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EFFECT OF HUMIC PREPARATIONS ON PRODUCTIVITY AND QUALITY TRAITS OF EGGS FROM GREENLEG PARTRIDGE HENS*

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Abstract

Greenleg Partridge (Z-11) laying hens were simultaneously offered Humokarbowit and Humobentofet humic preparations (HuP) in an amount of about 4.5 g/hen/day during the entire production cycle. Production parameters and quality traits of eggs, including shell, were evaluated. Giving HuP had no effect on productivity, egg production, feed consumption and egg weight. In experiment I (layers without cockerels), shell percentage, shell thickness and shell strength were significantly higher in the experimental compared to the control group, which caused a significant decrease in the proportion of cracked and broken eggs. The other parameters of these eggs such as weight, height, pH of albumen and yolk, shell colour, yolk colour and Haugh units did not differ between the groups. In experiment II (layers with cockerels) no significant differences were found between the egg quality parameters studied, and only in the experimental group was there a tendency towards lighter shell colour, increased shell thickness and strength, and higher Haugh units in relation to the control group.

Key words: laying hen, humic preparations, performance, egg quality

Many different feed additives of both organic and inorganic origin are used in the nutrition of laying hens. These include preparations from herbs and special plants (Guo et al., 2003), mineral and amino acid chelates (Lim and Paik, 2006), yeast-like and microbiological preparations (Dobrzański et al., 2006; Kalavathy et al., 2005), aluminosilicate and calcium preparations (Dobrzański et al., 2007 a; Miles and Henry,

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2007; Moghaddam et al., 2008), or byproducts of the processing industry (Górecki et al., 2006; Świątkiewicz and Koreleski, 2007).

These additives are aimed to supplement the diet with biologically active substances, including amino acids, vitamins and mineral salts, to improve the productivity and health of poultry, and to improve the quality of eggs in terms of physical traits, biological traits and nutritive value (Trziszka et al., 2005).

An interesting feed additive are humic preparations, especially Humokarbowit (humic-mineral preparation) and Humobentofet (humic-fat preparation). The former, made on the basis of natural humic and carbonate raw materials and other components, is added to litter and/or feed for all farm animals and is patented (Patent No. PL-172908). The latter (Patent No. PL-315211) is produced on the basis of humic and aluminosilicate preparations with the addition of vegetable fats and other components. Because of its composition, it is used to feed all productive groups of animals exclusively as a feed additive. Research (Dobrzański et al., 2007 b; Rudnicka and Dobrzański, 2000; Trziszka et al., 2004) has shown that they have positive effects in poultry, but these observations were too short to fully evaluate the effect of these preparations on production results and egg quality traits.

The aim of the present study was to evaluate the efficiency of humic preparations offered to Greenleg Partridge laying hens (Z-11) during the entire egg-laying cycle with regard to production results and quality traits of eggs, both infertile eggs and eggs fertilized in the final stage of egg production.

Material and methods

Subjects were 18-week-old hens of the native Greenleg Partridge breed (Z-11), originating from the Experimental Station of the National Research Institute of Animal Production in Chorzelów. Layers were kept in groups of 20 on litter floor in fully equipped boxes (feeders, drinkers, nests, mechanical ventilation, automatically controlled lighting system). In experiments I and II, humic preparations (HuP) were used in the feeding of layers throughout the production cycle. In experiment I (21–65 weeks of age), hens were assigned to the groups as follows:

– Group K-1 – control (20 layers, standard feed);

– Group D-1 – experimental (20 layers, standard feed + humic preparations).

In experiment II (21–61 weeks of age), the design of the groups was similar except that layers were kept with cockerels:

– Group K-2 – control (20 layers + 2 cockerels);

– Group D-2 – experimental (20 layers + 2 cockerels, standard feed + humic preparations).

Hens were fed complete standard feed (from a commercial feed plant) for layers from commercial flocks with the following components, as declared by the manufacturer: maize, wheat, wheat bran, GM soybean meal, sunflower meal, vegetable oil, monocalcium phosphate, sodium chloride, calcium carbonate, sodium bicarbonate, mineral-vitamin premix, and Biostrong 510 preparation. The mixture contained

11.32 MJ/kg metabolizable energy, 17.8% crude protein, 4.11% fat, 0.87% lysine and 0.41% methionine, 3.48% calcium and 0.36% available phosphorus. Both the mixture and humic preparations were fed *ad libitum*.

