Journal of Advanced Veterinary Research Volume 8, Issue 3 (2018) 66-72

Journal of Advanced Veterinary Research

http://advetresearch.com/index.php/avr/index

Effect of Feeding Propolis on Growth Performance of Broilers

Rasha I.M. Hassan[1], Gamal M.M. Mosaad[1], Hala Y. Abd El-wahab[2]

[1]*Department of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, Assiut University, Egypt*
[2]*Department of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, New Valley branch, Assiut University, Egypt*

ARTICLE INFO

Original Research

Received:
08 July 2018

Accepted:
23 July 2018

Keywords:

Broilers, Carcass characteristics, Hematological parameters, Performance, Propolis

ABSTRACT

An experiment was conducted to investigate the effect of propolis on broiler performance, carcass characteristics and blood parameters. The experiment was carried out with a completely randomized design of 4 treatments, supplemented with propolis at the rate of 0, 1, 2, and 3 mg/kg diet for 6 weeks. The results indicated that birds diet supplementation with propolis increased body weight ($P<0.05$), decreased feed intake and improved feed efficiency during the experiment. Carcass traits did not show significant differences for the treatments, with the exception of dressing percentage. The serum total protein and globulins were significantly ($P<0.05$) increased and the serum cholesterol and triglycerides were significantly ($P<0.05$) decreased in propolis supplemented broilers. No significant differences were observed in hematological parameters among the different groups. It could be concluded that dietary inclusion of propolis to poultry diets had a positive effect on growth performance and improved the immune response by elevating blood globulins level. Also, it decreases blood cholesterol and triglyceride levels.

Introduction

Propolis is a resin-like mixture produced by bees and composed of natural substances expounding broad range of biological activities involving antibacterial, antifungal (Silici *et al.*, 2005), antioxidant (Kumazawa *et al.*, 2004; Wang *et al*, 2004), anti-inflammatory (Borrelli *et al.*, 2002), anticancer (Nagei *et al.*, 2003), anesthetic and antiviral activities (Ramos and Miranda, 2007), in addition to its character as a probiotic (Macfarlane *et al.*, 2008). Propolis has tasty substances like resin, wax, honey and vanillin (Shalmany and Shivazad, 2006).

More than 300 ingredients have been identified in propolis. These ingredients including polyphenols, flavonoids, phenolic acids, aromatic aldehydes, esters and amino acids (Trusheva *et al.*, 2006), which can affect various phases of immune system activation, such as the increased expression of cytokines, which are involved in initiating the immune response (Freitas *et al.*, 2011), antibody production (Galal *et al.*, 2008) and macrophage phagocytic activity (Sforcin, 2007). In addition to its content of chemical compounds, propolis is highly nutritive due to its content of vitamins B_2, B_3, B_6, C and E, as well as minerals such as Mg, Ca, I, K, Na, Cu, Zn, Mn and Fe. Propolis also contains some enzymes such as dehydrogenase, glucose-6-phosphatase, adenosine triphosphate and acid phosphatase (Kumova *et al.*, 2002; Yilmaz *et al.*, 2003).

Latterly, propolis has been used as nutritional substances in broiler chickens as it has proven effects on health status, economic profiles, feed conversion, carcass traits and meat quality (Abdel-Mohsein *et al.*, 2014; Haščík *et al.*, 2014).

Chinese propolis is a prevalent type of propolis. Flavonoids, cinnamic acids and their esters are the main active constituents in this propolis (Bankova, 2005). Flavonoids and phenolic acids of propolis are found to be responsible for its antimicrobial and biological activities (Haile *et al.*, 2012).

The effect of dietary propolis supplementation on growth performance, carcass characteristics and hematological indices of broiler chickens was investigated.

Materials and methods

Animals and diets

A Total of sixty, one days old (Ross 308) broiler chicks were randomly assigned to four equal groups, A corn-soybean meal

*Corresponding author: Rasha I.M. Hassan
E-mail address: rasha_feeding@yahoo.com

ISSN: 2090-6277/2090-6269/

basal starter and finishing diets was formulated to meet the nutrient requirement guidelines of National Research Council (1994). The dietary groups were as follows: T1) control group, T2) supplemented with 1.0 g propolis/kg, T3) supplemented with 2.0 g propolis/kg and T4) supplemented with 3.0 g propolis/kg.

The birds were fed with starter diet until 21 days of age, followed by finishing diet until 42 days of age. Commercial propolis produced by Dalian Tianshan Industrial Co., Ltd, Liaoning, China. Experimental diets and water were provided for ad libitum consumption. Birds received all vaccination required. Continuous lighting program (23 hours lightning: 1 hour darkness) was provided.

