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The effect of the humic acid and garlic (*Allium sativum* L.) on performance parameters and carcass characteristic of broiler chicken

Účinok humínových kyselín a cesnaku (*Allium sativum* L.) na produkčné parametre a jatočnú charakteristiku brojlerových kurčiat

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Abstract

In this study the effect of humic acids and humic acids and garlic powder (*Allium sativum* L.) combination on performance parameters and carcass characteristic of broiler chickens were studied. A total of 120 Ross 308 broiler chickens were divided into 3 treatments (n=40). The control group of chickens was fed complete feed mixtures without any additives. Treatment T1 was fed complete feed mixtures containing 1% of humic acid. Treatment T2 was fed complete feed mixtures containing 1.8% of humic acid and 0.2% of garlic powder (*Allium sativum* L.). At the end of the experiment was average body weight (values in the order of the groups: 1796.4±188.1; 1999.1±355.8 and 1958.6±201.2 g±SD) significantly higher (P≤0.05) in both treatments groups compared to control group. In T1 was weight of gizzard (values in the order of the groups: 34.9±5.2; 43.1±9.4 and 38.9±7.0 g±SD) significantly higher (P≤0.05) compared to control group. Carcass weight, weight of heart weight of liver and carcass yield of treatments groups was higher, but differences in these indicators were not statistically significant (P≥0.05). The results of this experiment indicate that humic acids may by an alternative replacement of feed antibiotics.

Keywords: carcass parameters, garlic, humic acid, chickens, performance

Abstrakt

Cieľom tohto experimentu bolo sledovať vplyv humínových kyselín a humínových kyselín v kombinácii s cesnakom kuchynským (*Allium sativum* L.) na produkčné parametre a jatočnú charakteristiku brojlerových kurčiat. Celkovo 120 brojlerových kurčiat hybridu Ross 308 bolo rozdelených do 3 skupín (n=40). Kontrolná skupina bola kŕmená kompletnou kŕmnou zmesou bez akýchkoľvek doplnkov. Pokusná skupina P1 bola kŕmená kŕmnou zmesou s prídavkom 1 % podielu humínových kyselín. Pokusná skupina P2 bola kŕmená kŕmnou zmesou obohatenou o 1,8 % podiel humínových kyselín a 0,2 % podiel cesnaku kuchynského (*Allium sativum* L.). Na konci experimentu bola zaznamenaná štatisticky významne (P≤0,05) vyššia priemerná živá hmotnosť kurčiat v oboch pokusných skupinách v porovnaní s kontrolnou skupinou (v poradí skupín: 1796,4±188,1; 1999,1±355,8 and 1958,6±201,2 g±SD). V pokusnej skupine P1 bola hmotnosť svalnatého žalúdka (v poradí skupín: 34,9±5,2; 43,1±9,4 and 38,9±7,0 g±SD) štatisticky významne vyššia (P≤0,05) v porovnaní s kontrolnou skupinou. Jatočná hmotnosť, hmotnosť srdca, hmotnosť pečene a jatočná výťažnosť pokusných skupín bola vyššia, ale rozdiely v týchto ukazovateľoch neboli štatisticky významné (P≥0,05). Výsledky tohto experimentu naznačujú, že humínové kysliny môžu byť alternatívnou náhradou kŕmnych antibiotík.

Kľúčové slová: cesnak, humínové kyseliny, jatočné parameter, kurča, produkcia

Detailný abstrakt

Cieľom tejto štúdie bolo sledovať vplyv podania humínových kyselín do kŕmnej zmesi pre brojlerové kurčatá, a rovnako sledovať vplyv podania zmesi humínových kyselín s cesnakom kuchynským do kŕmnej zmesi pre brojlerové kurčatá na produkčné parametre a jatočnú charakteristiku brojlerových kurčiat. Kurčatá výkrmového hybridu Ross 308 (n=120) boli rozdelené do 3 skupín (n=40). Kontrolná skupina bola kŕmená kompletnou kŕmnou zmesou bez akýchkoľvek doplnkov. Pokusná skupina P1 bola kŕmená kŕmnou zmesou s doplnkom 1 % podielu humínových kyselín. Pokusná skupina P2 bola kŕmená kŕmnou zmesou fortifikovanou o 1,8 % podiel humínových kyselín a 0,2 % podiel cesnaku kuchynského v prášku (*Allium sativum* L.). Výkrm trval v súlade s welfare 42 dní. Počas výkrmu bola v týždenných intervaloch zaznamenávaná živá hmotnosť kurčiat. Po ukončení výkrmu a porážke bol vykonaný jatočný rozbor. Na konci experimentu bola zaznamenaná štatisticky významne (P≤0,05) vyššia priemerná živá hmotnosť v pokusných skupinách v porovnaní s kontrolnou skupinou (tabuľka 2.). To súhlasí so závermi viacerých autorov (Islam et al., 2008; Choi et al., 2010; Stanaćev et al., 2010; Ozturk et al., 2012;), ktorí popísali pozitívny vplyv podávania humínových kyselína a cesnaku v krmive pre brojlerové kurčatá na ich rast a živú hmotnosť. V prvej pokusnej skupine s doplnkom 1 % podielu humínových kyselín bola hmotnosť svalnatého žalúdka (tabuľka 4.) štatisticky významne vyššia (P≤0.05) v porovnaní s kontrolnou skupinou. Jatočná hmotnosť,

