The effect of propolis extract in the diet of chickens Ross 308 on their performance

Vplyv propolisového extraktu vo výžive kurčiat Ross 308 na ich úžitkovosť

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Abstract

The focus of the study was the performance of Ross 308 chickens after the application of propolis extract in their diet. The nutritional value of feed mixtures for chickens was equal, but the experimental groups were also added propolis extract in the dose of 200 $mg.kg^{-1}$ (E1), 300 $mg.kg^{-1}$ (E2) and 400 $mg.kg^{-1}$ (E3), respectively. The results of the experiments showed that the propolis extract in the examined concentrations can be applied to the diet of chickens, since it managed to raise ($P \geq 0.05$) the body weight positively (E1 – 2354.60 g; E2 – 2371.40 g; E3 – 2382.90 g), compared to control group (2272.89 g). Total increase of body weights indicates positive tendency of propolis extract in the diet of chickens Ross 308, because higher values ($P \geq 0.05$) were reached in the experimental groups (2311.60 g – E1 to 2339.60 g – E3) compared to control (2230.80 g). Total feed consumption was higher in the experimental groups, on the contrary, FCR was lower ($P \geq 0.05$) in the experimental groups (1.64 to 1.67) compared to control (1.69). The best performance results were reached in the group with the greatest addition of propolis extract, i.e. in the dose 400 $mg.kg^{-1}$ of feed mixtures (E3).

Keywords: broiler Ross 308, nutrition, performance, propolis extract

Abstrakt

Štúdia bola zameraná na skúmanie úžitkovosti kurčiat Ross 308 po aplikácii propolisového extraktu v ich výžive. Výživná hodnota kŕmnych zmesí pre kurčatá bola rovnaká, ale pokusným skupinám bol navyše pridávaný extrakt propolisu v dávke 200 $mg.kg^{-1}$ (E1), 300 $mg.kg^{-1}$ (E2) a 400 $mg.kg^{-1}$ (E3). Výsledky experimentu preukázali, že propolisový extrakt v preverovaných koncentráciách môžeme aplikovať vo výžive kurčiat, nakoľko pozitívne ($P \geq 0,05$) zvyšoval živú hmotnosť (E1 – 2354,60g; E2 – 2371,40 g; E3 – 2382,90 g) oproti kontrolnej skupine (2272,89 g). Celkový prírastok živej hmotnosti tiež poukazuje na kladnú tendenciu využitia propolisového extraktu vo výžive kurčiat Ross 308, nakoľko vyššie hodnoty

(P ≥ 0,05) boli dosiahnuté v pokusných skupinách (2311,60 g – E1 až 2339,60 g – E3) oproti kontrole (2230,80 g). Celková spotreba krmiva bola vyššia v pokusných skupinách, ale konverzia krmiva bola naopak nižšia (P ≥ 0,05) v pokusných skupinách (1,64 až 1,67) oproti kontrole (1,69). Najlepšie výsledky úžitkovosti boli dosiahnuté v skupine s najvyšším prídavkom propolisového extraktu, t.j. v množstve 400 mg.kg^{-1} kŕmnej zmesi (E3).

