Assiut Journal of Agricultural Sciences 55 (1) 2024 (181-196)
ISSN: 1110-0486 / EISSN: 2356-9840
Website: http://ajas.journals.ekb.eg/
E-mail: ajas@aun.edu.eg

(Original Article)

Assessment of Feeding Date Palm Pollen and Bee Pollen on Growth Performance, Carcass Characteristics, Intestinal Development and Microbiota of Japanese Quail (*Coturnix japonica*)

Mariam A. ELDeeb; Mahmoud A. Abdelnabi; Ali Elsayed Galal, and Warda AbdelKareem*

Department of Poultry Production, Faculty of Agriculture, Assiut University, Assiut 71516, Egypt.

* Correspondence: eldeebmariam800@gmail.com
DOI: 10.21608/AJAS.2024.234549.1290

Abstract

This study aimed to assess the effect of dietary supplementation of date palm pollen (DPP) and bee pollen (BP) on growth performance, carcass characteristics, some hematological blood parameters, intestinal morphology, and intestinal microbiota of Japanese quail during the growing period (7- 42 days). A total of 250, 7-day-old, Japanese quail chicks were distributed into 5 dietary treatments (45 birds/ treatment, with 3 replicates 15 birds each). The chicks were allotted to treatment groups as follows: T1: fed basal diet without any supplementation (control), T2 and T3 fed basal diet plus 0.6 or 1.2 g DPP/kg diet, and T4 and T5 fed basal diet plus 0.5 or 1.0 g BP /kg diet. Results indicated no differences in either total average BW or daily BWG, however, average daily BWG during week 6 revealed superiority due to feed additives T3, T4 and T5 (P≤0.05) compared to the control group (4.04, 3.67, and 3.88 *vs*. 2.7g, respectively). Histological examination of the duodenum showed a considerable upgrade (P≤0.05) in villi heights in T2, T3, and T5 compared to the control group. *Lactobacillus* counts in the ileum and cecal contents (log10 CFU/g) were increased (P≤ 0.05) in birds fed on DPP at a level of 0.6 g/ kg diet. Blood concentration levels of ALT and AST enzymes were not affected by treatment accenting no harmful effect on liver function. In conclusion, the result suggests that dietary supplements of either DPP or BP could be incorporated into the quail diet as feed additives to boost growth performance.

Keywords: *Quail، Diet، DPP، BP، Performance، Growth.*

Introduction

Japanese quail (*Coturnix coturnix* Japonica) is considered one of the most economical poultry species and become widely employed for future meat and egg production (Roussot *et al*., 2003).

In Egypt, quail is a cheap and economically viable source for meat production (Runjaić-Antić *et al*., 2010; Mahrose *et al*., 2022). It is also praised for its high-

Received: 13 September 2023/ Accepted: 31 December 2023/ Published online: 26 January 2024

quality protein, low-calorie count, and mouthwatering flavor by customers (Genchev *et al*., 2008; Agiang *et al*., 2011).

Recently, quails have received significant attention for their disease resistance (Santos *et al*., 2011), meat and egg production (Ahmad *et al*., 2018), easiness of breeding and management as well as low production costs (Hassan and Abd–Alsattar, 2017). Quails are of satisfactory feed conversion efficiency; and small space for housing, where, one space for one chicken can accommodate 6-7 quails (Dehka and Borah, 2008; Bashtar *et al*., 2010; Bahar *et al*., 2014).

Date palm pollen (DPP) as a feed additive in poultry diet comprehends essential substances like sugars, amino acids, fatty acids, vitamins, minerals, and trace levels of polyphenolic ingredients mainly flavonoids (Villanueva *et al*. 2002; Almeida *et al*. 2005; Human *et al*. 2006). DDP is an herbal remedy used as a male infertility enhancer (Zargari, 1989; Zaid, 2002). It is also a respectable supply of natural antioxidants; flavonoid, the major class of phytoestrogen that functionally and structurally has a lot of estradiol and estrogen hormone (Arhaem, 2014). Research cited by Al-Salhie *et al*., (2017) indicated that the dietary inclusion of date palm pollen helps progress and improve the reproductive and physiological traits of Japanese quail.

Bee-pollen (BP) is a pile of pollen particles, gathered by bee laborers and mixed with nectar and hypopharyngeal glands excretions such as glycosidase enzymes (Carpes *et al*., 2008; Farag and El-Rayes, 2016).

Supplying BP in feed is accredited to have an ample source of saccharides, amino acids, fatty acids, vitamins, and minerals (Isidorov *et al*., 2009; Taha, 2015), and flavonoids (Villanueva *et al*., 2002; Attia *et al*., 2011) required for livestock growth and development (Bell *et al*., 1983; Villanueva *et al*., 2002; Petruska *et al*., 2012: Kolesarova *et al*., 2013). Moreover, digestive enzymes were boosted by the BP (Shalmany and Shivazad, 2006; Wang *et al*., 2007). BP holds the utmost essential nutrients required for the growth and development of livestock, Kolesarova *et al*., 2013; Petruska *et al*., 2012). Farag and El-Rayes (2016) claimed that up to 0.6% of dietary supplements of BP heightened blood metabolites, growth performance, and carcass of broilers.

The current study's objectives are to assess the outcome of different dietary levels of DPP and BP as dietary feed additives on the performance of Japanese quail.

Materials and Methods

This experiment was conducted at the Research unit of the Department of Poultry Production, Assiut University, during the period from 21 September 2020 to 2 November 2021.

1. Birds, housing, diets, experimental design, and managerial procedures

Altogether, 225 seven-day-old Japanese quail chicks were utilized in this study over the growing period (7 - 42 days). Each chick received a unique wing band, weighed, and put into five dietary treatments, with each treatment having three duplicates (15 birds/ pen). Birds of each duplicate were kept in galvanized batteries battery had with dimensions of (75*50*45 cm). According to the advice of NRC (1994), the basic corn-soybean meal diet was composed to satisfy all of the nutritional needs of grown Japanese quail, Table 1. The first treatment group received the basic diet without any supplement and served as control (T1), while the second, third, fourth, and fifth groups got the same basic diet supplemented with 0.6 (DPP1), 1.2 (DPP2), g/kg diet Date palm pollen (DPP) and 0.5 (BP1),1.0 (BP2) g/kg diet Bee pollen (BP), respectively. Feed and fresh water were continuously available ad libitum to the quails throughout the study. The birds were kept under similar managerial, environmental, and hygienic measures following the animal welfare guidelines.

