The quality of eggs of gene reserve Czech Golden Spotted Hens kept in backyard under different external conditions

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Abstract: In Czech Republic, there are two national poultry breeds, Czech Goose and Czech Golden Spotted Hen (CZH), which are under governmental project of gene reserves. In 2012 there were less than 220 CZH both males and females in this program. The aim of this study was to evaluate the egg quality of CZHs included in the project of gene reserves kept by six different breeders in backyard under different both nutrition and environmental conditions. The hens were the same age. Eggs for measurement their quality were collected three times during three months. The egg weight ranged from 51.7g to 60.7g ($P<0.05$). The eggshell strength was, except one flock, higher than 30.0N, and the differences among the flocks were no significant ($P>0.05$). There was high variability in eggshell color expressed as SCI (shell color index) ($P<0.05$). But there were not significant differences in yolk weight. The weight of yolk was higher than 18g in all flocks. The yolk proportion was significantly ($P<0.05$) different only between two flocks (36.6% versus 33.4%). Although the hens were at the same age and representatives of relatively small population the egg quality was very unbalanced. The main reason of the variability is probably different nutrition among the breeders. Advantage of the eggs is high weight of yolk and consequently yolk proportion.

Key-Words: egg weight, eggshell color, yolk proportion, Czech Golden Spotted Hen

Introduction

During the last 50 years of the 20th century, about 20% of livestock and poultry breeds have become extinct, and the remainder is at risk. This erosion of unique biodiversity is due to changes in farm practices developed in the West that involve mono-breed, intensive farming systems that are unsustainable. The close symbiotic relationship of *Homo sapiens* and domestic animals and birds over millennia is changing, resulting in a lost understanding of sustainability among urban communities (Hodges, 2006). In European countries, various governmental, non-governmental, 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 noncommercial farms). In the case of poultry, maintaining in situ populations of the noncommercial (fancy) breeds largely relies on hobby farmers. In addition to in situ conservation, gene banks are being established for ex situ conservation (Wiekders et al, 2006). In Czech Republic, there are two national poultry breeds, Czech Goose and Czech Golden Spotted Hen (CZH), which are under governmental project of gene reserves. Despite the financial support for the breeders the numbers of CZHs included in the gene reserves project was no more than 220 both males and females together in 2012 and they were kept by six breeders. The breeders focus their attention mainly on exterior characteristics to the detriment of performance. The laying intensity ranges from 58 to 110 eggs per hen and the egg weight from 51.5 to 56.5 g in years 2007-2012. The aim of this study was to evaluate egg quality of CZHs, included in the project of gene reserves, kept in backyard by six different breeders under different both nutrition and environmental conditions.

Material and methods

All CZHs were the same age and they were kept by six breeders under different nutrition and environmental condition in backyards. All breeders were under the gene reserves project. They kept different number of hens in their flocks with

different sex ratio and different diets. Eggs for measurement egg quality were collected three times in three months; 20 eggs every time per each flock, in 70, 78, 84 weeks of hens age. Followed characteristics were evaluated: egg weight, yolk weight, proportion and color, eggshell thickness, weight and proportion, eggshell strength, eggshell color, albumen weight, proportion and Haugh units.

The shell breaking strength was determined on the vertical axis using Egg Force Reader. The color of the yolk was measured using the DSM Yolk Color Fan. The albumen height was measured using a digital micrometer (TSS EQS, England). Haugh units (HU) were calculated as indicated by Haugh (1937). Shell weight and shell thickness were determined after washing and drying of shells. The shell thickness was evaluated using the micrometer expressed as mean of thickness on equator and both poles. Eggshell color was determined by the L*a*b* Color System using a spectrophotometer (CM-2600d, Konica Minolta, Osaka).

- L*: lightness (value between 0= black and 100=white)
- a*: hue as a function of the red-green scale (<0 = green, >0 = red)
- b*: hue as a function of the blue-yellow scale (<0 = blue, >0 = yellow)

Color was expressed by shell color index (SCI) based on the three color parameters calculated with the formula SCI = L* - a* - b*, lower values indicating darker shell color (Cavero et al., 2012). Standard conditions for the SCI method were set: measurement gap 8mm, 10° standard observer, standard illuminant D65 – average daylight including ultraviolet wavelength region. The color of eggshell was measured at the equatorial area.
Data obtained from this experiment were analyzed using the single factor analysis of variation. Data were followed by LSD test using the software package Unistat 5.1 (UNISTAT Ltd, ENGLAND).

