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Effect of Adding Different Rates of Bee Pollen to Quail Rations on Performance and Carcass Parameters

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Abstract

This study was conducted to determine the effects of different amounts of pollen added to quail (*Coturnix coturnix japonica*) diets on fattening performance, some carcass, and internal organ parameters. In this study, 625 one-day-old mixed-sex Japanese quail (*Coturnix coturnix japonica*) chicks were used as animal material. The quail chicks were randomly divided into 5 main groups of 125 chicks each and each main group was divided into 5 subgroups of 25 chicks. According to the feed groups; the control group (C) was fed with the basic ration, while the trial (Trial I, II, III, and IV) groups were formed by adding pollen to the basic ration at different rates (0.25, 0.50, 0.75 and 1.00 %). In the 42-day study, quails were reared in cages with dimensions of 96x46x25 cm. At the end of the research, the PI group was found to be significantly higher than the C group in terms of live weight and live weight gain ($P<0.001$), while no statistical difference was detected between the groups in terms of feed consumption. Among the carcass parameters, slaughter weight ($P<0.001$), hot and cold carcass weight ($P<0.01$), and breast weight ($P<0.05$) were found to be statistically higher in the PI group than in the C group. Among the visceral organ weights, the PI group was determined to be higher than the C group in terms of intestine weight. As a result, considering the overall experiment, it is recommended to use 0.25 % pollen in quail rations due to its positive effect on fattening performance, some carcass parameters, and intestinal weight.

Research Article

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1. Introduction

In order to meet the protein needs of the increasing world population, there has been a significant increase in the production of farm animal products, especially poultry and pigs (OECD-FAO, 2023). In particular, poultry meat and meat products are preferred one step ahead because they are more economical than other farm animals, easier to raise and obtain, have lower cholesterol and fat content than red meat, and consumer habits are shifting towards white meat (Grom, 1990; Yücesoy and Kaya, 2022). One of the most preferred reasons for commercial quail farming is that it reaches slaughter weight in a short time of 42 days and is rich in nutritional value and essential fatty acids (Griggs and Jacob, 2005; Szczesna, 2006; Ergün et al., 2014).

Antibiotics have been used for many years to control all kinds of external factors that may cause suppression of the immune system and to increase fattening performance, especially in the process of reaching slaughter weight in a short period of 42 days in commercial poultry (chicken and quail) fed with high nutritional composition (Leeson and Summers, 2008). With the banning of antibiotics in the European Union and Turkey in 2006, researchers have intensified their research on natural alternative feed additives that can show the effect of antibiotics (Tuncer, 2007; Bolacali and Irak, 2017). For this purpose, research is being conducted on phytobiotics, probiotics, prebiotics, and bee products such as pollen and propolis, which are natural products that can be an alternative to antibiotics (Griggs and Jacob, 2005; Ergün et al., 2014).

Bee pollen is rich in active ingredients such as proteins, amino acids, carbohydrates, lipids and fatty acids, phenolic compounds, enzymes and coenzymes, vitamins, and bio-elements (Campos et al., 2008; Komosinska-Vassev et al., 2015). Although the nutritional content of bee pollen varies depending on the flora around the hive, it has a rich nutritional composition (Silva et al., 2006; Campos et al., 2008). The average protein level of bee pollen is 20-30 %, and approximately 10 % of this protein consists of essential amino acids such as lysine, methionine, histidine, threonine, tryptophan, leucine, isoleucine and phenylalanine. The total carbohydrate level in bee pollen is on average 15-50 %, and especially fructose and glucose constitute approximately 25 % of the total carbohydrate (Roulston, 2000; Villanueva et al., 2002; Almeida-Muradian et al., 2005; İlçeli and Yıldız, 2021). Pollen, which is rich in essential fatty acids (EFA) such as linoleic, γ-linoleic, and archaic acids, has an average crude oil content of 5-10 % and contains significant amounts of phospholipids and phytosterols. Bee pollen also contains approximately 0.04-3 % of active compounds such as flavonoids, leukotrienes, catechins, and phenolic acids (Asafova et al., 2001; Villanueva et al., 2002; Campos et al., 2008; İlçeli and Yıldız, 2021).

