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Quality of eggs from native Greenleg and Yellowleg Partridge hens

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Intensive selection of hens for laying performance and large imports of high-yield laying hens from foreign breeding flocks led to the displacement of native less productive breeds and reduction of genetic diversity in the Polish market. Although supply of poultry products from intensive production systems is still overwhelming, currently some consumers prefer eggs and meat products from free-range systems, whereas native, domestic breeds of hens more resistant to environmental conditions are most suitable for such farming system (Sarter, 2004). Small local populations of native-breed hens survived in European countries in small numbers being a reservoir of valuable genes and subject of scientific research (Spalona et al., 2007). From among breeds/lines included in Poland in the conservation program, two old native breeds, i.e. Greenleg Partridge (Z-11) and Yellowleg Partridge (Ż-33) hens were chosen for the present studies. These breeds were included in the FAO World Watch List for Domestic Animal Diversity (2000) which also contains their characteristics. These breeds are maintained in Poland on two farms in single flocks of ca. 1000 birds on litter in closed poultry houses.

Quality of eggs depends on a number of factors, of which the origin and age of hens are most important. Studies of many authors demonstrated a significant impact of hen genotype on physical traits of eggs (Silversides & Budgell, 2004; Czaja & Gornowicz, 2006; Cywa-Benko et al., 2003).

The eggs of Greenleg Partridge hens won consumers' recognition and their quality is even improved when they are produced in organic or backyard system (Krawczyk, 2009 b). Greenleg Partridge hens belong to the oldest indigenous breeds of laying hens in Poland. They lay relatively small eggs with cream-coloured shell, which are willingly bought by consumers. Yellowleg Partridge hens (Ż-33) are general-purpose hens developed by crossing Greenleg Partridge hens with New Hampshire cocks. They have partridge plumage with brown tint, yellow skin and characteristic yellow shanks.

In these studies, it was hypothesized that Yellowleg Partridge laying hens (Ż-33) derived from Greenleg Partridge breed, differing in phenotypic traits and maintained in the same environmental conditions for many years, preserve genetic distinction which is manifested, for instance, by different egg quality traits.

The aim of these studies was to evaluate quality of eggs obtained from two Polish native breeds of laying hens: Greenleg Partridge (Z-11) and Yellowleg Partridge (Ż-33) hens.

Material and methods

The studies were conducted in 2016 in the Experimental Station in Chorzelów. Thirty eggs randomly collected from the eggs laid on the same day by 33- and 53-weeks old Yellowleg Partridge (Ż-33) and Greenleg Partridge (Z-11) hens were used as the study material. Hens were kept in a closed poultry house in a litter flooring system, and in the laying period were fed *ad libitum* a free-flowing diet containing 16.1% of total protein and 11.3 MJ/kg.

Egg quality was evaluated using a specialized equipment EQM, and the obtained data were analyzed for statistical significance with Statistica 6.0 software package.

Results and discussion

Analysis of results presented in Tab. 1 and 2 indicates a significant effect of breed and age of hens on quality of eggs. The results for eggs from Greenleg Partridge hens, especially attractive for consumers and increasingly more often sold in large retail chains, were less favorable compared with eggs of Yellowleg Partridge hens.

Egg shape is an inherited trait. It is described by the shape index, i.e. long-to-short axis length ratio expressed in percent. The smaller value of the shape index, the more elongated the eggs. As can be seen from Tab. 1, hens of both breeds laid eggs with similar shape but a significant influence of age on this trait was noted although this relationship was not observed in earlier studies (Krawczyk, 2009 a). Eggs of both breeds assumed a more elongated shape with age and the differences were confirmed by statistical analysis ($P \leq 0.01$).

Weight of eggs from native breeds is much smaller compared with eggs from commercial hybrids in which there is a genetically determined strong positive correlation between egg weight and yolk, white and shell weight (Zhang et al., 2005). The weight of eggs randomly chosen for analysis from 33 weeks old Greenleg Partridge hens was lower by 2.9 g compared with eggs of Yellowleg Partridge hens and the differences were highly statistically significant (Tab. 1).

In parallel, a greater variability in these parameters was noted in eggs laid by 53- and 33-weeks old layers, which is the effect of the lack of selection for these traits. Results of other studies on commercial hybrid layers indicate that the weight of eggs from young hens is less uniform but after achieving of stable laying performance by hens, the coefficient of variation is reduced (Hocking et al., 2003). Egg weight significantly rose with age which was confirmed also by other studies (Krawczyk, 2009 a).