In the experimental groups (D-1 and D-2), Humobentofet and Humokarbowit humic preparations were provided in special feed troughs, the former being modified by the addition of 1.5% linseed oil and 1.0% fish oil. These preparations were mixed at a 1:2 ratio. After weighing, they were fed at several-day intervals when feed was left over in the troughs, which made it possible to calculate daily intake.

In experiment II, both groups (D-2 and K-2) contained cocks (9.1% of the flock) in addition to hens. They also had free access feed and preparations and were accounted for in the balance calculations by deducting 10.3% from total feed intake and HuP. This followed from earlier observations that ZK cocks have an approx. 15% greater intake of feed and preparations than hens (Trziszka, 2007).

Feed intake, number of eggs laid (including cracked and broken eggs) and total egg weight were recorded daily, and in the final stage of egg production 30 eggs were collected from each group for laboratory tests. They were collected over three successive days at 64 (exp. 1) and 60 days of age (exp. 2). The eggs from K-1 and D-1 groups were considered to be infertile and those from groups K-2 and D-2 fertile. Production parameters, egg production, egg weight and feed intake were evaluated, and the following egg quality traits were determined: egg weight (g), shell, albumen and yolk weight (g, %), albumen and yolk height (mm), yolk width (mm), shell (%) and yolk colour (pts), albumen and yolk pH, and shell thickness (mm) and strength (N). Haugh units were calculated.

Qualitative analyses were performed at a laboratory of the Department of Animal Products Technology and Quality Management using EQM and EQR devices (Technical Services and Supplies). Yolk colour was estimated using Roche colour scale of 1 to 15. Shell strength was determined using a Zwick-Roell type device.

The results were analysed statistically by calculating means and standard deviations. Duncan's test was used to calculate significant differences between the control (K) and experimental groups (D) (Statgraphics ver. 5.1).

Results

Layers were fed in accordance with poultry feeding standards (Normy Żywienia..., 2005) except that layers from the experimental groups received additional humic preparations (Humokarbowit and Humobentofet).

In experiment I, the initial body weight of layers was 1.76 (K-1) and 1.84 kg (D-1) and increased during the late stage of egg production (after 45 weeks) by 3.41 and 3.26%, respectively. In experiment II, the initial body weight of 1.77 and 1.68 kg was higher at the end of egg production (after 41 weeks) by 11.86 and 9.45%, respectively. No significant differences were found in the body weight of chickens between groups K and D in experiments I and II (Table 1).

Egg production in all the groups was not very high, with mean egg production for 45 weeks (exp. I) being 62.14% in group K-1 and 61.11% in group D-1 (Table 1). Peak egg production in group D-1 occurred at 31 weeks of age (80.71%) and in group K-1 at 32 weeks of age (89.28%) (Figure 1). In group D-1, mean egg weight was slightly higher compared to K-1 (57.16 and 56.43 g, respectively). In the group receiving HuP, the number of defective and cracked eggs was significantly lower.

Table 1. Body weight and production parameters of Greenleg Partridge hens over the entire egg production cycle

Item	Group			
	experiment I (45 weeks)		experiment II (41 weeks)	
	K-1	D-1	K-2	D-2
Number of hens	20	20	20 +2*	20+2*
Body weight of hen (kg)				
initial	1.76	1.84	1.77	1.68
final	1.82	1.90	1.98	1.92
Egg production				
total (pcs)	3915	3850	3527	3603
per hen	195.8	192.5	176.4	180.2
rate (%)	62.14	61.11	61.45	62.77
cracked egg (%)	4.06 a	3.43 b	4.83	4.25
Egg weight				
total (kg)	220.95	220.06	197.21	198.85
per hen (kg)	11.05	11.00	9.86	9.94
per egg (g)	56.43	57.16	55.91	55.19
Feed consumption				
total (kg)	775.8	774.4	745.4	748.1
g/day/hen	123.1	122.9	129.9	130.3
g/egg	198.1	201.1	211.3	207.6
FCE**	3.51	3.52	3.78	3.76

a, b – $P<0.05$.
*Cockerel; **feed conversion efficiency (kg feed consumed/kg egg produced) – without HuP.