The use of bee products as apitherapeutic products dates back to ancient times; it has been reported to have anti-oxidant, antimicrobial, anti-fungal, anti-viral, anti-inflammatory, immune stimulation, and fattening performance-enhancing effects (Kroyer and Hegedus, 2001; Almaraz-Abarca et al., 2004; Sarıkaya et al., 2008; Eraslan et al., 2009; Liu et al., 2010; Pascoal et al., 2014; Dimitriou et al., 2023). In previous studies, pollen addition to poultry diets improved fattening performance and carcass yield (Babaei et al. 2016; Sarıkaya et al., 2017; İlçeli and Yıldız, 2021; Sevim, 2021), increases immunoglobulin levels and has an immunostimulating effect (De Oliveira et al., 2013; Hosseini et al., 2016), protects against heat and stress (Haščík et al., 2015) and improves meat quality (Sevim, 2021).

Although it has been determined that there have been studies on the use of pollen as a feed additive in poultry in previous years, there is limited information on the extent to which pollen can be added to the ration as a performance-enhancing feed additive alternative to antibiotics. In this study, the effect of pollen addition to quail rations at different rates (0.25, 0.50, 0.75, and 1 %) on fattening performance and carcass parameters was examined.

2 Materiel and Methods

2.1 Experimental chickens, diets, and design

In this study, 625 one-day-old different-sex Japanese quail (Coturnix coturnix japonica) chicks were used as animal material. The quail chicks were randomly divided into 5 main groups of 125 chicks each and each main group was divided into 5 subgroups of 25 chicks. Quails were fed with growth feed (day 1-42) whose nutrient content was prepared according to NRC (1994). Table 1. According to the feed groups; the control group (C) was fed with the basic ration, while the trial (PI, PII, PIII, and PIV) groups were formed by adding pollen to the basic ration at different rates (0.25, 0.50, 0.75 and 1.00 %). In the 42-day study, quails were reared in cages with dimensions of 96x46x25 cm. During the experiment, necessary heating and 24-hour lighting were provided and feed and water were provided ad libitum.

After weighing the hatching weight of the quails, their live weights were determined by weekly weighings, and live weight gain (LWG) was calculated. Feed was given to the quails by weighing and feed consumption (FC) of the quails was determined by deducting excess feed from the total feed given as a result of weekly weighings. Feed consumption was divided by live weight gain (FCR: FC/LWG) and feed conversion ratio (FCR) was calculated. On the 42nd day of the study, in order to determine the slaughter and carcass parameters, a total of 120 quails were slaughtered separately from the experimental groups, 4 quails from each subgroup and 20 quails from each main group, with live weights close to the group averages. In terms of slaughter and carcass parameters, hot and cold carcass weight, foot, thigh, breast, wing, liver, heart, intestine, neck, back, and other weights were determined.

Table 1. Composition and nutritional content of quail feed used in the research.

Ingredient	Initial-Growing Period (days 1-42), %	**Nutrient Content on a Dry Matter Basis, %**	Values
Maize	45.30	Dry matter	89.85
Wheat	8.91	Metabolic energy kcal kg^{-1} **	2903
Vegetable oil	1.60	Crude protein	24.08
Soybean Meal (48 %, HP)	30.00	Crude fat	3.41
Fish Meal (64 %, HP)	3.00	Crude fiber	4.65
Sunflower Meal (32 %, HP)	9.00	Crude ash	5.64
Limestone	1.16	Calcium	0.81
Vit. & Min. premix*	0. 25	P	0.38
Salt	0. 35	Na	0.20
DCP	0. 20	Cl	0.28
Antioxidant	0. 08	Met+Sis	0.85
L-Threonine	0. 15	Lysine	1.30
		Threonine	1.02
		Tryptophan	0.31

*: Per diet: 13,000 IU vitamin A, 3,500 IU vitamin D3, 100 mg vitamin E, 3 mg vitamin K3, 3 mg vitamin B1, 8 mg vitamin B2, 6 mg vitamin B6, 30 mg vitamin B12, 30 mg Niacin, 8 mg calcium-D-panthothenate, 2 mg folic acid, 70 mg vitamin C, 70 mg D-biotin, 200 mg choline chloride, 2 mg canthaxanthin, 0.75 mg apocarotenic acid esther, 120 mg Mn, 100 mg Zn, 90 mg Fe, 16 mg Cu, 1.5 mg I, 0.75 mg Co, 0.30 mg Se
**: Found by calculation (Jurgens, 1996).

