Effects of Dietary Supplementation of Humic Substances on Laying Performance of Oravka Hens

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Abstract
The aim of this study was to appraise the effect of humic substances (HS) on laying performance. In total, 20 Oravka hens were allocated to 4 treatments, each containing 5 birds. The control birds were fed a diet without additives (0.00% HS), other treatment birds were fed with diets containing HS at 0.50%, 0.75 and 1.00%. The birds in all treatments had available drinking water and feed mixtures ad libitum. The experimental period lasted 16 weeks. Feed consumption and egg production were determined daily, egg weight was measured biweekly, and live body weights were recorded at the beginning and the end of the experiment. At the end of the experiment, the supplementations of HS had a significant effect (P<0.05) on live body weight, egg production and feed efficiency. In liver, gizzard, spleen, ovary and oviduct relative to live body there were no significant differences (P>0.05) among the among treatments. Carcass weight and oviduct weight were the highest (P<0.05) in Oravka hens fed HS diets compared with control.

Key words: egg production, feed efficiency humic substances, laying hen, Oravka.

1. Introduction

In recent years, there has been a surge in antibiotic resistance in humans and animals, as well as increased public concern over medication residues in animal products. As a result, the use of antibiotics as growth promoters in chicken has been banned in the European Union, and consumer pressure is likely to lead to their removal in other countries. Different alternatives to antibiotics have been proposed as a measure to eliminate pathogens or to improve growth and feed conversion in poultry, such as probiotics, enzymes, bacteriophages and antimicrobial peptides, herbal compounds and organic acids [1].

Humic substances (HS) are organic macromolecules that play an important role in biochemistry; they are a fraction of soil organic matter and have the highest density in soil and composts. They are produced by the biodegradation of organic matter, which involves physical, chemical, and microbiological processes [2,3].

HS are a natural component of streams, lakes, and oceans, containing the majority of the nutrients in the soil, accounting for

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approximately 80% of the carbon in soils and 60% of the dissolved carbon in the aquatic environment [4].

The addition of HS in the drinking water or feed different concentrations improves most of the productive parameters of poultry, such as probiotics, prebiotics, phytogenics, organic acids, humates, and enzymes [5].

Supplementation of HS to laying and broiler chickens can boost profitability by improving the production performance, reducing mortality, lowering feed conversion, and increasing egg output [6].

This experiment was carried out to determine the effects of HS in different concentrations in laying diet on body weight, feed utility, egg production and some carcass parameters in relation with laying.

2. Materials and methods

2.1 Animal management and treatments

Totally 20 hens of Oravka breed were allocated to its own covered shelters with straw litter and with access to a grass paddock; feeders and drinkers were available both outdoors and indoors. The environmental temperature ranged from 15 to 25°C and the relative humidity ranged from 65 to 75%. Artificial lighting was provided at a pattern of 18 hours of light altering with 6 hours of darkness. Ventilation in the house was natural with additional ventilators to provide a minimal air changes per hour.

In total, 20 Oravka hens were housed in 4 groups of 5 per pen and assigned to 4 treatments: 1=basal diet without HS; 2=basal diet with 0.50% HS in the feed mixture; 3=basal diet with 0.75% HS in the feed mixture; and 4=basal diet with 1.00% HS in the feed mixture in a powder form during laying period.

During the egg production period hens were fed commercial feed mixture (Tekro Ltd., Nitra, Slovak Republic). Composition and nutritional value of diet are shown in Table 1. The poultry in all treatments had available drinking water and feed mixture *ad libitum*.

The Oravka hens of the experimental treatments received HS (Humac Ltd., Košice, Slovak Republic) with an 85% dry matter content; there was a minimum of 62% humic acid in the dry matter, a minimum of 48% free humic acids in the dry matter, a minimum of 9% fulvonic acids in the dry matter and a minimum of 9% minerals in the dry matter.