Table 1. The composition and calculated analyses of growing Japanese quail diet

Ingredients	100g
yellow Corn (ME 3350)	57.850
Soybean 46% (ME 2230)	29
Wheat bran (ME 1300)	2.3
Gluten 60 % (ME 3720)	7
Limestone	1
L-lysine	0.1
Methionine	0.15
Di-calcium phosphate	2
Premix[1]	0.3
Sodium chloride	0.3
Calculated analyses	
M E (k cal/kg)	2904.9
Crude protein %	23.36
Crude fiber %	3.5
Crude fat (=EE) %	2.71
Calcium %	0.98
Available phosphorus %	0.45
Methionine %	0.59
Lysine %	1.18
Arginine %	1.40
Sodium %	0.14
Total %	100.00
Price EGP/Ton	7008

[1] Each Kg of Vitamin minerals premix contains *vit. A:* 130,000 IU. D3: 26,000 IU; vit. E: 120 IU; vit B12: 150 µg; vit. K_3 MSB: 16 mg; vit B2: 50 mg; capantothenate B3: 120 mg; nicotinic acid PP: 250 mg; Thiamine B1: 25 mg; folic acid: 15 mg; pyridoxine B6: 15 mg; Betain-Choline-HCl: 5000 mg; Mn: 700 mg; Zn: 600 mg; Fe: 400 mg; Cu: 40 mg; Iodine: 7 mg; Co: 2 mg; Se: 1.5 mg; B.H.T.: 1250 mg; Zinc bacitracin: 150 mg.

2. Data collection and parameters measured

2.1. Growth performance

Quail chicks' weekly live body weight was measured and recorded using an electronic digital scale to the closest 0.1 g. Also, weekly feed consumption (FC) for each replicate was recorded and computed by subtracting the amount of feed residual at the end of the week from the amount of feed supplied at the start of the same week. The gain in body weight (BWG) and the ratio of feed conversion (FCR) were calculated by the following formula:

$$\text{BWG} = \frac{BW_{week\ n} - BW_{week\ n-1}}{7\ days}$$

$$\text{FCR} = \frac{FC}{BWG}$$

2.2. Carcass features

At 42 days old (end of the experiment), 9 birds from each treatment group (3 birds/ replicate) representing the body weight average of their replicate ±10% were selected to determine the carcass characteristics. All selected birds were slaughtered, scalded, defeathered, and eviscerated. The weights of the eviscerated carcass, dressed carcass (eviscerated carcass with giblet parts), and edible parts (heart, liver, gizzard, and spleen) were expressed as a percentage of the live weight of bird's body.

2.3. Blood analysis

During the slaughtering process, two blood samples were obtained from each slaughtered bird. The first sample was carefully collected in a tube with EDTA to analyze the hemoglobin concentration (Hb), red blood cell count (RBCs), packed cells volume % (PCV), and White blood cell differential was done as described by Hawkey and Dennett (1989). The second blood sample was collected in a non-heparinized tube and centrifuged for 15 minutes at 3000 rpm. Separated plasma was collected in Eppendorf tubes and kept in a freezer (-20 C) for later analysis. Liver enzymes ALT (Alanine Aminotransferase) and AST (Aspartate Aminotransferase), were analyzed by spectrophotometer instrument P M using a commercial kit (BIOMED)

2.4. Intestinal microbial count

After the slaughtering process, the contents of the cecum and ileum of each slaughtered bird were squeezed into sterile Eppendorf tubes and preserved in a freezer (-20 ºC). one-gram digesta from each sample tube was homogenously mixed with 9 ml saline solution (w: v). Then, the mixture was serially diluted in 9 ml sterile saline solution (V:V) to make graduated gradual dilutions. To determine lactobacillus counts in the ileum and cecum contents, 100 µl from dilutions 10-5 to 10-7 were inoculated on nutrient agar media and incubated at 37 C for 24 hours. Also, 100 µl from dilutions 10-3 to 10-5 were inoculated on MACCONKY agar media and incubated at 37 C for 24 hours. Then counted following conventional microbiological techniques.

2.5. Histo-morphological analysis of duodenum.

After the slaughtering process, 3 segments with 1 cm length from three regions of the duodenum (upper, middle, and lower) for each bird were fixed in 10% buffered formalin after removing the digesta with a saline solution. After complete fixation, the duodenum samples were washed with tap water, dehydrated in ascending serials of ethanol up to absolute alcohol, cleared in xylol, and embedded in paraffin. A microtome Leica RM 2235 (Leica Biosystems Nussloch GmbH, Germany) was used to cut sections with 5µm thickness from each segment. Sections were stained with hematoxylin and eosin. The histological methods were performed according to Romeis, (1989). A lighting microscope with a digital camera was used to take photos of stained sections. Villi height and width and crypt depth were measured by using Image J software.

3. Statistical analysis

All variables measured were subjected to a one-way analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS software (version 9.3, 2012). Duncan's multiple range test (Duncan, 1955) was used to determine the significant differences among all treatment means.

$$Y_{ik} = \mu + T_i + e_{ik}$$

Where: Y_{ik} = The individual observation, μ = The overall mean, T_i = Treatment effect, (i = 1,2……5), e_{ik} = The experiment error

Results and Discussion

1. Growth performance

1.1. Body weight (BW) and body weight gain (BWG)

The effects of dietary supplementation of DPP and BP on Japanese quail during the growth period from 1-6 weeks of age are presented in Table 2. The results revealed that there were no significant differences among all dietary treatments in (BW) during the first three weeks of age. However, in 4^{th} and 5^{th} weeks, birds fed a 1.2g DPP / kg diet recorded the lowest BW of all treatments (148.24±2.93 and 185.0g±3.13; respectively) in comparison to the other groups ($P \leq 0.05$). In addition, chicks fed a 0.5g BP /kg diet showed a significant decrease ($P \leq 0.05$) in average BW during weeks 4th and 5th, (154.5±2.15 and 186.57g± 2.63; respectively) compared to the control group (162.81±2.04 and 193.23±2.60g; respectively) in the same period. It is worth noticing that most studies on DPP and BP as feed additives for poultry focus on adult birds and there is limited data on their performance during the growing period. In terms of average daily body weight gain during 5-6 week period (Table,2), groups fed feed additives were superior ($P \leq 0.05$) than the control group (4.04±0.36, 3.67±0.50 and 3.88±0.25 vs. 2.78±0.49g, in treatments; 3,4 and 5 vs. control, respectively). However, in the last week of the growth period, there were no differences in average BWG among treatments.