2.2. Statistical Method

Determination of the difference between trial groups was determined according to the General Linear Model procedure (One-Way Anova) in the SPSS package program. Duncan's test was used for multiple comparisons of groups. The statistical significance level was accepted as $P<0.05$.

3. Results

In this study, live weight values of quails to which pollen was added to the ration at various periods are presented in Table 2. It was determined that adding pollen to quail rations as a feed additive significantly increased live weights in PI and PII groups compared to group C at the 5th (P<0.05) and 6th weeks (P<0.001).

Table 2. Effect of pollen addition to quail rations on weekly (wk) live weights of quails, (g).

Items	Control (M±SE)	PI (M±SE)	PII (M±SE)	PIII (M±SE)	PIV (M±SE)	P
Hatching	7.19±0.01	7.18±0.01	7.19±0.01	7.18±0.01	7.19±0.01	-
1st wk	34.46±0.25	35.19±0.37	34.63±0.40	34.66±0.20	33.88±0.10	-
2nd wk	68.93±0.53	70.15±0.35	69.92±0.27	68.46±0.64	68.34±0.64	-
3rd wk	102.09±1.44	106.82±1.72	104.34±1.35	102.41±1.65	100.89±1.82	-
4th wk	132.33±2.07	137.92±2.41	134.85±2.47	134.48±3.28	130.57±2.65	-
5th wk	165.07±3.31^{ab}	170.59±2.67^{a}	168.38±2.12^{a}	162.94±2.63^{ab}	159.64±2.40^{b}	*
6th wk	196.66±1.49^{b}	202.95±1.92^{a}	198.49±1.97^{ab}	196.34±2.15^{b}	190.16±0.51^{c}	***

C: Control; P I: 0.25% Pollen; P II: 0.50% Pollen; PIII: 0.75% Pollen; PIV: 1 % Pollen added.
-: Non significant (P>0.05; *: P<0.05; ***P<0.001). M: Mean; SE: Standard Error

The findings of the study on live weight gain (LWG), daily feed consumption (FC), and feed conversion ratio (FCR) for the initial (day 1-21), growth (day 21-42), and general experiment (day 1-42) periods are presented in Table 3. It was determined that the addition of pollen to the ration as a feed additive did not affect terms of LWG, FC, and FCR in the initial and growth periods.

In the overall study, it was determined that the addition of pollen as a feed additive improved the daily LWG (P<0.001) values in quails. Throughout the study, the highest LWG value and the best FCR performance were determined in the PI groups. There was no statistical difference between the groups in terms of the FC (P>0.05).

Table 3. Effect of pollen supplementation to quail diets on daily live weight gain (g), daily feed intake (g/day/head), feed conversion ratio (g).

Items	Control (M±SE)	PI (M±SE)	PII (M±SE)	PIII (M±SE)	PIV (M±SE)	P
Initial Period (Day 1-21)						
LWG	4.52±0.07	4.74±0.08	4.62±0.06	4.54±0.08	4.46±0.09	-
FC	11.37±0.35	11.56±0.19	11.48±0.31	11.37±0.39	11.61±0.43	-
FCR	2.52±0.04	2.43±0.04	2.48±0.06	2.51±0.09	2.60±0.06	-
Growth Period (Day 22-42)						
LWG	4.50±0.08	4.58±0.11	4.48±0.76	4.47±0.09	4.25±0.08	-
FC	23.24±0.56	22.77±0.56	23,26±0.52	23.21±0.37	22.36±0.26	-
FCR	5.16±0.08	4.98±0.05	5.18±0.09	5.19±0.11	5.26±0.06	-
Overall Experiment (Day 1-42)						
LWG	4.51±0.03^{b}	4.66±0.05^{a}	4.55±0.05 ^{ab}	4.50±0.05^{b}	4.35±0.01^{c}	***
FC	17.31±0.20	17.17±0.33	17.37±0.38	17.30±0.33	16.99±0.20	-
FCR	3.84±0.03	3.68±0.04	3.81±0.06	3.84±0.08	3.90±0.04	-

C: Control; P I: 0.25% Pollen; P II: 0.50% Pollen; PIII: 0.75% Pollen; PIV: 1 % Pollen added. M: Mean; SE: Standard Error
-: Non significant (P>0.05); *: P<0.05; ***P<0.001.

