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# The influence of humic substances on carcass quality and sensory properties of rabbit meat

**Zuzana Lacková[1], František Zigo[1]*, Jakub Ješík[2]**
[1]*Department of Nutrition and Animal Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 041 81 Košice, Slovakia*
[2]*Clinic of Ruminats; University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 041 81 Košice, Slovakia*

***For Correspondence**

**Assoc. prof. DVM. FRANTIŠEK ZIGO, PhD.**
*Department of Nutrition and Animal Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, Košice, Slovakia*

frantisek.zigo@uvlf.sk

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**Abstract:** *This study aimed to evaluate the effects of humic substances (HS) supplementation in the diets of rabbits on growth performance, carcass traits, qualitative and sensory parameters of rabbit meat. Two groups of silver rabbit and chinchilla crossbred rabbits were fed with pellets enriched with the additive 0.5% and 1.0% of HS (HS0.5 and HS1.0) during the 63 days of fattening period. The control group (C) of same crossbred rabbits and age was fed a basal diet without supplements. In both supplemented groups was observed lower weigh at the end of the fattening periodwhich was reflected in the reduction of fat content in the thigh and loin muscle. On the contrary, in the thigh muscle was recorded an increase in protein and meat protein free of connective tissue protein (BEFFE) comparing to control group. The lower values of colorimetric parameters were recorded from thigh and loins meat in HS0.5 group comparing to control and HS1.0 group.*

## I. INTRODUCTION

Humic substances are organic compounds resulting from the decomposition of animal and plant bodies. They occur naturally in soil and are among the most abundant organic substances on earth. The term humic substances refers to humic acids, fulvic acids and humin, which differ from each other in certain properties and structure [1]. Their influence on the organism consists in stabilizing the intestinal microflora, better utilization of nutritional substances from food, in the support of pancreatic enzymes and subsequent improvement of feed conversion. They are characterized by low resorption in the gastrointestinal tract at a maximum level of 0.1%. Even after partial resorption, they are not harmful to the body [2]. Currently, humic substances (HS) are considered a suitable alternative to replace antimicrobial substances, due to their many positive effects on production parameters, immunity and animal health. They have antibacterial, antiviral and antimicrobial effects, improving the economics and ecology of animal production [3, 4].

The aim of the work was to determine the effect of humic substances (HS) as an organic supplement in a granulated feed mixture on the quality of the carcass and the sensory properties of rabbit meat.

## II. Material and Methods

24 silver rabbit and chinchilla hybrids were included in the study. At the beginning of the experiment, the animals were divided into three groups (n= 8/group): C (control group, standard diet without additives), group H0.5 (experimental group 1, receiving standard feed + 0.5% Humac Natur AFM), group H1.0 (experimental group 2, received standard feed + 1% Humac Natur AFM). During the study (63 days), animals were fed pelleted mixtures ad libitum and had free access to drinking water. The weight of the rabbits was determined by weighing at the age of 113 days. The rabbits were then killed after stunning with a spring-loaded slaughter gun (AGROFORTEL s.r.o., Prague, Czech Republic) followed by cutting the jugular vein and exsanguination [5]. At the end of the experiment, after 9 weeks administrations of the HS sample, at the age of 113 days, the muscles were taken from the rabbits for further examination. Carcass weight was recorded after removing the head, skin, internal parts and distal parts of the limbs. Carcass yield was determined as the ratio of final carcass weight to carcass weight.

The chemical analysis of the basic muscle components was determined from back and thigh muscle samples. The muscle sample was taken no later than 1 hour after killing, wrapped in foil and stored at 4°C until the analysis of the samples. The proportion of individual chemical components in the samples were determined using a TANGO FT-NIR spectrophotometer (Bruker, Germany) with a resolution of 16 cm-1, a measurement time of 64 scans, and the measurement of one sample was repeated for three results.