These findings are consistent with a previous study by Sevim (2021) who found no effect of bee pollen supplementation on either final body weight or body weight gain in Japanese quail at 42 days old. It is worth noticing that; dietary supplementation of DPP or BP improved the final BWG which could be explained due to the enhancement of digestion and the intestine capacity of nutrients' absorbance (Salami *et al*., 2015). However, decreasing the final BW at the high level of DPP reported by (Skibola and Smith ,2000 and Refaie *et al*., 2019) could be interpreted by high concentrations of flavonoids that act as mutagens. In addition, Shanoon *et al*. (2015) reported that birds fed high DPP levels (0, 6, 8, and 10 g/kg diet) resulted in a significant decrease in body weight. Contradicting results were obtained from growing broiler chicks, where the inclusion of flavonoids improved the chicken's growth performance (Ouyang *et al*., 2013 and Xie et al.,2002). Further explanation by Ouyang *et al*. (2016) that the growth promotion in chickens fed either DPP or BP may be due to their contents of flavones, enzymes, and coenzymes which increased the upregulation of growth hormone and hepatic receptors of growth hormone. This stimulated the insulin-like growth factor 1 and resulted in increased animal growth.

Table 2. Impact of dietary supplementation of date palm pollen (DPP) and bee pollen (BP) at different concentrations on the BW and BWG of growing Japanese quails (mean ± SE)

Age/Period	Treatments					Sig.
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg	
Average Weekly BW (g)						
1st week	26.56 ±0.48	27.6±0.46	27.60±0.43	27.73 ±0.43	27.62 ±0.43	NS
2nd week	67.29 ±1.01	68.42±1.08	66.25 ± 0.96	67.52 ±1.01	67.83 ±0.85	NS
3rd week	109.59±1.37	106.11±2.42	94.14±2.53	102.15±2.20	103.62±1.93	NS
4th week	162.81±2.04^{a}	161.0±2.17^{ab}	148.24±2.93^{c}	154.5±2.15^{b}	158.46±1.96^{ab}	**
5th week	193.23±2.62^{a}	191.02±2.60^{ab}	185.00±3.13^{c}	186.57±2.63^{b}	189.79±2.55^{ab}	**
6th week	213.13±4.11	214.54±3.84	213.15±3.92	212.32±3.99	216.94±3.57	NS
Average Daily BWG (g)						
1-2 week	5.82±0.15^{a}	5.84±0.04^{a}	5.52±0.06^{b}	5.68±0.02^{ab}	5.74±0.07^{ab}	*
2-3 week	5.42±0.40	5.08±0.70	3.99±0.84	4.64±0.68	5.11±0.48	NS
3-4 week	7.74±0.17	7.47±0.48	7.28±0.19	7.49±0.11	7.71±0.26	NS
4-5 week	4.26±0.17	4.23±0.51	4.69±0.48	4.55±0.64	4.59±0.26	NS
5-6 week	2.78±0.49^{b}	3.30±0.65^{ab}	4.04±0.36^{a}	3.67±0.50^{a}	3.88±0.25^{a}	*
2-6 week	5.1±0.20	5.2±0.20	5.4±0.09	5.2±0.21	5.2±0.13	NS

^{a,b,c} Means within the same row with different superscripts are significantly different (P ≤ 0.05). Sig.: Significant. DPP1: treatment group fed diet supplemented with 0.6 g DPP/kg, DPP2: treatment group fed diet supplemented with 1.2 g DPP/kg, BP1: treatment group fed diet supplemented with 0.5 g BP/kg, BP2: treatment group fed diet supplemented with 1.0 g BP/kg, NS: no significant difference, **: significant (P<0.01), *: significant (P<0.05).

1.2. Feed consumption (FC) and feed conversion ratio (FCR)

Based on FC and FCR information provided in Table 3, it can be observed that there were no significant differences in FC among all dietary treatments during the majority of the experimental periods. However, there were some inconsistent trends during the 2nd and 5th week of the experimental period, where the treatments fed with 1.2g DPP or 0.5g BP/kg diet had the lowest feed consumption compared to the control group. This observation can be attributed to good levels of amino acids, sterols, fatty acids, sugars, vitamins, minerals, and enzyme contents in DPP and BP. Regarding the FCR, the dietary supplementation of DPP and BP didn't significantly affect the FCR during both the weekly period intervals and the overall mean of the experimental period. This means that the different diets didn't result in significant differences in the efficiency of converting feed into body weight. Similarly, Refaie *et al*. (2019) concluded that feed intake wasn't affected significantly by the addition of levels of DPP during the growing period compared to control.

Table 3. Effect of dietary supplementation of date palm pollen (DPP) and bee pollen (BP) at different concentrations on feed consumption and feed conversion ratio of Japanese quails (*Coturnix coturnix japonica*) (mean ± SE)

Period interval	Treatments					*Sig.*
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg	
			FC (g/d/bird)			
1-2 week	11.06±0.39	11.2375±0.25	10.54±0.13	10.60±0.36	11.13±0.18	NS
2-3 week	15.90±0.07^{a}	13.78±0.84^{ab}	12.41±1.12^{b}	13.73±0.68^{ab}	13.76±0.72^{ab}	*
3-4 week	19.47±0.07	18.40±0.54	18.50±0.34	18.48±0.58	19.42±0.49	NS
4-5 week	23.57±0.67	22.53±0.75	22.51±1.39	23.46±0.73	24.13±0.42	NS
5-6 week	23.21±0.36^{ab}	23.51±0.66^{ab}	24.91±0.69^{a}	22.84±0.73^{b}	24.40±0.60^{ab}	*
1-6 week	17.8±44	17.9±52	18.6±0.39	17.8±0.56	18.6±0.07	Ns
			FCR (g feed/g gain)			
1-2 week	1.90±0.06	1.93±0.05	1.91±0.01	1.86±0.06	1.94±0.02	NS
2-3 week	2.99±0.25	2.81±0.24	3.53±0.06	3.08±0.27	2.72±0.12	NS
3-4 week	2.52±0.06	2.49±0.17	2.55±0.07	2.47±0.09	2.52±0.04	NS
4-5 week	5.56±0.22	5.62±0.82	4.88±0.24	5.47±0.74	5.32±0.36	NS
5-6 week	9.32±0.71	8.62±0.84	6.32±0.54	6.48±0.64	6.38±0.47	NS
1-6 week	3.8±0.20	4.3±0.52	3.8±0.15	3.9±0.13	4.5±0.40	Ns

[a,b] Means within the same row with different superscripts are significantly different (P ≤ 0.05). Sig.: Significant. DPP1: treatment group fed diet supplemented with 0.6 g DPP/kg, DPP2: treatment group fed diet supplemented with 1.2 g DPP/kg, BP1: treatment group fed diet supplemented with 0.5 g BP/kg, BP2: treatment group fed diet supplemented with 1.0 g BP/kg, NS: no significant difference, *: significant (P<0.05).