Kľúčové slová: kurčatá Ross 308, výživa, úžitkovosť, propolisový extrakt

Detailný abstrakt

Štúdia sa zamerala na skúmanie mäsovej úžitkovosti kurčiat Ross 308 po aplikácii propolisového extraktu v ich výžive. Experiment sa realizoval v testovacej stanici hydiny Katedry hydinárstva a malých hospodárskych zvierat pri Fakulte agrobiológie a potravinových zdrojov, Slovenskej poľnohospodárskej univerzity v Nitre. Do pokusu sa zaradilo 360 ks jednodňových kurčiat a následne sa vytvorili 4 skupiny zvierat: kontrolná (K) a tri pokusné (E1, E2, E3) po 90 ks kurčiat. Vlastný výkrm trval 42 dní. Kurčatá sa kŕmili systémom *ad libitum* rovnakou štartérovou kŕmnou zmesou HYD-01 (sypká štruktúra) do 21. dňa veku a od 22. dňa do 40. dňa rastovou kŕmnou zmesou HYD-02 (sypká štruktúra). Skrmované kŕmne zmesi HYD-01 a HYD-02 sa vyrobili bez antibiotických preparátov a kokcidiostatík. Výživná hodnota kŕmnych zmesí pre kurčatá bola rovnaká, ale pokusným skupinám sa navyše pridával extrakt propolisu v dávke 200 mg.kg^{-1} (E1), 300 mg.kg^{-1} (E2) a 400 mg.kg^{-1} (E3). Propolisový extrakt sa pripravil z rozomletého propolisu, ktorý sa následne zmiešal s 80 %-ným etanolom. Extrakcia roztoku propolisu prebiehala vo vodnom kúpeli pri 80 $^{\circ}$C pod spätným chladičom po dobu 1 hodiny. Zmes sa po extrakcii a ochladení centrifugovala. Získaný supernatant sa odparil na rotačnej vákuovej odparke pri teplote kúpeľa 40-50 $^{\circ}$C a následne odvážil. Odparok v množstve 20 g, 30 g a 40 g sa rozpustil v 1000 cm^{3} etanolu o koncentrácii 96 % a aplikoval do 100 kg príslušnej kŕmnej zmesi. Na konci výkrmu (42. deň) sa z každej skupiny experimentu vybralo po 60 ks kurčiat na jatočný rozbor (30 ks sliepok a 30 ks kohútov), ktorý sa uskutočnil na Katedre hodnotenia a spracovania živočíšnych produktov pri Fakulte biotechnológie a potravinárstva, Slovenskej poľnohospodárskej univerzity v Nitre. Výsledky experimentu preukázali, že propolisový extrakt v preverovaných koncentráciách sa môže aplikovať vo výžive kurčiat, nakoľko pozitívne (P ≥ 0,05) zvyšoval živú hmotnosť (E1 – 2354,60g; E2 – 2371,40 g; E3 – 2382,90 g) oproti kontrolnej skupine (2272,89 g). Celkový prírastok živej hmotnosti poukázal na kladnú tendenciu využitia propolisového extraktu vo výžive kurčiat Ross 308, nakoľko vyššie hodnoty (P ≥ 0,05) sa dosiahli v pokusných skupinách (2311,60 g – E1 až 2339,60 g – E3) oproti kontrole (2230,80 g). Celková spotreba krmiva sa zistila vyššia v pokusných skupinách, ale konverzia krmiva sa zaznamenala naopak nižšia (P ≥ 0,05) v pokusných skupinách (1,64 až 1,67) oproti kontrole (1,69). Najlepšie výsledky úžitkovosti sa dosiahli v skupine s najvyšším prídavkom propolisového extraktu, t.j. v množstve 400 mg.kg^{-1} kŕmnej zmesi (E3).

Introduction

Rational nutrition of people is nowadays focusing on highly digestible animal products, poultry meat being the most significant of them, having high nutritional and biological value and its composition is influenced by genotype, diet, age, cultivation environment and various extra- and intravital factors (Haščík et al., 2005a). Production of poultry meat is nowadays interesting and important mainly because of the short generation interval and relatively fast return on investment, as well as because of the highly valued protein from poultry products (Adeymo et al., 2010). This production represents a very important system of protein supply with high contents of essential amino acids for the quickly growing human population. These acids are the most important component of poultry meat (Guéye, 2009). Recently, the human population has been creating pressure on the need and creation of highly qualitative universal groceries that are source of proteins, raise the level of income and standard of living and that is why there is a continual increase in demand after poultry products (FAO, 2002). The most bred poultry animal species in the world are chickens (Moreki et al., 2010) and poultry breeding plays an important role also in bridging the protein gap in the third-world countries, where an average daily dose of proteins is significantly lower than the recommended standards (Onyimonyi et al., 2009). Several authors, in order to increase the performance and quality of carcass poultry product, besides selection and creation of new hybrid chicken combinations, conducted experiments also in terms of new proposals for the composition of feed mixture. The basis of broiler farms, with the right content and also the ratio of nutrients and energy is achieving maximum performance. The performance is expressed as weight gain at the most economical use of food and at the highest profit possible, while the set of requirements for nutrients and their limitations created specifically for each hybrid combination of chickens and the quality of their carcass body are influenced by the price of food material making up the feed mixture, as well as by requirements for nutritional composition of chicken meat (Saleh et al., 2004; Cerrate and Waldroup, 2009). Produced feed mixtures can be and are prevalently based on increased protein and essential amino acids content, while energy is being maintained at a constant level (Eits et al., 2005). However, other authors state that the feed mixture may have conversely increased energy value, while other nutrients remain unchanged in the feed mixture (Leeson et al., 1996; Dozier et al., 2006).