2.2 Production parameters and analytical procedures

Throughout the experimental period, Oravka hens were fed in groups and via weekly measurements, the mean of group feed consumption was determined. Egg production records were taken daily in each group. Eggs were weighed at weekly intervals after being stored at room temperature for 24 hours and their masses were measured by to Kucukersan et al. (2005) [7].

The live body weights of hens were recorded at the beginning and the end of the experiment.

According to Samya (2016) [8], at the end of experimental period (52 wk of age), hens from each group were taken, slaughtered and eviscerated to calculate carcass weight, liver, gizzard, heart, spleen, ovaries and oviducts relative to live body weight and oviduct length

2.3 Statistical analysis

The differences among the treatments were analyzed with a one-way analysis of variance (ANOVA) by using the statistical program JASP 0.8.6 (2018) [9]. The results were evaluated using Duncan's multiple range test [10].

3. Results and discussion

3.1 Live body weight

Data presented in Table 2 regard to the effect of different dietary levels of HS supplementation on live body weight that hens in all treatment groups were significantly ($P<0.05$) heavier than the controls. These results are in agreement with those reported by Hanafy and El-Sheikh (2008) [11], who indicated that live body weight was significantly ($P<0.05$) affected by HS addition. In this respect, several authors indicated that HS had a positive effect on live body weight of laying hens [12-13] and broilers [14-21]. In contrast to the present results, other authors [22-24] found insignificant effect of HS on body weight of broiler chickens.

3.2 Feed intake and feed efficiency

Data presented in Table 2 revealed that significant effect of HS supplementation on feed intake. However, Hanafy and El-Sheikh (2008) [11], Sahin et al. (2011) [24] and Taklimi et al. (2012) [15] found that feed intake was not affected significantly by HS addition. The hens with HS showed significantly ($P<0.05$) the best feed efficiency compared with control group. In this respect, Mirnawati and Marlida (2013) [16] observed that HS can improve feed conversion ratio. On the other hand, Sahin et al. (2011) [24] reported that feed conversion ratio was not significantly affected by HS addition. The results concerning the improvement effect of the addition of humic acid to layer hen rations on feed efficiency rates are similar to the results obtained from studies carried out on this subject [22,25].

3.3 Egg production and egg weight

As shown in Table 2, hens in experimental groups with HS supplementation do diets had significantly ($P<0.05$) the highest egg production and the heaver egg weight as compared to control group.

These results are in agreement with those obtained by Ozturk et al. (2012) [14], who indicated that the addition of HS to layer diet increased the egg production compared to control. Also, Hanafy and El-Sheikh (2008) [11] and Kucukersan et al. (2005) [7] showed that the dietary HS can be used to improve egg weight and egg production. Yorük et al. (2004) [6] found that supplementation of HS in layer diets increased egg production as compared to control group without significant effect on egg weight.

Our findings revealed that HS addition significantly improved egg production rates and also some studies found positive HS effect on egg production [6,7,11,14,26-29]. Nevertheless, Wang et al. (2007) [30] indicated that the dietary HS decreased egg production.

Our results indicated a significant improvement in egg weight and egg mass in response to dietary HS, and this is in line with previous reports that HS exerted a beneficial effect on egg weight [7,11,28-31]. Our results do not correspond with Yorük et al. (2004) [6] who indicated that the addition of HS to layer diet has.

Table 1. Composition and nutritional value of complete feed mixture

Component	Unit	Feed mixture
Wheat	%	15.00
Maize	%	32.00
Soybean meal	%	19.20
Fish meal	%	3.00
Malt flower	%	3.00
Rapeseed meal	%	7.00
Sunflower meal	%	4.50
Monocalcium phosphate	%	1.00
Fodder salt	%	0.30
Animal fat	%	4.00
Calcium carbonate	%	10.00
Premix of additives[1]	%	1.00
Nutrient	**Unit**	**Feed mixture**
Crude protein	g/kg	200.00
ME_N	MJ/kg	11.70
Ash matter	g/kg	160.00
Fibre	g/kg	60.00
Lysine	g/kg	11.00
Methionine and cistine	g/kg	7.90
Ca	g/kg	35.00
P	g/kg	5.00
Na	g/kg	1.50

Notes: CP=crude protein; ME_N=nitrogen-corrected metabolizable energy; Ca=calcium; P=phosphorus; Na=natrium; MJ=megajoule; [1]active substances per kilogram of premix: vitamin A 15 000 IU; vitamin E 20 mg; vitamin D_3 2 000 IU; vitamin B_2 6 mg; vitamin B_{12} 20 μg; Mn 60 mg; Zn 40 mg; Fe 40 mg; Cu 6 mg; Se 0.2 mg.