2. Carcass characteristics and internal organs

Effects of dietary supplementation of DPP and BP on carcass characteristics and internal organs of Japanese quail are presented in Table 4. The results revealed that the dietary addition of DPP and BP on growing Japanese quail had no outcome on the absolute and relative weights of dressed carcass and internal organs. Similar results were claimed by Growth (2002). In contrast, results obtained by Mousa *et al*. (2016) reported the presence of a significant difference between the DPP and control quail groups in the thigh, breast, carcass, breast, and liver weights. However, according to the results herein (Table, 4) the lower concentration of DPP and BP increased the weights of some organs as the liver and bursa numerically but not significant compared to the control or higher concentration. The level of 1.2g/kg diet of DPP displayed an increase in the weight of heart, and gizzard and spleen in case of the high level. Concerning BP, the low level of 0.5g/kg diet increased the relative weights of bursa, gizzard, and liver.

Table 4. Effect of dietary supplementation of date palm pollen (DPP) and bee pollen (BP) at different concentrations on carcass traits and internal organs of growing Japanese quails (*Coturnix coturnix japonica*) (mean ± SE)

Traits	Treatments				
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg
(g)					
LBW	217.75 ±7.37	219.63 ±8.63	218.25 ±7.30	225.00±7.56	220.50±5.60
Carcass	153.50 ±4.14	155.00 ±5.17	153.25 ± 2.79	154.75±5.72	152.13 ±1.58
Liver	4.34 ± 0.32	5.29 ±0.84	4.80 ±0.60	5.23±0.51	4.94±0.40
Heart	1.78 ± 0.076	1.81 ± 0.08	1.86 ±0.084	1.78±0.075	1.74 ±0.10
Gizzard	2.65 ±0.23	2.73 ±0.13	3.05 ± 0.15	3.00±0.15	2.87 ± 0.19
Spleen	0.111±0.015	0.108 ±0.02	0.134 ±0.030	0.11±0.02	0.15 ±0.05
Bursa	0.70± 0.21	0.77 ±0.25	0.57 ± 0.201	0.75±0.24	0.65± 0.22
Percentage (%)					
Carcass	70.82±2.089	70.85 ± 1.78	70.54±1.59	68.84±1.51	69.29 ± 1.86
Liver	1.985±0.123	2.37 ±0.33	2.15±0.21	2.30±0.18	2.24 ± 0.17
Heart	0.825±0.051	0.83 ± 0.025	0.86±0.047	0.79±0.032	0.79 ±0.04
Gizzard	1.204±0.063	1.24 ±0.03	1.40 ± 0.04	1.34±0.06	1.30 ±0.08
Spleen	0.052±0.008	0.049±0.008	0.061 ±0.012	0.049±0.008	0.066 ± 0.022
Bursa	0.342±0.106	0.381±0.129	0.281±0.104	0.358±0.118	0.307 ± 0.104
Dressing (%)	74.83±2.33	75.29±2.17	74.95±2.31	73.27±1.79	73.62±2.15

^{a,b} Means within the same row with different superscripts are significantly different ($P \leq 0.05$). Sig.: Significant. DPP1: treatment group fed diet supplemented with 0.6g DPP/kg, DPP2: treatment group fed diet supplemented with 1.2 g DPP/kg, BP1: treatment group fed diet supplemented with 0. g BP/kg, BP2: treatment group fed diet supplemented with 1. g BP/kg, NS: no significant difference.

3. Histological examination of duodenum

The results of the duodenum histomorphometry examination presented in (Table 5; Figure 1), showed that the values of villus height were increased significantly ($P<0.05$) in the groups fed with diet T2, T3, and T5 in comparison to the control and those fed the 0.5g BP/kg diet (568.89±27.36, 580.09±71.35, and 579.62±49.55 vs. 485.23±21.15 and 410.42±6.92; respectively). This indicates an improvement and increase in the area of absorption within the intestinal tract, as well as the efficient utilization of the digested feed (Rodjan *et al*., 2018). The positive impact and significant changes of DPP on the growth of intestinal microbiota may be due to being rich in polyphenols and fiber and short-chain fatty acids production in addition to its previously observed enhancing effect on the intestinal tissue (Eid *et al*., 2015). On the contrary, there were no significant differences recorded in crypt depth and villi width among all dietary treatments. These findings suggest that the different dietary treatments had no significant impact on these particular histo-morphometric parameters. The enhancement in villus height of the intestine due to DDP may be attributed to the high potent tissue-protective properties and good antioxidant activities due to its augmented activities of antioxidant enzymes along with the significant reduction in malondialdehyde (MDA) (El-Neweshy *et al*., 2013). Flavonoid content of DPP could be a factor contributing to its cytoprotective ability through the inhibition of cytochrome P-450 aromatase (Kowalska *et al*., 1990). Regarding BP, it is composed of sufficient levels of protein and carbohydrate in addition to its good level of water- and fat-soluble vitamins, enzymes, coenzymes, and sterols which have a potential role in cell biology, protection, integrity and consequently cell life span (Farag and El-

Rayes, 2016; Nemauluma *et al*., 2023). The villus growth (site of digestion and absorption) explains the cause of decreased feed intake and enhanced FCR of some treated groups (Mousa *et al*., 2018)

Table 5. Effect of dietary supplementation of (DPP) and (BP) at different concentrations on duodenum histological measurements of growing Japanese quails during the period from 1 to 6 weeks (mean ± SE)

Measurements	Treatments					*Sig.*
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg	
Hight of villus (V H)	485.23±21.15[b]	568.89±27.36[a]	580.09±71.35[a]	410.42±6.92[cb]	579.62±49.55[a]	*
Crypt depth (CD)	57.25±3.13	57.65±2.77	71.46±7.25	55.05±2.23	60.18±3.75	Ns
Width of villus	70.52±4.61	70.85±3.42	74.89±8.03	66.54±3.25	66.48±5.15	Ns
VH:CD	8.98±0.72[bc]	10.25±0.75[a]	8.14±0.52[bc]	7.65±0.37[c]	9.71±0.54[ab]	*

[a,b,c] Means within the same row with different superscripts are significantly different ($P \leq 0.05$). Sig.: Significant. DPP1: treatment group fed diet supplemented with 0.6 g DPP/kg, DPP2: treatment group fed diet supplemented with 1.2 g DPP/kg, BP1: treatment group fed diet supplemented with 0.5 g BP/kg, BP2: treatment group fed diet supplemented with 1.0 g BP/kg, NS: no significant difference, *: significant ($P \leq 0.05$).

