Analysis of Changes in Egg Quality of Autochthonous Chicken Breed Oravka during Laying Period

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Abstract
The aim of the work was to analyse of changes in external and internal characteristics of eggs of autochthonous chicken breed Oravka during laying cycle. A total of 350 eggs were collected to study for egg weight in g, egg shape index in %, shell thickness in mm, yolk, albumen and shell weight in g and their proportion in the egg mass, yolk index in % and Haugh units score in 26, 31, 36, 41, 46, 51 and 56 weeks of age (60 eggs for each age). The results showed that as the laying cycle of hens progressed, the egg weight and egg shape index were increased ($P<0.05$). During laying period increased ($P<0.05$) yolk weight and yolk proportion in the egg mass, whereas the albumen proportion and Haugh unit score decreased ($P<0.05$) with age of hens. The quality of yolk and albumen decreased ($P<0.05$) as the laying cycle advanced. The other results showed that eggshell proportion and thickness were reduced ($P>0.05$), especially by the end of laying cycle.

Key words: age, egg quality, hen, laying cycle, Oravka.

1. Introduction

In European countries, various governmental, nongovernmental, and private organizations try to preserve genetic diversity of livestock in situ (e.g., by stimulating the use of indigenous, rare breeds by farmers; in nature reserves; or in non-commercial farms). In the case of poultry, maintaining in situ populations of the non-commercial (fancy) breeds largely relies on hobby farmers. In addition to in situ conservation, gene banks are being established for ex situ conservation [1,2].

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Named after the province of Orava, in northern Slovakia, Oravka was created by crossbreeding of the regional hens with Rhode Island, Wyandotte and New Hampshire was fulfilled during the individual stages of breeding programme, which started in the 1950`s [3,4]
Oravka was recognised as breed in year 1990. The original breeding goal to create a dual-purpose poultry breed with good egg production, growth ability and adaptability on alternative outdoor rearing [5,6],
The agreement with standard of breed Oravka is the egg production 180 to 200 eggs with a brownish eggshell, the minimum hatching egg weight is 58g [6-10].
The egg quality parameters are under the influence of a number of factors and major one

of which is the breed or variety of the observed chicken. From the point of view of consumers, egg weight is the most important quality trait. Among many quality characteristics, external factors including cleanliness, freshness, egg weight and shell weight are important in consumer's acceptability of shell eggs [11-13].
The internal quality of egg is very important from the consumers view point but it cannot be assessed without breaking the egg. The interior of hen´s egg consists of the yolk and white or albumen. Interior characteristics such as yolk index, Haugh unit and chemical composition are also important in egg product industry as the demand for liquid egg, frozen egg, egg powder and yolk oil increases [14,15].
The present study was conducted to evaluate of some parameters of external and internal egg quality during lying period of Oravka hens.

2. Materials and methods

The birds were kept in deep litter system with density 7 hens/m^2. During the egg production period, hens were fed *ad libitum* a commercial feed mixture. Feeding and watering were *ad libitum*. Birds were exposed to natural light as a practiced in rural areas of South-West Slovakia.

Table 1. Nutritional value in 1 kg complete feed mixture

Nutrient	Unit	Value
Crude protein	g	158.06
ME	MJ	11.32
Lysine	g	8.07
Methionine and cistine	g	7.02
from that methionine	g	3.87
Calcium	g	35.13
Phosphorus	g	5.48
Sodium	g	2.17
Cooper	mg	18.74
Zinc	mg	102.27
Manganese	mg	148.79
Selenium	mg	0.38
Vitamin A	I.U.	10 000
Vitamin D_3	I.U.	2 500
Vitamin K	mg	21.27

Egg weight was individually determined to 0.01g accuracy using a laboratory scale Owa Labor (VEB Wägetechnik Rapido, Germany). Egg shape index was calculated as the ratio of egg width to length (%) by the method of [16].
After the eggs were broken, egg shells were washed with water and dried in order to clean the remaining albumen. Following this procedure, shell weight (with membrane) was measured using a laboratory scale Owa Labor (VEB Wägetechnik Rapido, Germany) and the percentage proportion of the shell in the egg was determined. Shell thickness (with membrane) was measured at the sharp poles, blunt poles and equatorial parts of each egg. Shell thickness was obtained from the average values of these three parts.
The albumen weight was calculated from the difference between the egg weight, and the yolk and shell weight and the percentage proportion of the albumen in the egg was determined. Albumen index (%) was determined by the method of [17] on the basis of the ratio of the thick albumen height (mm) measurement taken with a micrometer to the average of width (mm) and length (mm) of this albumen with 0.01mm accuracy. Haugh unit score was calculated according to the procedure of [18].
Yolk weight with 0.01 g accuracy was determined using the laboratory scale Owa Labor (VEB Wägetechnik Rapido, Germany) and its percentage proportion was calculated. Yolk index (%) was measured on the basis of the ratio of the yolk height (mm) to the yolk width (mm) by the method of [19] using micrometer with 0.01mm accuracy.
Data were analyzed using analysis of variance [20]. Significant difference was used at 0.05 probability level and differences between ages of hens were tested using the Duncan's Multiple Range Test [21]

3. Results and discussion

As shown in Table 2, in our experiment egg weight of Oravka was statistically significant (P<0.05) increased by the age of hens (from 49.62g in 26 weeks of age to 54.76g in 56 weeks of age). On the other authors, egg weight increases with the breeder age [22-26]. This fact was due to the increasing weight of the yolk rather than white, whose proportion in the egg mass decreased [27]. [28] found that egg weight of Cobb hens aged 35 and 45 weeks was 66.44g and 70.56g, respectively, and it was higher than in our experiment. Equally to our experiment, [29] observed a successive increase in egg weight as the Cobb 500 hens grew older. [30] recorded that average egg weight of Hubbard Flex hens increased by about 2.5g within each three-week interval.