In the study, a statistical difference was found between the groups in terms of slaughter (P<0.001), hot carcass (P<0.01), cold carcass (P<0.01) and breast (P<0.05) weight. The

highest value in these parameters was found in the PI group. In terms of visceral organ weights, it was determined that there was no statistical difference between the groups in parameters other than intestine weight (P>0.05). Unlike these, a statistical difference was found in intestine weight (P<0.05), while the highest intestine weight was observed in the PI group (P<0.05).

Table 4. Effect of pollen addition to the diet on slaughter and carcass weights of quails (g).

Parameter	Control (M±SE)	PI (M±SE)	PII (M±SE)	PIII (M±SE)	PIV (M±SE)	P
Slaughter	189.16±0.50^{b}	196.72±0.38^{a}	193.06±0.76^{ab}	190.17±0.88^{b}	185.33±0.59^{c}	***
Hot carcass	142.56±1.00^{b}	152.24±1.32^{a}	149.85±1.59^{ab}	144.52±1.71^{b}	140.85±2.66^{c}	**
Cold carcass	141.03±1.52^{b}	150.85±1.90^{a}	147.85±1.62^{ab}	143.01±1.98^{b}	138.87±3.07^{c}	**
Leg	32.71±0.81^{b}	37.56±1.45^{a}	33.64±1.18^{b}	31.25±2.80^{b}	31.74±1.22^{b}	-
Breast	50.38±1.34^{b}	53.88±1.58^{a}	52.81±1.85^{ab}	51.08±3.26^{b}	45.60±2.13^{c}	*
Wing	12.10±0.36	12.98±0.27	12.68±0.42	12.27±1.34	11.91±0.52	-
Back	17.02±0.91	18.20±1.03	17.84±0.77	17.26±1.85	16.76±1.40	-
Neck	10.42±0.36	11.14±1.22	10.92±1.32	10.56±1.28	10.26±1.45	-
Other	18.59±1.08	19.86±1.32	19.47±1.08	18.83±1.68	18.29±1.07	-
Heart	1.83±0.36	1.95±0.27	1.91±0.40	1.85±0.20	1.80±0.31	-
Liver	3.07±0.40	3.29±0.36	3.22±0.26	3.11±0.19	3.02±0.23	-
Intestinal	4.76±2.03^{ab}	5.02±1.45^{a}	4.84±0.63^{ab}	4.62±1.69^{bc}	4.42±1.23^{c}	*
Gizzard	3.84±0.21	4.10±0.26	4.02±0.31	3.89±0.39	3.78±0.23	-
Abdominal fat	2.36±0.64	2.53±0.35	2.44±0.10	2.39±0.18	2.32±0.35	-

C: Control; P I: 0.25% Pollen; P II: 0.50% Pollen; PIII: 0.75% Pollen; PIV: 1 % Pollen added. -: Non significant (P>0.05), *: P<0.05; **P<0.01; ***P<0.001. M: Mean; SE: Standard Error

4. Discussion

Bee pollen, which is rich in nutrients, contains most of the essential nutrients required for growth and development (Villanueva et al., 2002; Capcarova et al., 2012; Petruska et al., 2020), not only promotes growth, but also improves the immune system of poultry, protects the health of the intestinal system and improves the quality and safety of animal products (Liu et al., 2010; Hosseini et al., 2016; Sevim, 2021; İlçeli and Yıldız, 2021; Al-Kahtani et al., 2022). There are also studies in the literature reporting that bee pollen has positive effects on performance (Farag Soha and Rayes, 2016; El-Medany et al., 2017; İlçeli and Yıldız, 2021).

In this study, it was determined that the addition of bee pollen to quail rations did not affect LW in the first 4 weeks of the study, which is compatible with the findings of Sevim (2021). In this study, the LW findings of PI and PII groups at 6 weeks were significantly higher than group C, which was consistent with the results of Attia et al. (2014) and Farag Soha and Rayes (2016).

Table 3 shows data on growth performance. Considering the starting and growth period in this study, it was determined that there was no statistical significance between the groups in terms of LWG, FC, and FCR values, which was compatible with research on quail and broiler chickens (Haščík et al., 2016; Sevim, 2021). Considering the overall experiment, the PI group was found to be significantly higher in LWG than the C group, which was similar to the findings of other studies on poultry (Attia et al., 2014; Hosseini et al., 2016). Considering the overall experiment, the PI group was found to be significantly higher in LWG than the C group, which was similar to the findings of other studies on poultry (Attia et al., 2014; Hosseini et al., 2016). In this study, it was determined that the lowest LWG and FCR values were in the PIV group, to which 1 % pollen was added to the rations, and the feed consumption of the same group

decreased numerically. Although the reason why the addition of 1 % pollen to the ration negatively affects fattening performance is not fully explained, it can be thought that it negatively affects fattening performance due to some components it contains. It was determined that the result that there was no statistical difference between the groups in terms of FC at any period of the study was compatible with the reports of İlçeli and Yıldız (2021).