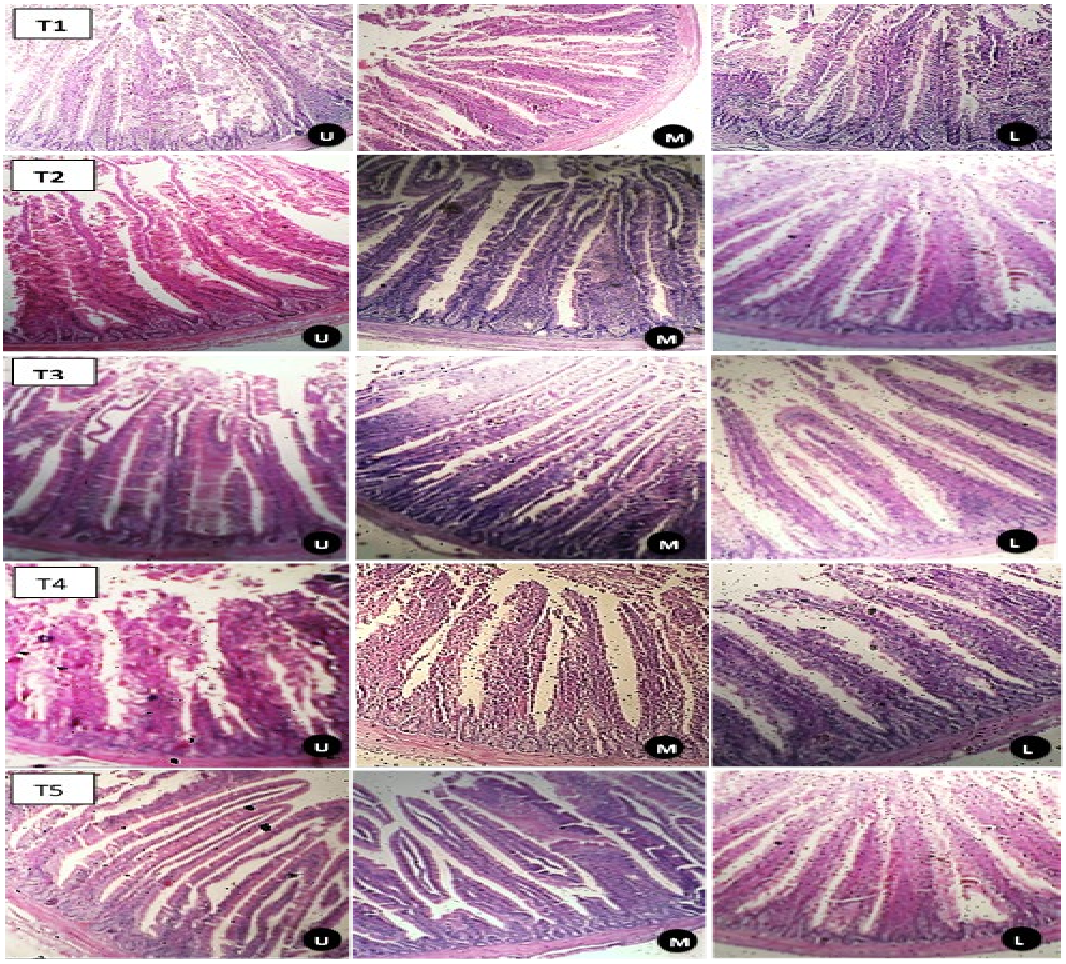

Figure 1. The effect of DPP and BP on the morphometrical features on the duodenum of Japanese quails. T1: control, T2: 0.6 g DPP/kg diet, T2: 1.2 g DPP/kg diet, T3: 0.5 g BP/kg diet, T4: 1.0 g BP/kg diet. U: upper part of the duodenum, M: middle part of the duodenum, L: lower part of the duodenum. H&E

4. Intestinal microbiota

Data concerning bacterial population count in the ileum and cecum are presented in Table 6. The statistical analysis of total Lactobacillus counts (log10cfu/g) revealed the highest counts of all treatments ($P \leq 0.05$) in a group-fed diet supplemented with DPP1 (11.57±0.01) in the ileum section. On the contrary, the lowest Lactobacillus counts (log10cfu/g) were recorded in groups that received DPP2 followed by those fed BP2. On the contrary, cecum Lactobacillus counts (log10cfu/g) showed a significant increase ($P \leq 0.05$) due to dietary supplementation DPP2 (11.71±0.03), and the lowest Lactobacillus counts were recorded in groups received DDP1 followed by those fed diet supplemented with BP2 compared to the control group (7.53±0.05 and 8.59±0.03 vs. 10.32±0.07; respectively). In terms of coliform count, it appeared that all dietary treatments had a positive influential effect ($P \leq 0.05$) compared to the control in the ileum. However, no consistent trend was found in the cecum area. The current results showed that the low level of bee pollen supplementation significantly affected the number of Lactobacillus spp. and coliform in the caecum and ileum. The decreasing effect of BP at high levels on the Lactobacillus and coliform agreed with Abouda *et al*. (2011) who found that BP have the capacity to inhibit the growth of a wide range of microorganisms. The microbiome in poultry gut plays a vital role in protecting against pathogens, producing nutrients, and aiding in the maturation of the host immune system (Broom and Kogut, 2018).

