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EFFECT OF DIETARY SUPPLEMENTATION OF HUMIC SUBSTANCES ON PRODUCTION PERFORMANCE AND SLAUGHTER VALUE OF BROILER CHICKEN

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Abstract

The effects of dietary supplementation with preparation of humic substances (HS) on production parameters were monitored in the experiment with the broiler chickens (n=90). The experimental groups were fed with the complete feed mixture for broiler chicken with the addition of 0.5% and 0.7% humic substances, respectively. The control group received the complete feed mixture without HS. The average live body weight of chickens was 2291.7 g in the control group and 2281.9 g (HS 0.5%) respectively 2326.6 g (HS 0.7%) in the experimental groups on day 35 of the experimental period. The average daily gain in the last week of the experiment was higher by 4.45 g in the group received 0.7% HS and lower by 2.38 g in the group received 0.5% HS compared to the control group. In the present study, the lower feed conversion ratio was observed in the control group (1.51 kg/kg) compared to experimental groups where feed conversion ratio was 1.53 (0.5% HS) and 1.63 (0.7% HS) kg/kg, respectively. Carcass weight of broilers at autopsy on day 37 in the experimental group (HS 0.7%) was significantly higher ($P<0.05$) than in the group of control broilers. We did not determine any statistically significant differences of the other observed production parameters in the experiment with broiler chickens after the application of humic substances preparation added into the feed mixture at the concentration of 0.5 and 0.7%.
Keywords: nutrition, humic substances, production, poultry

Introduction

Humic substances are organic compounds found in high quantity in peat, lignite and oxihumolite as the final degradation product of plant and animal residues (*Skokanová and Dercová,* 2008). Humic substances are natural compounds that have been used in agriculture for many years. They include humus, humic acid, fulvic acid, ulmic acid and some macro and microelements. Humates or humic substances have been shown to induce rates of seed germination, transfer microelements from soil to plants, improve water retention and enhance microbial counts in soil. They are being utilized in industry, in veterinary and human medicine, pharmacology and environmental protection as well (*Veselá et al*., 2005). The use of humic acids in animal nutrition

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has been a topic of study of several authors. There were performed experiments with ruminants (*Majewska et al*., 2017; *El-Zaiat et al*., 2018; *Terry et al*., 2018), pigs (*Chang et al*., 2014), rabbits (*Rzasa et al*, 2014) as well as experiments with using of humic substances in combination with plant extracts or probiotics in poultry (*Yoruk et al*., 2004; *Pistová et al*., 2016; *Arpašová et al*., 2018). Although the positive effects were not demonstrated in some parameters after dietary intake of humic acids to laying hens, the significant effects such as yolk colour and egg grading (*Arafat et al*., 2015), eggshell strength (*Ergin et al*., 2009), higher hatchability (*Sopoliga et al*., 2016) and in the case of laying hens to cope with social stresses (*Cetin et al*., 2011) were observed. Numerous studies have been devoted to the investigation of the effect of humic substances on production parameters, blood metabolites, immunity and carcass trait in broilers (*Nagaraju et al*., 2014; *Salah et al*., 2015; *Arif et al*., 2016, *Jaďuttová et al.*, 2019, *Mudroňová et al*., 2020).

This work was undertaken to study the efficacy of humic substances on production parameters in broiler chicken.

Material and methods

Ninety of one-day-old chickens of the Cobb 500 breed were used in the experiment. The broilers were randomly divided into one control and two experimental groups, each group consisting of 30 chickens, The chickens were fed with the commercial feed mixtures BR1 (starter), BR2 (grower), BR3 (finisher). Diets were formulated according to the recommended nutrient content for poultry (*Zelenka et al*., 2007). The chemical compositions of diets were determined for dry matter, crude protein, crude fat, crude fibre, starch, calcium and total phosphorus according to the EC Commission Regulation 152/2009. The metabolisable energy value of diets was calculated with the formula according to the EC Commission Regulation (2009). The nutrient contents of the control and two experimental feed mixtures are shown in *Table 1*.

