Effects of Probiotic (Biogen) and Zinc Bacitracin Supplementation on Laying Hen Performance, Some Blood Parameters and Egg Quality

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Abstract: An experiment was conducted to evaluate the effect of different levels of probiotic Biogen (0.05, 0.1, 0.15 and 0.2 %), zinc bacitracin (0.05 and 0.1%) and their mixture (0.05 % Biogen + 0.05% zinc bacitracin) on productivity performance and egg quality of laying hens. Ninety six laying hens of Bovans Brown at 39 weeks of age were individually weighed and randomly divided into eight equal groups (12 females in each group). Each group represented one treatment; each treatment was randomly assigned to 4 replicate pens. Hens were fed on the experimental diets for 8 weeks (39-47 weeks of age). The hen's performance and egg parameters were evaluated on two 28-d periods (39-43 and 44-47wks). Final body weight values were significantly ($P\leq0.05$) higher for hens fed diets containing 0.2% Biogen compared with all other treatments. No significant differences in egg weight were noticed between experimental groups and the control group. Hens fed diets containing 0.1 and 0.2 % Biogen had the best egg weight during the different periods of study. Data showed no significant differences among all treatments in egg number, egg mass, egg production rate, feed consumption (g/bird) or feed conversion (g feed /g egg mass) concerning the entire experimental periods. Results indicated that the experimental diets had no significant effect on albumen % (Al %), yolk % (Y %), yolk index (YI %), shell thickness (SHT), shell % (SH %) and Haugh unit (HU) during the entire study period. However, there were significant differences between treatments in yolk color (YC) and egg shape index (ESI). Results showed that the addition of Biogen, zinc bacitracin or their mixture to diet of laying hens caused significant ($P\leq0.05$) decreases in egg yolk total lipid (YTL) and serum triglyceride (Trig), total lipid (TL) and cholesterol (CH) and a significant ($P\leq0.05$) increase in serum total protein compared with the control group. No significant ($P\leq0.05$) differences in GOT and GPT enzymes activity was observed among treatments. Addition of Biogen as 0.05 % or zinc bacitracin to experimental diets improves both economic efficiency (EEF) and relative economic efficiency (REEF) as compared with the control group. The best REEF value (110%) was recorded by the hens fed diet containing 0.05 % Biogen. Results of the present study recommended that the Biogen supplementation at level of 0.05% showed the best performance and economic efficiency of Bovans Brown layers.

Keywords: Laying hen, Biogen, Zinc bacitracin, productive performance, egg quality and serum parameters.

INTRODUCTION

Increasing number of feed additives are offered to monogastric animals in order to improve their growth rate, feed efficiency and health status (Hollister *et al.*, 1989, Soliman, *et al.*, 2000 and Abd El-Gawad, *et al.*, 2004). Probiotics are non-nutritional additives containing beneficial microbial cultures and/or ingredients that enhance the growth of desirable gastrointestinal microbes of the host animal (Fuller, 1988 and Marionnet and Lebas, 1990). The addition of probiotic preparation to layer and quail diets improved feed conversion (Sellars, 1991); egg number, egg weight (Salwa *et al.*, 2004) and egg mass (Haddadin *et al.*, 1996). Probiotics regulate microbial environment of the intestines, decrease digestive disturbances, inhibit pathogenic intestinal microorganisms and improve FCR (Dhingra, 1993). Biogen is a kind of non- antibiotic feed supplement. It is an effective growth promoter feed additive used in diets of poultry and livestock. The main ingredients of Biogen are *allicin* (the product of garlic) + Ginseng + Bacillus subtitles + High unit hydrolytic enzymes (amylolytic, lipolytic, protolytic and cell separating enzymes). It has particular good flavor and appetizing function which can increase the palatability of feed, promote the secretion of digestive fluids and stimulate the appetite (Mona *et al.*, 2002). Quta *et al.* (2002) indicated that Biogen addition to 10% soaked linseed cake containing diet had slight improvements in broiler growth. Moreover, reports indicated that dietary Biogen supplementation improved growth and feed efficiency and it can help in eliminating environmental pollution (multiplication of flies and stinking odour, Yang and Yu, 1990). Bacitracin, is an antibiotic produced by *Bacillus Liceniformm* and *Bacillus subtitles* which belong to the group of peptide antibacterial compounds. Bacitracin which is authorized as a feed additive for poultry, pigs and calves is more stable as a zinc salt and is used as a growth promoter. It is mainly active against gram positive bacteria. The antibiotic performance promoter, e.g., zinc bacitracin (ZnB) is largely unabsorbed from the intestine. The main site of antibiotic activity is within the gastrointestinal tract, where ZnB acts to modify the intestinal flora as well as the gut wall structure (Bernsten, 1994). Also, these additives appear to improve the post absorptive metabolism in terms of egg quality, fertility, maternal carryover, and heat tolerance (Damron *et al.*, 1991; Männer and Wang, 1991). The performance-enhancing effect of ZnB has been observed in different species of fowl, including turkeys, broiler breeders, laying hens, and broiler chickens (Moran and McGinnis, 1965; Keppens *et al.*, 1981; Foster and Stevenson, 1983). Francis *et al.* (1978) noted that the performance of laying hens was improved with the dietary inclusion of either *Lactobacillus acidophilus* or zinc bacitracin, but not when the two components were fed together. Abaza, *et al.* (2006) found that addition of 0.05% of zinc bacitracin to the laying hen diet significantly ($P<0.05$)

increased egg number, egg mass, feed conversion ratio, total protein and albumen and significantly ($P<0.05$) decreased feed intake as compared to the control.

