Effects of Different Supplement Inclusion of the Enriched Diet on Productive Performance and Egg Structure

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Abstract

Nutritional manipulation and genetic selection for egg size and production may lead to changes in egg components. This experiment was carried out to analyse the egg structure parameters of eggs produced by Hisex Brown laying hens fed with a diet including different supplements. The intensity of egg production was significantly higher in the groups fed with feed enriched with iodine (90.00%), vitamin E (90.00%) and selenium (91.98%), and significantly lower in the group fed with DHA inclusion (76.00%) as comparative to the control group (82.00%), at a confidence interval of 95%. Concerning diet supplemented with selenium and diet supplemented with vitamin E, the egg yolk weight was statistically different compared with those in the control group (confidence interval of 95%). The yolk weight averaged 1.80 g more and 1.29 g more, respectively, than the yolk weight in the control group. The egg shell weight was statistically different in diet enriched with iodine compared with the control. The egg shell weight averaged 1.48 g less per egg for the eggs enriched with iodine, which is 17.45% less than in the control group. Enriched eggs offer consumers a variety of value-added options for their egg purchase. Although enriched eggs may provide consumers with a specific quality attribute or healthy ingredient, they do not appear to provide quality and value in a traditional sense as defined by the standards of quality and grade.

Keywords: *eggs, Hisex Brown, egg production, structure, supplements.*

INTRODUCTION

The global approach for improving the nutritional value of eggs (ω3 fatty acids, vitamins, minerals) by manipulating the components of the hen's feed is called the "enhanced egg" (Anton *et al.*, 2006). Enrichment of egg content with some supplements was performed with modification of the feed composition (Gjorgovska and Filev, 2011). The most common enriched eggs are with omega 3 fatty acids (Filev *et al.*, 2001a; Filev *et al.*, 2001b; Laca *et al.*, 2009; Csuka *et al.*, 2008), vitamin E (Grobas *et al.*, 2002; Mori *et al.*, 2003; Zang *et al.*, 2011), selenium (Yaroshenko *et al.*, 2003; Skrivan *et al.*, 2006;) and iodine (Dobrzanski *et al.*, 2001; Opalinski *et al.*, 2012). A lot of studies presented the content of the supplementary element in the eggs enriched as functional food, but there is a lack of information about the egg structure parameters and productive performance. The nutrient content and values specified on the product labelling determine consumer acceptance of specialty eggs. Previously reported data on egg components found that eggs are 58% white, 31% yolk, and 11% shell (Stadelman and Cotterill, 1977). Nutritional manipulation and genetic selection for egg size and production may lead to changes in egg components.

The present study was carried out to analyse the egg structure parameters of enriched eggs produced by Hisex Brown laying hens fed with feed enriched with different supplements.

MATERIAL AND METHODS

The current experiment was conducted on 80 moulted laying hens (hybrid Hisex Brown), 80 weeks old, divided in four groups, 20 in each, and accommodated 2 per cage. The birds were housed in standard poultry house. The hens were fed with 120g feed per day/hen (in the feeder for 2 hens, 240g feed was added daily). The experiment was conducted under permitted ethical rules and regulations. The composition of the basal diet is shown in Table 1. The basal diet was enriched with 5 mg/kg iodine (group 1), 200 mg/kg Vitamin E (group 2), 0.46 mg/kg selenium (group 3) and 1,180 mg/kg DHA (Docosahexaenoic acid) (group 4).

The experiment was performed during 45 days. The number of produced eggs was monitored every day. The egg structure parameters (egg weight, white weight, yolk weight and eggshell weight) and their percentage in the egg weight was measured on 6 randomly selected eggs 3 times during the experiment (every 15th day) on balance Precisa BJ 1000C with 0.1 g accuracy. The eggs were weighed, and then yolks were separated with an egg separator and weighed. The shell was wiped clean and weighed. The albumen weight was calculated by subtracting yolk and shell weight from total egg weight.

Statistical analysis was performed by Statgraph 3 software package. One-way analysis of variance (ANOVA) was used for the differences between groups. When the F values were significant, the Duncan's Multiple Range Test was performed.

RESULTS AND DISSCUSION

The effects of the different supplements (iodine, vitamin E, selenium and DHA) on the productive performances of the experimental hens are presented in table 2.

