Effect of Probiotic Preparation Enriched with Selenium on Qualitative Parameters of Table Eggs

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Abstract

In this experiment the effects of the diet for laying hens supplemented with probiotic product with an organic form of selenium on egg weight, albumen quality, yolk quality and egg shell quality were studied. Isa Brown hens (n=90) were randomly divided at the age of 17 weeks into three groups (30 birds per group). Hens in all groups consumed the complete feed mixture *ad libitum*. In the control group water for drinking contained no additions. In the first experimental group probiotic product was added to the water, in the second experimental group the same probiotic preparation enriched with 0.8 to 1 mg of organic selenium per 1 g of the product was added to the water. The probiotic preparations were administered at the dose of 15 mg per 6 l of water daily, in both experimental groups. Monitored physical parameters of eggs: egg weight (g), specific egg weight (g/cm^3), albumen weight (g), albumen height (mm), albumen index, Haugh units (HJ), yolk weight (g), yolk index, yolk color (HLR), egg shell weight, egg shell specific weight (g/cm^3), egg shell strength (N/cm^2), the average eggshell thickness (μm). Experiment lasted 48 weeks. The results showed that egg weight was slightly higher in both experimental groups compared with the control group, differences between the groups were not statistically significant ($p>0.05$). The values in the order of groups: 60.97±4.97, 61.18±5:00; 61.75±5.89 (g±SD). Was found insignificant impact of the add probiotic preparation and probiotic preparation enriched with selenium on the quality parameters of table eggs. Yolk index, albumen index, Haugh units and the average egg shell thickness were only slightly, statistically insignificant higher in the experimental groups ($p>0.05$).

Keywords: organic selenium, probiotic preparation, table eggs

1. Introduction

Poultry are bred in mass production conditions at high concentrations. Possible resulting health problem so can the birds spread rapidly. The important role played by alternative materials which are in the form of feed additives can be added to feed or water the animals [1].

Feed supplements used for poultry have antimicrobial and antioxidant effects. Among the candidate replacements for antibiotics are competitive exclusion products, probiotics, prebiotics, organic acids, enzymes and plant extracts [2].

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For the longest time nutritional supplements used are probiotics. Probiotics are defined as microbial food supplements which beneficially affect the host animal by improving its intestinal microbial balance. The probiotics improved feed conversion for the target species, reduced morbidity or mortality and benefits for the consumer through improved product quality. Potentiated probiotics are more effective than their components separately. Probiotics enhanced the growth of many domestic animals, improved the efficacy of forage digestion and quantity and quality of milk, meat and egg [3]. Probiotic bacteria are used to balance a disturbed intestinal microflora and dysfunctions of the gastrointestinal tract. They could be an effective alternative to the use of synthetic substances in nutrition and medicine [4].

Any microorganism irrespective of its origin, capable of surviving in the digestive tract of host and exerting such effects can be a candidate. Most of the currently used probiotics belong to prokaryotic origin [5].

Implementation of probiotics has great potential in delivering promising results by reducing the intestinal pathogenic load and thereby reducing the subsequent contamination in poultry production. Several mechanisms of action have been proposed including resistance to colonization, competitive exclusion, production of toxic and inhibitory compounds, competition for nutrients and stimulation of the immune system [6]. The modulation of the gut microbiota with new feed additives, such as probiotics and prebiotics, towards host-protecting functions to support animal health, is a topical issue in animal breeding and creates fascinating possibilities. Genomic-based knowledge on the composition and functions of the gut microbiota, as well as its deviations, will advance the selection of new and specific probiotics [7].

Options to use of probiotics in poultry breeding. Probiotics research focuses on the impact on health or performance and quality of poultry products. In the experiment of Van Coillie, et al., (2007) [8] were lactobacilli isolated from the cloaca and vagina of laying hens. Lactobacilli were observed to inhibit Salmonella growth in vitro, most probably through production of lactic acid, and to decrease in vivo the *Salmonella enteritidis* colonization of chicks. The favorable impact of certain strains of lactobacilli about salmonella inhibition observed also Yamazaki et al., (2012) [9] or Chen et al., (2012) [10].