Table 2. Effect of age on egg and eggshell characteristics

Week of age	Egg weight (g).	Egg shape index (%)	Eggshell weight (g)	Eggshell proportion (%)	Eggshell thickness (μm)
26.	49.92±3.84	75.24±2.97	4.94±0.59	9.95 ±0.78	323.41±24.85
31.	50.11±4.08	75.08±2.74	4.97±0.44	9.91±0.65	322.97±22.51
36.	51.46±3.96	75.06±2.81	5.09±0.61	9.89±0.71	322.77±23.94
41.	52.04±4.21[a]	74.88±2.59	5.14±0.52	9.87±0.84	322.48±23.17
46.	52.39±4.46[b]	74.63±2.87	5.17±0.41	9.86±0.63	321.95±24.28
51.	53.11±4.32[c]	74.38±2.25	5.22±0.47[a]	9.83±0.72	321.74±23.37
56.	53.76±4.39[d]	74.16±2.43[a]	5.28±0.51[b]	9.77±0.81	321.42±24.49

Values shown are mean±SD (standard deviation)
[a,b,c,d] means in a row with different superscript differ significantly

Present study showed significantly (P<0.05) increase egg shape index as the laying period progressed (from 75.24% in 26 weeks to 74.16% in 56 weeks of age) because eggs become more elongated [31,32].

The eggshell percentage proportion in the egg mass was proved to have no significantly lower (P>0.05) values with increasing hen age (from 9.95% in 26 weeks to 9.77% in 56 weeks of age). However, eggshell weight was higher (P<0.05) in hens in 56 weeks (5.28g) than in 26 weeks (4.94g) of age (Table 2). We found no statistically significant (P>0.05) reduction in the eggshell thickness during laying period (from 323.41μm in 26 weeks to 321.42μm in 56 weeks of age. [33] observed decrease in eggshell characteristic until broiler breeders reached 60 weeks of age. [34] found statistically deterioration of eggshell characteristics for increased age of hens from 28 to 80 weeks of age.

Table 3. Effect of age on yolk and albumen characteristics

Week of age	Yolk weight (g)	Yolk proportion (%)	Yolk index (%)	Albumen weight (g)	Albumen proportion (%)	Haugh unit score
26.	14.24±1.68	28.69±1.21	45.87±1.86	30.44±2.65	61.35±2.11	88.21±2.67
31.	14.69±2.07	29.34±1.19	45.31±1.71	30.45±2.54	60.95±2.14	88.07±2.54
36.	15.09±1.89	29.31±1.14	44.96±1.96	31.28±2.69	60.79±2.17	87.51±2.86
41.	15.46±1.97	29.72±1.18	44.11±1.74	31.44±2.71	60.42±2.15	87.39±2.31
46.	15.99±2.11[a]	30.53±1.22	43.64±1.68	31.53±2.54	60.18±2.19	87.11±2.49
51.	16.34±1.86[b]	30.76±1.17	42.88±1.72[a]	31.55±2.66	59.41±2.17[a]	86.88±2.73
56.	16.82±1.95[c]	31.13±1.18[a]	41.95±1.69[b]	31.96±2.87[a]	59.12±2.21[b]	85.59±2.61[a]

Values shown are mean±SD (standard deviation)
[a,b,c] means in a row with different superscript differ significantly

We recorded significantly increase (P<0.05) of yolk weight in relation with progressing age of hens (14.24g in 26 weeks vs. 16.82 g in 56 weeks of age. [33] recorded that egg from older broiler breeders (aged 58 weeks) had a higher yolk weight compared with hen in start of laying period

(22 weeks of age). During laying cycle we found a significant increase in the yolk percentage from 28.69% in 26 weeks to 31.13% in 56 weeks of age. The reduction in the yolk index value in our experiment (45.87% in 26 weeks vs. 41.95% in 56 weeks of age) with advancing of laying period may indicate decrease of yolk quality. The results of studies on broiler breeders made by [29] also provide unequivocal results. The authors found a higher yolk height value in birds aged 58 weeks, as compared with the age of 54 and 62 weeks.

We recorded significantly increase ($P<0.05$) of albumen weight in relation with progressing age of hens (30.44g in 26 weeks and 31.96g in 56 weeks of age), whilst albumen proportion decrease during laying period (61.35% in 26 weeks and 59.12% in 56 weeks of age. [35] recorded that eggs from older broiler breeders (aged 58 weeks) had a lower white weight compared with hen at the start of egg laying (22 weeks of age).

We found decrease ($P<0.05$) of number of Haugh units score by progressing age of hens (from 88.21 in 26 weeks of age to 85.59 in 56 weeks of age). This fact indicates deterioration of this characteristic with hen age Albumen characteristics (index, Haugh units) gradually worsened with the increasing age of the [36-38]. The mean number of Haugh unit score obtained in our experiment was about 10.2 points higher than that observed by [29] for the same broiler breeders Cobb 500 of the same age. [28,39,40] proved similar tendencies.

4. Conclusions

In conclusion, the findings of this experiment showed that egg weight, egg shape index, yolk percentage and eggshell, albumen and yolk weights increased by progressed of laying period, whereas eggshell and albumen percentages decreased. The quality of yolk and albumen deteriorated during reproductive season of hens. Eggshell thickness was reduced by the end of laying cycle.

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