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QUALITY OF TABLE EGGS OF WHITE AND BROWN SHELL

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ABSTRACT

Since the white shell eggs are present in the domestic market, it is necessary to examine their quality in order for consumers to be adequately informed, especially because they have certain prejudices against white shell eggs. The purpose of this study was to examine the effects of genotype (brown or white layers) on the table eggs quality after storage of 28 days. Total of 60 eggs from two strains of laying hens (Hisex brown and Hisex white) were sampled and the first set of 15 eggs were examined first day after laying. The second set of 15 eggs per strain was stored in a refrigerator (4°C) and examined after storage period of 28 days. The following egg quality parameters were evaluated: egg weight, shell breaking force, albumen height, Haugh units (HU) and yolk color. The results showed no significant differences in egg quality parameters between white and brown shell eggs neither in fresh eggs nor after storage. However, in both strains the storage significantly affected the albumen height (6.34 vs. 5.46 mm in brown eggs; 6.74 vs. 5.64 mm in white eggs) and HU (76.87 vs.70.40 in brown eggs; 79.11 vs. 71.44 in white eggs). pH values of albumen were not significantly affected by storage (9.14 vs.9.35 in brown eggs; 9.37 vs. 9.42 in white eggs). The results suggest that the albumen height and the HU significantly decreased during storage in both white and brown shell eggs.

Key words: *Brown eggs, White eggs, Storage, Quality.*

INTRODUCTION

Egg quality is very important issue for consumers because eggs are one of the most valuable foods available to humans and they are less expensive than other equivalent animal protein sources (Windhorst, 2006). Eggs are rich in proteins and minerals, containing many essential amino acids with important biological values (Abeyrathne *et al*., 2013) and consumers are very interested in their freshness, quality, and chemical composition. Besides that, shell quality of eggs is of major importance to the egg industry worldwide.

The internal quality of eggs depends on several factors such as strain of hens (Silversides and Scott, 2001; Samli *et al.*, 2005), nutrition (Franchini *et al*., 2002*)*, hen age (Silversides and Scott, 2001; Đukić Stojčić *et al.*, 2017), and storage duration (Roberts, 2004; Jin *et al*., 2011*)*. Storage is one of the most important factors that affect egg quality, especially the albumen quality (Samli et al., 2005). After a longer storage in the refrigerator, table eggs are losing their quality, and this process depends on the duration of the storage period (Jin *et al.*, 2011; Đukić Stojčić and Perić, 2018), temperature of storing (Akter *et al.,* 2014) the age of laying hens (Perić *et al.,* 2018) and genetic factors (Silversides and Scott, 2001; Hanusova *et al.,* 2015)

One of the very important issues for the consumers is the color of the shell. In general, the fact is that eggshell colour has always received more attention from the consumer than it deserves (Hanusova *et al.,* 2015). The fact is that eggshell color does not give an indication of the egg quality. White eggs are produced commercially by lines derived from the White Leghorn breed, whereas brown eggs are produced by hens derived from several dual-purpose breeds (Barred Plymouth Rock, Rhode Island Red, New Hampshire, and others). However, in some parts of the world brown eggs have been perceived by the consumer to be more natural or healthy than white eggs (Scott and Silversides, 2000). In Serbia, as well as in the surrounding countries, brown shell eggs are predominantly represented on the market. Considering that white shell eggs are also appearing more and more on the market, it is necessary to examine their quality for consumers to be adequately informed, especially because they have certain prejudices against white shell eggs.

The purpose of this study was to examine the effects of genotype (brown or white strain layers) on the table eggs quality after storage of 28 days.

MATERIAL AND METHODS

Total of 60 eggs from two strains of laying hens (Hisex brown and Hisex white) were sampled on the commercial farm. Both strains were of the same age (47 weeks) and the laying hens were fed according to the nutrient requirements suggested in the Hisex white and Hisex brown Management Guide.

The first set of 15 eggs were examined first day after laying. The second set of 15 eggs per strain was stored in a refrigerator (4°C) and examined after storage period of 28 days. The egg quality analysis was performed at the Laboratory for Poultry Meat and Egg Quality, the Department of Animal Science, the Faculty of Agriculture in Novi Sad. The following egg quality parameters were evaluated: egg weight, shell breaking force, albumen height, Haugh units (HU), yolk color, pH of yolk and albumen. The egg weight was measured using a precision scale (0.01 g). Shell breaking force was determined by Egg Force Reader (Orka Food Technology Ltd, Israel). Yolk color was determined using the Roche yolk color fan. Albumen height was measured with a tripod micrometer. Based on egg mass (M) and albumen height (H), Haugh units were calculated according to formula HU=100log (H+7.57-1,7M0.37).

Statistical analyses were done in program STATISTICA (TIBCO, v. 14) using factorial ANOVA. When the effect of the main factor was significant, the means were separated using Duncan's test. Probabilities of less than 0.05 were considered significant for all analyses.

RESULTS AND DISCUSSION

Effects of the strain of hens and storage on the external egg quality are shown in the table 1.