New legislative restrictions and prohibitions of the European Union for the use of meat and bone meal, conventional antibiotic growth stimulators and antimicrobial agents in the diet of polygastric and monogastric animals lead in science as well as in practical use to the alternative application of new possible additions and products in biotechnology (Haščík et al., 2007; Bobko et al., 2009). In chicken diet, there have been widely used complete feed mixtures, which are in recent years enriched by the addition of different supplements, including vegetable oils, probiotic, prebiotic and enzymatic preparations (Lee et al., 2003, 2004; Khojasteh and Shivazad, 2006; Haščík et al., 2007). Possible alternatives for the use are bee products (propolis, pollen, or their extracts), which can also have a positive impact on health condition, economic use of feed, meat performance, product quality and also on the economics of poultry industry (Kimoto et al., 1999; Prytzyk et al., 2003; Wang et al., 2004; Haščík et al., 2005a,b, 2007; Shalmany and Shivazad, 2006; Seven et al., 2008).

One of the possible alternative supplements is also propolis as resinous material collected by bee colonies from the leaf buds and bark of certain trees and plants.

From the chemical point of view, propolis is a multi-component mixture of different compounds with a prevalence of flavonoids and phenolic acids (Greenway et al., 1991), with discovered biological attributes such as anticancer, antioxidant, antimicrobial, anti-inflammatory effects and antibiotic activity (Nagai et al., 2003).

The most common use of propolis in folk medicine is the ethanol extract (Menezes et al., 1999) and in Japan, by contrast, native propolis is widely used for the treatment of inflammations, heart diseases and even diabetes and cancer (Walker and Crane, 1987). Standardization of propolis products is relatively difficult, because changes of its chemical composition and pharmacological activity result from variability in geographical and botanical location (Ghisalberti, 1979). It is also important to verify the mechanism of the propolis effect in order to anticipate its potential therapeutic effect, and also study and design new drugs with propolis supplement, which are even more effective for prevention and treatment in broiler nutrition (Kanno et al., 2003). Scientific research showed that natural additives, including bee products, i.e. also propolis, can stimulate the natural immunity of poultry and decrease the activity of pathogenic microorganisms, and in this way, improve the performance as well (Cross, 2002; Dalloul et al., 2003; Kačániová et al., 2011).

Based on the above facts, the aim of the experiment was to examine and evaluate the usage of commonly produced commercial feed mixtures with propolis extract supplement in varied amounts for commercial use of feed mixture and performance of hybrid combination chickens Ross 308.

Materials and Methods

The experiment was conducted at the poultry test station of Department of Poultry Science and Small Animal Husbandry at Faculty of Agrobiology and Food Resources of Slovak University of Agriculture in Nitra with broiler chickens of hybrid combination Ross 308. In the experiment, there were 360 1-day old chickens and consequently, 4 groups of animals were created: control (C) and three experimental groups (E1, E2 and E3) with 90 chickens of each group. Fattening was lasted for 42 days. Chickens were fed by an *ad libitum* system, with the same starter feed mixture HYD-01 (loose structure) to the 21st day of age and from the 22nd to the 42nd day with grower mixture HYD-02 (loose structure). These feed mixtures were made without any probiotic preparates and coccidiostats. Nutritional value of given feed mixtures (table 1) was the same in the individual groups, but experimental groups were fed with feed mixtures HYD-01 and HYD-02, supplemented with propolis extract with doses 200 mg.kg^{-1} (E1), 300 mg.kg^{-1} (E2) and 400 mg.kg^{-1} (E3), respectively. The propolis extract was prepared from grinded propolis by the Krell (1996) method. Propolis extract was added in the amount of 20 g (E1), 30 g (E2) and 40 g (E3), respectively, was dissolved in 1000 cm^3 ethanol with 80% concentration and applied to 100 kg of corresponding feed mixture. In this experiment, body weight of chickens, body weight gains, consumption and feed conversion ratio (FCR) of feed mixture, as well as consumption of crude protein and metabolizable energy were evaluated. The results of the experiment (arithmetic average, standard deviation) were processed by statistical program Statgraphics Plus, Version 5.1 (AV Trading, Umex, Dresden, Germany) and to define the differences between the groups, variance analysis, followed by Scheffé's method, was used.

