Investigation of dietary probiotic effects on productive traits in broiler breeders

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SUMMARY

The experiment was performed with breeder hens of line K – White Plymouth rock, from the gene pool of the Poultry Hybrid Centre, used as maternal form for broiler production. Control hens received a traditional compound feed, and the experimental group – compound feed supplemented with 500 g probiotic/tonne. The biologically active substances of the bioproduct were: active microflora - *Lactobacillus delbrueckii subsp. bulgaricus* with total counts of 6.5×10^5, *Streptococus thermophilus* with total counts 3.4×10^8, vitamins and amino acids. The aim of the study was to investigate the effect of this probiotic on productive and morphological traits of produced eggs. The egg mass in experimental group was 2955.56 g, due to the higher egg laying intensity. The lower feed conversion per egg resulted in lower feed conversion per kg egg mass – by 0.515 g in experimental group. It could be concluded that the dietary supplementation with the probiotic increased the survival of experimental hens. By the end of the experimental period, egg mass increased statistically significantly in breeders that received the supplement ($p<0.001$).

Keywords: probiotic, egg production, egg quality, broiler breeder hens, productive traits

INTRODUCTION

Nowadays, probiotics become increasingly important for poultry industry with the implementation of new concepts for their utilization. They are defined as microbial cell preparations with beneficial effects on the health and productivity of organisms (Yu et al., 1999).

The addition of probiotics to the feed of poultry was reported to increase egg productivity, egg quality (Haddadin et al., 1996), and feed conversion efficiency (Tortuero and Fernandez, 1995).

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Goodling et al. (1987) reported a higher egg production, feed conversion efficiency, vitality, egg weight, when young layers received feed supplemented with probiotic.

Having investigated the effect of the probiotic product Calsporin on productive traits of layer hens, Sohail et al. (2002) observed no effect of the preparation on egg quality and the productivity of hens.

Opinions about the effect of microbial products on layers' productivity and egg quality are controversial. The inclusion of probiotics to poultry feed did not have any effect on the sized of produced eggs (Cerniglia et al.*,*1983, Mohan et al., 1995, Haddadin et al., 1996), but reduced the content of cholesterol in blood and in egg yolk (Abdulrahim et al. 1996).

Mahdavi et al. (2005) investigated the effect of a dietary probiotic on stock layers and reported a statistically insignificant influence on egg mass, feed conversion efficiency and egg traits, and considerable effect on egg cholesterol content.

Chen and Chen (2003) concluded that the utilization of probiotics in poultry feed increased egg production rates, but did not influence the average weekly egg mass and their quality. Ali Aghaii et al. (2010) reported a better egg productivity in stock layers whose feed was supplemented with a probiotic, as well as a reduction of cholesterol and triglycerides in blood and egg yolk.

The purpose of this study was to investigate the effect of dietary probiotic supplementation in broiler breeder hens on productive and morphological traits of their eggs.

MATERIAL AND METHODS

The experiment was carried out with line K broiler breeders – White Plymouth rock breed from the gene pool of the Poultry hybrid centre, used as maternal form for broiler chickens production. Birds were reared in groups of 100 hens with an equal body weight, at a ratio of 12 hens per rooster in a box. The access to compound feed was limited. The experiment lasted for 70 days and at its start, breeders were at the age of 32 weeks. They were weighed at the beginning and the end of the trial.

Control and experimental hens received a traditional compound feed. The compound feed contained: metabolizable energy 1810.005 kcal/kg, crude protein 16.012%, crude fat 6.836%, fibre 5.889%, lysine 0.75%, methionine 0.38%, calcium 3.2%, phosphorus 0.81% and was recommended for this category of birds (Todorov et al., 2007). Each hen received 160 g compound feed and 5 g grain. But the experimental group– compound feed supplemented with 500 g probiotic/ one ton. The probiotic contained: active microflora– *Lactobacillus delbrueckii subsp.*

bulgaricus with total counts of 6.5×10^5, *Streptococus thermophilus* with total counts 3.4×10^8.

During the experimental period, the following parameters were controlled: live body weight (kg), death rate (%), egg production traits – daily egg production (number of eggs), egg laying intensity (%) – on the basis of laid eggs for 14 days, average egg mass (g) – of all eggs produced daily at 2-week intervals; egg mass (g), feed conversion per egg laid (kg), feed conversion per 1 kg egg mass (kg); egg incubation traits – hatchability of total eggs set (%), hatchability of fertile eggs (%), embryonic death rate at the end of the experimental period and morphological traits by days 35 and 70. Thirty eggs were collected from each group for evaluation of individual morphological traits as followed:

1. Egg weight – measured with balance with precision of 0.01g.
2. Shape index – determined by an index meter.
3. Yolk index – determined through yolk diameter and height (by a caliper and micrometer, respectively) by the formula:

   YI (%) = (h /d) x100

4. Albumen index – determined by measuring the large and small egg diameters and albumen height (by a caliper and micrometer, respectively) by the formula:

   Iб (%) = (h /[D+d] /2) x100

5. Thickness of eggshell with the eggshell membrane – determined at three locations (at both poles and in the middle, the average of the three measurements being retained) with a micrometer Ames 25EE with precision of 0.0001 mm.
6. Albumen, yolk and eggshell weights – weighed in a balance with precision of 0.01 g.
7. Haugh units – calculated by the formula

   $HU = 100 \log (H + 7.57 – 1.7 W^{0.37})$ by the method of Haugh (1937), where H – the height of thick albumen (mm); W – egg weight (g).

