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Original Paper

The impact of the humic acid and phytobiotics on performance and carcass parameters of broiler chickens

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The aim of this experiment was to determine the influence of humic substances, and combination humic substances and selected phytobiotics on production and carcass parameters of broiler chickens. In experiment from total 200 one-day-old ROSS 308 chickens were randomized into four groups (n = 50). The control group was fed with basal diet (BD) without any additives. Group of chickens marked as treatment 1 (T1) was fed a BD containing 2% of humic acid, the group marked as treatment 2 (T2) was fed a BD containing 78% of humic acids, 18% of garlic powder (*Allium sativum* L.), 1% of milled dried leaves of wormwood (*Artemisia absinthium*), 1% of milled dried leaves of thyme (*Thymus vulgaris*), 1% of milled dried leaves of oregano (*Origanum vulgare*) and 1% of milled dried leaves of bogbean (*Menyanthes trifoliata*), together 2 kg.100 kg^{-1} complete feed mixture (BD). In the group marked as treatment T3 were chicken fed with BD containing industrially produced coccidiostats. Experiment lasted 42 days. At the end of the experiment was average body weight (values in the order of the groups: 1,808.03 ±212.39; 1,981.75 ±203.32; 1,895.59 ±178.75 and 1,955.31 ±237.16 g ±*SD*) significantly higher (P <0.05) in all treatment in compare to control group. In T2 was thigh part (29.27 ±1.50; 29.07 ±3.35; 30.45 ±2.15 and 29.49 ±2.34 mean ±*SD*) significantly higher (P <0.05) compared to control group. Carcass weight (values in the order of the groups: 1357.18 ±95.8; 1486.38 ±156.7; 1369.69 ±118.0 and 1440.68 ±132.1 g ±*SD*) and carcass yield (74.35 ±1.33; 76.10 ±1.97; 74.03 ±1.35 and 73.45 ±1.82 mean ±*SD*) were the highest in treatment T1 with humic acid addition (P >0.05).

Keywords: *Allium sativum* L., *Artemisa absinthium*, broiler chicken, carcass parameters, humic acid, *Menyanthes trifoliata*, *Origanum vulgare*, performance parameters, *Thymus vulgaris*

1 Introduction

A substantial growth in poultry industry has been observed mainly due to exploitation of various modern growth promoting strategies and appropriate disease preventive and control measures (Kuldeep Dhama et al., 2014). Antimicrobial growth promoters have made a tremendous contribution to profitability in intensive husbandry, but as a consequence of the increasing concern about the potential for antibiotic resistant strains of bacteria, the European Commission decided to ban all commonly used feed antibiotics. (Hassan et al., 2010). So, there is the need to find alternatives to the use of antibiotics. Humic acids are the most active substances with antioxidant effect. Humic acids have a positive impact on meat quality, increasing weight gains and improve the immune system of broiler chickens (Nagaraju et al., 2014). Spices and herbs, generally used for their flavouring characteristics, can be added to meat products in various forms: whole, ground, or as isolates from their extracts (Diaz-Sanchez et al., 2015. Garlic helps to improve feed palatability, feed intake and feed efficiency, it has antioxidant effect (Khan et al., 2010). Oregano is known by several notable beneficial effects on animal growth performance, feed efficiency, production traits and product quality, as well as on modulation of immune system, intestinal architecture and bacterial microbiota (Giannenas et al., 2018). Thyme is aromatic plant possess stimulant properties. Thyme is used in poultry nutrition in the form of herbal feed additive as it is known that its contents, such as thymol and carvacrol, have a positive impact on broiler performance and feed utilization, which in turn results in enhanced economic profits (Alipour et al., 2015). The results of study of Bertella et al. (2018) suggest that the essential oil of Artemisia can be a source of natural antibacterial agents with potential pharmacological

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applications, the essential oil of this species was known for its therapeutic disinfectant, anthelminthic and antispasmodic virtues. *Menyanthes trifoliata* (bogbean) is a very valuable medicinal plant. Bogbean is generally used in conjunction with other medicinal herbs. The leaf of the bogbean is a source of valuable herbal material. Bogbean contains iridoid glycosides, flavonol glycosides, phenolic acids, coumarins, triterpenoids, and very small amounts of alkaloids. The iridoids are strongly bitter and stimulate digestive secretions and appetite (Bacler-Żbikowska, 2012).

