THE INFLUENCE OF HUMATES ON THE CARCAS AND BIOCHEMICAL PARAMETER OF QUAILS

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ABSTRACT

Humic substances (HS) are organic compounds resulting from the decomposition of plant and animal remains. Positive effects of humic substances in the treatment of a whole range of diseases such as inflammation of various organs, gastrointestinal diseases, poisoning, cancer, diabetes, infectious diseases or anemia have been known for centuries. The aim of the work was to determine the influence of humic substances as an organic supplement in a feed mixture on the quality of the carcass and the sensory properties of quail meat. Total 200 Japanese quails were included in the study, divided into four groups (n= 50/group) with two replicates: C (control group, standard diet without additives), group H0.5 (experimental group 1, receiving standard feed + 0.5% HS), group H1.0 (experimental group 2, received standard feed + 1% HS) and group H1.5 (experimental group 3, received standard feed + 1,5% HS). The results of the study show the effect of the addition of

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HS in the H1.0 group of quails, which recorded a lower final weight and carcass yield (P<0.05) after 50 days of fattening. In addition, HS supplementation positively affected lipid parameters, with a lower total fat content in the meat of quails supplemented with 1.0% HS.

Keywords: quail, humic substances, meat, carcass, sensory analyze

INTRODUCTION

Meat plays an important role in the human diet due to the content of proteins, fatty acids, minerals or vitamins. The consumption of poultry meat is becoming more and more popular on a global scale. According to current forecasts, by 2030, poultry will account for 41% of all meat protein intake in the human diet (OECD and FAO, 2021). Modern poultry farming focuses mainly on improving productivity, animal health and the production of healthy meat for consumers (Long et al., 2020). Thanks to intensive farming methods, poultry meat is cheaper and more available, but it brings many problems in farming in the form of increased stress, reduced immunity and infectious diseases. The most frequently reported zoonotic alimentary infections in the EU are mainly caused by agents from the genera Campylobacter and Salmonella, where the primary source of infection is poultry meat and eggs (EFSA, 2023). Humic substances (HS) are considered a suitable alternative to replace antimicrobial substances, due to their number of positive effects on production, immunity and animal health. They have antibacterial, antiviral and antimicrobial effects, thus improving the economy and ecology of animal production (Yasar et al., 2002)

Humic substances are natural organic compounds found in soil, coal, water and other sources, which are formed during the decomposition of plant and animal remains by the action of organisms and abiotic

environmental factors (Marcinčák et al., 2023). They are composed of humic acid, humus, ulmic acid, fulvic acid and minerals (Arif et al., 2019).

Their positive effects in the treatment of a whole range of diseases such as inflammation of various organs, gastrointestinal diseases, poisoning, cancer, diabetes, infectious diseases or anemia have been known for centuries. Modern research mainly focuses on humic acids for their multifaceted positive effects on the organism at the molecular level in both humans and animals (Mudroňová et al., 2020).

HS are characterized by immunostimulating, anti-inflammatory and antiviral properties thanks to the ability to form a protective film on the intestinal mucosa against infections and toxins (Gálik et al., 2023).

Humic substances with a high proportion of humic acids (more than 40%) have been classified by the European Commission as feed materials usable in animal nutrition since 2013 (Marcinčák et al., 2023). Therefore, the aim of study was to determine the influence of HS as an organic supplement in a feed mixture on the quality of the carcass and the sensory properties of quail meat.

MATERIAL AND METHODS

Total 200 quails were used in this study. The quails were housed under the same conditions in cages (150 × 150 × 200 cm), with 50 quails per cage. All quails were fed standard mixture *ad libitum*. They had unlimited access to drinking water. At the beginning of the experiment, the animals were divided into four groups (n= 50/group) with two replicates in each group: C (control group, standard diet without additives), group H0.5 (experimental group 1, received standard feed + 0.5% Humac Natur AFM; Tab. 1), group H1.0 (experimental group 2,

received standard feed + 1% Humac Natur AFM), group H1.5 (experimental group 3, received standard feed + 1,5% Humac Natur AFM).