The present study aimed to investigate the effect of different levels of Biogen and zinc bacitracin in layer diets on productive performance, egg quality and serum blood constitute.

MATERIALS AND METHODS

Experimental birds, housing and feeding:

The present work was carried out at the Poultry Farm, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt. Ninety six laying hens of Bovans Brown at 39 week of age were individually weighed and randomly divided into eight equal groups (12 females in each group). Each group represented one treatment; each treatment was randomly assigned to 4 replicate pens. Each pen represented an experimental unit and contained 3 hens. All birds were kept in batteries under similar conditions during the experimental period. The hens were weighed at the start of experiment (39 week of age) and at the end of experiment (47 week of age) and body weight change was calculated. The first treatment was used as control that received standard food (corn-soybean meal). The experimental diets were formulated according to the strain catalog recommendation, as shown in Table 1. The 2^{nd}, 3^{rd}, 4^{th} and 5^{th} treatments were fed the basal diet supplemented with 0.05, 0.1, 0.15 and 0.2 % Biogen, respectively. The 6^{th} and 7^{th} treatments were fed the basal diet supplemented with 0.05 and 0.1 % zinc bacitracin, respectively. While the 8^{th} treatment was fed the basal diet supplemented with 0.05% Biogen + 0.05 % zinc bacitracin. The additives were incorporated into the diets at the expense of yellow corn. Feed and water were offered *ad libitum*. The birds were kept under a 16 hr light: 8 hr dark lighting schedule. Feed intake, egg number and egg weight were recorded and feed conversion ratio, egg production and egg mass were calculated. Egg quality traits were measured for three consecutive days at the end of each 4-week period (after 4 weeks of the beginning and at the end of treatment period, after 8 weeks). Three eggs from each replicate (12 egg /treatment) were collected, weighed and broken out. Shell weight, yolk weight, height and diameter and albumen height were recorded. Albumen weight was determined by differences. Shell thickness (including shell membranes) was measured by using micrometer. Egg and yolk diameters were measured using a caliber. Yolk and albumen height were measured using a tripod micrometer reading to the nearest 0.01 mm. Yolk index was calculated as height / diameter × 100 (Well, 1968). Egg shape index (ESI) was estimated as the ratio between maximum width of the eggs and length of the egg × 100. Haugh unit (HU) score for each egg was calculated according to Haugh (1937) as follows:

$$HU = 100 \log (H + 7.57 - 1.7\, W^{0.37})$$

Where,

H= Albumen height (m.m.); W = egg weight (gm.)

Yolk color was determined using Hoffmann La Roche yolk color fan. Yolk total lipid was extracted by petroleum ether in Soxhlet apparatus. Blood sample were collected from 4 birds/ treatment from the brachial vein in clean tubes without heparin at the end of the experimental period. Serum was obtained by centrifugation of blood at 3000 rpm for 20 min for later analysis. Serum samples were subjected to biochemical analysis using specific kits produced by Diamond Company. Total protein (TP), total lipid (TL), triglycerides (TRI), cholesterol (CH) and transaminase enzyme activities (GOT and GPT) were evaluated in serum samples (according to the procedure outlined by the manufacture. Economic efficiency for egg production was calculated from input-output analysis according to the price of the experimental diets and eggs produced. Net revenue was calculated by subtracting total feed costs from total income of egg price. The values of economical efficiency were calculated as the net revenue per unit of total feed cost.

Statistical analysis was computed using the General Linear Model (GLM) procedure of Statistical Analysis Software (SAS Institute Inc., 1998), and the significant differences between means were detected according to Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Productive performance

The effects of feed additives supplementation on body weight (BW), egg weight (EW), egg number (EN), egg mass (EM), egg production rate (EPR), feed consumption (FC, g/ bird) and feed conversion ratio (FCR, g feed/g egg mass) are presented in Table (2).

Live body weight

Results indicate that initial body weight (39 weeks old) did not differ significantly among the treatment groups, indicating the complete randomization of distribution of birds into the experimental groups. Results presented in the same Table show that final body weight values at the end of experiment were significantly ($P \leq 0.05$) higher for hen group fed diets containing 0.2% Biogen compared with all treatments which decreased in their weights. The depression in control group was greater than the other groups. Increased body weight with 0.2 % Biogen may be due to larger microbial population which favorably changed the balance of enteric intestines or the availability of nutrients as reported by Alder and DaMassa (1980). The improvement of Biogen supplementation may be attributed to the mode of action of the Biogen which contain bacteria that stimulate appetite (Nahashon *et al.*, 1994). Similarly, Abdalla *et al.* (2004) reported that all Biogen supplemented birds had significantly ($P \leq 0.01$) higher body weight than those fed garlic. Tollba *et al.* (2005) reported that there were no significant differences in body weight gain due to supplementing studied herbal additives (including garlic). While, in 2007 they found that feeding of both Probiotics and Prebiotics to Fayoumi laying hens under hot climate, improved ($P \leq 0.05$) live body weight. The present results agreed with those reported by Salwa *et al.* (2004) who found significant improvement in hen body weight by the addition of probiotics to the diets compared to the unsupplemented control.

