EGGSHELL AND EGG CONTENT TRAITS IN PEKING DUCK EGGS FROM THE P44 RESERVE FLOCK RAISED IN POLAND

CECHY SKORUPY I TREŚCI JAJ KACZEK PEKIN ZE STADA REZERWOWEGO P44 UTRZYMYWANEGO W POLSCE

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ABSTRACT

The egg quality of Peking ducks was evaluated on three different dates (the beginning, peak, end) of the first egg laying period. During the laying period the following increases were noted: in egg weight (from 71.7 to 86.7 g), in length (from 61.9 to 65.1 mm), in egg width (from 45.0 to 48.8 mm) and in eggshell area (from 81.7 to 92.7 cm^2). Percentage of eggshell and albumen have decreased respectively from 10.1 to 9.6% and from 61.2 to 57.1%, while the yolk percentage has increased form 28.7 to 33.1%. The quality of egg albumen and yolk deteriorated with the age of the ducks. Increases in pH of both yolk (from 5.77 to 6.09) and egg albumen (from 8.06 to 8.70) were noted.

KEYWORDS: duck, egg, albumen, yolk, pH

STRESZCZENIE

Oceniano jakość jaj kaczek pekin w trzech terminach (początek, szczyt, koniec) pierwszego okresu nieśności. W czasie nieśności zwiększały się masa jaja (z 71,7 do 86,7 g), długość (z 61,9 do 65,1 mm) i szerokość jaja (z 45,0 do 48,8 mm) oraz powierzchnia skorupy (z 81,7 do 92,7 cm^2). Procentowy udział skorupy i białka zmniejszały się (odpowiednio: z 10,1 do 9,6 i z 61,2 do 57,1%), a udział żółtka zwiększył się (z 28,7 do 33,1%). Wraz z wiekiem kaczek pogorszeniu uległa jakość białka i żółtka. Zanotowano zwiększenie wartości pH żółtka (z 5,77 do 6,09) oraz białka (z 8,06 do 8,70).

SŁOWA KLUCZOWE: kaczka, jajo, białko, żółtko, pH

DETAILED ABSTRACT

Badania przeprowadzono na jajach kaczek pekin ze stada rezerwowego P44 utrzymywanego w Polsce od 1961 (import z Holandii). Ocenę jakości jaj wykonano na początku, w szczycie i na końcu nieśności, zawsze 24 godziny po zniesieniu. W pierwszym i trzecim terminie oceniono po 60 jaj, a w drugim 90 jaj, łącznie 210 jaj. Stwierdzono statystycznie istotne większą masę jaja, długość i szerokość jaja oraz powierzchnię skorupy jaj znoszonych przez kaczki na końcu pierwszego okresu reprodukcji, w porównaniu z jajami pozyskiwanymi na początku i w szczycie sezonu. Nie zanotowano istotnych różnic pod względem grubości, elastycznego odkształcenia i barwy skorupy między kolejnymi próbami. Wraz z wiekiem kaczek zaokrągleniu uległ kształt jaja, a barwa skorupy pociemnieniu. Analiza cech treści jaj wykazała statystycznie istotne różnice pod względem masy, procentowego udziału i średnicy żółtka oraz masy i udziału białka między kolejnymi terminami. W trakcie nieśności pogorszeniu uległa jakość białka gęstego wyrażona wysokością i jednostkami Haugha oraz jakość żółtka wyrażona indeksem. Ponadto stwierdzono zwiększenie pH żółtka, białka gęstego i białka rzadkiego.

INTRODUCTION

In several countries of the Far East duck eggs are produced and consumed in large quantities by the local population thus substituting hen eggs. In Poland duck eggs are mainly used for reproduction which results from their high retail prices, as well as a common opinion that they carry greater microbiological contamination than hen eggs, inclusive of Salmonella type bacteria [11].

Until now the research regarding the eggshell and duck egg content traits in Poland used eggs produced by ducks from pedigree strains and reserve flocks [1, 2, 3, 4, 7, 8, 12]. It was proven that the mean egg weight of Peking ducks from pedigree strains (A44, A55, P66, P77, K11) in the entire reproduction period ranged from 80.5 to 89.2 g, the length from 64.9 to 65.6 mm, the width from 46.9 to 48.8 mm and the eggshell thickness from 0.349 to 0.364 mm. The percentage of eggshell in the egg ranged from 9.0 to 9.5%, the yolk from 31.6 to 34.0%, the albumen from 56.9 to 59.1% [6, 7]. Whereas Peking ducks from the reserve flocks P8, P9, P33 lay eggs of a similar weight (from 78.1 to 89.9 g), length (from 65.0 to 65.6 mm) and width (from 47.8 to 48.3 mm), but their eggshell is thicker (from 0.400 to 0.418 mm) and the percentage of yolk in the egg is greater (from 36.7 to 38.3%) in comparison to ducks from pedigree strains [3, 4].