Table 1. Dietary composition of experimental starter and finisher broiler diets

Ingredients %	Starter diet (1-22 days)	Finisher diet (23-42 days)
Yellow corn	54.53	61.37
Soya bean meal (44%)	36.96	31.59
Sun flower oil	4.83	3.85
Lime stone	1.20	1.29
Dicalcium phosphate	1.74	1.26
Salt	0.30	0.30
Methionine	0.14	0.04
Premix*	0.30	0.30
Total	100	100
Calculated composition		
Kcal ME/Kg diet	3200	3200
Crude protien (%)	23.00	21.00
Calori : protien ratio	139	152
Calcium (%)	1.00	0.90
Phosphorus available (%)	0.45	0.35
Methionine	0.50	0.38
Lysine	1.32	1.16

*Each 3 kg contains Vit. A, 1200000 IU; Vit. D_3, 300000 IU; Vit. E, 700 mg; Vit. K_3, 500 mg; Vit. B_1, 500 mg; Vit. B_2, 200 mg; Vit. B_6, 600 mg; Vit. B_{12}, 3 mg; Vit. C, 450 mg; Niacin, 3000 mg; Methionine, 3000 mg; Pantothenic acid, 670 mg ; Folic acid 300 mg; Biotin, 6 mg; Choline chloride, 10000 mg; Magnesiumsulphate, 3000 mg; Copper sulphate, 3000mg; Iron sulphate, 10000 mg; Zinc sulphate, 1800 mg; Cobalt sulphate, 300 mg.

Performance and Carcass characteristics

Chicks were individually weighed once a week to obtain the average live body weight and body weight gain. Feed intake was also recorded weekly to calculate feed conversion ratio. At 42 days of age, three birds from each treatment were randomly chosen and weighed to obtain live body weight, then slaughtered by a sharp knife for complete bleeding. The weight of dressed carcass, liver, heart, gizzard, spleen, bursa and thymus were expressed as percentage of live body weight.

Serum metabolites

At the end of the experiment, 2 ml of blood was collected from the brachial vein from three birds from each group. Serum was isolated by centrifugation at 3000 rpm for 15 minutes. Serum samples were assayed for estimation of total protein and its fractions (albumin and globulins), triglycerides, cholesterol and uric acid by Spectrophotometer using commercial test kits (Spectrum, Cairo, Egypt).

Hematological parameters

To study the effects of different dietary treatments on blood hematology, blood samples were collected from three birds in each treatment into EDTA-anticoagulant treated vials. Red blood cells (RBCs) and white blood cells (WBCs) counts were measured according to the method of Natt and Herrick (1952). Hemoglobin (Hb) was measured according to the method of Benjamin (1978). Packed Cell Volume (PCV) and subclasses percentages of WBC's differential as heterophils, lymphocyte and monocytes were measured according to the protocol described by Stoskopf *et al*. (1983).

Economical evaluation

Total feed cost, total production cost, price of body weight, net revenue and economic feed efficiency were calculated according to Mohamed (2014) and Kamel and Mohamed (2016).

Statistical analysis

All data were analyzed using one way analysis of variances (ANOVA) followed by Duncan test using the statistical software package SPSS for Windows (version 20.0; SPSS Inc., Chicago, IL, USA).

Results

The results of body weight and gain of broilers (Tables 2 and 3) indicated that inclusion of propolis in broiler diets had no significant effect on body weight and weight gain until the

Table 2. Body weight (g/bird) of chicks in the experiment

Exp. period (week)	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
Initial	51.80±1.39^a	51.17±1.27^a	51.50±0.95^a	52.78±1.37^a
1	197.13±4.62^a	205.09±2.74^a	201.08±6.19^a	202.36±4.16^a
2	474.13 ±11.88^a	465.34±10.44^a	476.83±10.45^a	465.61±15.70^a
3	918.05±22.83^b	1009.34±12.86^a	1015.53±19.29^a	1058.79±16.40^a
4	1362.63±35.60^b	1516.84±21.62^a	1478.03±29.89^a	1500.87±21.81^a
5	1760.13±53.36^b	1908.09±46.38^a	1918.95±57.80^a	1933.14±48.99^a
6	2131.80±64.40^b	2329.09±73.88^a	2347.58±83.39^a	2338.81±35.83^a

Data were expressed as Mean ± Standard deviation

Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table 3. Weight gain (g/bird) of chicks in the experiment

Exp. period (week)	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
1	145.33±3.22^{a}	153.92±1.77^{a}	149.58±5.29^{a}	149.58±3.08^{a}
2	277.00±11.11^{a}	260.25±10.05^{a}	275.75±10.40^{a}	263.25±12.24^{a}
3	443.92±12.98^{b}	544.00±29.84^{ab}	538.70±25.79^{ab}	593.18±17.70^{a}
4	444.58±23.06^{a}	507.50±11.26^{a}	462.50±11.57^{a}	442.08±20.86^{a}
5	397.50±21.69^{a}	391.25±29.33^{a}	440.92±9.78^{a}	432.27±28.86^{a}
6	371.67±16.61^{a}	421.00±3.21^{a}	428.63±27.90^{a}	405.67±4.77^{a}

Data were expressed as Mean ± Standard deviation

Means within the same row with different superscripts are significantly different (P < 0.05).

second week of feeding. The body weight and gain began to increase significantly (P<0.05) from the third week until the end of the experiment in groups fed diets supplemented with propolis.