In experiment II, mean egg production was 62.77% in group D-2 and 61.45% in group K-2 (Table 1). Peak egg production occurred at 38 weeks of age and was 81.42% in group K-2 and 85.70% in group D-2 (Figure 2). No significant differences were found in egg production parameters, while the proportion of cracked eggs and individual egg weight were similar between the groups.

Feed consumption per layer and per egg produced did not differ significantly between the groups in both experiment I and II. Feed conversion efficiency (FCE) did not differ between the groups in experiment I (3.51 and 3.52 kg/kg), while in experiment II this parameter tended to increase in group D-2. The values do not account for HuP intake. The intake of preparations averaged 4.57 g/hen/day in experiment I and was slightly lower (4.41 g/hen/day) in experiment II. This constituted 3.72 and 3.38% in relation to feed intake, respectively.

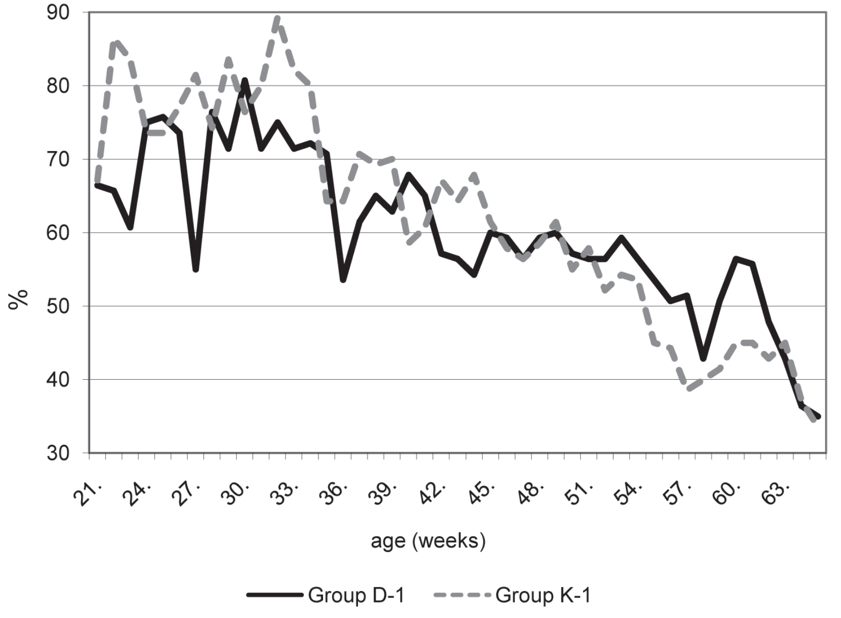

Figure 1. Laying rate – experiment I

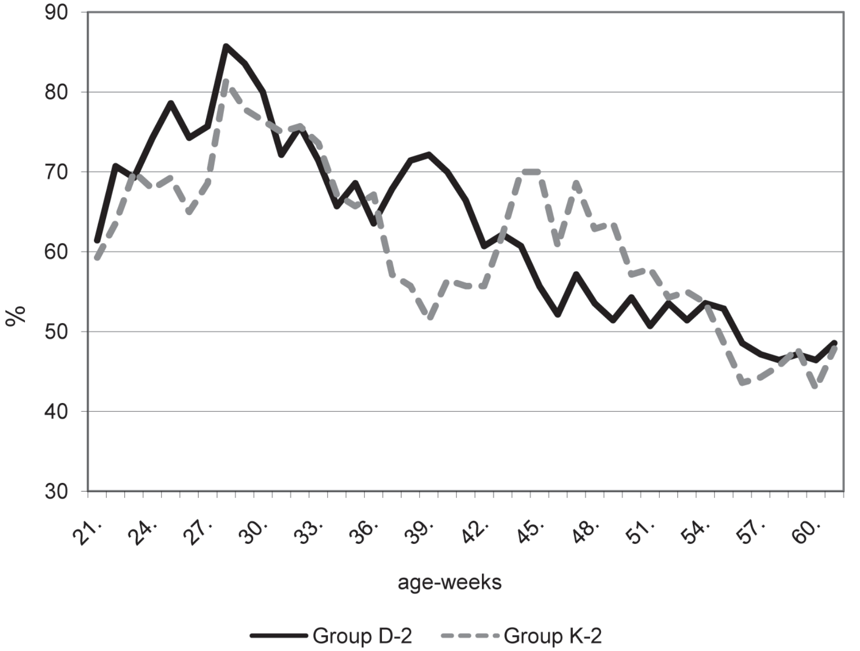

Figure 2. Laying rate – experiment II

Table 2. Results of laboratory analyses of Greenleg Partridge hen eggs – experiment I (45 weeks)