Coccidiosis in chickens is a parasitic disease with great economic significance, which has been controlled successfully for decades using mainly anticoccidial products. It is caused by coccidian protozoans of the genus *Eimeria*. However, large-scale and long-term use of anticoccidial drugs has led to the worldwide development of resistance against all these drugs (Peek and Landman, 2011). Increasing concerns about parasite resistance, consumer health, and environmental safety of the commercial drugs warrant efforts to search for novel agents with anti-Eimeria activity. Currently, it appears to be promising to identify safe combinations of low-cost natural products with high anti-*Eimeria* efficacy for a potential use as feed supplementation in animal farming (Wunderlich, et al., 2014).

The aim of this study was to determine the effect of humic acid and the combination humic acid with phytobiotics on production parameters and carcass characteristic of broiler chicken of hybrid Ross 308. Our goal was verify possibility of replacement of chemical coccidiostatics in the feed mixture of chicken by the substances on the natural basis, as well.

2 Material and methods

Animals, diets and treatments

In experiment from total 200 one-day-old ROSS 308 meat hybrid chicken were randomized into four groups. Each treatment group contained 50 birds. Chickens in individual groups were stabled on deep litter, with a maximum occupation of the breeding areas 33 kg·m^2. During the fattening period, the light regimen based on 23 h of light and 1 h of dark was used. The temperature at the beginning of the experiment was 31–33 °C and week fell by 2 °C to 20–22 °C. The temperature was maintained using electronic hen-like devices providing radiant heat. The fattening lasted 42 days.

The starter diet was used from 1 to 21 days of age, the grower diet was used from 22 to 35 days of age and a finisher diet was used from 36 to 42 days of age. In connection with include of supplement were feed mixtures in powdery form. Anticoccidial drugs were not included in the feed mixtures for first and second treatment group. In the feed mixture for a third treatment group were incorporated anticoccidial drugs (coccidiostats). Feed and water were supplied *ad libitum*. Composition of complete feed mixtures (Biofeed a.s., Kollárovo, Slovakia) is presented in Table 1.

In control group we used complete feed mixture without any additives. Group of chickens marked as treatment 1 (T1) was fed a diet containing 2% of humic acid, 2 kg per 100 kg complete feed mixture (basal diet – BD) (Vetservis s.r.o., Nitra, Slovakia); the group marked as treatment 2 (T2) was fed a BD containing 78% of humic acids; 18% of garlic powder (*Allium sativum* L.); 1% of milled dried leaves of wormwood (*Artemisia absinthium*); 1% of milled dried leaves of thyme (*Thyme vulgaris*);1% of milled dried leaves of oregano (*Origanum vulgare*) and 1% of milled dried leaves of bogbean (*Menyanthes trifoliata* L.) together 2 kg per 100 kg complete feed mixture (BD) (Vetservis s.r.o. Nitra, Slovakia). In the group marked as treatment T3 were chicken fed with BD containing industrially produced coccidiostats. In the starter diet was used coccidiostats Dicluzaril, in the grower diet was used coccidiostats Salinomycinát sodný. Additives were mixed into the feed by the manufacturer of feed mixture used in the experiment.

Monitored performance and carcass parameters

Performance parameters as body weight (g), feed intake (kg) and feed conversion (kg) were recorded weekly. At the end of the experiment 10 chickens from each group were slaughtered. In the laboratory of the Department of Poultry Science and Small Farm Animals in Slovak University of Agriculture in Nitra analysis of samples of chickens was realized. We focused on the carcass weight (g), weight edible offal (g) and carcass yield (%).

Statistical analysis

All data were analysed by analysis of variance using the general linear model procedure of the software program SAS (Statistical Analysis System). Differences between the indicators were tested using one-way analysis of variance by Duncan's test. Significance was considered at $P < 0.05$.

3 Results and discussion

The objective of the present study is to investigate the effect of humic acid with various herbal additives to body weight, feed consumption, feed conversion and carcass parameters – carcass weight, percentage of breast part, percentage of thigh part, weight edible offal and carcass yield of broiler chickens. The effect of humic acid, combination of humic acid with phytobiotics and coccidiostats on body weight is presented in Table 2.