Egg production:

Data show significant ($P \leq 0.05$) differences in EW between treatments during the different periods studied (Table 2). Hens fed diets with 0.05 or 0.15% Biogen recorded the worst values. While, hens fed diets with 0.1 or 0.2 % Biogen had the best egg weight. Meanwhile, no significant differences between experimental groups and control group. Kout El-Kloub and Roushdy (2007) reported that EW was significantly ($P \leq 0.05$) improved up to 0.15% pronifer (probiotic) inclusion level in Bandara compared with the other treatments. Similar results were obtained in Bovine White by Salwa *et al.* (2004) and Nahashon *et al.* (1996) who reported that egg weight was significantly higher for birds fed diets supplemented with probiotics. Also, Tollba *et al.* (2005) showed that EW of birds fed diet supplemented with garlic laid significantly ($P \leq 0.05$) heavy eggs compared with unsupplemented control birds. On the other hand, Abaza *et al.* (2006) reported that addition of probiotics or zinc bacitracin at levels of 0.1 or 0.05%, respectively, had insignificant effect on egg weight. Also, Mona *et al.* (2003) found that EW was insignificantly improved throughout the entire experimental period as feeding diets contained 4, 8, 12 and 20% levels of corn gluten feed with probiotic supplementation.

The effects of inclusion levels of Biogen, zinc bacitracin or their mixture on EN, EM and EPR are presented in Table (2). The results show a progressive increase with no clear trend as a result of including different levels of dietary supplementation as compared with the control group. However the differences detected in all parameters among the experimental groups were not significant. These results were supported by Abdulrahim *et al.* (1996) who found no significant effect on egg production due to the addition of bacitracin (22.5 mg zinc bacitracin /kg diet), while Tollba, *et al.* (2005) reported that supplementing the basal diet with garlic significantly increased egg production and egg mass. Abaza *et al.* (2006) found that the addition of probiotics or zinc bacitracin significantly ($P \leq 0.05$) improved EN, and EM, and had no significant effect on EW as compared to the control group. Also, Salwa *et al.* (2004) reported that the addition of *lactobacillus acidophilus* or *bifidobacterium bifidum* or their mixture had significantly positive effect on egg production rate, egg weight and egg mass.

Feed consumption and feed conversion ratio:

As shown in Table (2), there were significant differences among treatments in feed consumption (FC) during the first period (39-43 weeks). Concerning the second and the entire periods studied, results indicate that there were insignificant differences in FC among treatments. The birds fed control diet had the lowest FC (6013 g in the entire period), whereas, the birds fed diet with 0.05 % zinc bacitracin had the highest (6149 g for the same period). In this respect, Abdalla *et al.* (2004) showed that there were insignificant differences in feed intake between the duck fed diet with Biogen supplementation and those fed diet with garlic supplementation. Also, they found that duck fed Biogen at level of 2.0g/kg diet recorded significantly lower feed intake. Kout El-Kloub (2006) and Mona *et al.* (2003) did not find any effect of the addition of probiotics to laying hens on feed consumption. While, Abaza *et al.* (2006) reported that the addition of dinafrem as probiotics significantly ($P \leq 0.05$) increased feed intake, while, zinc bacitracin addition significantly ($P \leq 0.05$) decreased feed intake as compared to the control group.

Table (2), indicates insignificant differences among treatments in feed conversion ratio (FCR) during the experimental periods. The FCR for hens fed 0.2 % Biogen was superior than those fed other experimental diets including the control diet during the intervals or the entire period studied (1.77 vs. 1.87 for the control group). Similar results were found by Al-Harthi (2006) who reported that the addition of probiotcs to the laying hen diets did not give any significant differences in FCR. The opposite was true with Salwa *et al.* (2004); Ghazalah and Ibrahim (1998) who observed that the addition of some probiotics significantly improved feed conversion. Abdulrahim *et al.* (1999) found that feed conversion was reduced by zinc bacitracin alone but was improved by the use of *L. acidophilus* and bacitracin in combination.