Table 1 Ingredient and nutrient composition of basal feed mixtures

Tabuľka 1 Zloženie základných kŕmnych zmesí a ich obsah živín

Ingredients (%)	Starter (1 to 21 days of age)	Grower (22 to 42 days of age)
Wheat	35.00	35.00
Maize	35.00	40.00
Soybean meal (48% N)	21.30	18.70
Fish meal (71% N)	3.80	2.00
Dried blood	1.25	1.25
Ground limestone	1.00	1.05
Monocalcium phosphate	1.00	0.70
Fodder salt	0.10	0.15
Sodium bicarbonate	0.15	0.20
Lysine	0.05	0.07
Methionine	0.15	0.22
Palm kernel oil Bergafat	0.70	0.16
[1]Premix Euromix BR 0.5%	0.50	0.50
Analysed composition ($g.kg^{-1}$)		
Crude protein	210.76	190.42
Fibre	30.19	29.93
Ash	24.24	19.94
Ca	8.16	7.28
P	6.76	5.71
Mg	1.41	1.36
Linoleic acid	13.51	14.19
ME_N ($MJ.kg^{-1}$) by calculation	12.02	12.03

[1] active substances per kilogram of premix: vitamin A 2,500,000 IU; vitamin E 50,000 mg; vitamin D_3 800,000 IU; niacin 12,000 mg; d-pantothenic acid 3,000 mg; riboflavin 1,800 mg; pyridoxine 1,200 mg; thiamine 600 mg; menadione 800 mg; ascorbic acid 50,000 mg; folic acid 400 mg; biotin 40 mg; vitamin B_{12} 10.0 mg; choline 100,000 mg; betaine 50,000 mg; Mn 20,000 mg; Zn 16,000 mg; Fe 14,000 mg; Cu 2,400 mg; Co 80 mg; I 200 mg; Se 50 mg

Results

Achieved values of body weight, weekly and daily body weight gains in chickens Ross 308 without and after the propolis extract supplement in their diet are in Table 2 and feed consumption, NL and ME_N, or FCR of feed mixture are in Table 3.

After the first week of fattening, the body weight of chickens was from 120.30 g (E1) to 142.60 g (E3) with significant differences ($P \le 0.05$) between E1 and E2, or E3. In the course of the next week of fattening, the significant difference ($P \le 0.05$ to $P \le 0.01$) was found between the control group (342.20 g) and E2 (377.60 g), or E3 (392.70 g) and E1 (322.80 g), compared to E2 and E3 ($P \le 0.01$). In the age of 21 days, the effect of propolis extract showed by gaining the body weight of 2.6 to 92.50 g in experimental groups, but statistically significant differences ($P \le 0.05$) were found only in group E2 (749.60 g) and (P ≤ 0.001) in group E3 (783.40 g), compared to control group (690.90 g). In the fourth week, significant difference in body weight (P ≤ 0.05 till P ≤ 0.01) was found between the control group (1121.40 g), or E1 group (1125.80 g) and E3 group (1210.00 g). During the fifth week, significant differences were found only between the control group and E1 group (P ≤ 0.05), or E3 group (P ≤ 0.01). At the end of the fattening (day 42), positive (P ≥ 0.05) impact of the propolis extract in the diet of chickens Ross 308 on their achieved body weight compared with the control group was found, while the body weight of chickens Ross 308 proportionally increased in the experimental group with increased rate of propolis extract in the feed mixtures. In the course of evaluating weekly gains for the first three weeks, significant differences (P ≤ 0.05 to P ≤ 0.01) between E1 and E2, or E3 group, were found, while the highest weight (740.10g) was achieved in the E3 group. The following three weeks increased the increases in body weight gain in the E1 group to 1661.10 g, thus achieving significant difference (P ≤ 0.05), compared with control (1582.00 g). The rest of the groups did not show statistically significant differences (P ≥ 0.05) after 6 weeks of fattening, even though also in this growth phase there were higher values found in E2 and E3, compared with control.