hmotnosť srdca, hmotnosť pečene a jatočná výťažnosť (tabuľka 4.) v pokusných skupín bola vyššia, avšak nebol zaznamenaný štatisticky významný rozdiel (P≥0,05) v porovnaní ku kontrolnej skupine. Podobne ako výsledky mnohých vedcov (Ozturk et al., 2010, Stanacév et al., 2011, Nagaraju et al. 2014) aj výsledky tohto experimentu naznačujú, že humínové kyseliny, či už v čistej forme alebo v kombinácii s inými rastlinnými doplnkami by mohli byť jednou z alternatívnych náhrad kŕmnych antibiotík.

Introduction

Poultry researchers and nutritionists are looking for viable additives since conventional supplements have been criticised for negative impact on the food chain (Khan et al., 2012). Humic acids are one of the potential substances alternatives to antibiotics in the diet of poultry. Humic substances are used for their detoxifying, antiseptic and antifungal properties and as natural growth stimulator (Rath et al., 2006). Humic acids are the most active substances with antioxidant effect (Vašková et al., 2011). Humic acids have a positive impact on meat quality, increasing weight gains and improve the immune system of broiler chickens (Ozturk et al., 2010; Nagaraju et al., 2014). The other alternatives to antibiotics as growth promoters are phytogenic feed additives (Puvača, 2015). Garlic (*Allium sativum* L.) is one of the most traditionally used plants as a spice and herb. The potency of garlic (*Allium sativum*) has been acknowledged for 5000 years. In ancient times, the Babylonians, Egyptians, Phoenicians, Vikings, Chinese, Greeks, Romans and Hindus used garlic frequently. They took garlic as a remedy for intestinal disorders, flatulence, worms, respiratory infections, skin diseases, wounds, symptoms of aging and many other ailments (Amagase et al., 2001). Garlic is today use for a variety of reasons, it has anti-microbial, anti-bacterial, anti-inflammatory effects etc. (Mansoub, 2011). Garlic was reported as a natural feed additive, it has improved broiler chickens growth and feed conversion (Stanaćev et al., 2011).

The aim of this study was to determine the effect of humic acid and the combination of humic acid with garlic (*Allium sativum* L.) on production parameters and carcass characteristic of broiler chickens hybrid Ross 308.

Material and Methods

Animals, diets and treatments

In experiment from total 120 one-day-old ROSS 308 meat hybrid chickens were randomized into three groups, each containing 40 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 weekly 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 feeding program included three phases: starter (1-21 days of age), grower (22-35 days of age), and finisher (36-42 days of age). Composition of complete feed

mixtures (Biofeed a.s., Kolárovo, Slovakia) is presented in Table 1. Feed and water were supplied *ad libitum.*

Were used complete feed mixture without any additives in control group. Group of chickens marked as treatment 1 (T1) was fed a diet containing 1% of humic acid (Humic Acid Manufacturer Co., Košice, Slovakia), and the group marked as treatment 2 (T2) was fed a diet containing 1.8% of humic acid and 0.2% of garlic powder (*Allium sativum* L.) (Humic Acid Manufacturer Co., Košice, Slovakia). Additives used in the experiment were mixed into the feed by the manufacturer of feed mixture (Biofeed a.s., Kolárovo,Slovakia).

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

Tabuľka 1. Zloženie štartérovej, rastovej a finálnej kompletnej kŕmnej zmesi

Ingredient	Feed mixture		
	Starter	Grower	Finisher
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
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 (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

Premix (%)	0.50	0.50	0.50

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. The analysis of samples of chickens was realized in the laboratory of the Department of Poultry Science and Small Farm Animals in Slovak University of Agriculture in Nitra. The experiment was focused on the carcass weight (g), weight of edible offal (g) and carcass yield (%).