Concerning the feed intake of broilers during the experiment (Table 4), the results cleared that inclusion of propolis in broiler diets numerically decrease the feed intake when compared with the control group.

Table 4. Feed intake (g/bird) of chicks in the experiment

Exp. period (week)	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
1	190.38	203.17	197.45	195.95
2	498.60	387.77	446.72	460.69
3	834.57	946.56	980.43	943.16
4	978.08	771.40	726.13	747.12
5	1077.23	841.19	793.66	778.09
6	1040.68	888.31	900.12	811.34

The obtained results (Table 5) demonstrated that inclusion of propolis in broiler diets improved the feed conversion ratio compared with the control one.

The obtained data (Table 6) revealed that there were no

Table 5. Feed conversion ratio of chicks in the experiment

Exp. period (week)	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
1	1.31	1.32	1.32	1.31
2	1.80	1.49	1.62	1.75
3	1.88	1.74	1.82	1.59
4	2.20	1.52	1.57	1.69
5	2.71	2.15	1.80	1.80
6	2.80	2.11	2.10	2.00

significant differences between groups in pre-slaughter weight, eviscerated carcass weight and between percentages of liver, heart, gizzard, spleen, bursa and thymus. Broiler chickens fed a propolis-supplemented diet had a significantly higher carcass dressing weight and percentage, in comparison with birds fed a non-supplemented diet.

Data presented in Table 7 showed that birds fed on diet supplemented with propolis exhibited a significant (P<0.05) increases in serum total protein and globulins level and a significant (P<0.05) decreases in triglyceride and cholesterol levels compared with the control one. No significant differences were detected in serum albumin and uric acid between differ-

Table 6. Carcass characteristics of chicks in the experiment

Parameters	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
Eviscerated carcass weight (g)	1505.00±0.04^{a}	1613.40±0.11^{a}	1576.60±0.07^{a}	1529.58±0.04^{a}
Eviscerated carcass (%)	70.00±5.08^{a}	71.18±0.34^{a}	72.32±2.26^{a}	70.11±1.09^{a}
Dressing weight, g	1585.34±50.81^{a}	1700.34±117^{a}	1671.21±77.50^{a}	1611.36±33.20^{a}
Dressing (%)	73.48±5.26^{b}	78.40±20.96^{a}	76.38±1.81^{a}	78.52±0.69^{a}
Liver (%)	1.99±0.11^{a}	1.98±0.07^{a}	1.94±0.11^{a}	1.70±0.14^{a}
Heart (%)	0.44±0.06^{a}	0.44±0.07^{a}	0.49±0.04^{a}	0.45±0.02^{a}
Gizzard (%)	1.63±0.04^{a}	1.60±0.06^{a}	1.88±0.20^{a}	1.68±0.18^{a}
Spleen (%)	0.09±0.02^{a}	0.10±0.02^{a}	0.12±0.003^{a}	0.11±0.01^{a}
Bursa (%)	0.08±0.07^{a}	0.09±0.01^{a}	0.10±0.003^{a}	0.11±0.02^{a}
Thymus (%)	0.25±0.01^{a}	0.27±0.07^{a}	0.26±0.01^{a}	0.29±0.04^{a}

Data were expressed as Mean ± Standard deviation

Means within the same row with different superscripts are significantly different (P < 0.05).

ent experimental groups.

Effects of feeding propolis on some hematological parameters of broilers (Table 8): The results revealed that there were no significant differences between different experimental groups in RBCs count, hemoglobin concentration, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration and differential leucocytes count.

The economical evaluation of the different experimental diets was shown in Table 9. The results cleared that the highest total feed cost was 16.67 L.E./ bird in treatment 4 and the lowest was 14.62 L.E./bird in treatment 2. The net revenue and economic feed efficiency were highest in treatment 2 and the lowest in treatment 4.

Table 7. Serum constituents of chicks in the experiment

Item	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
Total proteins (g/dl)	5.84±0.55^{b}	6.43±0.25^{a}	6.46±0.31^{a}	6.47±0.1^{a}
Albumin (g/dl)	3.89±0.14^{a}	3.85±0.24^{a}	3.50±0.07^{a}	3.78±0.04^{a}
Globulins(g/dl)	1.95±0.41^{b}	2.58±0.08^{a}	2.96±0.25^{a}	2.79±0.13^{a}
Triglycerides (mg/dl)	101.61±22.84^{a}	64.66±7.85^{b}	59.91±4.21^{b}	69.06±7.83^{b}
Cholesterol (mg/dl)	126.92±9.03^{a}	105.45±28.52^{b}	102.04±5.79^{b}	105.25±8.83^{b}
Uric acid (mg/dl)	48.00±0.80^{a}	51.31±4.08^{a}	46.08±1.25^{a}	52.18±1.79^{a}