Table 2 The effect of propolis extract on body weight and body weight gains of chickens Ross 308

Tabuľka 2 Účinok propolisového extraktu na živú hmotnosť a prírastok živej hmotnosti kurčiat Ross 308

Parameter	Group C (without propolis extract supplement)	Group E1 (200 mg.kg^{-1})	Group E2 (300 mg.kg^{-1})	Group E3 (400 mg.kg^{-1})
n	90	90	90	90
Body weight in individual weeks (g)				
Mean ± S.D.				
1 wk	127.90^{ab}±19.06	120.30^{a}±21.62	135.60^{b}±7.89	142.60^{b}±15.37
2 wk	342.20^{a}±33.82	322.80^{a}±48.91	377.60^{b}±19.97	392.70^{b}±37.30
3 wk	690.90^{a}±45.02	693.50^{a}±64.36	749.60^{b}±50.35	783.40^{b}±58.36
4 wk	1121.40^{a}±52.12	1125.80^{a}±78.71	1172.60^{ab}±69.93	1210.00^{b}±81.47
5 wk	1680.80^{a}±87.34	1756.50^{b}±67.77	1763.80^{ab}±112.16	1804.90^{b}±101.27
6 wk	2272.90±107.79	2354.60±70.18	2371.40±131.72	2382.90±143.55
Daily weight gain (g)				
1 wk	85.80^{ab}±17.70	77.30^{a}±20.86	91.80^{ab}±9.00	99.30^{b}±14.64
2 wk	214.30^{a}±31.04	202.50^{a}±36.32	242.00^{b}±14.95	250.10^{b}±23.47
3 wk	348.70^{a}±26.19	370.70^{ab}±23.19	372.00^{ab}±38.18	390.70^{b}±29.76
0-3 wk	648.80^{ab}±100.89	650.50^{a}±64.01	705.80^{b}±51.11	740.10^{b}±58.14
4 wk	430.50±18.69	432.30±23.35	423.00±36.22	426.50±43.34
5 wk	559.40^{a}±51.22	630.70^{b}±39.61	591.20^{ab}±44.43	594.90^{ab}±51.06
6 wk	592.10±63.70	598.10±49.01	607.60±51.68	578.00±60.31
4-6 wk	1582.00^{a}±94.97	1661.10^{b}±69.20	1621.80^{ab}±87.91	1599.50^{ab}±126.62
0-6 wk	371.80±17.99	385.26±11.74	387.93±22.06	389.93±24.21
Total weight gain in the course of fattening (g)				
0-6 wk	2230.80±107.93	2311.60±66.76	2327.60±132.35	2339.60±145.29
Daily weight gain (g)				
1 wk	12.25^{ab}±2.53	11.04^{a}±2.98	13.11^{ab}±1.29	14.19^{b}±2.09
2 wk	30.61^{a}±4.43	28.92^{a}±5.19	34.57^{b}±2.14	35.73^{b}±3.35
3 wk	49.81^{a}±3.74	52.95^{ab}±3.31	53.14^{ab}±5.45	55.82^{b}±4.25

0-3 wk	30.89^{a}±2.07	30.97^{a}±3.05	33.61^{b}±2.43	35.25^{b}±2.77
4 wk	61.50±2.67	61.75±3.33	60.43±5.17	60.95±6.19
5 wk	79.91^{a}±7.32	90.10^{b}±5.66	84.46^{ab}±6.35	84.99^{ab}±7.29
6 wk	84.58±9.10	85.44±7.00	86.80±7.38	82.57±8.61
4-6 wk	75.33^{a}±4.52	79.10^{b}±3.30	77.23^{ab}±4.19	76.17^{ab}±6.03
0-6 wk	53.11±2.57	55.03±1.67	55.41±3.15	55.70±3.46

*C: control group, *E1, E2, E3: experimental groups, * mean average value, *S.D.: standard deviation, values in the same columns with different superscripts (a, b) are significantly P ≤ 0.05 levels

Table 3 Effect of propolis extract on feed intake and FCR; crude protein intake and metabolizable energy intake of chickens Ross 308

Tabuľka 3 Vplyv propolisového extraktu na spotrebu a konverziu krmiva; spotreba dusíkatých látok a metabolizovateľnej energie u kurčiat Ross 308