The experimental results were processed with the STATISTICA software.

RESULTS AND DISCUSSION

Our results demonstrated a positive effect of the probiotic on live body weight of supplemented hens manifested by its maintenance at the same level at experiment’s beginning and end, related to better feed conversion efficiency, whereas body weight of control birds decreased statistically significantly over the 70-day period from 4.034 kg to 3.880 kg ($p<0.01$; Table 1). Stimulating effects of probiotics on digestive metabolism and nutrient utilization are reported also by Yeo and Kim (1997). On the contrary, Dizaji and Pirhommadi (2009) did not observed any effect of the probiotic on the live body weight of hens at the end of the experiment.

The death rate of experimental birds was by 3.06% lower (Table 1) compared to controls resulting from the effect of the probiotic, which creates favourable conditions for beneficial bacteria in the alimentary tract, suppressing the development of pathogens (Line et al., 1998, Ehrmann et al., 2002), decreasing the incidence of disease (Mountozouris et al., 2007) and improving the immune system function (Zulkifli et al., 2000; Balevi et al., 2001; Kabir et al., 2004).

Table 1. Effect of probiotic on live body weight of hens (kg) and death rates (%)

Group	Body weight at the beginning	Body weight at the end	Death rate (%)
Control	4.034 ± 0.035**	3.881 ± 0.043	9.18
Experimental	3.941±0.041	3.959 ± 0.047	6.12

**p<0.01

The results for egg production, average egg mass, feed conversion efficiency per egg and per 1 kg egg mass are presented in Table 2.

The addition of probiotic to the ration of experimental hens resulted in higher number of laid eggs – 48.82 vs. 44.68 in controls, that makes an egg production higher by 9.27%. As a result, the egg mass of the experimental group was also higher– 2955.56 g. The productivity of experimental hens was characterized by lower amount of feed spent to produce one egg: 0.239 g compared to 0.270 g in controls. The lower feed spent per egg resulted in lower feed conversion per 1 kg egg mass by 0.515 g. These results are also confirmed by the experimental results of Aghaii et al. (2010), and Horniakova et al. (2006).

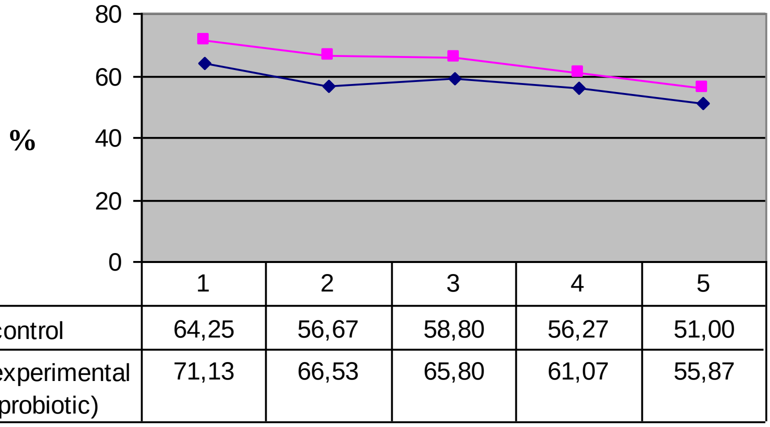
Table 2. Egg production traits of breeders

Traits	Group	
	control	experimental
Egg production (number of eggs)	44.68	48.82
Laying intensity (%)	57.39 ± 2.14	64.08 ± 2.60 *
Egg weight (g)	60.25 ± 0.95	60.54 ± 0.40
Egg mass (g)	2691.97	2955.56
Feed conversion efficiency per egg (kg)	0.270	0.239
Feed conversion per 1 kg egg mass (kg)	4.476	3.961

* p<0.05

The egg laying intensity in both groups was determined by the number of eggs laid over a 14-day period (Fig. 1). As early as during the first weeks, egg laying intensity was higher in experimental hens – 71.13% vs. 64.25 % in controls. This tendency was preserved over the entire period of the study. In both groups, this parameter decreased gradually that, in our view, could be attributed to the age of breeders. By the end of the experiment, egg laying rate was 55.87 % in experimental hens and 51% in controls. In ducks, Nickholova and Penkov (2004) reported similar results about the effect of probiotic dietary supplements on egg laying intensity.

Figure 1. Laying intensity (%)



	1	2	3	4	5
control	64,25	56,67	58,80	56,27	51,00
experimental (probiotic)	71,13	66,53	65,80	61,07	55,87

periods (days)

Table 3 presents the data about the fertility and hatchability of eggs. The total number of eggs set for incubation was 407 from control hens and 439 from experimental birds. The fertile eggs' percentages were high in both groups – 95.58% in control and 96.81% in experimental breeders. This reflected upon higher hatchability percentages of total and fertile eggs.