Table 6. Effect of dietary supplementation of (DPP) and (BP) at different concentrations on the intestinal microbial flora of growing Japanese quails during growing period from 1 to 6 weeks (mean ± SE)

Bacterial strains	Treatments					*Sig.*
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg	
Lactobacillus (log_{10}cfu/g)						
Ileum	10.70±0.05^{b}	11.57±0.01^{a}	10.06±0.06^{c}	10.76±0.06^{b}	9.97±±0.04^{c}	**
Cecum	10.32±0.07^{c}	7.53±0.05^{e}	11.71±0.03^{a}	10.83±0.04^{b}	8.59±0.03^{d}	**
Coliform						
Ileum	6.77±0.05^{e}	10.0±0.02^{c}	10.63±0.03^{a}	10.23±0.01^{b}	8.15±0.01^{d}	**
Cecum	8.73±0.03^{c}	9.96±0.02^{a}	7.11±0.03^{e}	9.30±0.02^{b}	7.20±0.03^{d}	**

a,b,c,d Means within the same row with different superscripts are significantly different ($P \leq 0.05$). Sig.: Significant. DPP1: treatment group fed diet supplemented with 0.6 g DPP/kg, DPP2: treatment group fed diet supplemented with 1.2 g DPP/kg, BP1: treatment group fed diet supplemented with 0.5 g BP/kg, BP2: treatment group fed diet supplemented with 1.0 g BP/kg, NS: no significant difference, **: significant ($P \leq 0.01$).

5. Hematological parameters, differential count of leukocytes and liver enzymes

According to the information provided in Table 7, the dietary supplementations of date palm pollen DPP and bee pollen BP had a significant effect on some hematological parameters of growing Japanese quail. Firstly, the hemoglobin concentration was significantly increased ($P \leq 0.05$) in DPP1 compared with BP2 and the control. However, there was no significant difference between DPP1 and the groups received T3 or T4. Secondly, the percentage of packed cell volume (PCV) showed the lowest values in the BP2 group compared with all other treatments. In terms of leukocyte differential count, the percentage of heterophils was significantly ($P \leq 0.05$) decreased in the DPP2 group compared to the BP1 group and the control group. However, there was no significant difference among the other treatments. Additionally, the DPP2 group had the lowest value of the H/L ratio compared to the BP1 group, but there was no significant difference between the other treatments. These results partially agreed with Refaie *et al*. (2019). They found that adding the DPP (1 and 3 g / kg) in the diets of fayoumi cocks aged from 1 d to 12 weeks of age achieved significantly higher WBC count and Hemoglobin values compared to control. Also, the present data differed partially from Saleh *et al*.'s (2021) results as they noticed that the increased DPP levels significantly ($p \leq 0.05$) increased white blood cells (WBC), and hemoglobin (Hb), while H/L ratio significantly decreased. DPP has a role in RBC membrane protection as well as increased iron uptake capacity from the digestive tract. Furthermore, DPP contains a good level of minerals, antioxidant contents represented in the flavonoids, and vitamins such as B1, B2 and B12, which consequently enhance the immune system in treated birds. The effect of high level of BP on the blood cells and hemoglobin concentration disagreed with Abuoghaba *et al*. (2018), who found that hemoglobin level, lymphocytes, heterophils and H/L ratio in the chicks treated with bee pollen were significantly affected ($p \leq 0.05$), while monocytes and eosinophil were not affected. The BP1 effect on blood cells and PCV agreed with Farag and El-Rayes, (2016). The noticed that chick fed 0.6 % BP pollen had high packed cell volume, hemoglobin concentration, red blood cells, white blood cells, heterophils, lymphocytes, serum total protein, albumen, and globulin compared to the control group and lower concentrations.

Furthermore, the supplements tested did not have an effect on liver enzymes ALT and AST, indicating no toxicity due to the concentration levels of dietary supplementation on liver function. It is important to note that these findings are specific to the data provided in Table 7 and may not necessarily apply to other factors not mentioned.

Table 7. Effect of dietary supplementation of (DPP) and (BP) at different concentrations on blood traits of growing Japanese quails. (mean ± SE)

Parameters	Treatments					Sig.
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg	
Hb	8.77 ± 0.71^{b}	11.30 ± 0.63^{a}	9.03 ± 0.52^{ab}	9.14 ± 0.71^{ab}	6.84 ± 0.93^{b}	*
PCV	40.66 ± 2.29^{a}	45.0 ± 1.15^{a}	42.33 ± 1.52^{a}	43.40 ± 1.72^{a}	33.50 ± 5.50^{b}	*
RBC	150.66±15.63	163.66±20.43	195.00±20.31	124.60±23.26	131.50±11.50	NS
Heterophils	34.66 ± 0.21^{a}	30.33 ± 2.40^{ab}	25.83 ± 3.46^{b}	36.60 ± 40.00^{a}	29.00 ± 4.50^{ab}	*
Lymphocyte	49.66±0.21	51.50±1.73	54.00±2.29	46.80±1.07	52.00±3.00	NS
H/L	0.69 ± 0.00^{ab}	0.60 ± 0.06^{ab}	0.49 ± 0.09^{b}	0.78 ± 0.02^{a}	0.57 ± 0.012^{ab}	*
Liver enzymes						
ALT	18.50±1.31	19.33±2.01	17.33±1.36	19.50±1.84	16.67±1.09	NS
AST	239.50±12.23	233.17±12.78	228.33±13.54	250.50±14.51	258.67±12.15	NS

a,b, Means within the same row with different superscripts are significantly different ($P \leq 0.05$). Sig.: Significant.DPP1: treatment group fed diet supplemented with 0.6 g DPP/kg, DPP2: treatment group fed diet supplemented with 1.2 g DPP/kg, BP1: treatment group fed diet supplemented with 0.5 g BP/kg, BP2: treatment group fed diet supplemented with 1.0 g BP/kg, NS: no significant difference, *: significant ($P\leq0.05$).

In agreement, Farag and El-Rayes (2016) found that when chicks were fed diets containing BP at levels of 0.2%, 0.4%, or 0.6%, their blood levels of the enzymes aspartate aminotransferase (AST) and alanine aminotransferase (ALT) decreased considerably compared to the control group. Also, Attia et al. (2015) mentioned that adding BP (200 mg/kg BW) to rabbit diets resulted in a significantly lower level of ALT and AST in blood. This discrepancy may be due to different species response to treatment and the natural high-quality genome of quail which affect its susceptibility to materials and pathogens and delivered it as a model experimental avian species.

6. Economic efficiency

The economic efficiency and relative economic efficiency were evaluated based on the current market prices for one-kilogram of feed and one- kilogram of meat at 42 days of age. The data shown in Table 8 indicated that tested supplements led to lower economic efficiency and relative economic efficiency, especially with the higher levels of addition of both substances and that was due to high prices of these supplements in regard to live body weight at marketing age.