Parameter	Group C (without propolis extract supplement)	Group E1 (200 mg.kg^{-1})	Group E2 (300 mg.kg^{-1})	Group E3 (400 mg.kg^{-1})
n	90	90	90	90
Weekly feed consumption (g)				
Mean ± S.D.				
1 wk	107.66^{ab}±11.82	99.91^{a}±8.65	114.70^{b}±2.92	118.76^{b}±5.88
2 wk	293.54^{a}±7.87	293.83^{a}±6.47	320.58^{b}±16.29	304.33^{ab}±25.37
3 wk	523.15^{a}±17.28	521.82^{ab}±46.32	547.60^{b}±19.07	556.85^{b}±17.69
0-3 wk	924.36^{a}±25.04	915.55^{a}±42.65	982.88^{b}±15.40	979.94^{b}±36.92
4 wk	661.79^{a}±7.50	716.88^{b}±13.11	676.30^{ad}±39.13	679.46^{cd}±3.50
5 wk	1002.73^{a}±19.53	1016.57^{ab}±43.13	1036.17^{ab}±75.92	1038.51^{b}±18.91
6 wk	1165.55^{a}±12.73	1208.18^{a}±65.48	1139.56^{b}±19.34	1128.52^{b}±36.74
4-6 wk	2830.07^{a}±22.93	2941.63^{b}±90.83	2852.03^{ab}±40.97	2846.49^{ab}±54.36
Total consumption of feed in the course of fattening (g)				
0-6 wk	3754.43^{a}±14.33	3857.18^{b}±48.58	3834.91^{b}±27.36	3826.43^{b}±27.36
Daily feed consumption (g)				
1 wk	15.38^{ab}±1.69	14.27^{a}±1.23	16.38^{b}±0.42	16.96^{b}±0.84
2 wk	41.93^{a}±1.12	41.97^{a}±0.92	45.79^{b}±2.33	43.47^{ab}±3.63
3 wk	74.73^{a}±2.47	74.54^{ab}±6.62	78.22^{b}±2.72	79.54^{b}±2.53
0-3 wk	44.01^{a}±1.19	43.59^{a}±2.03	46.80^{b}±0.73	46.66^{b}±1.76
4 wk	94.53^{a}±1.07	102.41^{b}±1.88	96.61^{ad}±5.59	97.06^{cd}±0.50
5 wk	143.25^{a}±2.79	145.22^{ab}±6.16	148.02^{ab}±10.84	148.35^{b}±2.70
6 wk	166.50^{a}±1.82	172.59^{a}±9.35	162.79^{b}±2.76	161.21^{b}±5.25
4-6 wk	134.76^{a}±1.09	140.07^{b}±4.32	135.80^{ab}±1.95	135.54^{ab}±2.59
0-6 wk	89.39^{a}±0.34	91.83^{b}±1.16	91.30^{b}±0.65	91.10^{b}±0.65
FCR				
1 wk	1.29±0.22	1.40±0.46	1.26±0.13	1.22±0.20
2 wk	1.39^{ac}±0.19	1.60^{a}±0.37	1.33^{c}±0.08	1.23^{b}±0.11
3 wk	1.51±0.12	1.41±0.09	1.48±0.15	1.43±0.10
0-3 wk	1.43^{a}±0.10	1.42^{ab}±0.14	1.40^{ab}±0.09	1.33^{b}±0.11
4 wk	1.54^{a}±0.06	1.66^{b}±0.09	1.61^{ab}±0.15	1.61^{ab}±0.16
5 wk	1.81^{a}±0.16	1.62^{b}±0.10	1.76^{acd}±0.13	1.62^{bd}±0.21
6 wk	1.99±0.21	2.03±0.16	1.89±0.16	1.97±0.20
4-6 wk	1.79±0.11	1.77±0.07	1.76±0.10	1.79±0.14
0-6 wk	1.69±0.08	1.67±0.05	1.65±0.09	1.64±0.10
Crude protein intake (g)				