Table 1 Composition of starter, grower and finisher complete feed mixture

Ingredient	Feed mixture		
	Starter	Grower	Finisher
Wheat (%)	35.00	35.00	36.82
Maize (%)	35.00	40.00	37.00
Soybean meal (%)	21.30	18.70	20.00
Fish meal 71% (%)	3.80	2.00	0.00
Limestone (%)	1.00	1.05	1.10
Monocalcium phosphate (%)	1.00	0.70	1.00
Salt (%)	0.10	0.15	0.20
Lysine (%)	0.05	0.07	0.29
Methionine (%)	0.15	0.22	0.29
Premix (%)	0.50	0.50	0.50
Chemical composition			
Metabolic energy (MJ)	12.01	12.03	12.37
Crude protein (g)	210.76	190.42	170.58
Crude fiber (g)	30.18	29.93	30.54
Crude ash (g)	24.24	19.93	38.49
Lysine (g)	11.30	9.89	9.95
Methionine(g)	4.96	5.21	5.46
Ca (g)	8.15	7.27	7.37
P (g)	6.75	5.70	6.00

Broiler chickens fed a diets containing 2% of humic acid (T1) showed significantly (P <0.05) higher body weight at the age of 35 and 42 days compared to the control group (C). The group of chickens fed a diets containing humic acid and phytobiotics (T2) showed significantly (P <0.05) higher body weight at the age of 21; 28; 35 and 42 days compared to control group (C). The group with coccidiostats supplement showed significantly (P <0.05) higher values at the age of 28; 35 and 42 days. Body weight in all the treatment groups was significantly higher compared to control group (P <0.05). The highest body weight on the 42. day of fattening was recorded in the first experimental group of chickens fed a diets containing only humic acids but the different treatments were not statistically significant. Our results are in agreement with Taklimi et al. (2012) or Lala et al. (2017) who likewise recorded significantly increased weight gain by adding of humic acid. Miloševic et al. (2013) reported that supplementation of 1.5% and 3.0% of garlic powder had significant positive effect of body mass (P <0.05). Increased body weight in the experimental group with garlic supplement was also observed in experiment Ramiah et al. (2014) with 0.5% garlic powder addition. Issa and Omar (2012) recorded in this parameter no significant influence of 0.2% and 0.4% garlic complement. Study conducted by Toghyani et al. (2010) reported that broilers receiving 5 g.kg^{-1} thyme had a significantly higher body weight at day 42 of age, while a report published by Kamali Sangani et al. (2014) claimed the opposite by demonstrating that no significant effect was recorded. In the experiment Hafeez et al. (2016) were body weight of birds at day 42 and overall body weight gain from day 1 to day 42 higher in treatment by carvacrol, thymol, and limonene than birds in control treatment.

The values of feed intake and feed conversion ratio of broiler chicken both treatment and control group were comparable (P >0.05) in our experiment. Average feed conversion ratio in the order of the groups: 1.77; 1.75; 1.77 and 1.67 kg. In contrast, Šamudovská and Demeterová (2010) or Lala et al. (2017) introduce that feed consumption of broiler chickens supplemented with humic acids improved feed conversion ratio. In the

Table 2 The impact of humic acid, humic acid with phytobiotics and coccidiostats supplement on body weight of broiler chickens of hybrid Ross 308 (g)

Age/day	Group			
	C	T1	T2	T3
1.	40.78	40.50	39.54	40.08
7.	145.90 ±14.59	147.85 ±17.25	139.38 ±18.53	143.70 ±14.84
14.	341.29 ±36.81	331.90 ±47.46	334.67 ±34.65	347.65 ±45.10
21.	602.78 ±55.56	600.45 ±79.62	628.58 ±59.64*	624.20 ±82.35
28.	987.38 ±113.02	1009.92 ±125.86	1052.45 ±89.04*	1040,11 ±117.56*
35.	1380.80 ±160.52	1480.23 ±176.07*	1477.20 ±122.04*	1461.55 ±174.29*
42.	1808.03 ±212.39	1981.75 ±203.32*	1895.59 ±178.75*	1955.31 ±237.16*

C – BD (complete feed mixture), T1 – BD + humic acid, T2 – BD + humic acids + garlic (*Allium sativum* L.) + wormwood (*Artemisia absinthium*) + thyme (*Thyme vulgaris* L.) + oregano (*Origanum vulgare* L.) + bogbean (*Menyanthes trifoliata* L.); T3 – BD + coccidiostats; Values are Means ±*SD*; n = 50; Distinct superscript within row = significant difference (P <0.05)

Table 3 The impact of humic acid, humic acid with phytobiotics and coccidiostats supplement on carcass parameters of broiler chickens Ross 308