Results and discussion

Egg weight, eggshell strength and eggshell color (SCI) are shown in table 1. The egg weight was very unbalanced among the flocks (P<0.05). The highest difference was 9g. Except two flocks, the egg weight was higher than Stanishevkaya and Toritsina (2007) reported for local unselected breed (55g). Zanon et al. (2006) also published lower egg weight for local light Italian breeds Modenese and Romagnolo (53.7g and 54.0g).Turkish breeds (Benizli and Gerze) also lay eggs with lower weight than CZHs (53.94 and 54.30g, Sarica et al., 2006). The main reason for the higher egg weight in comparison with other authors is also probably the higher age of the CZHs.

The eggshell strength was sufficient, except one flock (28.6N) it was higher than 30.0N, and the differences among the flocks were no significant (P>0.05). The significantly darkest eggshell color expressed as SCI was found in fifth flock in comparison with the others (P<0.05). It means that there were also eggs with brown eggshell but this color is not in agreement with breed standard. The eggshell should be cream-colored. On the other side there were eggs with white eggshell too.

Table 1 Egg quality of CZHs – weight, eggshell strength and eggshell color

Flock	*Egg weight (g)*	*Eggshell strength (N)*	*SCI*
	mean ± SE	mean ± SE	mean ± SE
1	54.8 ± 0.63^{ab}	28.6 ± 0.91^{a}	75.3 ± 1.14^{cd}
2	51.7 ± 1.23^{a}	32.4 ± 1.01^{a}	68.9 ± 1.51^{bc}
3	57.8 ± 0.85^{bc}	32.7 ± 1.54^{a}	76.3 ± 0.80^{d}
4	55.5 ± 0.79^{ab}	33.2 ± 1.04^{a}	65.9 ± 1.76^{ab}
5	60.7 ± 0.95^{c}	32.1 ± 1.77^{a}	60.9 ± 1.48^{a}
6	56.7 ± 0.67^{bc}	30.2 ± 1.69^{a}	75.8 ± 1.14^{cd}

a, b *indicate statistical significant difference between groups (P<0.05) for the same characteristics*

Eggshell weight, proportion and thickness are shown in table 2. There was no significant difference among the flocks in eggshell thickness. There were significant differences in eggshell weight only between three flocks (P<0.05). The proportion of eggshell from the egg weight ranged

from 7.8 to 9.3% and the thickness form 0.325 to 0.347mm. Zanon et al. (2006) reported higher eggshell proportion for both local Italian breeds (12.88 and 13.29%) but the eggshell thickness were similar to CZHs (0.337 and 0.369mm).

Table 2 Eggshell quality of CZHs

Flock	*Eggshell weight (g)*	*Eggshell proportion (%)*	*Eggshell thickness (mm)*
	mean ± SE	mean ± SE	mean ± SE
1	4.67 ± 0.099^{ab}	8.5 ± 0.13^{ab}	0.325 ± 0.50^{a}
2	4.82 ± 0.141^{ab}	9.3 ± 0.13^{c}	0.343 ± 0.61^{a}
3	5.04 ± 0.102^{b}	8.7 ± 0.16^{bc}	0.347 ± 0.69^{a}
4	5.03 ± 0.112^{b}	9.1 ± 0.17^{bc}	0.344 ± 0.82^{a}
5	4.96 ± 0.109^{ab}	8.2 ± 0.21^{ab}	0.339 ± 0.54^{a}
6	4.42 ± 0.149^{a}	7.8 ± 0.28^{a}	0.346 ± 0.71^{a}

a, b *indicate statistical significant difference between groups (P<0.05) for the same characteristics*

Yolk quality is shown in table 3. There were no significant differences in yolk weight (P>0.05). The weight of yolk was higher than 18g in all flocks.