Table 1. Effects of strain and storage on external egg quality traits

Strain	Storage time, day	Egg weight, g	Egg weight loss, %	Shell breaking force, (kg)
Hisex white	0	65.14	-	4.85
	28	63.58	2.39	4.96
	SEM	0.530	0.231	0.290
Hisex brown	0	65.37	-	4.91
	28	63.64	2.46	4.93
	SEM	0.478	0.232	0.256
Source of variation				
Strain	p value	0.255	0.666	0.927
Storage		0.135	<0.01	0.758
Interaction		0.160	0.666	0.989

SEM – standard error of means

Regarding the egg weight, the results of this research showed no differences between white and brown eggs although other authors reported significant effect of the strain on the egg size. Silversides and Scott (2001) found that eggs from ISA Brown were larger than eggs from ISA-White. Larger egg size in brown hens compared to white hens was also reported by Vits *et al.* (2005) and Joubrane *et al.* (2019). These authors assumed that genotype has a direct influence on egg weight and other egg characteristics.

Significant effect of storage on egg weight loss was found in both strains. However, there was no significant difference between weight loss during storage between white and brown shelled eggs. The effect of storage on egg weight loss was also confirmed by Akter *et al.* (2014), Đukić Stojčić *et al.*, (2017) and Perić *et al.* (2018). The main factors which affect egg weight loss are time of storage and temperature of storage (Akter *et al.*, 2014). Weight loss during storage occurs due to loss of solvents (water and other gaseous products) from the egg content through the shell by evaporation so with increase length of storage, egg weight loss increase (Hasan and Okur, 2009). Shell strength was under no influence neither of strain nor the storage which is in line with the results reported by Jones and Musgrove (2005). Joubrane *et al.* (2019) found no significant differences in shell quality between brown and white shell eggs. Contrary to our results, Đukić Stojčić *et al.* (2017) found that shell strength significantly decreased during storage.

Table 2. Effects of strain and storage on internal egg quality traits

Strain	Storage time, day	Albumen height, (mm)	Haugh units, (HU)	Yolk color	pH of yolk	pH of albumen
Hisex white	0	6.74^{A}	79.11^{A}	11.73	6.83^{B}	9.37
	28	5.64^{B}	71.44^{B}	12.21	7.14^{A}	9.42
	SEM	0.181	1.388	0.255	0.095	0.02
Hisex brown	0	6.34^{A}	76.87^{A}	12.00	6.73^{B}	9.14
	28	5.46^{B}	69.41^{B}	12.53	6.99^{AB}	9.35
	SEM	0.186	1.594	0.229	0.068	0.085
Source of variation						
Strain	p value	0.208	0.256	0.396	0.175	0.141
Storage		<0.01	<0.01	0.144	<0.01	0.409
Interaction		0.633	0.958	0.939	0.773	0.217

$^{A-B}$ Different letters indicate significant differences between the means in each column (P < 0.01)
SEM – standard error of means

Albumen quality is a standard measure of egg quality that is most often measured as the height of the inner thick albumen or a function of this, such as the Haugh unit. In our research albumen height was not significantly affected by the strain of the hen. Similarly, Joubrane et al. (2019) showed that no significant differences in albumen height were observed between brown and white eggs. On the other hand, a ssignificant decrease in albumen height during storage was found in both white and brown shell eggs. Similar results were reported by Đukić Stojčić *et al.* (2017) who found that albumen height was approximately 3 mm higher in initial sampling than after 28 days of storage. These results agree with those of Scott and Silversides (2000) and Samli *et al.* (2005). These authors established significant decrease in albumen height during the prolonged storage of eggs.
Decrease in albumen height was also reflected in the decrease of Haugh units during storage. The primary cause of the decrease in Haugh units during storage is the loss of water and carbon-dioxide from the egg white during the storage period. Therefore, the egg mass loss and the decrease in the egg white quality took place (Samli *et al.*, 2005, Scott and Silverside, 2000; Akyurek and Okur, 2009).
In our research (Table 2) the yolk color was not significantly influenced by strain and storage time. On the contrary, Joubrane et al. (2019) found significant differences in yolk color between white and brown shell eggs. In their research yolk color score was higher in brown eggs, but authors emphasized that the primary determinant of yolk color is the xanthophyll (plant pigment) content of the diet consumed. Regarding the storage Perić *et al*. (2018) reported a significant reduction in yolk color during storage in both young and old flocks of laying hens. According to Santos *et al.* (2019) color changes in yolks are caused by the degradation of carotenoids by oxidative processes because of water diffusion from

albumen into yolks under conditions of longer storage periods and higher storage temperatures. Jin *et al.* (2011) determined significant changes in yolk color after only two days of storage under the temperature of 29^{o} C. Carranco-Jauregui et al. (2006) also determined that the changes in yolk color occurred under high temperatures of storage (20^{o}C), but under lower temperatures (4^{o}C) no changes in yolk color occurred even after 30 days.

pH of albumen was not affected by treatments, but pH of yolk was significantly affected by storage ($P<0.01$). In research of Silversides and Scott (2001) the pH of the albumen was not different between white and brown strains, but it increased with time in storage. Samli *et al.* (2005) found significant increases in pH of albumen and yolk with increased storage time and temperature. Authors reported a rapid alkalinity increase in albumen, even after 2 days of storage time, regardless of temperature. It is interesting that the increase in pH observed in yolk was not as large as in albumen.

CONCLUSIONS

According to the results of this trial it can be concluded that no significant differences in egg quality parameters between white and brown shell eggs were established, neither in fresh eggs nor after storage. However, the storage of eggs negatively affected egg quality in both strains. The albumen height and Haugh units which were significantly lower after 28 days of storage. pH values of albumen were not significantly affected by storage, but pH of yolk was significantly increased after 28 days of storage. The results confirmed that the color of the shell has no influence on the egg quality traits either in fresh eggs or after storage.

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