***Table 1*: Nutrient contents of the complete feed mixtures in the control group and in the experimental groups (dry matter basis)**

	BR1	BR1+ HS0,5	BR1+ HS0,7	BR2	BR2+ HS0,5	BR2+ HS0,7	BR3	BR3+ HS0,5	BR3+ HS0,7
CP g.kg^{-1}	230.0	225.3	225.1	222.0	219.7	218.3	207.0	207.2	207.1
Ash g.kg^{-1}	57.3	61.7	68.8	60.6	63.0	63.2	40.7	50.6	51.8
EE g.kg^{-1}	31.3	32.0	33.2	83.8	80.0	84.1	52.2	51.8	52.8
CF g.kg^{-1}	35.3	37.7	37.1	39.5	43.9	55.0	49.8	46.6	49.1
Ca g.kg^{-1}	5.9	5.8	5.9	6.0	6.4	8.5	7.6	8.4	8.8
P g.kg^{-1}	5.7	6.0	6.6	7.9	8.4	9.0	5.1	5.1	6.3
ME MJ.kg^{-1}	13.26	13.09	12.96	14.29	14.00	14.18	13.21	13.43	13.58

HS – humic substances; CP – crude protein, EE – ether extract, CF – crude fiber, Ca – Calcium, P – phosphorus, ME – metabolizable energy

The characteristics of the applied HS preparation (HUMAC®Natur AFM Monogastric; Humac s.r.o., Slovak Republic) were the following: 60% humic acids, 5% fulvic acids and 3.2% formic acid in the dry matter. The control group (C) received the feed mixture without HS. The

experimental group (H1) was fed with the feed mixture with the addition of 0.5% humic substances. As for the second experimental group (H2), the humic substances were added into the feed mixture at the concentration of 0.7%. The broilers were housed in conditions according to the standard for the fattening of chickens. The feeding was *ad libitum* with free access to water. The feed consumption and the live weights were evaluated at weekly intervals. The weight gain, the average daily feed consumption and the total weight were determined as well as the feed conversion ratio was calculated.

The human slaughter act of broilers on day 37 terminated the experiment. 12 broiler chickens from each group were weighed before slaughter, subsequently cleaned, gutted and after removal of the head and runners weighed (carcass yield). After portioning was performed the individual weighting of boneless breasts, thighs with bones, wings and hulls to determine the percentage of recovery and the percentage of the individual parts.

The data are expressed as means ± standard deviation (SD) of single values (IBM SPSS Statistics, Version 24). Results were statistically compared by Tukey-Kramer multiple comparison test. Significance had been declared at levels below $P < 0.05$.

Results and discussion

The effect of humic substances on the selected production parameters was observed in the experiment with broiler chickens.

The mortality of one chicken in the control group and two chickens in the group with the addition of 0.7% HS were registered in the first week of the experiment. There was not observed any mortality in the experimental group with the addition of 0.5% HS during the all experimental period. As a result of a significant lag in growth, one chicken from the H1 group and one chicken from the H2 group were discarded. The reduction of mortality in the case of the application of humic substances in broiler fattening was confirmed by *Vaško et al*. (2012) and in the breeding of laying hens by *Arafat et al*. (2015). In our experiment, the application of humic substances had no effect on mortality. Correspondingly *Kocagabli et al* (2002) observed in an experiment with broilers supplemented with humates in the groups from day 1 to 21, from day 22 to 42 and for the entire duration of the experiment from day 1 to 42 that mortality was not significant for any dietary regime.

The total consumption of the feed mixture used in the control group was 97.35 kg. The broilers from the experimental group H1 consumed 104.06 kg and the total feed consumption in the group H2 was 103.96 kg in the experiment till day 35. The lowest average live body weight of 2281.9 kg/bird was observed in the experimental group H1. The average live body weight of the broiler chickens in the control group was by 9.98 g higher compared group H1. The highest live body weight of broilers on day 35 was ascertained in the experimental group H2 (2326.6 g/bird). The feed conversion ratio in the control group was 1.51 kg/kg. The values of this parameter were 1.53 kg/kg in the group H1 group and the highest was in the H2 group (1.63 kg/kg). The differences in the live body weights and the average feed conversion ratio during the experimental period were not statistically significant (*Table 2*).

Karaoglu et al. (2004) reported average feed conversion ratio (1.81 – 1.87 kg/kg) in the experiment with broiler chicks after addition of humates added at concentrations of 0.0, 0.1, 0.2 and 0.3%.

A higher average feed conversion ratio (1.99, 1.95, 1.89 and 1.92 kg/kg, respectively) compared to the results from our experiment was demonstrated by *Kocabagli et al*. (2002) without

any statistically significant difference in individual groups during different feeding periods with the addition of 0.25% humate in the diet.

The better values of the feed conversion ratio parameter compared to the findings of mentioned authors were achieved in our experiment because of the better balanced diet with the higher concentration of protein and higher energy value as well as because the breed included in the experiment.