While no difference was detected between groups in terms of feed consumption throughout the study, the best FCR value was detected in the PI group ($P<0.05$). In the study conducted by İlçeli and Yıldız (2021) on quails, they reported that the addition of 3, 6, 9, 12, and 15 g of pollen to the ration had no effect on LW, LWG, and FC, but the addition of 6 g of pollen significantly increased the FCR value compared to the C group. Unlike this result, Sarıkaya et al. (2018) reported that the addition of 0.25 and 0.50 % pollen to quail diets did not affect the overall LWG, FC, and FCR values. It is thought that one of the reasons for the inconsistency between studies is due to the difference in pollen used. In addition, animal material (such as using quails of different genders), trial design, and environmental differences can also be considered among the factors affecting the research.

As seen in Table 4, the slaughter, hot and cold carcass, breast, and intestinal weights of the PI group, to which 0.25 % pollen was added to their diet, were determined to be significantly higher than the C group, while the lowest value was found to be in the PIV group. Since breast meat is a commercially important product in poultry meat, the increase in breast meat in the PI and PII groups to which pollen was added is gaining importance. The finding that no statistical significance was detected in terms of other carcass and internal organ parameters was confirmed by Sarıkaya et al. (2018) (except for abdominal fat weight in Sarıkaya et al. 2018) and Canogullari et al. (2009) was found to be compatible with the research findings.

Farag Soha and Rayes (2016) report that adding different amounts of pollen to broiler and quail diets has positive effects on some carcass parameters and visceral organs. Unlike these reports, Canogullari et al. (2009) and Haščik et al. (2015) report that adding pollen to the diet has no effect on carcass parameters. Haščík et al. (2015) found that the addition of propolis to the broiler diet did not affect the carcass ratio, breast ratio, and liver ratios, but increased the leg ratio. Haščík et al. (2016) found that adding propolis to the broiler diet did not affect slaughter weight, carcass weight, carcass ratio, heart ratio, liver ratio, and gizzard ratio, but reduced abdominal fat weight. In this study, it was determined that there was an increase in intestinal weight in the PI group compared to the control. The increase in intestinal weight can be explained by studies reporting that supplementing bee pollen into the diets of birds can improve the initial development of the gastrointestinal tract and the digestive process (Toman et al., 2015; Haščík et al., 2017; Nemauluma et al., 2022). Fazayeli-Rad et al. (2015) reported that adding 20 g/kg pollen to broiler diets increased intestinal weight, and also increased the villus length and crypt depths of groups to which pollen was added at different rates to the diet. According to this result, it is thought that the high fattening performance of the PI group, whose diet was supplemented with pollen throughout the experiment, may be related to the positive effect of pollen on the digestive system.

5. Conclusions

As a result, it is recommended to use 0.25 % pollen in quail diets in poultry rations due to its positive effect on overall fattening and performance parameters and some carcass parameters and intestinal weight. However, when the findings of this and other studies on the use of pollen as a feed additive are evaluated; More detailed studies are needed on its effects on metabolism, considering the bioactive substances it contains.

Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

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Ethical Committee Approval

This research was conducted based on the permission numbered 2017-04 of Siirt University Animals Research Local Ethic Committee (SİU-DEHAM) (Ethics Committee decision dated 15.12.2017 and numbered 07.07.2017).

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References

Almaraz-Abarca, N., Campos, M.D.G., Avila-Reyes, J.A., Naranjo-Jim´enez, N., Herrera-Corral, J., Gonz´alez-Valdez, L.S., 2004. Variability of antioxidant activity among honeybee-collected pollen of different botanical origin. *Interciencia*, 29: 574-578.

Al-Kahtani, S.N., Alaqil, A.A., Abbas, A.O., 2022. Modulation of antioxidant defense, immune response, and growth performance by inclusion of propolis and bee pollen into broiler diets. *Animals*, 12(13): 1658.