Egg quality:

Concerning the entire period studied, results in Table (3) indicate no significant effects on albumen % (Al %), yolk % (Y %), yolk index (YI %), shell thickness (SHT), shell % (SH %) and Haugh unit (HU) when laying hens were fed experimental diets. Yolk index was higher for 3^{rd}, 4^{th}, 5^{th}, 6^{th} and 7^{th} treatments compared to the control. The 4^{th} treatment group recorded the lowest HU value compared to the other experimental groups without significant differences. This is in agreement with results obtained by Yousefi and Karkoodi (2007), who reported that SH % and albumen weight were not differ significantly among treatment groups when hens were fed diets with different levels of probiotics. Similarly, Kout El-Kloub and Roushdy (2007) reported that treatments had no significant effect on egg quality. Tollba *et al.* (2005) reported that egg quality improved numerically compared to unsupplemented control group when hens were fed different herbal additives (black seeds, fresh garlic and thyme).

Data in the same Table showed that there were significant ($P \leq 0.05$) differences between treatments in yolk color (YC) and egg shape index (ESI). Concerning the entire period, YC was higher for 3^{rd}, 5^{th}, 6^{th}, 7^{th} and 8^{th} treatments compared to the control. Egg shell index followed the same manner as HU, the 4^{th} treatment group recorded the lowest value compared to the other experimental groups. Mona (2003) reported that the inclusion of levels of probiotics up to 4 gm / kg had no significant effect on either SHT or HU but had a significant increase in ESI. Also, Mona *et al.* (2003) found that egg quality parameters were not affected by adding 20 % corn gluten feed supplemented with probiotic as compared to the control.

In general, results of Tables (2 and 3) concerned with performance and egg quality may lead us to conclude that supplementing laying hen diets with Biogen at levels of 0.1 and 0.2 %, improved productive performance compared with control group. Interestingly, interior and exterior egg qualities were not affected during the experimental periods.

Physiological traits:

Serum parameters:

The mean values of triglyceride (Trig), total lipid (TL), cholesterol (CH), total protein (TP), glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), and yolk total lipids (YTL) are presented in table (4). Results indicate that the addition of Biogen, zinc bacitracin or their mixture to the diet of laying hen caused a significant ($P \leq 0.05$) decrease in serum Trig, TL and CH compared with the control group. The respective decrease was about 1.28, 15.99, 10.02, 18.11, 13.74, 10.34 and 3.99 % in serum Trig, while it was 7.3, 12.97, 4.81, 17.57, 14.14, 15.62 and 4.65 in serum TL and 1.52, 16.62, 16.67, 11.36, 18.93, 18.74 and 4.65 % in serum CH when hens were fed diets with 0.5, 0.1, 0.15 and 0.2 % Biogen or 0.05 and 0.1 % zinc bacitracin or their mixtures (0.05 % Biogen + 0.05 % zinc bacitracin), respectively, compared with the control group. These results are in agreement with relevant reports (Tollba *et al.*, 2007 and Abdulrahim *et al.*, 1996). This reduction was explained by Tortuero *et al.* (1975) who attributed it to bacteria which may assimilate or degrade the cholesterol to bile acid followed by de-conjugation to prevent re-synthesis. Similar trend was obtained by Sayed *et al.* (2003) with Gimmizah and Mamourh strains. Table (2) show an increase ($P \leq 0.05$) in serum total protein for groups fed experimental diets as compared with control group by about 8.50, 9.91, 10.09, 17.09, 23.42, 23.42 and 14.87, respectively. The increase in serum protein may indicate improvement in feed conversion, absorption and utilization of nutrients. Similar results were obtained by Kout El-Kloub and Roushdy (2007) with Dokki4 and Bandara strains, Tollba *et al.* (2007) with Fayoumi hens and Sayed *et al.* (2003) with Gimmizah and Mamourh strains. No significant differences in GOT and GPT enzymes activity were observed among treatments (Table 4). The similarity of enzyme activity in supplemented or unsupplemented groups is indication of healthy, non pathological or non- toxic effects of Biogen or zinc bacitracin on liver function. Similarly, Tollba *et al.* (2007) concluded that GOT and GPT enzymes of layers fed supplemented diets with probiotic and prebiotic for 16 weeks were not affected. Also, Soliman *et al.* (2003) reported that broiler chicks fed microbial probiotic recorded insignificant effects on GOT and GPT enzymes activity.

Yolk lipids:

The mean values of yolk total lipids (YTL) are presented in Table (4). Results show significant depression in YTL and the percentages of reduction about 0.94, 4.05, 3.33, 4.77, 4.72, 4.22 and 3.81 than the control value when hens were fed 0.05, 0.1, 0.15 and 0.2 % Biogen or 0.05 and 0.1 % zinc bacitracin or their mixtures (0.05 % Biogen + 0.05 % zinc bacitracin), respectively. Kout El-Kloub and Roushdy (2007) reported that total lipids were decreased significantly by the addition of probiotic levels compared with the control group. This reduction may be due to the inhibition of their synthesis (Ghazalah and Ibrahim 1998).

Economical efficiency:

The results of economic efficiency (EEF) and relative economic efficiency (REEF) estimated for the experimental diets used during the experiment are shown in Table (5). Results indicated that the addition of Biogen at only 0.05 % or zinc bacitracin to experimental diets improved both EEF and REEF as compared with the control group. The best relative economic efficiency value was recorded by the hens fed diet containing 0.05 % Biogen (110%). This improvement could be due to reducing the amount of feed required to produce one unit of egg mass or improving the egg production rate. In this respect, Soliman (2003) indicated that the addition of live yeast as a probiotic in laying hen diets gave the best economical efficiency values.