Table 8. Effect of dietary supplementation of (DPP) and (BP) on economic efficiency of growing quails

Items	Treatments				
	Control	DPP1 0.6/kg	DPP2 1.2g/kg	BP1 0.5/kg	BP2 1.0g/kg
Price of one chick at hatch (LE)	2.0	2.0	2.0	2.0	2.0
Total starter FC (Kg/chick)	0.623	0.627	0.651	0.623	0.651
Price per one kg of starter feed (LE)[2]	7.27	8.02	8.77	7.895	8.52
Cost during starter period (LE)	4.53	5.02	5.71	4.92	5.55
Total cost per bird (LE)	6.53	7.02	7.71	6.92	7.55
Body weight (kg/chick)	0.193	0.191	0.185	0.186	0.189
Price of one kg of body weight (LE)[3]	62.10	62.10	62.10	62.10	62.10
Total return (LE)	11.99	11.86	11.49	11.55	11.74
Net return (LE)	5.46	4.84	3.78	4.63	4.19
EFF	0.83	0.69	0.49	0.67	0.55
Relative EFF %	100	83	59	80.7	66.27

1. LE: price in Egyptian pound
2. According to price of different ingredients available in Egypt at the experimental time
3. According to local price at the experimental time
4. EFF- economic efficiency= (net return LE/Total cost LE)
5. Relative EFF= assuming EFF of the control equals 100%

In conclusion, the effect of dietary DPP and BP on growing quail was variable. The dietary supplementation of either DPP or BP although it couldn't increase the growth performance of growing quail but successfully improved some carcass traits, some vital internal organs (liver and bursa), the intestinal lining mucosa, gut microbial count, and some hematological parameters. But the negative economic impact is considerable. So, DPP and BP could be therefore used as a feed additive candidate with prebiotic activity to the quail diet. However, it's important to note that this study is conducted on growing quails that call for further long- and large-scale research to be considered in quails during the growing period.

References

Ahmad, S.; Mehmood, S.; Javed, K.; Mahmud, A.; Usman, M.; Rehman, A.; Ishaq, H.M.; Hussain, J. and Ghayas, A. (2018). Different selection strategies for the improvement of the growth performance and carcass traits of Japanese quails. Brazilian Journal of Poultry Science, 20: 497-506.

Almeida, J.D.F.; Reis, A.S.D.; Heldt, L.F.S.; Pereira, D.; Bianchin, M.; Moura, C.D.; Plata-Oviedo, M.V.; Haminiuk, C.W.I.; Ribeiro, I.S.; Luz, C.F.P.D. and Carpes, S.T. (2017). Lyophilized bee pollen extract: A natural antioxidant source to prevent lipid oxidation in refrigerated sausages. LWT Food Sci. Technol., 76: 299–305.

Almeida-Muradian, L.B.; Pamplona, L.C.; Coimbra, S. and Barth O.M. (2005). Chemical composition and botanical evaluation of dried bee pollen pellets. Journal of Food Composition and Analysis, 18(1): 105-111

Al-Salhie, K.Ch.K.; Shawket, T.F. and Lehmood, B.A.M. (2017). Effect of supplementation date palm pollen on some physiological and reproductive traits of Japanese quail birds (*Coturnix Coturnix* japonica). The Iraqi Journal of Agricultural Science, 48(6): 1389-1398.

Attia, Y.A.; Al-Hanoun, A.; Tag El-Din, A.E.; Bovera, F. and Shewika, Y.E. (2011). Effect of bee pollen levels on productive, reproductive and blood traits of NZW rabbits. Journal of animal physiology and animal nutrition, 95(3): 294-303.

Attia, Y.A.; Bovera, F.; El-Tahawy, W.S.; El-Hanoun, A.M.; Al-Harthi, M.A. and Habiba, H.I. (2015). Productive and reproductive performance of rabbits does as affected by bee pollen and/or propolis, inulin and/ or mannan-oligosaccharides. World Rabbit Science, (23): 1–12.

Bahar, S.; Shahrokh, R.B. and Mohsen, M. (2014): Study on Parasitic infections of Quails in Garmsar, Iran. International Journal of Advanced Biological and Biomedical Research, 2(2): 262-266.

Bashtar, A. R.; Abd El-ghaffar, F.; Al-Rasheid, H.A.S.; Melhorn, H.and Al-Nasr, I. (2010). Light microscopic study on *Eimeria* species infecting Japanese quails reared in Saudi Arabian farms. Parasitol. Res., (107): 409-416

Bell, R.R.; Thormber, E.J.; Seet, J.L.L.; Groves, M.T.; Ho, N.P. and Bell, D.T. (1983). Composition and protein quality of honeybee collected pollen of *Eucalyptus marginate* and *Eucalyptus calophylla*. Journal of Nutrition, 113: 2479–2484.

Kolesarova, A.; Bakova, Z.; Capcarova, M.; Galik, B.; Juracek, M.; Simko, M.; Toman, R. and Sirotkin, A.V. (2013). Consumption of bee pollen affects rat ovarian functions. Journal of animal physiology and animal nutrition, 97(6): 1059-1065.

Dehka, K and Borah, J. (2008). Hematological and biochemical changes in Japanese quails *Coturnix coturnix* japonica and chickens due to *Ascaridia galli* infection. J. poultry sci., 7: 704-710

Duncan, O.D. and Duncan, B. (1955). A methodological analysis of segregation indexes. American Sociological Review, 20(2): 210-217.

Farag, S. and El-Rayes, T. (2016). Effect of bee pollen supplementation on performance, carcass traits and blood parameters of broiler chickens. Asian Journal of Animal and Veterinary Advances, 11: 168-177.

Genchev, A.; Mihaylova, G.; Ribarski, S.; Pavlov, A. and Kabakchiev, M. (2008). Meat quality and composition in Japanese quails. Trakia Journal of Sciences, 6(4): 72-82.

Hassan, H.M. (2011). Chemical composition and nutritional value of palm pollen grains. Global J Biotechnol Biochem, 6(1): 1-7.

Hassan, K.H. and Abd-Alsattar, A.R. (2017). Study of productive performance of three varieties of Japanese quail in meat production. Diyala Agricultural Sciences Journal, 9(1): 39-47.

Human, H. and Nicolson, S.W. (2006). Nutritional content of fresh, bee–collected and stored pollen of *Aloe greatheadii* var. davyana (Asphodelaceae). Phytochemistry, 67(14): 1486–1492.