Data were expressed as Mean ± Standard deviation

Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table 8. Hematological parameters of chicks in the experiment

Item	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
Haemoglobin (g/dl)	7.80±0.53^{a}	6.65±0.20^{a}	7.55±0.74^{a}	6.95±0.78^{a}
WBCs (x10^{3}/mm^{3})	12.23±0.64^{a}	13.10±0.26^{a}	11.43±0.25^{a}	10.50±0.92^{a}
RBCs (x10^{6}/mm^{3})	4.43±0.24^{a}	4.10±0.06^{a}	4.23±0.42^{a}	4.40±0.12^{a}
PCV (%)	22.63±1.47^{a}	19.40±0.58^{a}	21.98±2.10^{a}	20.25±2.17^{a}
MCV (fl)	71.10±0.59^{a}	67.35±0.72^{a}	70.30±1.57^{a}	68.6±5.54^{a}
MCH (pg)	16.95±0.26^{a}	16.05±0.38^{a}	17.33±0.57^{a}	15.85±1.47^{a}
MCHC (%)	34.43±0.09^{a}	34.25±0.03^{a}	34.30±0.12^{a}	34.3±0.17^{a}
Heterophils (%)	20.50±3.60^{a}	20.75±4.91^{a}	22.50±3.18^{a}	22.00±4.62^{a}
Lymphocyte (%)	80.00±4.00^{a}	72.00±9.24^{a}	77.50±7.31^{a}	70.00±1.15^{a}
Monocyte (%)	10.00±1.00^{a}	10.50±0.29^{a}	8.25±0.33^{a}	9.30±3.46^{a}

Data were expressed as Mean ± Standard deviation

Means within the same row with different superscripts are significantly different ($P < 0.05$).

WBC: White blood cells; RBC: Red blood cells: PCV: Packed cell volume; MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration

Table 9. Economical evaluation of the different experimental diets.

Parameters	Treatments			
	Control group	Propolis groups		
	T1	T2	T3	T4
Average feed intake (kg/bird)	4.62	4.04	4.04	3.94
Price/kg feed (L.E.)	3.31	3.62	3.92	4.23
Total feed cost (L.E.)	15.29	14.62	15.84	16.67
Total production cost (L.E.)	21.29	20.62	21.84	22.67
Body weight (kg/bird)	2.132	2.329	2.348	2.339
Total revenue (L.E.)	36.24	39.59	39.91	39.76
Net revenue (L.E.)	14.95	18.97	18.03	17.09
Economic feed efficiency (%)	70.22	92.00	82.55	75.39
Relative economic feed efficiency	100	131.02	117.56	107.36

Discussion

The favorable effect of propolis might be related to the effect of propolis extract on gut microbiota, which increase the levels of beneficial bacteria and decrease the pathogenic types (Kacaniova *et al*., 2011). Also, propolis is known to contain vitamins (A, B_1, B_2, B_3 and biotin), flavonoids and minerals, which are important matters in improving the growth (Rathee *et al*, 1982; Awadalla and Kamel, 2000). The present results are in line with the findings of Seven *et al*. (2008); Tekeli *et al*. (2010); Khodanazary *et al*. (2011); Tekeli *et al*. (2011); Haščík *et al*. (2013);Shaddel-Tili *et al*. (2017) and Klarić *et al*. (2018), who reported significant increase in body weight and gain of broilers fed propolis supplemented diets. On the contrary, the results disagreed with that reported by Ziaran *et al*. (2005); Coloni *et al*. (2007) and Canogullari *et al*. (2009), who indicated that the supplementation of propolis in the bird's diet had no significant effects on live body weight. In addition, Santos *et al*. (2003); Daneshmand *et al*. (2012) and Mahmoud *et al*. (2013) reported that live body weight and weight gain significantly decreased by supplementation of propolis in the broiler diets.

Regarding the effect of propolis on feed intake, the obtained results are in harmony with the results of Roodsari *et al*. (2004); Açikgöz *et al*. (2005); Silici *et al*. (2007) and Daneshmand *et al*. (2012), who recorded that dietary inclusion of propolis decreased the feed intake in broiler chickens.

The present results disagree with that reported by Biavatti, *et al*. (2003); Ziaran *et al*. (2005); Shalmany and Shivazad (2006); Hassan and Abdulla (2011); Khodanazary *et al*. (2011) and Tekeli *et al*. (2011), who recorded that inclusion of propolis in broiler diets significantly increased the feed intake.

The positive effect of propolis on feed conversion ratio may be attributed to the high content of flavonoids and healthy status of birds fed propolis and also may be due to the decrease in pathogenic bacteria, formation of a more stable intestinal flora and hence, a greater digestibility (Eclache and Besson, 2004). The obtained results are in accordance with the earlier findings of Li and Zhang (2002); Denli *et al*. (2005); Silici *et al*. (2007); Hassan and Abdulla (2011) Khodanazary *et al*. (2011) and Haščík *et al*. (2014), who declared that dietary supplementation of propolis improved the feed conversion ratio.