Table 2. Effect of different HS concentrations on egg parameters

Parameter	0.00% HS	0.50% HS	0.75% HS	1.00% HS
Initial body weight (g)	2287.12±145.87	2281.68±142.65	2292.67±144.82	2285.74±145.17
Final body weight (g)	2574.07±156.54^{b}	2689.85±158.98^{a}	2697.41±161.48^{a}	2690.85±161.32^{a}
Feed intake (g/hen)	123.78±7.76^{b}	126.84±7.82^{a}	127.26±7.99^{a}	127.01±7.95^{a}
Feed efficiency (kg feed/kg egg)	2.29±0.32^{b}	2.16±0.22^{a}	2.13±0.21^{a}	2.15±0.22^{a}
Egg production (%)	84.22±2.76^{b}	87.39±2.88^{a}	87.77±2.93^{a}	87.50±2.92^{a}
Egg weight (g)	58.11±3.77	59.26±3.79	59.78±3.83	59.58±3.80

Values shown are mean ± SD (standard deviation)
^{a,b} means in a row with different superscript differ significantly (P<0.05)

Table 3. Effect of different HS concentrations on carcass parameters

Parameter	0.00% HS	0.50% HS	0.75% HS	1.00% HS
Carcass weight (g)	1637.86±102.31^{b}	1714.02±105.63^{a}	1716.67±106.07^{a}	1716.11±105.97^{a}
Liver (%)	2.56±0.22	2.58±0,24	2.60±0.25	2.59±0.25
Heart (%)	0.44±0.08	0.49±0.09	0.48±0.09	0.47±0.09
Gizzard (%)	1.67±0.13	1.71±0.14	1.71±0.14	1.69±0.15
Spleen (%)	0.09±0.01	0.10±0.02	0.09±0.02	0.09±0.02
Ovary (%)	1.49±0.11	1.50±0.12	1.51±0.12	1.51±0.12
Oviduct (%)	1.42±0.09	1.43±0.11	1.45±0.10	1.45±0.11
Oviduct length (cm)	67.65±4.11^{b}	71.78±4.55^{a}	71.82±4.56^{a}	71.81±4.55^{a}

Values shown are mean ± SD (standard deviation)
^{a,b} means in a row with different superscript differ significantly (P<0.05)

3.4 Carcass traits

Effect of the experimental treatment on carcass traits presented in Table 3 revealed that hens' experimental HS treatments showed significantly (P<0.05) the highest weights of carcass, liver, gizzard, spleen and oviducts relative to live body weight compared to control. In accordance with the present results, Hanafy and El-Sheikh (2008) [11] observed positive effect of HS on relative weight of ovary, spleen and oviduct length of laying hens. However, an insignificant effect of HS on relative weight of carcass, liver, gizzard, heart and oviduct. In our study, increasing level of HS caused significant (P<0.05) increase in all the previous parameters. Contrary, Eren et al. (2000) [25]; Kocabagli et al. (2002) [22] and Avci et al. (2007) [32] reported insignificant differences in slaughter characteristics of birds fed HS diet or HS compared with control broilers. Increase of the relative weight of ovary and oviduct length in the current study may reflect and contributes in the increment of egg production for hens fed HS compared with controls which support the previous findings by Hanafy and El-Sheikh (2008) [11].

4. Conclusions

According to results of this experiment, it was concluded that the addition of HS to layer hen diets increased live body weight, improved feed efficiency, egg production and egg weight.

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