Ikhlas, B.; Huda, N. and Noryati, I. (2011). Chemical composition and physicochemical properties of meatballs prepared from mechanically deboned quail meat using various types of lour. International J. of Poultry Sci., 10(1): 30–37.

Isidorov, V.A.; Isidorova, A.G.; Sczczepaniak, L. and Czyżewxska, U. (2009). Gas chromatographic-mass spectrometric investigation of the chemical composition of beebread. Food Chemistry, 115: 1056–1063.

Mahrose, K.M.; Abol-Ela, S.; Amin, R.M. and Abou-Kassem, D.E. (2022). Restricted feeding could enhance feed conversion ratio and egg quality of laying Japanese quail kept under different stocking densities. Animal Biotechnology, 33(1): 141–149.

Rodjan, P.; Soisuwan, K.; Thongprajukaew, K.; Theapparat, Y.; Khongthong, S.; Jeenkeawpieam, J. and Salaeharae, T. (2018). Effect of organic acids or probiotics alone or in combination on growth performance, nutrient digestibility, enzyme activities, intestinal morphology and gut microflora in broiler chickens. Journal of animal physiology and animal nutrition, 102(2): 931-940.

Romeis, J.C. (1989). Caregiver strain: Toward an enlarged perspective. Journal of aging and health, 1(2): 188-208.

Roussot, O.; Feve, K.; Plissonpetit, F.; Pitel, F.; Faure, J.; Beaumont, C. and Vignal Alain (2003). AFLP Linkage map of the Japanese quail *Coturnix japonica*. Genetic Selection and Evaluation, 35: 559-572.

Runjaić-Antić, D.; Pavkov, S. and Lević, J. (2010). Herbs in a sustainable animal nutrition. Biotechnology in Animal Husbandry, 26(3-4): 203-214.

Santos, T.C.; Murakami, A.E.; Fanhani, J.C. and Oliveira, C.A.L. (2011). Production and reproduction of egg-and meat-type quails reared in different group sizes. Revista Brasileira de Ciência Avícola, 13(1): 9-14.

Sevim, B. (2021). Effects of supplemental bee pollen on performance, meat quality, serum constituents and immunity system in growing quails. South African Journal of Animal Science, 51 (6): 745- 751.

Shalmany, S.K. and Shivazad, M. (2006). The effect of diet propolis supplementation on Ross broiler chicks performance. International Journal of Poultry Science, 5(1): 84-88.

Taha, E. A. (2015). Chemical composition and amounts of mineral elements in honeybee-collected pollen in relation to botanical origin. The Journal of Agricultural Science, 59(1): 75-81.

Villanueva, M.T.O.; Marquina, A.D.; Serrano, R.B. and Abellán, G.B. (2002). The importance of bee-collected pollen in the diet: A study of its composition. Int. J. Food Sci. Nutr., 53: 217–224.

Villanueva, M.T.O.; Marquina, A.D.; Serrano, R.B.; Wang, J.; Li, S. Wang, Q.; Xin, B. and Wang, H. (2007). Trophic effect of bee pollen on small intestine in broiler chickens. Journal of Medicinal Food, 10(2): 276-280.

Wang, J.; Li, S.; Wang, Q.; Xin, B. and Wang, H. (2007). Trophic effect of bee pollen on small intestine in broiler chickens. Journal of Medicinal Food, 102: 276–280.

Zaid, A. and Arias-Jimenez, E. J. (2002). Date Palm cultivation. FAO Plant Production and Protection Paper 156 Rome: FAO

Zargari, A. (1989). Medicinal Plants, vol. II. Tehran University Press, Tehran, pp. 519–521

تقييم تغذية طلع النخيل وحبوب اللقاح على اداء النمو وخصـــائص الذبيحة والتطور المعوي والميكروبات الحيوية لطائر السمان الياباني

مريم احمد الديب، محمود علي عبد النبي، علي السيد جلال، ورده عبد الكريم محمد

قسم انتاج الدواجن، كلية الزراعة، جامعة اسيوط، مصر.

الملخص

استـهدفت الدراسـة تقييم تأثير المكملات الغذائية لطلع النخيل (DPP) وحبوب اللقاح (BP) على اداء النمو، وخصـــائص الذبيحة، وبعض صـــفات الدم ومورفولوجيا الامعاء والميكروبات المعوية لطائر السـمان الياباني خلال فترة النمو (7-42 يوم). تم توزيع (225) فرخ طائر السـمان الياباني بعمر 7 أيام على 5 معاملات غذائية (45 طائر/معاملة)، و3 مكررات (15 طائر/ معاملة). تم تقسـيم الكتاكيت إلى معاملات على النحو التالي: T1: تمت تغذيته على علف أسـاسـي بدون أي مكملات (الكونترول)، T2و T3 تم تغذيتهم على علف أساسي مكمل بـــ 0.6 جم أو 1.2 جم DPP /كجم عليقه بينما T4 وT5 تم تغذيتهم على علف أساسي مكمل بـــ 0.5 جم أو 1.0 جم من حبوب اللقاح (BP)/ كجم من عليقه. أظهرت النتائج عدم وجود فروق في إجمالي متوسط وزن الجسم أو متوسط الزيادة اليومية في الجسم، ولكن متوسط وزن الجسم اليومي خلال الأسبوع السادس زاد (P≤0.05) بسبب إضافات الأعلاف في المعاملات 3، 4، 5 مقارنة بمجموعة الكونترول (4.04، 3.67، و3.88 مقابل 2.7 جرام، على التوالي). أظهر الفحص النسيجي للاثني عشر تحسناً ملحوظاً (P ≥ 0.05) في ارتفاع الخملات في T2 وT3 وT5 مقارنة بمجموعة الكونترول. أظهر العد البكتيري زيادة *Lactobacillus* في محتويات اللفائفي والأعور (log10 CFU/g) في الطيور التي تم تغذيتها على DPP عند مسـتوى 0.6 جم / كجم من العلف (P≤0.05). لم تتأثر مسـتويات تركيز إنزيمات ALT وAST في الدم بالعلاج ولم يكن هناك أي تأثير ضـار على وظائف الكبد. الخلاصـة تشـير النتائج إلى أنه يمكن اسـتخدام المكملات الغذائية DPP أو BP في النظام الغذائي للسمان كإضافات علفية لتحسين النمو.