Parameter	Group			
	C	T1	T2	T3
Carcass weight (g)	1,357.18 ±95.8	1,486.38 ±156.7	1,369.69 ±118.0	1,440.68 ±132.1
Breast part (%)	32.37 ±1.65	32.35 ±1.60	31.95 ±1.03	31.37 ±1.59
Thigh part (%)	29.27 ±1.50	29. 07 ±2.35	30.45 ±2.15*	29.49 ±2.34
Weight of liver (g)	45.61 ±6.12	43.25 ±9.46	43.13 ±6-83	45.75 ±7.02
Weight of heart (g)	9.73 ±1.23	10.56 ±1.55	9.66 ±1.80	10.22 ±0.94
Weight of gizzard (g)	34.55 ±4.02	33.61 ±7.96	32.55 ±4.62	33.28 ±5.39
Carcass yield (%)	74.35 ±1.32	76.10 ±1.97	74.03 ±1.35	73.45 ±1.82

C – BD (complete feed mixture), T1 – BD + humic acid, T2 – BD + humic acids + garlic (*Allium sativum* L.) + wormwood (*Artemisia absinthium*) + thyme (*Thyme vulgaris* L.) + oregano (*Origanum vulgare* L.) + bogbean (*Menyanthes trifoliata* L.); T3 – BD + coccidiostats; Values are Means±*SD*; n = 10; Distinct superscript within row = significant difference (P <0.05)

experiment of Samanthi et al. (2015) was the highest (P <0.05) feed intake observed in birds fed with zero garlic level. The highest weight gain and lowest feed conversion ratio were observed in birds fed with 1 kg.ton^{-1} of garlic (P <0.05). Similarly, Stanaćev et al. (2011) with addition of 2% garlic and Mansoub et al. (2011) with addition of 1 g.kg^{-1} garlic powder and 1 g.kg^{-1} thyme powder to the feed mixture reported increased body weight and better feed conversion ratio.

The body weight, feed consumption, feed conversion ratio or carcass weight were not statistically significant influenced in the experiment of Pourmahmoud et al. (2013) or Haselmeyer et al. (2014) by adding different doses of thyme. Authors Seddiek et al. (2011) found out improvement the weight and feed conversion ratio using of *Artemisia herba*-alba extracts (0.4 g.kg^{-1} body weight) in drinking water.

The effect of humic acid, their combination with phytobiotics and coccidiostats on carcass parameters present Table 3. Significant improvement in thigh part (P <0.05) we recorded as a result of combination of humic acid and phytobiotics supplementation in our experiment. In the others carcass parameters we found out any significant differences. Carcass weight (1,357.18 ±95.8; 1,486.38 ±156.7; 1,369.69 ±118.0 and 1,440.68 ±132.1 g ±*SD*) was the highest in treatment T1 with humic acid addition (P >0.05), however with statistically non-significant difference in compare with control group. Similarly, carcass yield (values in the order of the groups: 74.35 ±1.33; 76.10 ±1.97; 74.03 ±1.35 and 73.45 ±1.82 mean ±*SD*) was non-significantly the highest (P >0.05) in treatment T1 with humic acid supplement. A similar increase of carcass yield after administration of humic acid was found Marcinčáková et al. (2015). In the experiment of Ozturk et al. (2012) humic acid addition did not significantly affect carcass parameters. In the experiment of Ceylan et al. (2003) feed conversion ratio in period from 4 to 6 weeks was significantly improved by supplement of humic acid, probiotic and prebiotic. Mortality and carcass yield were not influenced by experiment. At the termination of 42-day-trial with supplementation of humic acid no significant differences were observed in dressing percentage, breast-meat yield, abdominal fat pad, relative weights of liver, heart, gizzard, spleen and bursa among different treatments in the experiment Nagaraju et al. (2014). The results of the studies of Slyranda Baltini Aji et al. (2011) with adding of 50 and 100 mg dose of garlic and Zamora et al. (2017) with 0.4 g.kg^{-1} oregano supplement showed that additives did not affect the carcass yield of the birds.

4 Conclusions

Based on the obtained results, it can be concluded that the humic acid, combination humic acid and phytobiotics as well as coccidiostats supplement has positive effect on production parameters of broiler chicken. Broiler chicken fed a diets containing 2% of humic acid (T1), humic acid and phytobiotics and coccidiostats showed significantly (P <0.05) higher body weight compared to the control group. The group of chicken fed a diets containing of humic acid and phytobiotics (T2) showed significantly (P <0.05) higher percentage of thigh part in comparison to the control group. In feed conversion ratio, carcass weight, weight of heart, liver, gizzard and carcass yield of broiler chicken were not observed statistically significant difference (P >0.05) in compare with the control group. According to the results, humic acid, eventually their combination thyme can be used as a good alternative for commercial antibiotic growth promotors.

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