Statistical analysis

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

Results and discussion

The aim of the presented study was to determinate the effect of humic acid and humic acid with garlic powder to body weight, feed intake and feed conversion, carcass weight, weight of edible offal and carcass yield of ROSS 308 broiler chickens. The effect of humic acid and humic acid with garlic powder on body weight is presented in Table 2. Broiler chickens fed a diets containing 1% of humic acid (T1) showed significantly ($P \leq 0.05$) higher body weight at the age of 14, 28 and 42 days compared to the control group (C). The group of chickens fed a diet containing 1.8% of humic acid and 0.2% of garlic powder (T2) showed significantly ($P \leq 0.05$) higher body weight at the age of 7, 28 and 42 days compared to the control group (C). Positive effects of the humic acid and the garlic (*Allium sativum* L.) in feed on growth of broiler chickens were obtained by other researcher (Islam et al., 2008; Choi et al., 2010; Stanaćev et al., 2010; Ozturk et al., 2012;). Nagaraju et al. (2014) introduced that the addition of humic acid up to 0.1% particularly in the low nutrient density antibiotic free diets can improve the performance and immune status of broilers without affecting their carcass characteristics. Ozturk et al. (2012) recorded that 1.5 $g*kg^{-1}$ of humic acid has a significantly positive effect on body weight and carcass weight. Miloševic et al. (2013) reported that supplementetion of 1.5% and 3.0% of garlic powder had the positive effect on body mass and difference between T1 and control group was statistically significant ($P<0.05$). Also Ramiah et al. (2014) recorded that broiler chickens fed basal diet with 0.5% garlic powder had significantly higher ($P<0.05$) weight gain compared to the control. This agrees with Puvača et al. (2014), who showed that broiler chickens with 0.5% garlic powder in diet had higher body weight with statistically significant differences ($p<0.05$) compared to the control treatment.

Table 2. Body weight of broiler chickens Ross 308 (g)

Tabuľka 2. Živá hmotnosť brojlerových kurčiat Ross 308 (g)

Age/day	Group		
	Control	T1	T2
1	39.4	38.3	39.5
7	153.0 ± 18.8	151.3 ± 22.4	162.9 ± 17.8 *
14	358.2 ± 55.7	378.2 ± 54.6 *	345.0 ± 47.6
21	665.9 ± 112.5	684.9 ± 114.0	677.7 ± 76.1
28	965.5 ± 159.3	1069.5 ± 168.5 *	1022.6 ± 116.9 *
35	1405.7 ± 155.2	1394.6 ± 233.2	1485.3 ± 143.0
42	1796.4 ± 188.1	1999.1 ± 355.8 *	1958.6 ± 201.2 *

T1 – complete feed mixtures + humic acid; T2 – complete feed mixtures + humic acid + garlic powder; Values are means±S.D.; n=120; Distinct superscripts within row=significant difference ($P \leq 0.05$)

T1 – kompletná kŕmna zmes + humínové kyseliny; T2 – kompletná kŕmna zmes + humínové kyseliny + cesnakový prášok; Hodnoty zanmenajú priemer+S.D.; Odližné indexy v rámci radu=štatisticky významný rozdiel ($P \leq 0.05$)

Feed intake and feed conversion of broiler chickens fed a diets containing 1% of humic acid (T1) and chickens fed a diets containing 1.8% of humic acid and 0.2% of garlic powder (T2) were not a significantly different ($P \geq 0.05$) compared to the control group (C). This is in accordance to results obtained by Ashayerizadeh et al. (2009). Also Rahamatnejad et al. (2009) introduced that 1 $g*kg^{-1}$ garlic powder added into broiler feed had not significantly effect on feed intake and efficiency. Ramiah et al. (2014) reported that broiler chickens fed basal diet with 0.5% garlic powder had significantly higher ($P<0.05$) feed intake compared to control. Nagaraju et al. (2014) found that supplementation of 0.5; 0.75 or 1 g humic acid based product per kg of feed had not impact to feed consumption and feed efficiency. Javandel et al. (2008) showed that birds fed the control diet and the diet with 2% garlic meal supplement showed a higher feed conversion ratios as compared with birds fed diets containing 0.125; 0.5 or 1% garlic meal.