The previous results suggest that the Biogen addition at 0.05% level to the basal diet gave the best economic efficiency without any harmful effects on laying hen productive performance and egg quality characteristics.

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

Ingrediants	%	Ingrediants	%
Yellow corn	64.85	Calculated analysis	
Soybean meal 44%	18		
Layer concentrate*	8	**ME(Kcal/kg)**	2760.4
Di-calcium phosphate	1.125	**Crude protein**	17.65
Limestone	7.5	**Calcium**	3.79
Salt	0.1	**Available phosphorus**	0.5656
Trace mineral mixture**	0.1	**Methionine**	0.3514
DL-Methionine	0.125	**Lysine**	0.7186
Lysine	0.1	**Methionine+ Cysteine**	0.5817
Choline chloride	0.1		
Total	**100.00**		

* Layer concentrate (MUVCO): meat and bone meal 60 % (CP), herring fish meal 72 % (CP), soybean meal, corn gluten, Di-calcium phosphate, limestone, sodium chloride, DL-Methionine, L- lysine, Choline chloride, vitamin mixture and mineral mixture.

*Each Kg contain: 2300 k cal. ME and 50 % crude protein.

** Min. mix (MUVCO): each 1kg contains: 60 g manganese, 20 g zinc, 30g iron, 5 g copper, 0.5 g iodine, 0.2 g cobalt and 0.1 g selenium

Table (2): Effect of feeding laying hens different levels of biogen and zinc bacitracin on body weight and productive performance (means ± SE).

Items	Treatments							
	Control	Biogen (B)%				Zinc Bacitracin (ZB)%		B +ZB %
		0.05	0.1	0.15	0.2	0.05	0.1	0.05 B+0.05 ZB
Body weight (g)								
Initial (39 wks old)	1868.00±14.88	1903.75±40.81	1875.75±29.28	1881.25±21.49	1884.75±24.28	1880.75±27.42	1845.00±22.76	1866.75±15.51
Final (47 wks old)	1796.00^{b}±13.91	1863.5^{ab} ±26.34	1844.75^{ab}±33.81	1828.25^{b}±21.28	1943.00^{a} ±36.65	1836.00^{ab} ±47.71	1785.00^{b} ±39.35	1825.25^{b} ±36.51
Change	-72.00^{b} ±24.65	-40.25^{ab} ±39.63	-31.00^{ab} ±26.38	-53.00^{ab}±30.41	58.25^{a} ±23.00	-44.75^{ab} ±38.61	-60.00^{ab} ±51.52	-41.50^{ab} ±49.93
Egg weight (g)								
39-43 wks	64.62^{ab} ±.1.84	61.91^{b} ±.0.87	66.06^{a} ±.1.27	62.37^{b} ±.0.52	65.78^{ab} ±1.14	64.59^{ab} ±.0.57	64.42^{ab} ±.0.59	63.11^{ab} ±.0.75
44-47 wks	64.29^{ab} ±1.55	62.06^{b} ±0.86	65.94^{a} ±1.01	61.73^{b} ±1.39	65.18^{ab} ±0.86	64.99^{ab} ±0.89	63.86^{ab} ±0.69	63.90^{ab} ±0.95
Overall	64.45^{ab} ±1.67	61.98^{b} ±0.87	66.00^{a} ±1.11	62.05^{b} ±1.43	65.48^{ab} ±0.89	64.79^{ab} ±0.63	64.15^{ab} ±0.63	63.51^{ab} ±0.85
Egg number/hen								
39-43 wks	26.17±0.79	26.08±1.07	26.33±0.49	26.92±0.31	26.34±0.81	26.34±0.30	26.34±0.70	25.99±0.62
44-47 wks	23.92±1.38	27.00±0.30	24.25±1.46	25.67±0.58	26.25±0.64	25.83±0.31	26.17±0.57	25.08±1.62
Total	50.08±1.67	53.09±1.27	50.58±1.80	52.59±.84	52.58±1.38	52.17±0.61	52.50±1.17	51.08±2.23
Egg mass g /hen								
39-43 wks	1686.85±19.05	1617.03±85.17	1739.12±41.98	1677.29±23.77	1729.5±24.79	1700.83±23.34	1697.17±56.02	1640.92±46.24
44-47 wks	1535.86±85.19	1676.48±41.61	1601.28±110.43	1582.42±21.62	1710.46±42.20	1678.00±7.72	1672.07±52.22	1604.69±113.16
Total	3223.74±93.07	3293.45±122.29	3339.73±143.18	3259.26±33.71	3440.07±59.94	3378.96±28.83	3369.00±100.88	3245.79±158.64
Egg production rate								
39-43 wks	93.45±2.86	93.16±3.8	94.05±1.75	96.13±1.13	94.05±2.88	94.05±1.09	94.05±2.54	92.86±2.23
44-47 wks	85.42±4.92	96.43±1.09	86.61±5.19	91.67±2.06	93.75±2.29	92.27±1.14	93.46±2.03	89.59±5.79
Overall	89.44±2.99	94.79±2.27	90.33±3.22	93.90±1.51	93.89±2.47	93.16±1.09	93.75±2.09	91.22±3.98
Feed consumption (g/bird)								
39-43 wks	3064.42^{b} ±10.61	3074.17^{ab} ±2.06	3074.00^{ab} ±2.69	3078.00^{a}±0.47	3075.84^{ab} ±1.55	3078.25^{a}±0.25	3077.50^{a}±.96	3075.67^{ab} ±1.26
44-47 wks	2949.05±106.59	3030.37±23.61	3041.00±20.36	3069.4±6.27	3014.2±36.46	3071.42±.90	3061.33±9.53	3041.85±30.72
Total	6013.47±116.85	6104.53±24.33	6115.00±22.75	6147.40±6.49	6090.04±37.98	6149.67±.83	6138.84±9.46	6117.52±31.95
Feed conversion (feed/E. mass)								
39-43 wks	1.82±0.03	1.92±0.108	1.77±0.04	1.84±0.03	1.78±0.03	1.81±28.83	1.82±0.06	1.88±0.06
44-47 wks	1.95±0.16	1.81±0.055	1.93±0.14	1.94±0.03	1.77±0.05	1.83±0.01	1.84±0.06	1.93±0.17
Overall	1.87±0.08	1.87±0.08	1.84±0.08	1.89±0.02	1.77±0.04	1.82±0.01	1.83±0.05	1.90±0.11