Table 3. Egg incubation traits

Traits		Group	
		control	experimental
Total number of eggs set		407	439
% fertile eggs		95.58	96.81
Embryonic death	up to the 7th day	1.23	1.59
	up to the 18th day	7.12	6.83
Hatchability of total eggs set %		86.98	88.38
Hatchability of fertile eggs %		91.00	91.29

Data from the investigation of egg parts' weights and eggs morphological traits are given in Tables 4 and 5, respectively.

Table 4. Egg parts' traits

Traits	I period, by the 35th day		II period, by the 70th day	
	control	experimental	control	experimental
	LS ± SE	*LS ± SE*	*LS ± SE*	*LS ± SE*
Egg weight, g	62.13 ± 0.83^{ab}	58.06 ± 0.81^{ac}	64.83 ± 0.74^{b}	64.07 ± 0.88^{c}
Eggshell weight, g	7.46 ± 0.17^{a}	7.03 ± 0,16	8.33 ± 0,27^{ab}	7.47 ± 0.2^{b}
Yolk weight, g	17.03 ± 0.29^{ab}	15.20 ± 0.48^{ad}	19.66 ± 0.31^{bc}	18.40 ± 0.25^{cd}
Albumen weight, g	35.16 ± 0.64^{a}	34.33 ± 0.59^{b}	37.43 ± 0.57^{a}	37.13 ± 0.69^{b}

- Same letter designates statistically significant differences at p<0.05

A statistically significant difference in egg weights between control and experimental groups was observed as early as the first stage of the trial: 62.13 g and 58.06 g, respectively (p<0.05). Daneshyar et al. (2007) also reported heavier eggs in control groups, non-supplemented with probiotic. By the end of the second period, the difference in egg weights was not significant. By the end of the experiment, egg weight increased in both groups, by 6.01 g in experimental group and by 2.70 g in controls (p<0.001).

The eggshell weight with the eggshell membrane was the highest in control breeders during the second period – 8.33 g. The eggshell weight increased insignificantly with egg weight in probiotic-supplemented hens.

Egg yolk weight tended to increase in heavier eggs, i.e. at the end of the experiment, by 17.39% in supplemented and by 13.38% in control hens. Such a relationship was reported for eggs of breeders from the gene pool (Lalev et al., 2010).

Table 5. Eggs' morphological traits

Traits	I period, by the 35th day		II period, by the 70th day	
	control	experimental	control	experimental
	LS ± SE	*LS ± SE*	*LS ± SE*	*LS ± SE*
Shape index, %	77.23 ± 0.90	78.13 ± 0.48	77.40 ± 0.67	77.30 ± 0.56
Yolk index, %	45.50 ± 0.55	45.05 ± 0.49	44.56 ± 1.46	44.63 ±0.53
Albumen index, %	9.21 ± 0.49^{a}	8.79 ± 0.29^{b}	7.44 ± 0.31^{a}	7.47 ± 0.38^{b}
Haugh unit, %	82.16 ± 1.91^{a}	82.00 ± 1.25^{b}	74.66 ± 1.57^{a}	74.66 ± 0.80^{b}
Eggshell thickness, mm	0.330 ± 0.005^{a}	0.335 ± 0.005^{b}	0.350 ± 0.005^{a}	0.357 ± 0.004^{b}

- Same letter designates statistically significant differences at p<0.05

The same tendency was preserved for albumen weight - 37.43 g in controls that was superior to the first period (p<0.01). Albumen weight increased also in the experimental group from 34.33 g to 37.13 g (p<0.001).

The shape index (Table 5) varied from 77.23% to 78.13% during the different periods of the trial. The difference between groups was not statistically significant. The average shape index varied within a narrow range (76.01±0.41 to 77.971±0.64) in different chicken breeds (Gerzilov, 2011).

The yolk index was not influenced by the supplementation of the diet of hens with a probiotic.

The egg albumen quality, expressed through the albumen index and Haugh units was not different between experimental and control groups in both experimental periods, but during the second stage, their values decreased in both groups ($p<0.05$). Haugh units vary within a broad range (60–90) under the influence of various factors– age, season, production technology (Van Den Brand et al., 2004).

Eggshell thickness with eggshell membrane, an indirect parameter of its strength, varied from 0.330 mm in eggs produced by control hens during the first period to 0.350 mm in eggs laid during the second period. In our studies, eggshell thickness was proportional to egg mass. No influence was observed after probiotic supplementation. These parameters were within the range ensuring a good hatchability of eggs.

CONCLUSIONS

1. The egg mass in experimental group was 2955.56 g, due to the higher egg laying intensity. The lower feed conversion per egg resulted in lower feed conversion per kg egg mass – by 0.515 g in probiotic-supplemented experimental group.
2. The dietary supplementation with the probiotic had a positive effect on the survival of experimental hens.
3. By the end of the experimental period, egg mass increased statistically significantly in breeders that received the probiotic supplement ($p<0.001$).

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