Item	Group	
	K-1	D-1
	x ± SD	x ± SD
Egg weight (g)	50.37±5.12	49.63±6.92
Shell weight (%)	11.57 b±1.01	12.23 a±1.41
Albumen weight (%)	60.41±6.39	59.18±8.15
Yolk weight (%)	28.02±4.76	28.59±5.94
Albumen height (mm)	5.57±1.38	5.58±1.52
Yolk height (mm)	18.25±1.14	18.32±0.78
Yolk width (mm)	3.61±0.31	3.62±0.34
Shell colour (%)	55.08±6.59	55.77±5.70
Yolk colour (1–15 pts)	12.43±1.19	12.50±1.25
Shell strength (N)	17.05 b±3.77	19.15 a±4.58
Shell thickness (mm)	0.321 b±0.023	0.347a±0.031
Albumen pH	8.95±0.62	8.81±0.71
Yolk pH	5.95±0.17	6.11±0.22
Haugh units	76.00±11.20	75.67±12.47

a, b – P<0.05.

Table 3. Results of laboratory analyses of Greenleg Partridge hen eggs – experiment II (41 weeks)

Item	Group	
	K-2	D-2
	x ± SD	x ± SD
Egg weight (g)	50.43±6.43	49.04±4.25
Shell weight (%)	12.23±1.15	12.24±1.00
Albumen weight (%)	59.23±8.05	60.21±8.51
Yolk weight (%)	28.54±5.33	27.55±2.96
Albumen height (mm)	6.27±1.66	6.57±1.83
Yolk height (mm)	18.53±1.22	18.03±1.07
Yolk width (mm)	3.63±0.27	3.77±0.33
Shell colour (%)	54.97±6.45	57.33±5.58
Yolk colour (1–15 pts)	12.32±1.04	12.10±0.97
Shell strength (N)	19.18±5.46	19.31±3.65
Shell thickness (mm)	0.342±0.020	0.357±0.024
Albumen pH	8.81±013	8.84±0.10
Yolk pH	6.01±0.05	5.98±0.07
Haugh units	81.52±11.52	82.50±12.06

a, b – P<0.05.

Physical traits of eggs, including shell quality parameters were only slightly different in experiment I (infertile eggs) (Table 2). Shell percentage, shell thickness and shell strength were significantly higher in group D-1 than in group K-1. The other parameters of these eggs such as weight, height, pH of albumen and yolk, shell colour, yolk colour and Haugh units did not differ in relation to group K-1. In experiment II (fertilized eggs) there were no significant differences between the analysed egg parameters except for a tendency in group D-2 towards more intense shell colour, increased shell thickness and strength, and higher Haugh units (Table 3).

Discussion

In keeping with the conservation programme, no selection for improvement of productive traits has been carried out in the flock of Greenleg Partridge hens, which results in low egg production (approx. 60%), with volume of feed intake in the intensive rearing system being comparable with that of highly productive layers. Because of these production results, the hens were eliminated from commercial production. Current research involving these hens is concentrated mainly on the search for specific egg quality traits (Krawczyk, 2009).

The results obtained indicate that the use of HuP did not cause significant changes to basic production parameters, although in experiment II (layers and cockerels) there was a tendency towards better egg production and lower feed consumption per egg in group D-2 compared to group K-2. These tendencies did not occur in experiment I (hens without cockerels). The intake of humic preparations was similar in both experiments (approx. 4.5 g/hen/day), which after conversion means a slight increase in the experimental groups in feed intake (including the preparations), feed consumption per egg produced and FCE. Other authors also reported this phenomenon (Rudnicka and Dobrzański, 2000; Zołoteńka-Synowiec, 2006). Layer health and condition was very good, as evidenced by no deaths and relatively high final body weights in both experiments. This was also reported by Calik and Krawczyk (2006) and Trziszka et al. (2004).

