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EFFECT OF GENOTYPE AND AGE OF LAYING HENS ON THE QUALITY OF EGGS AND EGG SHELLS

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Abstract

The paper presents the results of testing of the egg and egg shell quality of two light line hen hybrids (Tetra SL and Bowans Brown). There were total of 4 tests. At the end of 35, 45, 55 and 65 weeks of age, the external and internal egg quality properties were tested as well as the quality of egg shell. Testing was conducted on a sample of 30 eggs for each hybrid. The weight and egg shape index were determined for each egg, as properties of the external quality, also internal quality properties such as albumen height and value of Haugh units (HU), and of the egg shell qualities - measured the egg shell deformation, the shell breaking force, the weight of raw shell and egg shell thickness were determined. The weight of the eggs did not differ significantly under the influence of said factors. Significantly higher mean values of the egg shape index at the age of 35 weeks were determined in comparison to 65 weeks of age. Under the influence of genotype, significantly higher ($p<0.05$) values of the albumen height in genotype Tetra SL were recorded. Albumen height in the 35th week of age was significantly higher ($p<0.01$) compared to other ages. Tetra SL layers showed significantly higher ($p<0.05$) HU values. With the increase of the age of hens the value of this parameter decreased, so, in the 35th week of age, statistically significantly higher HU value ($p<0.01$) was determined, compared to other ages. Deformation of the egg shell, breaking force and egg shell weight did not differ significantly influenced by genotype and age of laying hens. Significantly higher egg shell thickness values ($p<0.05$) were recorded for genotype Bowans Brown. With the increase of age of laying hens, there were no significant changes in egg shell thickness. Overall, it is concluded that both examined hybrids in terms of egg and egg shell quality traits have given satisfactory results. For most of the egg quality traits, better results were observed for Tetra SL hen genotype, while the most egg shell quality traits were in favour of hens of Bowans Brown genotype.

Key words: *genotype, age, egg quality, egg shell quality.*

INTRODUCTION

In the conditions of intensive production of table eggs special attention should be paid to the egg quality traits. It is not enough to achieve a high laying capacity, it is necessary that the resulting products are of satisfactory quality. Important objectives of the leading breeding centres of light hybrid lines are aimed primarily at improving the egg quality properties and egg shell strength as well as maintaining the said quality properties during the production cycle. Given the prevalence of different hybrids of laying hens on the market, manufacturers of table eggs are often in a dilemma which hybrid to choose. End consumers require from manufacturers high standards in terms of quality of table eggs. It is necessary to produce healthy, safe and biologically correct product that will at the same time satisfy the criteria of freshness and good quality (Pavlovski et al., 2002).

Changes in individual traits of egg quality, in the case of the same genetic basis of laying hens, occur exclusively under the influence of the biological cycle of the laying hen (Roberts and Nolan, 1997; Perić et al., 1998). Zita et al. (2009) have found that, in addition to genotype, age of hens has a significant impact on the quality of the eggs. The quality of eggs and egg shell can be influenced by different factors: genotype, age, breeding system, lighting program, ambient temperature (Škrbić et al., 2006). Nutrition is also an important factor that can influence the individual quality properties, i.e. egg mass and egg shell strength (Supić et al., 1999; Vitorović et al., 2002; Petričević et al., 2014).

The poor egg quality traits represent a significant economic burden on commercial producers of table eggs. Of the total number of eggs laid, on average 7-8% are broken on their way to the consumer. Egg shell must meet certain requirements in terms of resistance to various physical deformities; it is a mineral structure that maintains and preserves the contents of the egg to the final consumer.

The aim of this study was to determine the effect of genetic basis and age of hens on egg quality traits and egg shell quality traits in conditions of farm production.

MATERIALS AND METHODS

The research was conducted at the experimental farm of the Institute of Animal Husbandry in Zemun, on laying hens of two light line hybrids: Tetra SL and Bowans Brown. 1000 birds of both hybrids were moved into the exploitation facility/building, of cage type, and evenly distributed, at the age of 18 weeks. During the duration of the trial, hens were provided the same conditions in terms of housing, environment and care.

Hens were fed ad libitum, with same mixtures for laying hens: in the period from 19-29 weeks of age, the mixture with a protein content of 17.4%; in the period from 30-50 weeks, the mixture with the protein content of 16.7%, and after 50 weeks the mixture with the protein content of 16.2%.