Freshness of eggs is the most important quality trait for consumers, and among other things, albumen height and Haugh units (HU) are used as its measures. Independently of hen genotype, freshness parameters deteriorated with age and the differences were confirmed by statistical analysis (Tab. 1). The obtained results are in agreement with studies by Krawczyk (2009 a). Albumen height and HU values decreased but variability on albumen height was high (10.0–15.7%) and higher than that of HU (4.4–8.8%).

Blood and meat spots in eggs are considered by consumers as a significant defect despite that this feature in no way reduces nutritional value. Among 30 eggs examined from each breed, more eggs with spots were noted in Yellowleg Partridge hens. Like in earlier studies by Cywa-Benko et al. (2003), a tendency towards an increase in the incidence of eggs with blood or meat spots with hen age was observed in the present studies, as well.

Average value of yolk colour assessed based on the Roche yolk colour score was lower in both breeds at 33 weeks of age than at 53 weeks. No statistically significant differences in this trait were noted between breeds because yolk colour depends most of all on the diet and access to a green yard (Roberts, 2004; Krawczyk et al., 2005, Krawczyk, 2009 b). Variability of yolk colour was high in both breeds, which is indicative of different ability of individual birds to assimilate xanthophyll dyes.

Eggs with a greater proportion of yolk in the total egg weight are tastier while those with natural yellow yolk colour are more willingly purchased by consumers. In general, yolk weight increases with egg weight, and indirectly with hen age, and such relationship was confirmed by results of the present studies (Tab. 1, Fig. 1 and 2). Since housing conditions and diets were the same, these differences resulted from hens' genotype. Yolks of Z-11 hens were much lighter than in eggs of Ż-33 hens but their percentage content in eggs was greater than in Ż-33 hens which improved tastiness of Z-11 eggs.

This relationship in proportions of egg components is characteristic of primitive hens laying less eggs with a relatively low weightbecause as demonstrated by the studies of Krawczyk (2009 a), percentage content of yolk in eggs of 56 weeks old commercial hybrids was only 26% while the respective value in conventional breeds was ca. 30%.

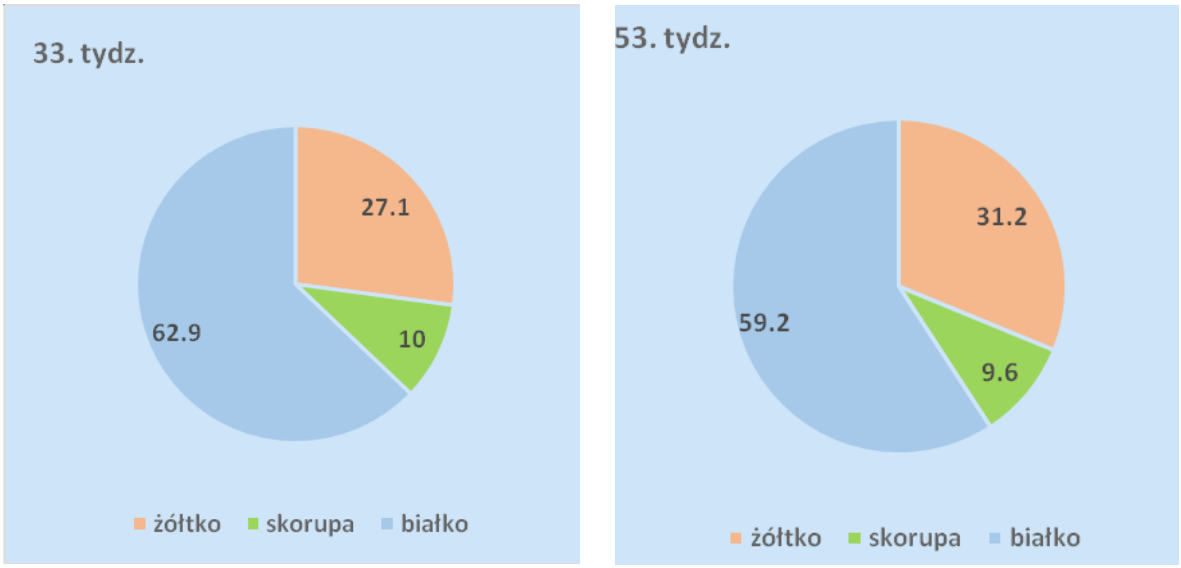
Table 1. Statistics for physical and interior egg characteristics