Table 1. Characteristics of preparations with humic substances

Parameter	**Humic substances***
Particle size	max. 100 µm
pH	5,8
Humidity	max. 15 %
Humic acids	min. 65% in dry matter
Fulvic acids	min. 5 % in dry matter

Note: Humic substances - HUMAC® Natur AFM (Humac s.r.o., Košice, Slovakia)*

In the control group, a crushed basal diet without any additives for growing quails. Feed mixture contain maize, soybean meal extracted, sunflower meal extracted, calcium carbonate, wheat stillage, corn germ, pea hulls, rapeseed meal extracted, NaCl. From nutritional supplements substances vitamin A (min. 10000 IU), vitamin D3 (min. 2500 IU), iron (40 mg), iodine (1.0 mg), copper (15.0 mg), manganese (60 mg), zinc (70 mg), selenium (0.3mg), lysine (2348.2mg). During the fattening period (from the first to the fiftieth day day of age), the second, third and fourth experimental groups were fed basal diet with 0.5%, 1% and 1.5% addition of humic substances (Humac® Natur AFM, Košice, SR; 65% proportion of HS in dry matter).

On the twenty-fifth day of the experiment, part of the quails were slaughtered painlessly in accordance with the applicable legislation. On the fiftieth day another part of the quails were slaughtered. The quails were slaughtered by cutting the *jugular vein* and blood was taken for further examination.

Carcass weight was recorded after removing the head, skin and feathers, viscera and distal parts of the limbs. Carcass yield was determined as the ratio of live weight before slaughtering and carcass weight. The chemical analysis of the basic muscle components was determined from breast muscle samples according to Marcinčák et al. (2023). A muscle sample was taken immediately after slaughtering, wrapped in foil and stored at -80°C until sample analysis. The water content was determined by drying in a dryer at 105°C (Hudák et al., 2021). Proteins were determined on a Kjeltec Auto analyzer, type 1030 (Hanon, Jinan, China). Fats in ground samples with petroleum ether were determined on a Soxhlet apparatus (LTHS 500, Brnenská Druteva, Brno, Czech Republic) according to Semjon et. al. (2020). Muscle pH was analyzed with an InoLab digital pH meter (Wissenschaftlich-Technische Werkstatten, Weilheim, Germany).

The determined values were evaluated by one-factor analysis of variance ANOVA with a significance level of $p < 0.05$. Significance of differences was confirmed using Tukey's multiple comparison test. The results in the tables are presented as mean values (X) and standard deviation (SD).

RESULTS AND DISCUSSION

Table 2 shows the values of live weight, carcass weight and breast muscle weight on 25th day. When evaluating the live weight, we recorded a slightly higher final weight ($P > 0.05$) on day 25 in the experimental group H1.5 compared to the control group. Higher weight in experimental groups H1.5 had a positive effect on higher carcass weight ($P < 0.05$) in comparing with control group.

Table 2. Effect of supplementation on live weight and slaughter parameters of quail on 25th day

Group	Live weight (LW)		Carcass weight (CW)		Carcass yield	Pectoral muscle weight		
	g		g		% LW	G		% CW
	x	sd	x	sd	x	x	sd	x
H0.5	178.5	3.2	107.8	3.5	60.4	29.3	1.6	27.2
H1.0	174.0	12.3	108.8	5.9	62.5	29.3	1.6	26.9
H1.5	185.0	21.8	111.7[a]	10.8	60.4	30.7	3.7	27.5
Control	168.0	13.8	98.0[b]	8.1	58.3	28.7	3.1	29.2

Note: H0.5 – quail group supplemented with 0.5% HS; H1.0 – group of quails supplemented with 1.5% HS; H1.5 - group of quails supplemented with 1.5% HS; a,b - different letters in the column at the level of significance p<0.05.

Table 3 shows the values of live weight, carcass weight and breast muscle weight on 50th day. In the control group H0.5 only a slightly increased value of live weight, carcass weight and carcass yield was recorded. Contrary, supplemented group H1.0 with 1.0% of HS had a lower value of live weight, carcass weight ($P < 0.05$) compared to the control group.

There are many studies focused on the effect of the addition of HS to the feed during the fattening period, but the results are controversial. Some researchers reported a significant effect on the broilers' live weight, weight gain, carcass yield and feed conversion ratio (Karaoglu et al. 2004; Pistová et al., 2016). In contrast, many other studies noted only non-significant effects on the above-mentioned parameters during the fattening period (Yıldız et al., 2013; Nagaraju et al., 2014).