Theoretical and scientific knowledge indicate that the number of *Escherichia coli* cells in the control groups should be higher and the number of CFU *Enterococcus faecium* and *Lactobacillus sporogenes* should be lower [11]. Among animal products are table eggs of aspect of handling their internal contains one of the most affordable modifiable livestock commodities [12]. According to Yodseranne et al., (2003) [13] probiotics can improve egg yolk color and increase content of albumen in eggs [14]. Investigated the effect of dried cultures of *Bacillus subtilis* on the quality of the eggs of laying hens. After addition of 500 mg of *Bacillus subtilis* culture results showed an increase in egg production, feed consumption and improved feed utilization laying hens.

Mo et al. (2004) [15] added to the feed of laying hens, three types of probiotics. Compared to the control group were egg production, egg quality and the number of intestinal lactic acid bacteria improved, or a significantly increased. Balevi et al., (2001) [16] recorded in a group with complement of 500 ppm probiotic products lower feed conversion and significantly lower number of damaged eggs.

2. Materials and methods

Animals, diets and treatments

Hens (n=90) of the laying hybrid Isa Brown 17 weeks old, were randomly divided into 3 groups (n=30) and fed for 48 weeks with standard feed mixture *ad libitum.*

At the beginning of the experiment, the hens were kept in three–deck cage technology system. The layer hens were kept by the standard bioclimatic conditions.

In the control group hens drank water without any additions. In the experimental groups probiotic was added daily to water. In the first experimental group was added probiotic preparation of *Enterococcus faecium*, in the second experimental group was added the same preparation enriched with selenium.

The product contained in 1 g of dry substance at least 200 x 109 lactacidogenic live bacteria *Enterococcus faecium–74.*

The probiotic preparation enriched with selenium contained 0.8 to 1 mg of organic selenium in 1 g of the product. The probiotic preparations were administered at a dose of 15 mg of 6 l of water daily, in both experimental groups.

During the trial were monitored following physical qualitative parameters of eggs: egg weight (g), specific egg weight (g/cm^3), albumen weight (g), albumen height (mm), albumen index, Haugh units (HJ), yolk weight (g), yolk index, yolk color (°HLR), egg shell weight, egg shell specific weight (g/cm^3), egg shell strength (N/cm^2), the average eggshell thickness (μm).

Sample Analysis

Eggs of laying hens of Isa Brown strain were collected regularly once a month and were assessed immediately after collection. All parameters were detected using routine methods. Weight parameters were detected using analytical weighting machine and the growth intensity and percentage contents were calculated from weight data. Indexes were calculated as the lenght: width ratio. Haught units (HU) detected egg quality as relation of albumin weight and egg weight [100 log.(dense albumin height–1.7x egg weight$^{0.37}$+7.6)]. Yolk color was evaluated using Hoffman la Roche color scale (Hoffman–La Roche, Switzerland) and egg shell strength was detected using Egg Crusher 1.1 (VEIT Electronics, Czech Republic).

Statistical analysis

Differences among the observed parameters in the groups were tested by one-way analysis of variance, the results were completed by Tukey's test, in the SAS program.

3. Results and discussion

Average egg weight in each group during the entire period was 60.95; 61.16 and 61.73 g respectively. As is clear from the undistinguished differences, the differences between treatment groups and control groups were not statistically significant ($p>0.05$). When comparing the experimental group with the addition of selenium-enriched probiotics to the control group, the mass of the egg is higher, particularly in the second and third period of the reference of the laying period. Increase of egg weight addition of probiotics found in their experiments Davis, and Anderson, (2002) [17], respectively Ramasamy et al., (2009) [18]. These conclusions to the results of their experiments, however, do not confirm Sohail et al., (2002) [19], respectively Gallazzi et al., (2008) [20].

In specific egg weight were observed between experimental groups and control group slight differences ($p>0.05$). The values in the order of groups: 1,082; 1.083 and 1.081 g.cm^{-3}). The results of experiments teams Tangtaweewipat et al., (2003) [21], respectively Kurtoglu et al., (2004) [22] was similarly negligible effect of probiotics on the change in specific weight of the eggs. Conversely Sohail et al., (2002) [19] after application of the formulation of *Bacillus subtilis* C-3102 and the addition of the protein had a significant increase in specific egg weight of hens in the experimental groups. Specific egg weight of eggs increased more in hens fed much higher doses than in hens fed the lower dose, at a protein concentration of 15%.