Trait	Week of age	Yellowleg Partridge (Ż-33)		Greenleg Partridge (Z-11)	
		$\bar{x}$ ± SD	V%	$\bar{x}$ ± SD	V%
Shape index (%)	33	77.1±2.60	3.4	76.6±2.28	3.0
	53	74.4±2.84	3.8	73.4±2.47	3.4
		**		**	
Egg weight (g)	33	53.5±2.57 A	4.8	50.6±2.4 B	4.7
	53	60.6±4.29	7.1	59.3±4.13	7.0
		**		**	
Albumen height (mm)	33	8.94±0.90 A	10.0	8.23±0.95 B	11.5
	53	7.50±0.92 A	12.3	6.62±1.04 B	15.7
		**		**	
Haugh units	33	95.7±4.19 a	4.4	92.9±5.04 b	5.4
	53	86.0±5.44 A	6.3	80.7±7.15 B	8.8
		**		**	
Eggs with blood spots (%)	33	0.0		0.0	
	53	3.3		3.3	
Eggs with meat spots (%)	33	6.6		0.0	
	53	6.6		0.0	
Yolk weight (g)	33	14.5±1.06	7.3	13.5±0.94	6.9
	53	18.9±1.52 A	8.0	17.4±1.43 B	8.2
		**		**	
Roche yolk colour score	33	7.0±1.14	16.2	6.77±1.10	16.2
	53	8.6±1.61	18.7	8.13±0.73	8.9
		**		**	

Notes: $\bar{x}$ – mean value, v – coefficient of variation (%), SD – standard deviation; A,B,C – highly significant differences (P≤0.01), a,b,c – significant differences (P≤0.05) between strains of hens, *, ** – significant or highly significant differences between the age of hens.

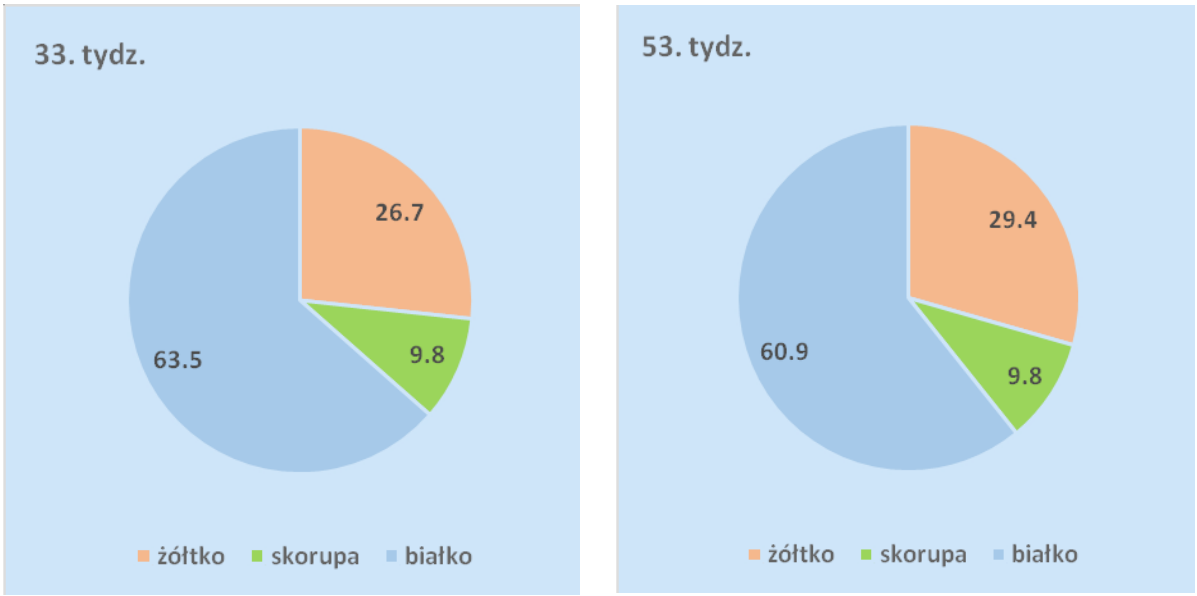
Variability of these traits in both breeds was at a medium level (<9%), thus, these groups can be defined as statistically uniform. Similar relationship was also observed for percent yolk content in the egg.

Irrespective of the breed, percentage yolk content increased with age while albumen content declined (Fig. 1–2). The increase in percentage yolk content at 53 weeks of age was greater in eggs from Z-11 than in Ż-33 hens.