Concerning yolk proportion there was significant difference only between two flocks (P<0.05). Very high variability was found in yolk color (P<0.05). As the diet has the highest effect on egg weight and consequently yolk weight and yolk color too, there were significant differences, because all hens fed the different diets. If the diet is the same to all layers, the color of the egg yolk of laying Czech hens is well balanced (Anderle et al., 2014).

Anyway the yolk weight of CZHs is relatively high. Stahishevskaya and Toritisna (2007) published weight of yolk in local breeds 18.2g, in Rhode Island 18.3g and in Leghorns 17.4g. Comparison of local and modern breeds revealed, that enlargement of egg weight for 8-10g was caused by increase of portion of albumen in eggs (Stahishevskaya and Toritisna, 2007). On the other hand it is necessary remind relatively high age of the CZHs in this experiment.

The yolk proportion was significantly (P<0.05) lower in fifth flock (33.4%) in comparison with the first flocks (36.6%). Zanon et al. (2006) found similar yolk proportion in one of the local Italian breeds; 34.69% in Modenese and lower proportion 32.35% in Romagnolo in comparison with CZHs. On the other side in commercial white hybrids these authors reported 30.8% of yolk and even only 26.2% in commercial brown laying hens. However Turkish breeds lay eggs with comparable weight of yolk (19.38 and 18.94g), and consequently with higher yolk proportion (35.94 and 34.90 %). Other authors also reported significantly (P<0.05) higher yolk weight of local breed in comparison with commercial layers (Rizzi and Chiericato, 2005).

In albumen quality significant difference were found among the flocks (table 4), except albumen proportion. There was significant difference in Haugh units only between two flocks (P<0.05).

Albumen weight ranged from 28.5 to 36.9g (P<0.05).

At feeding the same diets to CZHs under the same housing system and environmental condition, there were no significant differences among the flocks in majority of observed characteristics (Anderle et al., 2014). Despite the high variability in egg weight the advantage of the CZHs eggs is high weight of yolk and consequently yolk proportion, which is higher than in commercial hybrids.

Table 3 Yolk quality of CZHs

Flock	*Yolk weight (g)*	*Yolk proportion (%)*	*Yolk color*
	mean ± SE	mean ± SE	mean ± SE
1	20.1 ± 0.38[a]	36.6 ± 0.55[a]	10.5 ± 0.23[bc]
2	18.3 ± 0.75[a]	35.0 ± 0.87[ab]	9.2 ± 0.26[a]
3	19.7 ± 0.37[a]	34.2 ± 0.57[ab]	9.8 ± 0.23[abc]
4	19.1 ± 0.35[a]	34.3 ± 0.62[ab]	10.1 ± 0.33[abc]
5	20.3 ± 0.37[a]	33.4 ± 0.53[b]	11.1 ± 0.23[c]
6	19.8 ± 0.48[a]	34.9 ± 0.73[ab]	9.6 ± 0.35[ab]

a, b *indicate statistical significant difference between groups (P<0.05) for the same characteristics*

Table 4 Albumen quality of CZHs

Flock	*Albumen weight (g)*	*Albumen proportion (%)*	*Haugh units*
	mean ± SE	mean ± SE	mean ± SE
1	32.8 ± 1.10[ab]	59.9 ± 1.89[a]	58.8 ± 1.39[a]
2	28.5 ± 0.68[a]	55.6 ± 0.86[a]	68.8 ± 1.65[b]
3	34.7 ± 1.42[b]	59.9 ± 1.72[a]	62.8 ± 1.94[ab]
4	33.1 ± 0.97[ab]	59.7 ± 1.69[a]	60.9 ± 1.87[ab]
5	36.9 ± 1.22[b]	60.7 ± 1.77[a]	63.8 ± 1.85[ab]
6	33.1 ± 0.86[ab]	58.5 ± 1.45[a]	61.4 ± 1.77[ab]

a, b *indicate statistical significant difference between groups (P<0.05) for the same characteristics*

Conclusion

In conclusion, as both diet and environmental conditions have the highest impact of external factors on eggs quality the egg quality of Czech Golden Spotted hens kept by six breeders in backyards was very unbalanced, despite all breeders were included in the project of gene reserves. There were found significant differences among the flocks in followed characteristics (P<0.05): egg weight, yolk color and its proportion, albumen weight, Haugh units, eggshell weight, proportion and its color.

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