^{a,b} means with different superscripts within rows are significantly different ($P \leq 0.05$).

Table (3): Effect of feeding laying hens different levels of biogen and zinc bacitracin on egg quality characteristics (means ±SE) at 43 and 47 weeks of age.

Items	Treatments							
	Control	Biogen (B) %				Zinc Bacitracin (ZB) %		B +ZB %
		0.05	0.1	0.15	0.2	0.05	0.1	0.05 B +0.05 ZB
Albumen %								
43 week	63.32±0.41	63.28±0.66	63.46±1.24	64.52±1.01	64.06±0.42	62.97±0.64	63.48±0.57	64.97±0.54
47 week	63.70±.1.09	63.91±.0.16	63.34±.0.81	62.90±.0.47	63.56±.0.79	63.83±.0.58	63.56±.0.82	64.43±.0.68
Overall	63.51±0.73	63.59±0.36	63.40±0.96	63.71±0.64	63.81±0.56	63.39±0.31	63.52±0.59	64.69±0.26
Yolk %								
43 week	25.58±0.41	26.04±0.85	26.08±1.11	24.73±0.88	25.26±0.24	25.98±0.43	25.53±0.58	24.38±0.30
47 week	25.62±0.9	25.41±0.29	26.09±0.81	25.20±0.47	25.68±0.59	25.59±0.58	25.57±0.71	24.79±0.64
Overall	25.59±0.65	25.73±0.53	26.09±0.88	25.46±0. 61	25.47±0.32	25.79±0.29	25.55±0.55	24.59±0.40
Yolk index								
43 week	44.00±1.28	44.55±0.69	44.56±0.63	45.50±0.85	45.86±1.14	47.03±1.49	46.55±0.69	44.67±0.49
47 week	48.6±1.66	47.16±0.44	47.50±0.74	47.99±0.39	48.31±1.81	49.01±0.39	49.91±0.92	47.00±123
Overall	46.30±0.88	45.86±0.48	46.04±0.43	46.75±0.51	47.08±1.14	48.02±0.62	48.24±0.57	45.84±0.77
Yolk color								
43 week	6.34^{ab} ±0.19	6.17^{b} ±0.21	6.83^{a} ±0.17	6.33^{ab} ±0.14	6.49^{ab} ±0.17	6.50^{ab} ±0.09	6.67^{ab} ±0.14	6.50^{ab} ±0.22
47 week	6.75±0.16	6.75±0.16	7.00±0.00	6.84±0.09	6.75±0.08	6.75±0.16	6.67±0.14	6.75±0.16
Overall	6.54^{ab} ±0.14	6.46^{b} ±0.17	6.92^{a} ±0.08	6.58^{ab} ±0.08	6.63^{ab} ±0.08	6.63^{ab} ±0.11	6.67^{ab} ±0.07	6.63^{ab} ±0.13
Shell thickness (mm)								
43 week	0.53±0.01	0.49±0.01	0.53±0.01	0.53±0.03	0.53±0.02	0.54±0.02	0.52±0.01	0.52±0.02
47 week	0.51^{ab} ±0.01	0.52^{ab} ±0.02	0.51^{ab} ±0.02	0.47^{b} ±0.01	0.50^{ab} ±0.02	0.53^{a} ±0.01	0.51^{ab} ±0.01	0.49^{ab} ±0.02
Overall	0.52±0.01	0.50±0.01	0.52±0.01	0.50±0.02	0.51±0.01	0.54±0.01	0.52±0.01	0.51±0.02
Shell %								
43 week	11.1±0.08	10.68±0.31	10.46±0.15	10.76±0.19	10.68±0.29	11.06±0.23	10.99±0.25	10.64±0.38
47 week	10.68±0.18	10.68±0.22	10.57±0.24	10.90±0.13	10.76±0.41	10.58±0.07	10.88±0.17	10.79±0.28
Overall	10.89±0.08	10.68±0.24	10.51±0.18	10.83±0.07	10.72±0.29	10.82±0.10	10.93±0.15	10.72±0.20
Egg shape index								
43 week	77.52±0.69	76.84±0.75	78.13±1.34	74.84±2.35	78.89±0.68	78.19±1.44	78.77±0.91	77.69±0.97
47 week	77.69±1.28	77.14±0.68	77.67±1.31	75.97±0.90	78.64±1.69	77.78±0.45	78.31±0.72	78.04±0.88
Overall	77.60^{ab} ±0.98	76.99^{ab} ±0.61	77.89^{ab} ±1.17	75.41^{b} ±1.6	78.77^{a} ±1.17	77.99^{ab} ±0.74	78.54^{ab} ±0.64	77.86^{ab} ±0.71
Haugh unit								
43 week	91.77^{a} ±2.00	85.07^{ab} ±.3.73	85.51^{ab} ±2.33	84.49^{b} ±2.25	87.37^{ab} ±3.62	87.14^{ab} ±1.94	88.34^{ab} ±1.77	88.75^{ab} ±2.11
47 week	96.79^{ab} ±3.25	94.72^{ab} ±1.44	98.11^{ab} ±1.41	91.70^{b} ±2.57	93.22^{b} ±2.64	94.98^{ab} ±0.98	100.82^{a} ±1.11	93.06^{ab} ±2.20
Overall	94.28±2.21	89.89±2.58	91.81±1.67	88.09±1.85	90.29±3.97	91.06±0.94	94.58±1.02	90.91±1.68