33. tydz. – *wk 33*, 55. tydz. – *wk 55*, żółtko – *yolk*, skorupa – *shell*, białko – *albumen*

Figure 1. Proportion of egg components (%) – strain Z-11



33. tydz. – *wk 33*, 55. tydz. – *wk 55*, żółtko – *yolk*, skorupa – *shell*, białko – *albumen*

Figure 2. Proportion of egg components (%) – strain Ż-33

Shell colour is an inherited trait, characteristic of the breed. The present studies demonstrated highly significant differences in this trait between both breeds both in 33- and 53 weeks old hens (Tab. 2) which is in line with the studies of Cywa-Benko et al. (2003). Eggs from Greenleg Partridge hens were by several percent brighter than eggs of Yellowleg Partridge hens.

Shell thickness is also believed to be genetically determined but a slight impact of age

and environmental factors on this trait was also observed (Roberts, 2004). Eggs with thin shell are often broken in the course of trade causing measurable economic losses, thus, monitoring of this egg quality trait in breeding selection is of crucial significance and is conducted both in breeding and commercial flocks.

Table 2. Egg shell quality traits

Trait	Week of age	Yellowleg Partridge (Ż-33)		Greenleg Partridge (Z-11)	
		$\bar{x}$ ± SD	V%	$\bar{x}$ ± SD	V%
Shell colour (%)	33	59.0±3.93 A	6.7	74.4±2.32 B	3.1
	53	56.5±5.34 A	9.4	75.8±2.55 B	3.4
		*		*	
Shell thickness (μm)	33	338±26.4 a	7.8	320±26.4 b	8.2
	53	328±37.5	11.4	334±35.4	10.6
		NS		NS	
Shell weight (g)	33	5.37±0.41 A	7.6	4.96±0.42 B	8.4
	53	5.83±0.66	11.3	5.79±0.64	11.0
		**		**	
Shell density (mg/cm^2)	33	73.85±6.28	8.5	71.38±6.98	9.8
	53	75.29±9.93	13.2	76.28±8.97	11.7
		*		*	
Crushing strength (N)	33	52.7±11.9 a	22.5	46.4±8.65 b	18.6
	53	47.1±10.7 A	22.7	37.4±15.75 B	42.1
		**		**	

For notes, see Table 1.

Studies of Cywa-Benko et al. (2003) and Krawczyk (2009 a) showed that egg shell thickness and strength remained at a similar level in Z-11 and Ż-33 hens. However, in the present studies, shells of eggs from 33 weeks old Z-11 hens had smaller thickness, weight, density and strength compared with Ż-33 hens. In eggs from 53 weeks old hens, shell traits were at a similar level in both breeds except that eggs from Z-11 hens still had a smaller resistance to crushing. Independently of the breed, shell weight and density increased with age but crushing strength declined. Therefore, it can be stated that eggs of Greenleg Partridge hens having a thinner and more fragile shell than Yellowleg Partridge hens, can more often be damaged in the course of trade.

A high coefficient of variation in the crushing strength (18.6–42.1%) means that the groups were not uniform in respect of this trait and individual eggs often attained the value of this parameter widely different from the mean.

Conclusions

The populations of hens of native breeds investigated in the present study are valuable for domestic selection programs as a reservoir of unique traits, which are not present in lines selected for years for improved production performance. The results collected and analyzed in this study provided detailed characteristics of quality traits of eggs from two native breeds of hens increasingly often utilized in extensive production systems. Eggs of both breeds are characterized high tastiness due to *i.a.* high content of yolk in the egg.

Genotype of hens was noted to influence most of the egg quality traits which confirms their genetic distinction. Unfortunately, Greenleg

Partridge hens better known among farmers and more popular for production in small flocks achieved worse results in the egg quality assessment compared with Yellowleg Partridge hens. Egg quality was also shown to depend on hen age.

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QUALITY OF EGGS FROM NATIVE GREENLEG AND YELLOWLEG PARTRIDGE HENS

Summary

The aim of the study was to evaluate the quality of eggs from two Polish breeds of laying hens: Greenleg Partridge (Z-11) and Yellowleg Partridge (Ż-33). The material used in the study consisted of table eggs, which were randomly collected from 33- and 53-week-old native hens (Z-11, Ż-33), 30 eggs each. The collected and analysed results provided detailed characteristics of egg quality from two native breeds of hens, which are increasingly used under extensive conditions. Both breeds of hens produced eggs that are tasty due to the high egg yolk content. Hen's genotype was found to influence most of egg quality traits, which confirms their genetic distinctiveness. Greenleg Partridge hens, which are better known in the field and more popular in backyard farming, showed poorer egg quality compared to Greenleg Partridge hens. Age of hens had a significant effect on egg quality.

Key words: native breeds of hens, egg quality