Experimental samples of rabbit meat were subjected to sensory analysis, which was carried out in the Specialized Sensory Laboratory at the Institute for the Education of Veterinary Doctors in Košice, established according to the general plan for the arrangement of sensory workplaces [6]. The sensory panel was composed of 5 trained evaluators aged between 28 and 60 who had practical experience in evaluating meat. When compiling the protocol for assessing experimental samples of thigh muscle of rabbit meat, the authors Lawless and Heymann [7] followed. The protocol includes a 1 out of 9-point hedonic scale for evaluating the color, aroma, juiciness, tenderness and overall acceptability of the served as follows: 1 - very bad, 2 - bad, 3 - less tasty, 4 - unsatisfactory, 5 - average, 6 - satisfactory, 7 - tasty, 8 - good, 9 - very good.

We evaluated the determined values 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).

## III. Results and Discussion

The addition of HS in concentrations of 0.5 and 1% mainly increased live weight ($P<0.05$) and carcass weight ($P<0.05$). Both monitored parameters were at lower values compared to the control group. In the case of thigh bone weight, the values obtained within the experimental groups were lower compared to the control group of persons, but these differences were not statistically significant ($P<0.05$) (Table 1).

**Table 1. Effect of supplementation with different concentrations of humic substances on live weight (LW), carcass weight (CW) and thigh bone weight**

| Group | Live weight(LW) g | | Carcass weight (CW) g | | % z LW | Thigh bone weight g | | % z CW |
|---|---|---|---|---|---|---|---|---|
| | x | sd | x | sd | x | x | sd | x |
| **H 0.5** | **2775.62$^{a}$** | 150.36 | **1383.33$^{a}$** | 90.59 | 49.84 | 240.0 | 20.98 | 17.35 |
| **H 1.0** | **2861.25$^{a}$** | 126.19 | **1444.17$^{a}$** | 65.07 | 50.47 | 230.0 | 26.64 | 15.93 |
| **C** | **3118.12$^{b}$** | 111.74 | **1602.05$^{b}$** | 64.01 | 50.83 | 280.0 | 36.47 | 17.48 |

Note: C control group, rabbits fed with complete feed mixture, H0.5 experimental group of rabbits with diet enriched with 0.5.% addition of humic substances, H1.0 experimental group of rabbits with diet enriched with 1.0% addition of humic substances, [ab] Means in column with different superscript letter are statistically different (Tukey´s, P<0,05).

Burnett et al. [8] and Esenbuga et al. [9] found no effect on the growth performance of rabbits at concentrations (1% and 2%) of HS in feed. Lala et al. [4] described an increase in final weight and daily gains at higher concentrations of HS. The positive effect of HS on carcass yield was observed at concentrations ranging from 0.25 to 1.0% [10, 11, 12, 13].

The concentration of 05% HS resulted in a decrease in the fat and protein content of the loin muscle samples. In the case of dry matter content, no significant difference was found compared to the control group (P<0.05). When monitoring the thigh muscle, we noted an increase in water and protein content (P<0.05) and a decrease in fat and dry matter content (P<0.05). In the experimental group with a 1% concentration of HS in the feed, there was an decrease in the fat in the protein content (P<0.05) in the loin muscle samples. The water content was not changed. In the thigh muscle, we found an increase in water, dry matter and content (P<0.05), a decrease in fat (P<0.05) (Table 2). Hudák et al. [13] and Semjon et al. [14] and reported that after feeding humic substances, they reduced the decrease in fat content and the increase in protein content in breast muscles. Ozturk et al. [15] reported that the addition of different HS concentrations (0.5, 1.0 and 1.5%) contained fat content and overall content differently.