Conversely, dietary inclusion of propolis ethanolic extract had no significant effect on feed conversion ratio (Sahin *et al*., 2003; Botsoglou *et al*., 2004; Açikgöz *et al*., 2005; Gunal *et al*., 2006; Mohamed *et al*., 2008; Seven *et al*., 2008; Tekeli *et al*., 2011; Mahmoud *et al*., 2013).

The results of this study are in agreement with that found by Babińska *et al*. (2012); Hegazi *et al*. (2012); Eyng *et al*. (2013); Mahmoud *et al*. (2013); Abbas (2014); Attia *et al*. (2014); Duarte *et al*. (2014) and Haščík *et al*. (2015), who revealed that inclusion of propolis in the broiler diets did not affect the percentages of liver, heart, gizzard, spleen, bursa and thymus.

The obtained results disagree with those reported by Sahin *et al*. (2003); Denli *et al*. (2005); Ziaran *et al*. (2005); Mahmoud *et al*. (2013) and Abbas (2014), who indicated that, dressing percentage was not influenced by inclusion of propolis in broiler diets.

The obtained results are in harmony with the results of Omar *et al*. (2003); Daneshmand *et al*. (2012); Abdel-Rahman and Mosaad. (2013), who recorded that propolis supplementation to broiler diets significantly increased the serum levels of total protein and globulins. Aziz (1981); Brander *et al*. (1982); James *et al*. (1994) and Bonomi *et al*. (2002) suggested that the improvement in total protein is due to stimulating effect of propolis on the liver, exhibiting an anabolic action favoring protein synthesis and also its preserving effect on the body protein from degeneration. Daneshmand *et al*. (2012) investigated that the serum levels of cholesterol and triglyceride were decreased by inclusion of propolis in broiler diets. The lowering values of triglycerides and cholesterol may be imputed to propolis that either plays a major role as antioxidant to enhance glutathione enzyme activity, or contains components such as essential fatty acids, which suppress hepatic 3-hydroxy-3-methylglutaryl coenzyme A reductase activity, which is a key regulatory enzyme in cholesterol synthesis (Matsui *et al*., 2004; Babińska *et al*., 2013).

The present data agreed with that reported by Omar *et al*. (2003); Ziaran *et al*. (2005) and Eyng *et al*. (2015), who stated that there were no significant differences in hematological parameters in birds fed propolis. In contrast, Haro *et al*. (2000); Shihab and Ali (2012) reported that adding of propolis in broiler diets improves hemoglobin and RBCs count. Shaddel-Tili *et al*. (2017) and Klarić *et al*. (2018) reported that the heterophils percentage was significantly ($P<0.05$) higher in chicks fed propolis powder in the diet compared to control one.

Conclusion

Dietary inclusion of propolis in broiler diets had a positive effect on growth performance and improving the immune response by elevating blood globulins levels. In addition, it decreases blood cholesterol and triglyceride levels. Propolis at the 0.1% level had an important role in improving productivity and economic efficiency of broiler chicks.

References

Abbas, R.J., 2014. Effect of dietary supplementation with differing levels of propolis on productivity and blood parameters in broiler chicks. Basrah Journal of Veterinary Research 13, 164-179.

Abdel-Mohsein, H.S., Mahmoud, M.A.M., Mahmoud, U.T., 2014. Influence of propolis on intestinal microflora of Ross broilers exposed to hot environment. Adv. Anim. Vet. Sci. 2, 204-211.

Abdel-Rahman, M.A., Mosaad, G.M.M., 2013. Effect of propolis as additive on some behavioral patterns, performance and blood parameters in Muscovy broiler ducks. J. Adv. Vet. Res. 3, 64-68.

Açikgöz, Z., Yücel, B., Altan, Ö., 2005. The effects of propolis supplementation on broiler performance and feed digestibility. Arch. Geflügelk 69, 117-122.

Attia, Y.A., Abdel-Hamid, A.E., Ibrahim, M.S., Al-Harthi, M.A., Bovera, F., Elnaggar, A.S., 2014. Productive performance, biochemical and hematological traits of broiler chickens supplemented with propolis, bee pollen, and mannan oligosaccharides continuously or intermittently. Livest. Sci. 164, 87-95.

Awadalla, S.A., Kamel, A.M., 2000. Effect of Nigella sativa seeds and oil on performance and some biochemical parameters in rabbits serum. Egyptian Veterinary Nutrition Journal 1, 31-42.

Aziz, M.A., 1981. Growth promoting agents. In: Hand Book of Veterinary Pharmacology. M.A. Aziz ed., Zigzig Univ., Egypt. pp. 290 – 295.

Babińska, I., Kleczek, K., Makowski, W., Szarek, J., 2013. Effect of feed supplementation with propolis on liver and kidney morphology in broiler chickens. Pakistan Vet. Journal 33, 1-4.