Our finding is similar to the conclusion made by Nagaraju et al. (2014) who reported that broiler chickens fed a diet containing 0.75% and 1%

of HS showed a slightly reduced body weight (P > 0.05) in comparison to the control.

Table 3. Effect of supplementation on live weight and slaughter parameters of quail on 50th day

Group	Live weight (LW)		Carcass weight (CW)		Carcass yield	Pectoral muscle weight		
	g		g		% LW	g		% CW
	x	sd	x	sd	x	x	sd	x
H0.5	299.0	19.6	187.5	12.8	62.7	55.6	5,5	29.7
H1.0	262.0[a]	25.4	162.0[a]	18.2	61.8	49.5	7.6	30.6
H1.5	295.6	25.4	177.0	15.5	59.9	53.5	8.5	30.2
Control	298.6[b]	20.2	184.0[b]	9.7	61.6	56.8	3.7	30.9

Note: H0.5 – quail group supplemented with 0.5% HS; H1.0 – group of quails supplemented with 1.5% HS; H1.5 - group of quails supplemented with 1.5% HS; a,b - different letters in the column at the level of significance p<0.05.

Table 4. Comparison of selected quail meat indicators on 25th day

Parameter	H0,5		H1,0		H1,5		Control	
	x	sd	x	sd	x	sd	x	sd
Water	70.7	0.4	70.5	0.7	71.6	0.5	71.1	0.3
Fat	1.8	0.3	1.3[a]	0.4	1.4	0.3	1.7b	0.2
Ash	1.1	0.2	1.2	0.2	1.6	0.1	1.2	0.2
Protein	24.4	0.3	24.5	0.4	25.4	0.2	24.6	0.4
pH	5.9	0.1	5.9	0.1	5.7	0.1	5.9	0.1

Note: H0.5 – quail group supplemented with 0.5% HS; H1.0 – group of quails supplemented with 1.5% HS; H1.5 - group of quails supplemented with 1.5% HS; a,b - different letters are in a row at the significance level of p<0.05.

The water content in the meat on 25th day was slightly increased (P > 0.05) in the experimental group H1.5 compared to the control group. In experimental groups H0.5 and H1.0, the water content was slightly reduced (P > 0.05) compared to the control group.

The fat content was lower ($P < 0.05$) in H1.0 group compared to the control group. The protein content was not significantly changed in the all supplemented groups compared to the control group (Tab. 4).

Table 5 summarizes the results of selected quail meat indicators on 50th day of experiment. The water content was slightly reduced ($P > 0.05$) in all experimental groups compared to the control group. Significant shifts were occurred in the fat and protein content. In H1.0 and H1.5 groups, the fat content was lower ($P < 0.05$) compared to the control group. In the H1.0 group, there was a difference in lower protein content ($P < 0.05$) compared to the control group.

Table 5. Comparison of selected quail meat indicators on 50th day.

Parameter	H0,5		H1,0		H1,5		Control	
	x	sd	x	sd	x	sd	x	sd
Water	68.0	0.2	67.5	0.3	68.5	0.3	68.7	0.2
Fat	5.5	0.2	3.8a	0.2	4.0^{a}	0.2	5.6^{b}	0.3
Ash	0.6	0.2	0.7	0.2	1.2	0.1	1.1	0.2
Protein	24.5	0.2	23.9^{a}	0.2	25.1	0.3	25.2^{b}	0.2
pH	6.1	0.1	6.0	0.1	5.8	0.1	5.9	0.1

Note: H0.5 – quail group supplemented with 0.5% HS; H1.0 – group of quails supplemented with 1.5% HS; H1.5 - group of quails supplemented with 1.5% HS; a,b - different letters are in a row at the significance level of p<0.05.

CONCLUSION

Based on the effect of the addition of humic substances to the ration of Japanese quails, we can conclude that a lower final weight and carcass yield was recorded in the group of quails H1.0 supplemented with 1.0% addition of HS. In addition, HS supplementation positively affected lipid parameters, with a lower total fat content in the meat of quails supplemented with 1.0% HS. The current results allow us to assume

that the introduction of humic substances into feed mixtures for quail could improve meat quality indicators, especially when reducing the fat content.

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