**Table 2. Results of physicochemical analysis of loin and thigh muscle**

| Sample | Parameters | H 0.5 | | H 1.0 | | C | |
|---|---|---|---|---|---|---|---|
| | | x | sd | x | sd | x | sd |
| Loin muscle | Water % | 74.005 | 0.299 | 74.620 | 0.212 | 74.449 | 0.235 |
| | Fat % | **0.870**[a] | 0.187 | **0.787**[a] | 0.050 | **0.951**[b] | 0.169 |
| | Ash % | 2.110 | 0.223 | 2.109 | 0.071 | 2.15 | 0.037 |
| | Protein % | **24.464**[a] | 0.297 | **24.260**[a] | 0.140 | **25.177**[b] | 0.223 |
| | pH | 6.298 | 0.011 | 6.270 | 0.014 | 6.182 | 0.013 |
| Thigh muscle | Water % | 74.441 | 0.298 | 75.445 | 0.194 | 74.342 | 0.164 |
| | Fat | **2.070**[a] | 0.199 | **1.706**[a] | 0.138 | **3.333**[b] | 0.208 |
| | Ash % | **1.280**[a] | 0.081 | **1.699**[b] | 0.138 | **1.520**[b] | 0.043 |
| | Protein % | **22.728**[a] | 0.371 | **22.096**[a] | 0.329 | **21.577**[b] | 0.103 |
| | pH | 6.225 | 0.013 | 6.222 | 0.017 | 6.240 | 0.012 |

Note: C control group, rabbits fed with complete feed mixture, H0.5 experimental group of rabbits with diet enriched with 0.5.% addition of humic substances, H1.0 experimental group of rabbits with diet enriched with 1.0% addition of humic substances, [ab] Means in row with different superscript letter are statistically different (Tukey´s, P<0,05).

The results of sensory evaluation are shown in Table 3. The overall sensory evaluation of thigh meat samples including appearance, smell,consistency, taste and overall acceptability was not affected by different concentrations of HS (0.5 and 1%). HS can positively affect the sensory quality of meat. Semjon et al. (2020) recorded a positive response in the sensory evaluation of chicken breast meat with regard to the perception of meat quality in relation to the carbonation of HS in the diet, especially a significant improvement in the taste of the meat after feeding 1.0% HS. The favorable effect of HS on the sensory evaluation of chicken breast is also reported by Akaichi et al. [16].

**Table 3. Results of the sensory evaluation of the thigh muscle**

| Parameter | H 0.5 | | H 1.0 | | C | |
|---|---|---|---|---|---|---|
| | x | sd | x | sd | x | sd |
| **Appearance** | 7.60 | 0.70 | 7.60 | 0.70 | 7.70 | 0.48 |
| **Smell** | 7.70 | 1.16 | 7.40 | 1.35 | 7.40 | 1.07 |
| **Consistency** | 7.10 | 1.10 | 7.10 | 0.88 | 7.30 | 1.42 |
| **Taste** | 7.90 | 1.20 | 8.00 | 1.05 | 8.00 | 1.05 |
| **Overal acceptabilty** | 7.80 | 1.03 | 7.80 | 0.79 | 7.90 | 0.99 |

Note: C control group, rabbits fed with complete feed mixture, H0.5 experimental group of rabbits with diet enriched with 0.5.% addition of humic substances, H1.0 experimental group of rabbits with diet enriched with 1.0% addition of humic substances, [ab] Means in column with different superscript letter are statistically different (Tukey´s, P<0,05).

## IV. Conclusion

The application of HS concentrations in the feed contains various indicators of the quality of the loin and thigh muscles. 0.5% HS in the feed caused a decrease in the content of fat and protein in the samples of the loin muscle, on the contrary, in the thigh muscle we recorded an increase in the content of water and protein ($p < 0.05$) and a decrease in the content of fat and ash ($p < 0.05$). 1% HS in the feed had a significant effect on the increase in the content of fat and fat 0.5 ($p < 0.5$) in the loin muscle, in the thigh muscle we found an increase in the content of water, ash and protein ($p < 0.05$) and a decrease in fat ( $p < 0.05$). However, HS feed supplementation did not show an improvement in the body weight and slaughter parameters of rabbits, nor did it affect the sensory properties of the muscle.

## V. Acknowledgements

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