Babińska, I., Kleczek, K., Szare, J., Makowski, W., 2012. Modulating effect of propolis and bee pollen on chicken breeding parameters, pathomorphology of liver and kidneys in the course of natural infection with salmonella enteritidis. Bulletin of the Veterinary Institute in Pulawy 56, 3-8.

Bankova, V., 2005. Recent trends and important developments in propolis research. Evid. Based Complem. Altern. Medicine 2, 29–32.

Benjamin, M. M., 1978. Outline of Veterinary Clinical Pathology, 3rd edn, The Iowa State University Press. Ames, IA.

Biavatti, M.W., Bellaver, M.H., Volpato, L., Costa, C., Bellaver, C., 2003. Preliminary studies of alternative feed additives for broilers: Alternanthera brasiliana extract, propolis extract and linseed oil. Rev. Bras. Cienc. Avic. 5, 147-151.

Bonomi, A., Bonomi, B. M., Quarantelli, A., Sabbioni, A., Superchi, P.,

2002.The use of propolis in duck feeding. Riv. Sci. Aliment. 31, 15-28.

Borrelli, F., Maffia, P., Pinto, L.A., Ianaro Russo, A., Capasso, F., Lalenti, A., 2002. Phytochemical compounds involved in the anti-inflammatory effect of propolis extract. Fitoterapia 73, 353-363.

Botsoglou, N.A., Christaki, E., Florou-paneri, P., Giannenas, I., Papageorgiou, G., Spais, A.B., 2004.The effect of a mixture of herbal essential oils or alfatocopheryl acetate on performance parameters and oxidation of body lipid in broilers. African Journal of Animal Science 34, 52–61.

Brander, G.C., Pugh, D.M., Bywater, R.J., 1982. Growth promoters, Antibacterial, Veterinary Applied Pharmacology and Therapeutics, 4th ed., Bailliere Tindall, London.

Canogullari, S., Baylan, M., Sahinler, N., Sahin, A., 2009. Effects of propolis and pollen supplementations on growth performance and body components of Japanese quails (*Coturnixcoturnix japonica)*. Arch. Geflugelk.73, 173-178.

Coloni, R. D., Lui, J.F., Santos, E., Neto, A.C., Zanato, J.A.F., Silva, L.P.G., Malheiros, E. B., 2007. Effect of propolis alcoholic extract on the weight gain, carcass traits and cecal pH of growing rabbits. Revista Biotemas. 20, 59-64.

Daneshmand, A., Sadeghi, G. H., Karimi, A., 2012.The effects of a combination of garlic, oyster mushroom and propolis extract in comparison to antibiotic on growth performance, some blood parameters and nutrients digestibility of male broilers. Revista Brasileira de Ciência Avícola 14, 141-147.

Denli, M., Cankaya, S., Silici, S., Okan, F., Uluocak, A.N., 2005. Effect of Dietary Addition of Turkish Propolis on the Growth Performance, Carcass Characteristics and Serum Variables of Quail (Coturnix coturnix japonica). Asian-Australian Journal of Animal Science 18, 848-854.

Duarte, C.R.A., Eyng, C., Murakami, A.E., Santos, T.C., 2014. Intestinal morphology and activity of digestive enzymes in broilers fed crude propolis. Can. J. Anim. Sci. 94, 105-114.

Eclache, D., Besson, M., 2004.Effect of the substitution of feed growth promoter by plant extracts on the performances of broilers. J. Anim. Sci. 81, 48-48.

Eyng, C., Murakami, A.E., Pedroso R.B., 2013. Crude propolis as an immune stimulating agent in broiler feed during the starter phase. Semina: Ciências Agrárias, Londrina 34, 2511-2522.

Eyng, C., Murakami, A.E., Santos, T.C., Silveira1, T.G. V.,Pedroso, R.B., Lourenço A.L., 2015. Immune responses in broiler chicks fed propolis extraction residue-supplemented diets. Asian Australas. J. Anim. Sci. 28, 135.142.

Freitas, J.A., Vanat, N., Pinheiro, J.W., Balarin, M.R., Sforcin, J.M., Venancio, E.J., 2011. The effects of propolis on antibody production by laying hens. Poultry Science 90, 1227-1233.

Galal, A., Ahmed, A.M.H., Ali, W.A.H., Elsanhoury, M.H., Ahmed, H.E., 2008. Residual feed intake and its effect on cell-mediated immunity in laying hens given different propolis levels. International Journal of Poultry Science 7, 1105-1111.

Gunal, M., Yayli, G., Kaya, O., Karahan, N., Sulak, O., 2006. The effects of antibiotic growth promoter, probiotic or organic acid supplementation on performance, intestinal microflora and tissue of broiler. International Journal of Poultry Sciences 5, 149–155.

Haile, K., Kebede, T., Dekebo, A., 2012.A Comparative study of volatile components of propolis (bee glue) collected from Haramaya University and Assela Beekeeping Centers, Ethiopia. Bulletin of the Chemical Society of Ethiopia 26, 353-360.

