كما أدت الإضافات لمدة 16 اسبوع تحت ظروف المناخ الحار إلي زيادة معنوية (P<0.05) قي تركيزكل

من البروتين الكلى والألبيومين والجلوبيولين وتركيز هرمون تراي أيودوثيرونين (T_3) Triiodothyronine في بلازما الدم.

- كذلك أدت الإضافات لمدة 16 اسبوع تحت ظروف المناخ الحار إلي إنخفاض معنوي فى كل من مستوى

الكولسترول والدهون الكلية في بلازما الدم بالمقارنة بمجموعة عدم الإضافة.

- وأيضا لم تؤثر الإضافات المستخدمة لمدة 16 اسبوع تحت ظروف المناخ الحار معنويا علي تركيز الكرياتينين

وإنزيمي GOT and GPT في بلازما الدم بالمقارنة بمجموعة عدم الإضافة.

- كما أدت الإضافات لمدة 16 اسبوع تحت ظروف المناخ الحار إلي زيادة معنوية في كل من مستوي الأجسام

المناعية لفيروس النيوكاسل بعد 15يوم من التحصين . وتركيز الهيموجلوبين والهيماتوكريت وكذلك الوزن النسبي لكل من غدة الثيموسية والطحال بالمقارنة بمجموعة عدم الإضافة.

- كما أدت الإضافات لمدة 16 اسبوع تحت ظروف المناخ الحار إلي إنخفاض معنوي في كل من العدد الكلى

للبكتريا المرضية . E. Coli, Salmonella Pullorum or Clostridium perfringens. ودرجة الحموضة ال pH في الإمعاء (الإثنا عشر واللفائفي والصائمي والمستقيم).

- **وأيضا لم تؤثر الإضافات المستخدمة** معنويا علي كل صفات جودة البيض حيث تشابهت قيم كل من وزن البيض

ووزن الألبيومين ووزن القشرة ووزن الصفار وسمك القشرة ودليل الصفار ودليل شكل البيضة وكذلك قيم Haugh unit عند إضافة البكتريا المستخدمة وبادئاتها أو مخاليطهما لمدة 12 أو 16 اسبوع

وأظهرت النتائج أنة ينصح باستخدام الإضافات البكتيريا الحيوية المستخدمة أو بادئات البكتيريا الحيوية أو مخاليطهما لتحسين وزن الجسم وكفاءة التحويل الغذائى ومعدل إنتاج البيض وكتلة والصفات البيوكيميائية للدم وخفض معدل النفوق ومستوى كل من الكولسترول والدهون الكلية في الدم وذلك فى علائق الدجاج الفيومي تحت ظروف المناخ الحار أو أي ظروف بيئية مجهدة.