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

Asafova, N., Orlov, B., Kozin, R., 2001. Physiologically Active Bee Products (Ed: Y. A. Nikolaev), Russia.

Attia, Y.A., Abd Al-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. *Livestock Science*, 164: 87-95.

Babaei, S., Rahimi, S., Torshizi, M.A.K., Tahmasebi, G., Miran, S.N.K., 2016. Effects of propolis, royal jelly, honey and bee pollen on growth performance and immune system of Japanese quails. *Veterinary Research Forum*, 7: 13-20.

Bolacali, M., Irak, K., 2017. Effect of dietary yeast autolysate on performance, slaughter, and carcass characteristics, as well as blood parameters, in quail of both genders. *South African Journal of Animal Science*, 47: 460-470.

Campos, M.G. Bogdanov, S., De Almeida-Muradian, L.B., Szczesna, T., Mancebo, Y., Frigerio, C., Ferreira, F., 2008. Pollen composition and standardisation of analytical methods. *Journal of Apicultural Research*, 47: 154-161.

Canogullari, S., Baylan, M., Sahinler, N., Sahin, A., 2009. Effects of propolis and polen supplementations on growth performance and body components of Japanese quails (*Coturnix coturnix japonica*). *Archiv für Geflügelkunde*, 73: 173-178.

Dimitriou, T.G., Asoutis Didaras, N., Barda, C., Skopeliti, D., Kontogianni, K., Karatasou, K., Mossialos, D., 2023. Antiviral activity of beebread, bee-collected pollen and artificially fermented pollen against ınfluenza a virus. *Foods*, 12(10): 1978.

El-Medany, N.M., Abd El-Azeem, F., El-Faham, A.I. Hamed, M.M., 2017. Effect of some natural feed additives to substitute antibiotic as growth promoters on growth performance, carcass characteristics and economic efficiency of broiler chicks: 2-Bee-pollen. *Egyptian Journal of Nutrition and Feeds*, 20: 113-122.

Eraslan, G., Kanbur, M., Silici, S., Liman, B.C., Altınordulu, Ş., Sarıca, Z.S., 2009. Evaluation of protective effect of bee polen against propoxur toxicity in rat. *Ecotoxicology and Environmental Safety*, 72: 931-937.

Ergün, A., Çolpan, İ., Yıldız, G., Küçükersan, S., Tuncer, Ş.D., Yalçın, S., Küçükersan, M.K., Şehu, A., Saçaklı, P., 2011. Hayvan besleme ve beslenme hastalıkları (5. Baskı). Pozitif Matbaacılık, Ankara.

Farag Soha, A., El-Rayes, T.K., 2016. Effect of bee-pollen supplementation on performance, carcass traits and blood parameters of broiler chickens. *Asian Journal of Animaland Veterinary Advances*, 11: 168-177.

Fazayeli-Rad, A.R., Afzali, N., Farhangfar, H., Asghari, M.R., 2015. Effect of bee pollen on growth performance, intestinal morphometry and immune status of broiler chicks. *European Poultry Science/Archiv für Geflügelkunde*, 79(86).

Griggs, J.P., Jacob, J.P. 2005. Alternatives to antibiotics for organic poultry production. *Journal of Applied Poultry Research*, 14 750-756.

Haščík, P., Trembecká, L., Bobko, M., Kačániová, M., Bučko, O., Tkáčová, J., Kunová, S., 2015. Effect of different feed supplements on selected quality indicators of chicken meat. *Potravinarstvo Slovak Journal of Food Sciences*, 9: 427-434.

Haščík, P., Trembecká, L., Bobko, M., Kačániová, M., Čuboň, J., Kunová, S., Bučko, O. 2016. Effect of diet supplemented with propolis extract and probiotic additives on performance, carcass characteristic sand meat composition of broiler chickens. *Potravinarstvo*, 10: 223-231.

Haščík, P., Pavelkova, A., Bobko, M., Trembecká, L., Elimam, I., Capcarova, M., 2017. The effect of bee pollen in chicken diet. *World's Poultry Science Journal*, 73(3): 643-650.

Hosseini, S.M., Azghandi, M.V, Ahani, S., Nourmohammadi, R., 2016. Effect of bee pollen and propolis (bee glue) on growth performance and biomarkers of heat stress in broiler chickens reared under high ambient temperature. *Journal of Animal and Feed Sciences*, 25: 45-51.