^{a,b} means with different superscripts within row are significantly different ($P \leq 0.05$).

Table (4): Effect of feeding laying hens different levels of biogen and zinc bacitracin on some serum blood parameters and yolk total lipid.

Trait	Treatments							
	Control	Biogen (B) %				Zinc Bacitracin (ZB) %		B +ZB %
		0.05	0.1	0.15	0.2	0.05	0.1	0.05 B +0.05 ZB
Trig, (g/dl)	$389.25^{a} \pm 19.25$	$384.25^{a} \pm 35.29$	$327.00^{b} \pm 2.61$	$350.25^{ab} \pm 6.38$	$318.75^{b} \pm 4.27$	$335.75^{ab} \pm 23.71$	$349.00^{ab} \pm 5.09$	$373.75^{ab} \pm 5.02$
TL (g/dl)	$1253.25^{a} \pm 4.82$	$1161.50^{b} \pm 6.50$	$1090.75^{c} \pm 10.75$	$1193.00^{ab} \pm 6.25$	$1033.00^{c} \pm 29.40$	$1076.00^{c} \pm 42.78$	$1057.50^{c} \pm 40.85$	$1195.00^{ab} \pm 12.75$
CH (g/dl)	$157.33^{a} \pm 3.22$	$154.94^{ab} \pm 5.63$	$131.18^{c} \pm 6.63$	$139.45^{bc} \pm 4.51$	$123.25^{c} \pm 6.08$	$127.57^{c} \pm 6.02$	$127.84^{c} \pm 2.95$	$150.01^{ab} \pm 3.63$
TP (g/dl)	$5.85^{c} \pm 0.28$	$6.35^{bc} \pm 0.19$	$6.43^{abc} \pm 0.44$	$6.44^{abc} \pm 0.22$	$6.85^{ab} \pm 0.16$	$7.22^{a} \pm 0.05$	$7.09^{ab} \pm 0.20$	$6.72^{ab} \pm 0.31$
GOT U/l	72.50 ± 4.86	73.50 ± 0.65	73.75 ± 3.79	70.75 ± 2.39	75.50 ± 6.51	75.00 ± 2.04	73.50 ± 1.85	72.25 ± 2.43
GPT U/l	6.63 ± 0.07	6.38 ± 0.43	6.58 ± 0.29	6.41± 0.49	6.25 ± 0.09	6.15 ± 0.32	6.31 ± 0.15	6.23 ± 0.11
TL (g/ g yolk)	$269.15^{a} \pm 4.59$	$266.63^{ab} \pm 2.15$	$258.25^{b} \pm 5.22$	$260.18^{ab} \pm 2.20$	$256.30^{b} \pm 2.23$	$256.45^{b} \pm 1.19$	$257.78^{b} \pm 0.15$	$258.90^{b} \pm 2.30$

[a, b, c] means with different superscripts within row are significantly different ($P \leq 0.05$).

Trig= Triglyceride. TL= Total lipid. CH= cholesterol.

TP= Total protein. GOT = glutamic oxaloacetic transaminase.