***Table 2*: Daily weight gain (g), live weight (g)feed comsumption (g) and feed conversion rations of brojlers during experimental period**

Group\Week	1.	2.	3.	4.	5.	Average
Average daily weight gain						
C	21.80	45.22	64.62	92.49	94.11	63.64
H1	21.89	47.03	66.83	85.12	91.73	62,52
H2	18.45	46.28	64.95	92.89	98.56	64.22
Average live weight						
C	191.7	514.8	985.5	1633.0	2291,7	
H1	192.3	521.5	989.3	1585.2	2281.9	
H2	188.8	512.8	986.4	1636.6	2326.6	
Average daily feed consumption						
C	27.9	63.6	106.1	140.8	156.6	
H1	29.1	60.4	100.9	135.2	177.8	
H2	27.3	66.5	112.2	152.4	188.4	
Feed conversion ratio						
C	1.281	1.407	1.642	1.523	1.713	1.513
H1	1.330	1.285	1.511	1.589	1.939	1.530
H2	1.480	1.438	1.727	1.640	1.911	1.639

C – control group (n=28); H1 – group 0.5% humic supplement (n=29); H2 – group 0.7% humic supplement (n=27)

The experiment was terminated by the human slaughter of broilers on day 37. The average live weight before slaughter was 2319.3 g / broiler in the control group, 2377.8 g / broiler in the experimental group H1 and in the H2 group the average weight was 2401.3 g / broiler. The carcass weights, weights of broilers at autopsy, the weights of the cut parts and slaughter yields are shown in *Table 3* Statistically significantly higher ($P< 0.05$) carcass weight of broilers at autopsy was found in the group H2 compared to the control group. The broiler pectoral muscle of the group H2 had the highest weight. The highest average weight of chicken thigh was observed in this group as well. The broilers in the control group had the highest weight of wings and the weight of the chicken body was the highest in the group H1. The determined weights of the individual body parts were not statistically different after portioning. Similar results were obtained by *Jaďuttová et al.* (2019) in an experiment with the same broiler breed and in the case of using the preparation of humic substances which were applied at higher concentration (0.8% and 1.0%, respectively) compared to our experiment. They observed a significantly higher percentage of pectoral muscles and thighs in both experimental groups compared to control group.

Naguraju et al. (2014) observed no significant differences in dressing percentage, breast meat yield, abdominal fat pad, weights of liver, heart, spleen and bursa among different treatments at the termination of the 42-day experiment with the supplementation of humic acids based product as a substitute for antibiotic in broilers.

Arpasova et al. (2016) did not observe statistically significant differences in carcass weights between the control group and the experimental groups with the dietary addition of humic substances. The highest percentage of breasts was in the control group, but not statistically significant. As for thighs, the highest percentage of the carcass was in the group where the humic substances were combined with the garlic extract.

***Table 3*: Comparison of carcass weights and carcass composition; weights of broilers at autopsy, weights of the cut parts and slaughter yield (on day 37; a day of slaughter)**

	C (n=12)	**H1** (n=12)	**H2** (n=12)
Live body weight (g)	2319.3±92.6	2377.8±133.2	2401.3±154.8
Carcass weight (g)	1711.9±81.8^{b}	1793.7±158.5	1837.0±112.2^{a}
Carcass yield (%)	73.8±1.8	75.3±3.2	76.9±5.0
Breast without bone, (g)	522.1±50.4	512.1±67.1	561.3±67.1
Breast yield without bone, (%)	30.5±2.8	28.5±2.7	30.5±2.7
Thighs with bone (g)	484.6±43.7	522.9±62.1	534.3±55.5
Thighs yield with bone, (%)	28.3±2.6	29.2±2.8	29.1±2.2
Wings (g)	175.3±14.3	164.4±16.8	163.2±19.4
Wings (%)	10.2±0.7	9.2±0.5	8.9±1.1
Hull of a chicken (g)	454.3±51.8	496.2±72.4	457.2±42.0
Hull yield (%)	26.5±2.7	27.6±2.7	24.9±2.1

a,b – values with different superscripts in a row are significantly different at $P < 0.05$,
mean ± SD (standard deviation), C – control group; H1 - experimental group with 0.5% humic supplement; H2 - experimental group with 0.7% humic supplement

Conclusion

There were studied the effects of preparation of humic substances added into feed mixture on production performance and slaughter value in the experiment with broiler chickens. In conclusion, the dietary addition of humic substances (in dose 5g and 7 g/kg feed mixture) had no significant effect on the production parameters such as the feed conversion ratio, the final live weight of broilers and the mortality. The statistically significant differences were found only in the parameter of carcass weight of broilers in the experimental group fed with 0.7 % HS. In the following studies, it is necessary to focus on the effect of the administration of humic substances on the nutritional value of broiler chicken meat.

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