Randomly 30 eggs of both hybrids were taken at the end of 35, 45, 55 and 65 weeks of age. Egg quality has been tested on fresh eggs, immediately after collection, and thus a score of the initial quality of table eggs was obtained.

Egg quality traits are divided on the properties of the external and internal egg quality.

Determination of the external quality of eggs included:

-The egg mass was determined using the electronic scales of the accuracy 10^{-2} g.

-The egg shape index was determined by using the instrument that directly indicates the maximum width of the egg as a percentage of its length.

Testing the internal quality of eggs included:

-The albumen height, determined using the tripoid micrometre in the middle between the edges of the egg yolk and thick egg white accuracy of 0.1 mm.

-Value of Haugh units was determined as a logarithmic function of egg mass and thick albumen height.

Egg shell quality included the determination of the following properties:

-Deformation of the shell was determined by Marius instrument and expressed in µm, obtained as the mean value of 3 measurements.

-Egg shell breaking force expressed in kilograms.

-The egg shell mass with membranes measured by electronic scale with accuracy of 10^{-2} g.

-The egg shell thickness determined by micrometre on a part of the shell taken from the egg equator and after removing the membrane.

The software package STATISTICA, version 12 (StatSoft Inc.) was used for statistical analysis. The level of statistical significance of differences between groups was determined by the Tukey test.

RESULTS AND DISCUSSIONS

Average values of egg quality properties obtained during the test are shown in Table 1. In layers of Tetra SL genotype, higher values for the egg mass were determined, however, in the statistical processing of the obtained data no significant differences for egg mass depending on the genotype and age of laying hens were observed. The egg shape index was not different under the influence of hens' genotype. A significant ($p<0.05$) effect of age of hens on egg shape index was recorded. Significantly higher mean values of shape index were measured at the age of 35 weeks in comparison to 65 weeks of age. Also, under the influence of genotype, significantly higher ($p<0.05$) values of the albumen height were recorded for genotype Tetra SL. The albumen height in the 35th week of age was significantly higher ($p<0.01$) compared to other ages. HU have less variability compared to the albumen height and therefore, for the purpose of objective assessment of the internal quality of eggs are more appropriate indicator. Significantly higher ($p<0.05$) HU values were found for genotype Tetra SL. With the increasing age of hens the value of the HU decreased, in the 35th week, statistically significantly higher value of this parameter ($p<0.01$) was recorded compared to other ages.

Table 1. Egg quality properties

Genotype	Age (weeks)	Egg mass, g		Egg shape index		Albumen height, 0.1 mm		HU	
		ξ	SD	ξ	SD	ξ	SD	ξ	SD
Tetra		64.48	4.64	77.06	2.35	76.63[a]	14.72	85.04[a]	9.52
Bowans		63.75	5.14	77.15	2.14	72.04[b]	16.27	81.90[b]	11.28
	35	64.43	4.96	78.07[a]	1.91	87.47[A]	12.16	91.67[A]	6.34
	45	63.52	3.07	77.50[ab]	1.69	74.28[B]	11.54	84.06[B]	7.41
	55	64.02	5.24	76.63[ab]	2.37	68.23[B]	15.07	79.50[B]	10.65
	65	64.26	5.59	76.27[b]	2.38	66.27[B]	12.59	78.19[B]	10.50
Tetra	35	64.72	4.16	77.80	2.18	86.47	12.23	91.13	6.25
	45	64.68	2.52	77.33	1.87	76.78	13.58	85.22	8.84
	55	64.81	5.65	76.87	2.13	73.53	15.77	82.80	10.67
	65	63.68	5.39	76.23	2.95	68.77	11.54	80.46	8.88
Bowans	35	64.15	5.78	78.33	1.63	88.47	12.44	92.20	6.60
	45	62.37	3.27	77.67	1.58	71.78	9.20	82.89	5.95
	55	63.23	4.85	76.40	2.64	62.93	12.72	76.20	9.89
	65	64.85	5.95	76.31	1.75	63.77	13.55	75.92	11.82
Two-factorial variance analysis (p value)									
Genotype		0.413		0.785		0.025		0.036	
Age		0.938		0.011		0.008		0.006	
Genotype x Age		0.657		0.835		0.314		0.398	

*a, b Average values in each column without common superscript are significantly different at the level of 5%
*A, B Average values in each column without common superscript are significantly different at the level of 1%

In accordance with our results, Tolimir et al. (1999) and Kocevski et al. (2011) have not found significant differences in the egg mass under the influence of the genotype. Tolimir et al. (1999) have found a significant effect of the age on the decrease of the values of albumen height and HU. Vračar et al. (1995) and Ledvinka et al. (2012) have determined a significant decrease in the egg shape index with the increase of age of hens. Silversides and Scott (2001) have recorded a significant impact of genotype on the albumen height.
Egg shell quality traits are presented in Table 2.