İlçeli, E., Yıldız, A., 2021. Effect of the addition of bee pollen at different levels to the growing quails diets on performance and serum parameters. *Turkish Journal of Agriculture-Food Science and Technology*, 9(7):1292-1296.

Komosinska-Vassev, K., Olczyk, P., Kaźmierczak, J., Mencner, L., Olczyk, K., 2015. Bee pollen: chemical composition and therapeutic application. *Evidence-Based Complementary and Alternative Medicine*, 297425

Kroyer, G., Hegedus, N., 2001. Evaluation of bioactive properties of pollen extracts as functional dietary food supplement. *Innovative Food Science and Emerging Technologies*, 2: 171-174.

Leeson, S., Summers, J.D., 2008. Commercial Poultry Nutrition (3rd. Edition). Chapter 5 and 13, Nottingham University Press, Manor Farm, Church Lane, Thrumpton, Nottingham, NG11 0AX, England.

Nemauluma, M.F.D., Ng'Ambi, J.W., Kolobe, S.D., Malematja, E., Manyelo, T.G., Chitura, T. 2022. Bee pollen an alternative to growth promoters for poultry production-a review. *Applied Ecology & Environmental Research*, 20(5):3817-3832.

N.R.C. 1994. Nutrient Requirements of Poultry, 9th Revised Edition. National Academy Press, Washington, DC.

Liu, G., Yan, W., Zeng, Z., 2010. Application of bee pollen in Gallus feed. *Journal of Bee*, 3:22-29.

OECD-FAO. 2023. OECD-FAO Agricultural Outlook 2023-2032. https://www.oecd-ilibrary.org/agriculture-and-food/world-meat-projections_59158ab5-en) (Accessed: 01.04.2024)

De Oliveira, M.C., Da Silva, D.M., Loch, F.C., Martins, P.C., Dias, D.M.B., Simon, G.A., 2013. Effect of bee pollen on the immunity and tibia characteristics in broilers. *Brazilian Journal of Poultry Science*, 15: 323-327.

Pascoal A., Rodrigues, S., Teixeira, A., Feás, X., Estevinho, L.M., 2014. Biological activities of commercial bee pollens: Antimicrobial, antimutagenic, antioxidant and anti-inflammatory. *Food and Chemical Toxicology*, 63: 233-239.

Roulston, T.H., Cane, J.H., 2000. Pollen nutritional content and digestibility for animals. *Plant Systematics and Evolution*, 222: 187-209.

Sarıkaya, Y., Tufan, T., Bolacalı, M., 2018. Bıldırcın rasyonlarına polen ilavesinin besi performansı ve karkas parametreleri üzerine etkisi. *Harran Üniversitesi Veteriner Fakültesi Dergisi*, 7(1): 26-31.

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.

Silva, T.M.S., Camara, C.A., da Silva Lins, A.C., Barbosa-Filho, J.M., da Silva, E.M.S., Freitas, B.M., Dos Santos, F.D.A.R., 2006. Chemical composition and free radical scavenging activity of pollen loads from stingless bee Melipona subnitida Ducke. *Journal of Food Composition and Analysis*,19 (6-7): 507-511.

Szczesna, T., 2006 Long chain fatty acids composition of honeybeecollected pollen. *Journal of Apicultural Science*, 50: 65-79.

Toman, R., Hajkova, Z., Hluchy, S., 2015. Changes in Intestinal Morphology of Rats Fed with Different Levels of Bee Pollen. *Pharmacognosy Communications*, 5: 261-264.

Tuncer, H.İ., 2007. Karma yemlerde kullanımı yasaklanan hormon, antibiyotik, antikoksidiyal ve ilaçlar. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, 47: 29-37.

Villanueva, M.O., Marquina, A.D., Serrano, R.B., Abellán, G.B., 2002. The importance of bee-collected pollen in the diet: a study of its composition. *International Journal of Food Sciences and Nutrition*, 53(3): 217-224.

Yücesoy, F., Kaya, H., 2022. Kanatlı et kalitesi üzerine beslemenin etkisi. *Palandöken Journal of Animal Sciences Technology and Economics*, 1(1): 42-53.

Jurgens, M.H., 1996. Animal feeding and nutrition, 8th Edition. Kendall/Hunt Publishing, Dubuque, IA.

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