1 wk	22.69^{ab}±2.49	21.06^{a}±1.82	24.17^{b}±0.61	25.03^{b}±1.24
2 wk	61.87^{a}±1.66	61.93^{a}±1.36	67.56^{b}±3.43	64.14^{ab}±5.35
3 wk	110.26^{a}±3.64	109.98^{ab}±9.76	115.41^{b}±4.02	117.36^{b}±3.73
0-3 wk	194.82^{a}±5.28	192.96^{a}±8.99	207.15^{b}±3.24	206.53^{b}±7.78
4 wk	126.02^{a}±1.43	136.51^{b}±2.49	128.78^{ad}±7.45	129.38^{cd}±0.67
5 wk	190.94^{a}±3.72	193.57^{ab}±8.21	197.31^{ab}±14.46	197.75^{b}±3.60
6 wk	221.94^{a}±2.42	230.06^{a}±12.47	216.98^{b}±3.68	215.06^{b}±7.16
4-6 wk	538.90^{a}±4.37	560.14^{b}±17.30	543.08^{ab}±7.80	542.03^{ab}±10.35
0-6 wk	733.72^{a}±2.98	753.11^{b}±8.40	750.23^{b}±4.95	748.56^{b}±4.94
Metabolizable energy intake (MJ)				
1 wk	1.29^{ab}±0.14	1.20^{a}±0.10	1.38^{b}±0.03	1.43^{b}±0.07
2 wk	3.53^{a}±0.09	3.53^{a}±0.08	3.85^{b}±0.19	3.66^{ab}±0.30
3 wk	6.28^{a}±0.21	6.27^{ab}±0.56	6.58^{b}±0.23	6.69^{b}±0.21
0-3 wk	11.11^{a}±0.30	11.00^{a}±0.51	11.81^{b}±0.18	11.77^{b}±0.44
4 wk	7.96^{a}±0.09	8.62^{b}±0.16	8.13^{ad}±0.47	8.17^{cd}±0.04
5 wk	12.06^{a}±0.23	12.23^{ab}±0.52	12.46^{ab}±0.91	12.49^{b}±0.23
6 wk	14.02^{a}±0.15	14.53^{a}±0.79	13.61^{b}±0.24	13.58^{b}±0.44
4-6 wk	34.04^{a}±0.28	35.39^{b}±1.09	34.31^{ab}±0.49	34.24^{ab}±0.65
0-6 wk	45.15^{a}±0.17	46.39^{b}±0.58	46.18^{b}±0.33	46.02^{b}±0.33

*C: control group, *E1, E2, E3: experimental groups, * mean average value, *S.D.: standard deviation, values in the same columns with different superscripts (a, b, c, d) are significantly P ≤ 0.05 levels

Total weight gain points to a positive tendency of propolis extract use in the diet of chickens Ross 308, since higher values (P ≥ 0.05) were reached in experimental groups (2311.60 g – E1 to 2339.60 g – E3), compared with control (2230.80 g).

Values of daily body weight gains correspond to the trend of results of weekly weight gains and confirm the positive use (P ≥ 0.05) of propolis extract in experimental groups. Feed consumption in the starter phase of fattening, i.e. until the day 21 of the chickens was statistically significant (P ≤ 0.05 to P ≤ 0.001) higher in E2 and E3, compared with control, or with E3. In the grower phase to the day 42 of age, consumption in all experimental groups was higher, compared with control, but statistically significantly (P ≤ 0.05) only in comparison with the control and E1. Average feed consumption for the whole fattening was higher (P ≤ 0.001) in experimental groups in comparison with the control, while the highest was in the E1 group (3857.18 g) and the lowest one was in the control group (3754.43 g). Feed conversion ratio was higher in the control group, compared with experimental groups in the experiment after the first three weeks (1.43), and also from the 4th to the 6th week of fattening (1.79). Overall FCR at the end of fattening was lower (P ≥ 0.05) in experimental groups (1.64 to 1.67), compared with control (1.69). Consumption of crude protein, but also metabolizable energy is closely related to the feed consumption in various stages of fattening, or also in total. The lowest consumption of crude protein for the fattening was observed in the control group (733.72 g) and a higher one (P ≤ 0.001) in all experimental groups (E1 – 753.11 g; E2 – 750.23 g; E3 – 748.56 g). A similar tendency was also noted in the consumption of metabolizable energy for the fattening, where the lowest consumption was again in the control group (45.15 MJ) and significantly higher (P ≤ 0.001) in experimental groups (E1 – 46.39 MJ; E2 – 46.18 MJ; E3 – 46.02 MJ).