Table 2. Egg shell quality properties

Genotype	Age (weeks)	Deformation, µm		Breaking force, kg		Egg shell mass, g		Egg shell thickness, 0.01 mm	
		ξ	SD	ξ	SD	ξ	SD	ξ	SD
Tetra		22.27	3.90	4.06	0.81	8.77	0.93	31.29[b]	3.08
Bowans		22.15	3.17	4.11	0.90	8.44	0.93	32.15[a]	2.72
	35	21.97	3.79	4.22	0.72	8.61	1.04	31.40	2.90
	45	21.89	2.78	4.13	1.16	8.92	0.80	31.94	2.29
	55	22.80	3.61	4.03	0.76	8.38	0.87	31.77	3.48
	65	22.04	3.73	3.98	0.86	8.63	0.98	31.88	2.78
Tetra	35	22.07	4.59	4.22	0.74	8.71	0.95	31.13	2.56
	45	22.78	3.46	4.33	0.59	9.29	0.94	31.33	2.12
	55	22.47	3.02	3.93	0.76	8.70	0.89	31.47	4.27
	65	21.92	4.59	3.85	1.02	8.55	0.92	31.23	2.89
Bowans	35	21.87	2.95	4.22	0.73	8.51	1.15	31.67	3.27
	45	21.00	1.66	3.92	1.56	8.54	0.40	32.56	2.40
	55	23.13	4.21	4.12	0.78	8.07	0.75	32.07	2.58
	65	22.15	2.79	4.12	0.67	8.71	1.07	32.54	2.60
Two-factorial variance analysis (p value)									
Genotype		0.710		0.959		0.058		0.029	
Age		0.769		0.741		0.291		0.911	
Genotype x Age		0.715		0.590		0.309		0.948	

*a, b Average values in each column without common superscript are significantly different at the level of 5%

The deformation of the egg shell is a parameter which indirectly indicates the strength of egg shell. It represents the value that expresses how much the eggshell bends under the pressure of 500 g, at the equatorial part of the egg. Lower values of this egg shell quality parameter indicate its greater resistance to pressure, and a potentially stronger shell. Eggs of Bowans Brown genotype laying hens had lower values of egg shell deformation, but the differences were not statistically significant. Also, no significant differences in observed parameter were recorded under the influence of age of hens. The breaking force indicates a minimum load (in kg) that leads to the breaking of egg shell. Higher values of this parameter were measured in genotype Bowans Brown. Breaking force did not differ significantly between genotypes and ages of laying hens. The analysis of obtained results for egg shell mass showed no significant effect of genotype and age of laying hens on this parameter. Significantly higher ($p<0.05$) values for the egg shell thickness were determined for genotype Bowans Brown. The increase of hens' age had no significant influence on the egg shell thickness.

The obtained values for egg shell deformation for the hybrids are lower compared to those obtained by Perić et al. (1998) and Rajčić et al. (2008). Similar to our results, Solomon (2001) and Ledvinka et al. (2012) have found statistically significant differences in the egg shell thickness under the influence of genotype. Contrary to our results, Škrbić et al. (2006) have recorded statistically significant reduction in egg shell thickness with the increase of age of hens.

CONCLUSIONS

Based on the results of this research, it can be concluded that the laying hens of genotype Tetra SL had better quality of eggs. The greater egg mass was determined, significantly higher ($p<0.05$) value of albumen height, and significantly higher values ($p<0.05$) of Haugh units. With increasing age of hens, statistically significant ($p<0.01$) decrease in the values for albumen height and Haugh units were recorded. Better results of egg shell quality were found in laying hens of genotype Bowans Brown, expressed through less egg shell deformation, greater breaking force and significantly greater ($p<0.05$) egg shell thickness.

Overall it can be concluded that none of the hybrids can be characterized as absolutely better and that with the increase of age of hens there is a gradual decline in the quality of eggs.

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