In the group receiving HuP (exp. I), the number of broken and cracked eggs was significantly lower, which may be related to higher mechanical strength and thickness of the shell. It is rather difficult to explain this phenomenon because the literature provides little data on this subject. Gezen et al. (2005) reported that shell quality is significantly affected by dietary electrolyte balance, which could have been more favourable in the experimental group considering the rich mineral composition of HuP (Zołoteńka-Synowiec, 2006), or the chemical composition of humic raw materials in general (Islam et al., 2005). It is evident that in addition to the diet, the quality traits of eggs are significantly affected by various technological factors such as the housing system (Hidalgo et al., 2007; Vits et al., 2005; Wall and Tauson, 2002).

Eren et al. (2008), who used liquid humate, found significantly greater shell strength in Lohmann Brown hens but only in the late laying period. Meanwhile, Kucukersan et al. (2005) found in Hisex Brown hens receiving humic acid an increase in egg production, a decrease in feed conversion efficiency and an increase in egg weight, without any changes in egg quality traits. Similar conclusions were reported by Yörük et al. (2004) for Hisex Brown hens receiving humate with microbiological probiotic, although they found reduced mortality, lower FCE and increased egg production late in the production period in the experimental groups. Meanwhile, in molted Lohmann Brown hens receiving 3% HuP, Rudnicka and Dobrzański (2000) found no changes in production results, although there was a significant improvement in shell quality traits such as shell weight, thickness and strength.

The addition of HuP to layer diets did not cause significant differences in yolk colour, and an upward tendency for shell colour was observed. This could have been affected by natural pigments found in humic raw materials, although their chemical identification was not performed. Krawczyk and Sokołowicz (2008) indicate that a significant increase in shell and yolk colour in Z-11 hens can be obtained by allowing them to access free range.

It remains to explain the possible effect of male presence in the groups of laying hens on productive and quality parameters of eggs. Different egg production periods (41 weeks in exp. I and 45 weeks in exp. II) prevent a comparative statistical analysis of the results between the two experiments, although it seems that the presence of cockerels in the layer group has no effect on basic production parameters and quality traits of eggs. This issue is not discussed in the literature and only the earlier observations of Trziszka (2007) show that fertilized eggs from ZK hens are characterized by slightly different physico-chemical traits, especially with regard to albumen.

In general, it is concluded that the addition of humic preparations to feed had no significant effect on production parameters, but improved, to a limited degree, some egg quality traits, in particular shell strength parameters, thus reducing the proportion of defective and cracked eggs. Therefore it seems appropriate to give humic preparations, especially in the late laying period when layer condition and production parameters deteriorate. Another issue is the evaluation of the effect of HuP on chemical traits and nutritional value of the eggs, which will be discussed in a separate publication.

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Wpływ preparatów huminowych na produkcyjność i cechy jakościowe jaj kur Zielononóżka kuropatwiana

STRESZCZENIE

Kurom nieśnym Zielononóżka kuropatwiana udostępniono równocześnie preparaty huminowe Humokarbowit i Humobentofet (HuP) w ilościach około 4,5 g/kurę/dobę w całym cyklu produkcyjnym (system podłogowy, ściółkowy). Eksperyment I trwał 45 tygodni, a II 41 tygodni. W grupach doświadczalnych i kontrolnych znajdowało się po 20 kur, z tym że w eksperymencie II nioski utrzymywane były wraz z kogutami (20♀+2♂ w grupie). Oceniono parametry produkcyjne i cechy jakościowe jaj, zarówno niezapłodnionych, jak i zapłodnionych, w tym białka, żółtka i skorupy.

Zastosowanie HuP nie miało wpływu na wyniki produkcyjne, nieśność i zużycie paszy, masę jaj, które były podobne w grupach kontrolnych i doświadczalnych. W eksperymencie I (nioski bez kogutów) w grupie doświadczalnej istotnie wyższy był procentowy udział skorupy, jej grubości i wytrzymałości w stosunku do grupy kontrolnej, co spowodowało istotny spadek udziału jaj niepełnowartościowych i stłuczonych. Pozostałe parametry jaj, jak: masa, wysokość, odczyn białka i żółtka, barwa skorupy czy żółtka oraz jednostki Haugha nie różniły się między grupami. W eksperymencie II (nioski z kogutami) nie stwierdzono istotnych różnic między badanymi parametrami jakościowymi jaj, jedynie w grupie doświadczalnej zanotowano tendencje silniejszego wybarwienia skorupy, wzrostu jej grubości i wytrzymałości oraz wyższej wartości jednostek Haugha w stosunku do grupy kontrolnej, czego nie potwierdzono jednak statystycznie.