Haro, A., Lopez-Aliaga, F., Lisbona, M., Barrionuevo, M.J., Alferez, M., Campos, M.S., 2000. Beneficial effect of pollen and propolis on the metabolism of iron, calcium, phosphorous, and magnesium in rats with nutritional ferric anemia. J. Agric. Food Chem. 48, 5715-5722.

Haščík, P., Elimam, I.O., Kročko, M., Bobko, M., Kačániová, M., Garlík, J., Šimko, M., Saleh A.A., 2015. The influence of propolis as supplement diet on broiler meat growth performance, carcass body weight, chemical composition and lipid oxidation stability. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis 63, 411-418.

Haščík, P., Jozef, G., Elamin, I.O.E., Kačániová, M., Kňazovická, V., 2013. The effect of the propolis extract on broiler Hubbard JV internal fat. Proceedings of the 13th risk factors of food chain, Gödöllő, Hungary.

Haščík, P., Kročko, M., Garlík, J., Elimam, I., Kačániová, M., Bobko, M., Arpášová, H., Vavrišinová, K., Bučko, O., 2014. The effect of propolis extract in the diet of chickens Ross 308 on their performance. Journal of Central European Agriculture 15, 133-146.

Hassan, M.G., Abdulla, T.A., 2011.The effect of propolis feed supplementation on hygiene and performance of broiler chickens. Iraqi Journal of Veterinary Science 25, 77-82.

Hegazi, A., Abdou, A. M., Abd Allah, F., 2012.Egyptian propolis 9- its effect on chicken productivity and immune response against Newcastle disease vaccine. British J. of Poultry Sciences 1, 25-30.

James, W.A., Amy, A.J., Riddell-Mason, S., 1994.Ten different dietary fibers have significantly different effects on serum and liver lipids of cholesterol fed rats. Journal of Nutrition 124, 78–83.

Kacaniova M., Hascik, P., Hleba, L., Pochop, J., Melich, M., Knazovicka, V., Lejkova, J., Arpasova, H., 2011. Bee products effect to microbial colonization of chickens gastrointestinal tract. Potravinarstvo 5, 372-376.

Kamel, E.R., Mohamed, L.S., 2016. Effect of dietary supplementation of probiotics, prebiotics, synbiotics, organic acids and enzymes on productive and economic efficiency of broiler chicks. Alexandria Journal for Veterinary Sciences 50, 8-17.

Khodanazary, A., Tatar, A., Khezri, M., 2011. Effects of Different Dietary Levels of Propolis on Performance, Carcass Characteristics and Immunity Response of Broiler Chickens. J. Ethnopharm. 2, 80-83.

Klarić, I., Domaćinović, M., Šerić, V., Miškulin, I., Pavić, M., Paradinović, K., 2018.Effects of bee pollen and propolis on performance, mortality, and some haematological blood parameters in broiler chickens. Slovenian Veterinary Research 55, 23-34.

Kumazawa, S., Hamaska, T., Nakayama T., 2004. Antioxidant activity of propolis of various geographic origins. Food Chem.84, 329.

Kumova, U., Korkmaz, A., Avci, B.C., Ceyran, G., 2002. An important bee product: Propolis. Uludag Apiculture J. 2, 10-24.

Li, Z., Zhang, Z., 2002. Effects of ration supplemented with propolis on live weight gain of broilers. China Poult. 24: 22.

Macfarlane, G.T., Steed, H., Macfarlane, S., 2008. Bacterial metabolism and health-related effects of galacto-oligosaccharides and other prebiotics. J. Appl. Microbiol. 104, 305-344.

Mahmoud, U. T., Abdel-Rahman, M.A., Darwish, M.H., 2013.The Effect of Chinese Propolis Supplementation on Ross Broiler Performance and Carcass Characteristics. Journal of Advanced Veterinary Research 3, 154-160.

Matsui, T., Ebuchi, S., Fujise, T., Abesundara, K.J., Doi, S., Yamada, H., Matsumoto, K., 2004. Strong antihyperglycemic effects of water-soluble fraction of Brazilian propolis and its bioactive constituent, 3,4,5-tri-O-caffeoylquinic acid. Biological and Pharmaceutical Bulletin 27, 1797-1803.

Mohamed, A.E., 2014. Economic evaluation of probiotic (Lactobacillus acidophilus) using in different broiler breeds within Egypt. Benha Vet. Med. J, 26, 52-60.

Mohamed, M.A.: Hassan, H.M.A., El-Barkouky, E.M.A., 2008. Effect of mannan oligosaccharide on performance and carcass characteristics of broiler chicks. Journal of Agriculture and Social Sciences 4, 13–17.

Nagei, T., Inoue, R., Inoue, H., Suzuki, N., 2003. Preparation and antioxidant properties of water extract of propolis. Food Chemistry 80, 29-33.