During the experiment there were no health disorders, and mortality was within the technological norms, while differences between groups were not significant. At the beginning and the end of the experiment, the hens had similar body weight; differences in body weight between groups at the beginning and the end of the experiment were not statistically significant (P > 0.05). The absence of a response to the dietary inclusion of iodine, vitamin E, selenium and DHA, on the live weight of laying hens (P >0.05) in the present study (Table 2) confirmed the findings of

Tab. 1. Composition of the basal diet

Ingredient	%
Maize	54.72
Soybean meal	22.50
Sunflower meal (28%)	5.00
Maize gluten	2.00
Sunflower oil, crude	2.88
Synthetic methionine	0.07
Choline chloride (60%)	0.11
Potassium carbonate	0.31
Sodium bi carbonate	0.40
Bentonal	0.30
Mono calcium phosphate	1.25
Calcium carbonate	9.79
Salt	0.17
Premix	0.50
Total	100.00
ME, Kcal/kg	2750
Crude protein	17.8
Lysine	0.91
Methionine	0.36
Methionine + cysteine	0.69
Threonine	0.63
Tryptophan	0.19
Arginine	1.12
Calcium	4.00
Phosphorus, total	0.62
Phosphorus, available	0.37
Potassium	0.82
Sodium	0.21
Chlorine	0.17
Electrolyte balance, mEq/kg	249

studies conducted on laying hens (Opalinski *et al.*, 2012; Scheideler *et al.*, 2010; Ciftci *et al.*, 2005; Hamady, 2013).

In the present study, egg production was recorded as 91.98%, 90.00%, 90.00%, 76.00% in the groups fed the supplemented diets containing iodine, vitamin E, selenium and DHA, respectively (Table 2). The intensity of egg production was significantly higher ($P<0.05$) in the groups fed with feed enriched with iodine (90.00%), vitamin E (90.00%) and selenium (91.98%), and significantly lower ($P<0.05$) in the group fed with feed enriched with DHA (76.00%), as compared to the control group (82.00%), at a confidence interval of 95%. The egg production was significantly higher in the groups supplemented with iodine, vitamin E and selenium ($p<0.05$) and lower in hens supplemented with DHA ($p<0.05$). The positive response of the mentioned supplements was consistent with reports by Ciftci *et al.* (2005) for laying hens and supplemented vitamin E, and by Leeson *et al.* (2008) for selenium inclusion in broiler breeder hens.

The effects of different supplement-enriched diet on egg structure are presented in table 3.

The results reported in table 3 show that diet of the laying hens enriched with different supplements can greatly affect the egg structure components. These results show that egg weight, egg yolk weight and egg shell weight were statistically different. Egg weight in the selenium-enriched diet group differs statistically

Tab. 2. Effect of different supplements enriched layer diets on production parameters

Specification	Control group	Group 1 Enriched diet with iodine	Group 2 Enriched diet with vitamin E	Group 3 Enriched diet with selenium	Group 4 Enriched diet with DHA
Number of hens	20	20	20	20	20
Hen's weight, kg					
- at the beginning	2.18±0.12	2.33±0.19	2.26±0.24	2.27±0.21	2.22±0.16
- at the end	2.26±0.15	2.26±0.19	2.25±0.25	2.26±0.25	2.21±0.20
Egg production					
- laying intensity,%	82.00	90.00 [a]	90.00 [a]	91.98 [a]	76.00 [a]
Feed consumption					
- daily consumption, g	120	120	120	120	120

DHA - Docosahexaenoic acid
[a] Significant differences in respect to the control for the t-tests run to compare means.
Confidence interval of 95%

Tab. 3. Effects of different supplement-enriched layer diet on egg structure parameters

Egg components	Control group	Group 1 Enriched diet with iodine	Group 2 Enriched diet with vitamin E	Group 3 Enriched diet with selenium	Group 4 Enriched diet with DHA
Egg, g	67.36±3.11	68.35±4.43	70.00±5.75	71.93±5.39a	67.19±4.94
White, g	41.16±2.14	42.60±3.46	42.43±4.34	43.88±4.68	39.81±4.35
Yolk, g	17.72±1.56	18.84±0.95	19.01±1.73a	19.52±1.07a	19.31±2.12a
Shell, g	8.48±0.54	7.00±0.41a	8.56±0.76	8.53±0.52	8.07±0.58
White, %	61.11±1.65	62.27±1.59	60.54±2.26	60.87±2.29	59.15±3.21a
Yolk, %	26.28±1.64	27.62±1.34	27.22±2.02a	27.25±2.12	28.82±3.09a
Shell, %	12.61±0.87	10.27±0.72a	12.25±0.82	11.88±0.48a	12.03±0.74
Edible portion, %	87.39±0.87	89.89±1.13a	87.75±0.82	88.12±0.48a	87.98±0.74a
Yolk:white	43.09±3.70	44.42±3.12	45.13±4.97	44.96±5.32	49.13.±7.74a