Table 3. Feed intake and feed conversion of broiler chickens Ross 308 (kg)

Tabuľka 3. Príjem krmiva a konverzia krmiva kurčiat Ross 308 (kg)

	Control	T1	T2
Average feed intake per 1 chicken (kg)	3.12	3.40	3.00
Average feed conversion (kg)	2.19	1.98	1.91

T1 – complete feed mixtures + humic acid; T2 – complete feed mixtures + humic acid + garlic powder

T1 – kompletná kŕmna zmes + humínové kyseliny; T2 – kompletná kŕmna zmes + humínové kyseliny + cesnakový prášok

Carcass weight is presented in Table 4. Carcass weight in treatment groups was higher compared to control group, but it was not significantly different (P≥0.05) among groups. These findings agree with Issa et al. (2012), who reported that 0.2% or 0.4% of garlic powder in broiler feed had positive effect on carcass weight. Similarly Ozturk et al. (2012) reported that 1.5 $g*kg^{-1}$ of humic acid has a significantly positive effect on carcass weight.

Table 4. Average carcass weight and weight of edible offal of broiler chickens Ross 308 (g)

Tabuľka 4. Priemerná jatočná hmotnosť a hmotnosť požívateľných vnútorností brojlerových kurčiat Ross 308 (g)

	Group		
	Control	T1	T2
Carcass weight (g)	1293.1 ± 179.0	1426.9 ± 256.6	1389.2 ± 111.4
Weight of heard (g)	10.4 ± 1.9	12.6 ± 3.8	12.0 ± 2.7
Weight of liver (g)	49.3 ± 10.3	54.3 ± 9.3	56.0 ± 10.6
Weight of gizzard (g)	34.9 ± 5.2	43.1 ± 9.4 *	38.9 ± 7.0

T1 – complete feed mixtures + humic acid; T2 – complete feed mixtures + humic acid + garlic powder; Values are means±S.D.; n=120; Distinct superscripts within row=significant difference (P≤0.05)

T1 – kompletná kŕmna zmes + humínové kyseliny; T2 – kompletná kŕmna zmes + humínové kyseliny + cesnakový prášok; Hodnoty zanmenajú priemer+S.D.; Odližné indexy v rámci radu=štatisticky významný rozdiel (P≤0.05)

Weight of heart, liver and gizzard is presented in Table 4. Diet had no significant effect (P≥0.05) on weight of heart and liver between groups, however, weight of gizzard was significantly (P≤0.05) greater in group of chickens fed a diet containing 1% of humic acid (T1) compared to the control group (C). These findings were in contrast to Brzoska et al. (2015), they reported that supplementing the diet with garlic at the level of 1.50 ml*kg^{-1} caused a significant increase in liver weight (P<0.01). Also Miloševic et al. (2013) reported that broiler chickens with garlic powder (1.5% and 3.0%) in diets had significantly greater liver mass compared with the control group. According to Raeesi et al. (2010), when birds fed garlic in their starter diets, they showed higher relative liver weight. Dieumou et al. (2009) studied the effects of ginger and garlic essential oils on growth performance. They reported that all organ weights and carcass characteristics were not affected by the treatments, except a decrease (P<0.05) in relative liver weight of birds on garlic oil treatment compared with those given ginger oil and control. Carcass yield of broiler chickens fed a diet containing 1% of humic acid (T1) and chickens fed a diet containing 1.8% of humic acid and 0.2% of garlic (T2) was not significantly different (P≥0.05) compared to the control group (C). According to Raeesi et al. (2010), diets supplemented with 1% garlic powder had higher carcass yield than those which received 0.5 and 3%. Mahmood et al. (2009) shows that a basal feed containing 0.5% garlic failed to produce positive effects on carcass yield in terms of percentage, relative weight of heart, gizzard, liver, spleen and pancreas, which partly disagreed with the results of this study.

Conclusion

Based on the obtained results, it can be concluded that the humic acid and garlic powder (*Allium sativum* L.), have positive effect on production performance of broiler chickens. Broiler chicken fed a diet containing 1% of humic acid (T1) showed significantly (P≤0.05) higher body weight and weight of gizzard compared to the control group (C). The group of chickens fed a diet containing 1.8% of humic acid and 0.2% of garlic powder (T2) showed significantly (P≤0.05) higher body weight compared to the control group (C). Feed conversion, carcass weight, weight of heart, liver and carcass yield of broiler chickens fed a diets containing 1% of humic acid (T1) and chickens fed a diet containing 1.8% of humic acid and 0.2% of garlic powder (T2) were higher, but not a significantly different (P≥0.05) compared to the control group (C).

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