Weight egg yolks in our experiment was on average for the period in the order of groups 16.60 ±1.74; 16.82±1.63 and 16.59±1.65 g. Difference between the groups was not statistically significant ($p>0.05$). Similarly, Tangtaweewipat et al., (2003) [21] in line with our findings had a insignificant difference in this indicator.

Index yolks gradually decreased in all groups, which generally is related to a decline in the quality of the individual parts during egg laying. Yolk index values in the order of groups 51.85; 52.14 and 52.06. The experimental groups were on average higher yolk index value, a statistically significant difference compared to the control group was not observed ($p>0.05$). Kurtoglu et al., (2004) [22] reported increases the yolk index, with an increasing rate of probiotics in each group. Panda et al., (2000) [23] in their experiment had increased daily egg production, but the quality of the yolk is the positive effects of the addition of probiotics significantly not shown. Conversely Yalcin et al., (2002) [24] showed statistically significant differences not only in the live weight of chickens and feed consumption, but also in the yolk index.

Yolk color values in each group were in each month and for the whole experiment, on average, very balanced, and therefore differences between groups were not statistically significant. Our results are consistent with the findings of Kalavathy et al., (2005) [25]. Contrast to our results, however, Yodseranne et al., (2003) [26] found a beneficial effect of probiotics. Kurtoglu et al., (2004) [22] found a tendency to improvement in the yolk color group with the addition of probiotics.

Table 1. Influence of probiotic preparation on the base *Enterococcus faecium* and probiotic preparation on the base *Enterococcus faecium* enriched with selenium addition into laying hens feed mixture on the alterations of Isa Brown laying hen's egg weight and egg yolk quality

Statistical charakteristics	Groups			p value
	BD Control	BD+Probiotics on the base *Enterococcus faecium*	BD+Probiotics on the base *Enterococcus faecium*+Se	
		Egg weight (g)		
mean	60.95	61.16	61.73	
S.D.	4.92	5.00	5.89	0.4212
CV%	8.07	8.18	9.54	0.3984
min.	42.30	45.60	46.80	0.4113
max.	78.30	76.00	79.30	
		Specific egg weight (g/cm^3)		
mean	1.082	1.083	1.081	0.5924
S.D.	0.008	0.008	0.008	0.2940
CV%	0.74	0.74	0.74	0.1565
min.	1.037	1.047	1.034	
max.	1.105	1.110	1.101	
		Yolk weight (g)		
mean	16.60	16.82	16.59	0.6011
S.D.	1.74	1.63	1.65	0.8417
CV%	10.45	9.67	9.94	0.8414
min.	12.00	10.70	12.00	
max.	25.00	22.30	23.10	
		Yolk index		
mean	51.85	52.14	52.06	0.0661
S.D.	3.10	2.85	3.08	0.0947
CV%	5.98	5.47	5.92	0.3660
min.	43.00	45.0	43.90	
max.	62.85	61.1	63.64	
		Yolk color (°HLR)		
mean	7.66	7.56	7.69	0.2312
S.D.	0.67	0.69	0.67	0.2556
CV%	8.67	9.00	8.71	0.2356
min.	6.00	6.00	4.00	
max.	9.00	9.00	9.00	

Albumen weight. Over the entire twelve-month experimental period was between the second experimental group and the control group reported a statistically significant difference ($p<0.05$) (values in the order of groups 38.80, 38.96 and 39.25 g).

Egg albumen index in all groups gradually decreased, which is related to the deteriorating quality of whites advancing laying. Average values for each group were 87.13; 87.54 and 88.21. In the second experimental group with selenium supplement probiotics and the albumen index is slightly higher compared with the control group, but statistically significant difference was not observed in either of the combinations of the groups.

Higher index of sclera using probiotics reported Yalcin et al., (2002) [24].

Haugh unit values were in the order of groups 82.08; 82.55 and 81.90 HJ. They do not feature in this indicator probiotic effect, a slightly higher value compared with the control group was observed in both experimental groups ($p>0.05$). Above Haugh units recorded in his experiment after the addition of probiotics [14]. Yalcin et al., (2002) [24] in their experiment filed statistically significant differences in the index of the albumen, and Haugh units were significantly unchanged.