Values are means ± S.D. DHA - Docosahexaenoic acid
[a] Significant differences respect to the control for the t-tests run to compare means.
Confidence interval of 95%

significantly from the egg weight in the control group. Concerning diet enriched with selenium and diet enriched with vitamin E, the egg yolk weight was statistically different compared with the control group (confidence interval of 95%). The yolk weight averaged 1.80 g more and 1.29 g more, respectively, than the yolk weight in the control group. The egg shell weight was statistically different in the group whose diet was enriched with iodine as compared with the control. The egg shell weight averaged 1.48 g less per egg for the eggs enriched with iodine, which represents 17.45% less than in the control group. The total edible portion constituted 87.39 to 89.89% of all the eggs examined. The total edible portion was the lowest in the control group, and the highest value was recorded in eggs from hens with iodine-enriched diet ($P < 0.05$).

As compared to the control group, diet fortified with several supplements significantly increased some egg quality parameters. Hens receiving only selenium had a significantly higher egg weight. Selenium eggs are 6.78% heavier than those in the control group. These results are similar with the results reported by Attia *et al.* (2010) for breeders, for the Japanese quails reported by Maldarasanu *et al.* (2013) and Semaska *et al.* (2011), Arpasova *et al.* (2009a), and for Hy-line Brown laying breed, for ISA Brown Warren laying hens reported by Invernizzi *et al.* (2013). There are no significantly differences in white weight among the eggs from the control group and the eggs from the groups supplemented with iodine, vitamin E, selenium and DHA ($p > 0.05$). Addition of the different supplements in the diet improved the yolk weight by 10.16%, 8.97% and 7.28% in selenium, DHA and vitamin E eggs, respectively in comparison with the eggs in the control group ($p < 0.05$). In addition, other authors reported similar improvement of the egg yolk, Scheideler *at al.* (2010) in trial with supplemented vitamin E and selenium, Arpasova *et al.* (2009ab) with selenium, Hamady (2013) with different ratios of omega 6 and omega 3, and Mennicken *et al.* (2005) for quails. In this study, a lower weight of eggshell (7.00 g) in iodine eggs was recorded in comparison with the control group ($p < 0.05$). This response was similar with the findings of the study conducted by Lichovnikova *et al.* (2003) with long-term effects using higher amount of iodine, but in opposition to findings reported by Lichovnikova and Zeman (2004) and Opalinski *et al.* (2012).

The change in animal feeds that came along with domestication of animals has resulted in alterations in the vitamin, mineral and fatty acid content. The contents of yolk and white differed significantly among DHA eggs when compared to control eggs; the percentage of yolk increased significantly, but the percentage of white decreased significantly ($p < 0.05$). The egg yolk content was higher in vitamin E eggs when compared with control eggs $P < 0.05$). The highest value (49.13) of the yolk:white ratio was noticed in the eggs enriched with DHA ($P < 0.05$). Several factors affect the total edible portion and yolk:white ratio. The age of hen, size of eggs, nutrition, and strain can affect these parameters (Ahmadi and Rahimi, 2011; Roberts, 2004; Galea, 2011).

CONCLUSIONS

The results of the present study demonstrated that different supplements had varying effects on egg production, egg weight and egg structure of birds.

The intensity of egg production was significantly higher in the groups fed with feed enriched with iodine (90.00%), vitamin E (90.00%) and selenium (91.98%), and significantly lower in the group fed with feed enriched with DHA (76.00%) in respect to the control group (82.00%), at a confidence interval of 95%.

Concerning diet enriched with selenium and diet enriched with vitamin E, the egg yolk weight was statistically different compared with the control group (confidence interval of 95%).

The egg shell weight was statistically different in diet enriched with iodine compared with the control.

The total edible portion was the lowest in the control group, and the highest value was in enriched eggs with iodine ($P < 0.05$).

The current interest in the relationship between diet and health provides opportunities for producing and marketing nutritionally modified chicken eggs. Enriched eggs offer consumers a variety of value-added options for their egg purchase. Although enriched eggs may provide consumers with a specific quality attribute or healthy ingredient, they do not provide quality and value in a traditional sense as defined by the standards of quality and grade.

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