GPT = glutamic pyruvic transaminase.

Table (5): Input/output analysis and economical efficiency of experimental groups.

Items	Treatments							
	Control	Biogen (B) %				Zinc Bacitracin (ZB) %		B +ZB %
		0.05	0.1	0.15	0.2	0.05	0.1	0.05 B +0.05 ZB
Total feed consumption (kg/hen)	6.013	6.105	6.115	6.147	6.09	6.149	6.139	6.118
Price /kg feed (L.E.)	1.643	1.661	1.678	1.695	1.711	1.653	1.663	1.670
Total feed cost (L.E.)	9.879	10.140	10.261	10.419	10.419	10.164	10.209	10.217
Total number of eggs/hen	50.08	53.09	50.58	52.59	52.58	52.17	52.50	51.08
Total price of eggs/hen (LE.)[1]	15.024	15.927	15.174	15.777	15.774	15.651	15.75	15.324
Net revenue /hen (LE.)[2]	5.145	5.787	4.913	5.358	5.355	5.487	5.541	5.107
Economical Efficiency (EEF)[3]	0.52	0.57	0.48	0.51	0.51	0.54	0.54	0.50
Relative economical efficiency (%)[4]	100	110	92	98	98	104	104	96

[1] The price of one egg = 30 P.T.

[2] Net revenue= Total price of eggs/hen-total feed cost.

[3] Economic efficiency = net revenue/ total feed cost.

[4] Relative economical efficiency, assuming the control treatment = 100%.

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تأثيرإضافة البروبيوتك (البيوجين) والزنك باستراسين على الكفاءة الإنتاجية وبعض مقاييس الدم وصفات جودة البيضة للدجاج البياض

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أجريت هذه الدراسة لمعرفة تأثير إضافة مستويات مختلفة من البيوجين والزنك باستراسين والتداخل بينهما أثناء فترة إنتاج البيض من ٣٩-٤٧ أسبوع من العمر علي الكفاءة الإنتاجية وصفات جودة البيضة وبعض قياسات الدم لسلالة البوفانز البني. وقد تم إستخدام ٩٦ دجاجة قسمت عشوائيا إلي ثماني مجموعات متساوية تقريبا في وزن الجسم ، كل مجموعة قسمت إلي ٤ مكررات ، كل مكررة ٣ دجاجات. غذيت المجموعات كالتالي : - مجموعة المقارنة علي العليقة الأساسية بدون إضافات. المجموعات من الثانية حتي الخامسة تم تغذيتها علي العليقة الأساسية مضاف اليها البيوجين بالنسب ٠,٠٥ ، ٠,١ ، ٠,١٥ ، ٠,٢% علي الترتيب. المجموعتين السادسة والسابعة تم تغذيتها علي العليقة الأساسية مضاف اليها الزنك باستراسين بنسبة ٠,٠٥ ، ٠,١ % على الترتيب. بينما غذيت المجموعة الثامنة علي العليقة الأساسية مضاف اليها البيوجين والزنك باستراسين بنسبة ٠,٠٥ % لكل منهما. تم تغذية الطيور علي علائق التجربة لمدة ٨ أسابيع. تم تسجيل بيانات الأداء الانتاجي وبعض قياسات الدم ، كذلك صفات جودة البيضة وكانت النتائج كالتالي:

١- لم يكن هناك أي تأثير معنوى للإضافات علي وزن البيضة برغم زيادة وزن البيضة للطيور التي غذيت علي العليقة المحتوية علي البيوجين بنسبة ٠,٢% ، كذلك لم يكن هناك تأثير علي كل من عدد البيض ، معدل إنتاج البيض ، وكتلة البيض ، كمية الغذاء المستهلك ، الكفاءة التحويلية ، النسبة المئوية لكل من الألبيومين ، الصفار، دليل الصفار، القشرة وكذلك سمك القشرة ووحدة هاوف وتركيز كلا من انزيمي ال GPT , GOT.

٢- كان هناك تأثير معنوي للمعاملات علي دليل شكل البيضة وكذلك لون الصفار.

٣- هناك إنخفاض معنوي في نسب الدهون الكلية في الصفار وكذلك في نسبة الجليسريدات الثلاثية والكوليسترول والدهون الكلية في السيرم. بينما يوجد إرتفاع معنوي في البروتين الكلي للسيرم للطيور التي تم تغذيتها علي العلائق التجريبية مقارنة بمجموعة المقارنة.

٤- أدي إضافة النسب المختلفة من البيوجين والزنك باستراسين الي تحسن الكفاءة الإقتصادية حيث سجلت طيور المجموعة الثانية (٠,٠٥% بيوجين) أعلي كفاءة إقتصادية نسبية وصلت إلي ١١٠ % مقارنة بمجموعة المقارنة.

من هذه النتائج يتضح أن إستخدام البيوجبن بنسبة ٠,٠٥% أعطي أفضل كفاءة إقتصادية ولم يؤثر سلبيا علي الصفات الإنتاجية كما أنه خفض من تركيز الدهون في السيرم.