Table 2. Influence of probiotic preparation on the base *Enterococcus faecium* and probiotic preparation on the base *Enterococcus faecium* enriched with selenium addition into laying hens feed mixture on the alterations of Isa Brown laying hen's egg albumen quality

Statistical charakteristics	Groups			p value
	BD Control	BD+Probiotics on the base *Enterococcus faecium*	BD+Probiotics on the base *Enterococcus faecium*+Se	
		Albumen weight (g)		
mean	38.80	38.96	39.25	0.53500
S.D.	3.85	4.19	5.09	0.0431
CV%	9.92	10.75	12.88	0.0489
min.	19.90	24.40	25.70	
max.	52.10	57.90	58.00	
		Albumen index		
mean	87.13	87.54	88.21	0.4287
S.D.	11.27	11.83	71.70	0.0647
CV%	12.93	13.51	13.26	0.3151
min.	49.38	52.63	50.63	
max.	123.29	126.76	130.44	
		Haugh Units (HU)		
mean	82.08	82.55	81.90	0.5375
S.D.	5.56	5.57	5.50	0.4293
CV%	6.77	6.75	6.72	0.2312
min.	56.15	56.09	59.48	
max.	49.18	97.01	97.83	

Egg shell weight in our experiment was in the order of groups; 5.60; 5.68 and 5.64 g. Were not statistically significant differences for the whole laying period on average between the two experimental groups compared with the control group ($p>0.05$). The opposite conclusions reached in their experiment Perumalla, et al., (2012) [6]. The specific egg shell weight were similar to the specific weight of whole egg between groups and therefore at least statistically significant differences ($p>0.05$). A similar finding has also Kalavathy et al., (2005) [25].

Shell strength values in our experiment, 23.90; 24.37 and 23.62 N/cm^2. The highest strength was the first experimental group with the addition of probiotics, but the difference was not statistically significant compared to the control group ($p<0.05$). Reach the same conclusion in his experiment [28].

The average thickness of the shell was in the order of groups 353.11; 365.89 and 361.14 microns. Similar to the strength even in the indicators were not statistically significant differences between the two experimental groups compared with the control group ($p>0.05$). Insignificant effect of probiotics on eggshell thickness in accordance with our findings reported Kucukersan, et al., (2002) [28], respectively Asli et al., (2007) [29]. Beneficial effect of probiotics found Kurtoglu et al., (2004) [22], or Xu et al., (2006) [14].

Table 3 Influence of probiotic preparation on the base *Enterococcus faecium* and probiotic preparation on the base *Enterococcus faecium* enriched with selenium addition into laying hens feed mixture on the alterations of Isa Brown laying hen's egg shell quality

Statistical charakteristics	Groups			p value
	BD Control	BD+Probiotics on the base *Enterococcus faecium*	BD+Probiotics on the base *Enterococcus faecium*+Se	
		Egg shell weight (g)		
mean	5.60	5.68	5.64	0.3564
S.D.	0.61	0.64	0.67	0.3782
CV%	10.97	11.27	11.87	0.3779
min.	3.1	3.4	2.7	
max.	7.2	7.4	7.8	
		Egg shell specific weight (g/cm^3)		
mean	2.01	2.01	2.01	0.2783
S.D.	0.16	0.11	0.12	0.5027
CV%	7.96	5.47	5.97	0.6273
min.	1.29	1.48	1.28	
max.	3.20	2.86	2.89	
		Egg shell strength (N/cm^2)		
mean	23.90	24.37	23.62	0.2280
S.D.	6.32	6.23	5.66	0.1454
CV%	28.44	25.56	11.80	0.1119
min.	11.15	11.00	12.00	
max.	46.85	49.85	44.80	
		Average eggshell thickness (µm)		
mean	353.11	365.89	361..14	0.0913
S.D.	31.62	31.53	31.67	0.1108
CV%	8.96	8.83	8.87	0.3757
min.	223.33	240.13	236.0	
max.	420.00	430.00	450.0	

4. Conclusions

The results showed that egg weight was slightly higher in both experimental groups compared with the control group, differences between the groups were not statistically significant (p>0.05). The values in the order of groups: 60.95±4.92, 61.16±5:00; 61.73±5.89 (g±SD). Was found insignificant impact of the add probiotic preparation and probiotic preparation enriched with selenium on the quality parameters of table eggs. Yolk index, albumen index, Haugh units and the average egg shell thickness were only slightly, statistically insignificant higher in the experimental groups (p>0.05).

Acknowledgements

This study was supported by Grant Agency for Science, VEGA of Slovak Republic, Grant No.1/0493/12 and KEGA No 035 SPU–4/2012

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