Discussion

Body weight of chickens Ross 308 at the age of 21 days (690.90 to 783.40 g) of the our experiment is comparable with values achieved in Saleh et al. (2004), respectively higher than in Shalmany a Shivazad (2006). The results confirm the increase of body weight in the age of 21 days after application of propolis extract in the diet of chickens, as found by Shalmany and Shivazad (2006) and Tekeli et al. (2011), but they are contradictive to the results of Seven et al. (2008), who noted a contradictive effect in this age. Achieved body weight of chickens Ross 308 to 42 days of fattening (2272.90 g to 2382.90 g) is in compliance with the values achieved by this hybrid according to the results of Tekeli et al. (2010), respectively higher than found by Saleh et al. (2004), Abbas (2010) and Toghyami et al. (2010), but lower than was found after the application of selene in various forms by Skřivan et al. (2008) and Marcu et al. (2009). A series of experiments with broilers (Rutkowski et al., 2000; Osek et al., 2001; Pawlak et al., 2005; Seven et al., 2008), including our results, showed, that regardless of component diet, broiler chickens can reach final body weight 2.0 to 2.2 kg after 42 days of fattening, since the chickens in their last stage of fattening increase their weight by an average of 23% and more. Body weight is closely related to body weight gains achieved, since the total body weight gain in the course fattening of chickens Ross 308 was found in the range of 2230.80 g (control group) to 2339.60 g (E3), without significant differences ($P \geq 0.05$) among the experimental groups. Weekly increases of body weight after the application of propolis extract in the amount of 200 to 400 $mg.kg^{-1}$ to feed mixture in the diet of chickens Ross 308 were higher than achieved by Haščík et al. (2010) and similarly, achieved daily body weight gains were higher in comparison with results by Shalmany and Shivazad (2006), Seven et al. (2008), Onyimonyi et al. (2009) and Kumar et al. (2010). Feed consumption for the whole fattening was the highest in the E1 group (3857.18 g) and the lowest in the control group (3754.43 g), which are results comparable with results achieved by Shalmany a Shivazad (2006), Petrovič et al. (2010), but lower ones than found by Seven et al. (2008), Tekeli et al. (2011), respectively slightly higher in comparison with published study by Rezai et al. (2004) and Mohamed et al. (2008). Feed conversion ratio at the end of fattening was lower in experimental groups (1.64 to 1.67), compared with control (1.69), which is in compliance with the results by Shalmany and Shivazad (2006), who also recorded a decrease of FCR after the application of propolis extract in the diet of chickens Ross 308. The results of FCR are comparable with values achieved by Haščík et al. (2010), but Novel et al. (2009) found the FCR in 42-days old chickens at the level of 2.20 to 2.30. Inconclusive differences ($P \geq 0.05$) in FCR between control and experimental groups are in compliance with the results by Demir et al. (2003), Acikgoz et al. (2004), Botsoglou et al. (2004), Gunal et al. (2006), Mohamed et al. (2008), Seven et al. (2008), respectively Tekeli et al. (2011), who point that extracts from plants and propolis do not have a significant impact on improving FCR. The achieved performance results of chickens Ross 308 points at the possible positive impact of propolis extract in the verified quantity 200-400 $mg.kg^{-1}$ of complete feed mixtures and its application also in terms of mass production, which is in compliance with arguments by Pesti et al. (1986), Gonzalez-Alcorta et al. (1994), Perry et al. (2002), Saleh et al. (2004), Cerrate and Waldroup (2009), Moreki et al. (2010) and others, whose created various models of feed mixture composition after application of various feed additives and supplements in order to achieve maximum performance of chickens, expressed by body weight gain at the most economical use of feed and achieved at the highest income. In terms of overall assessment of performance parameters in the course of an experiment we can claim that the best group was the number E3 with their dose of 400 mg.kg^{-1} of propolis extract in feed mixtures of broiler chickens Ross 308.

Conclusion

The results of the experiment, which was focused on the impact of propolis extract applied in complete feed mixtures of chickens of hybrid combination Ross 308 in the dose of 200, 300 and 400 mg.kg^{-1}, respectively, and on body weight of chickens, body weight gains, feed consumption and FCR, as well as on consumption of crude proteins and metabolizable energy during different phases of fattening confirm that propolis extract in different concentrations can be applied into the diet of chickens Ross 308, since it has its importance in the economic utilization of feed mixtures and improves body weight and body weight gains of broilers. At the same time we found that the best results of performance were achieved in the group with the highest addition of propolis extract, in the amount of 400 mg.kg^{-1} of the compound.

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