National Research Council (N. R. C.), 1994. Nutrient Requirements of Poultry. 9th Revised. Ed., National Academy of Sciences Press, Washington, D. C., USA.

Natt, M.P., Herrick, C.A., 1952. A new blood diluent for Counting the erythrocytes and leucocytes of the chicken. Poult. Sci. 31, 735-738.

Omar, R.E.M., Mahmoud, E.A., Karousa, M.M., Randa S.A., 2003.Effect of additives propolis and nigella sativa seed oil on some behavioral patterns, performance products and blood parameters in Sasso chickens. Egypt. Poult. Sci. 21, 140-151.

Ramos, A.F.N., Miranda, J.L., 2007. Propolis: a review of its anti-inflammatory and healing actions. J. Venom. Anim. Toxins incl. Trop. Dis. 13, 697-710.

Rathee, P.S., Mishra, S.H., Kausal, R., 1982. Antimicrobial activity of essential oil, fixed oil and unsaponifiable matter of Nigella sativa. Indian Journal of Pharmacological Science 44, 8–10.

Roodsari, M.H., Mehdizadeh, M., Kasmani, F.B., Lotfelahian, H., Mosavi, F., Abolghasemi, A.H., 2004. Effects of oil extracted propolis on the performance of broiler chicks. Agric. Sci. Technol. 18, 57-65.

Sahin, A., Baylan, M., Sahinler, N., Canogullari, S., Gul A., 2003. The ef-

fects of propolis on fattening performance and slaughter traits of Japanese quail. Marmara Beekeeping Congress Proceedings, April 28-30, Yalova, Turkey.

Santos, A.V., Teixeira, A.S., Rodrigues, P.B., Freitas, R.T.F., Guimaraes, A.M., Giacometti, R.A., 2003. Nutritive value of propolis residue for broiler chickens. Ciencia Agrotecnologia 27, 1152.

Seven, T.P., Seven, I., Yilmaz, M., Şimşek, Ü.G., 2008. The effects of Turkish propolis on growth and carcass characteristics in broilers under heat stress. Animal Feed Science and Techn. 146, 137-148.

Sforcin, J.M., 2007. Propolis and the immune system: a review. Journal of Ethnopharmacology, Limerick 113, 1-14.

Shaddel-Tili, A., Eshratkhah, B., Kouzehgari, H., Ghasemi-Sadabadi, M., 2017. The effect of different levels of propolis in diets on performance, gastrointestinal morphology and some blood parameters in broiler chickens. Bulgarian Journal of Veterinary Medicine 20 (3), 215-224.

Shalmany, S.K., Shivazad, M., 2006.The effect of diet propolis supplementation on Ross broiler chicks performance. International Journal of Poultry Science 5, 84–88.

Shihab, I.M., Ali, B.H., 2012. Effect of propolis in diet supplementation on the immune response against Newcastle disease and hematological picture in broiler chicks. Al-Anbar Journal of Veterinary Sciences 5, 40-46.

Silici S., Karabacak, M., Balci, E., Cankaya, S., 2007. Effect of the propolis on the performance and carcass characteristics of growing quail. Mellifera 7, 20-26.

Silici, S., Koç, N.A., Ayangil, D., Çankaya, S., 2005. Antifungal activities of propolis collected by different races of honeybees against yeasts isolated from patients with superficial mycoses. Journal of Pharmacological Sciences 99, 39 -44.

Stoskopf, M.K., Neely, E., Mangold, B., 1983. Avian hematology in clinical practice. Modern Vet. Practice 64, 629-632.

Tekeli, A., Kutlu, H.R., Celik, L., 2011. Effects of Z. Officinale and propolis extracts on the performance, carcass and some blood parameters of broiler chicks. Current Research Poultry Sci. 1 (1), 12–23.

Tekeli, A., Kutlu, H.R., Celik, L., Doran, F., 2010. Determination of the effects of Z. officinale and propolis extracts on intestinal microbiology and histological characteristics in broilers. International Journal of Poultry Science 9 (9), 898-906.

Trusheva, B., Popova, M., Bankova, V., Simova, S., Marcucci, M.C., Miorin, P.L. da, Rocha Pasin, F., Tsvetkova, I., 2006. Bioactive constituents of Brazilian red propolis. Evidence-Based Complementary and Alternative Medicine - Oxford 3 (2), 249-254.

Wang, B.J., Lien, Y.H., Yu, Z.R., 2004. Supercritical fluid extractive fractionation study of the antioxidant activities of propolis. Food Chemistry 86, 237–243.

Yilmaz, L., Yilsay, T.O., Bayazit, A.A., 2003. Chemical composition of propolis, properties and biological effects on human health. II. Marmara Apiculture Congress, pp. 28-30.

Ziaran, H.R., Rahmani, H.R., Pourreza, J., 2005. Effect of dietary oil extract of propolis on immune response and broiler performance. Pakistan J. of Biological Sciences, Faisalabad 8 (10), 1485.