Currently there are two reserve flocks of ducks in Poland – P44 (maternal) and P55 (paternal) strain in which selection is not as intensive as it is in the pedigree strains. So far there was no comprehensive evaluation conducted of the quality of eggs produced by those flocks. The aim of this work was the evaluation and the comparison of the quality of Peking duck eggs from reserve flock P44 on three different dates of the first reproductive period.

MATERIAL AND METHODS

The research was carried out at the Department of Poultry Breeding, University of Technology and Life Sciences in Bydgoszcz, Poland. The material consisted of Peking duck eggs obtained from the reproductive flock ♂ P55 from ♀ P44. The evaluations of egg quality were conducted three times: at the beginning, the peak and the end of the laying period. At the first and the third evaluation dates there were 60 eggs evaluated each time, and 90 eggs at the second date. The evaluation was conducted 24 hours after the egg laid.

The egg mass (g) was determined with the laboratory scales made by Medicat. The egg length (long axis) and width (short axis) were measured with the electronic calliper. The width to length ratio was shown in percentage points and constituted the egg shape index. The Paganelli et at. [10] equation was used to calculate the eggshell area (cm^2):

$P_s = 4.835 \times W^{0.662}$, where W = egg weight.

Eggshell deformation ($\mu m/cm^2$) was determined with Marius apparatus. The eggshell colour (% white) was measured with the QCR reflectometer made by the English firm TSS.

The egg content was broken onto a glass-top table with a mirror, the yolk height and the thick albumen height were measured at the distance of approximately 1 cm from the yolk with the QCD apparatus made by TSS (mm). The height of thick albumen (H) and the egg weight (W) were used to calculate Haugh units from the formula Williams [13]:

$JH = 100 \lg (H + 7.7 - 1.7 W^{0.37})$.

Yolk diameter along the chalaz line was determined with the calliper (mm). The ratio of the yolk height to its diameter in percentage points constituted the yolk index. Yolk colour was determined with the 15-point scale of La Roche. After the completion of measurements on the egg content the thin albumen, thick albumen and the yolk were separated and their pH determined with the CP-401 pH-meter. Densities of the yolk and both fractions of the albumen (g/cm^3) were determined with the equipment designated for liquid density testing aided by the scales program WPS 360 C made by RADWAG.

The eggshell, after the removal of the egg content, was dried over a period of three hours in temperature of 105° C in the SUP 100 M drier. Subsequently the eggshell was weighed (g) on scales made by Medicat and its thickness was measured (mm) with the electronic micrometer screw. The albumen weight was calculated from the difference between the entire egg weight and the yolk and eggshell weight. The contents of yolk, albumen and the eggshell by percentage were compared with the weight of a fresh egg.

The numeric data gathered was analysed statistically and the mean values (x) and the coefficient of variation values (v) of the studied traits were calculated. A significance of differences within the egg traits between the evaluation dates were tested with the analysis of variance and the Tukey test.

RESULTS AND DISCUSSION

The mean weight of eggs laid by ducks at the beginning of the laying period was 71.7 g and it has increased with the ducks' age up to 86.7 g (Tab. 1). The variance of this trait took the highest value at the beginning of the season (11.2%) and then has decreased gradually.

The greatest values of length, width and eggshell area were found in eggs towards the end of the reproductive period (June – July), while lower values of these traits (statistically significant) were noted at the beginning of the season (January – February). Earlier research [2, 6] found duck eggs from the maternal strain P77 of greater length (65.5 mm) and width (48.8 – 49.5 mm). The egg shape index ranged from 72.8 to 75.0 % and it did not differ significantly statistically in the subsequent evaluations. Similar or lower values of the egg shape index for Peking ducks in the strain A44 and A55 were calculated by Mazanowski et al. [7].

Percentage of eggshell in the egg ranged from 9.6 to 10.1% and it was the greatest at the beginning of the laying period (Tab. 2). A lower part of eggshell in the egg of Peking ducks were obtained by Mazanowski et al. [8], while a greater fraction was found by Niewiarowicz and Płotka [9].

Table 1. Weight and dimensions of Peking duck eggs
Tabela 1. Masa i wymiary jaja kaczek Pekin

Trait		Egg laying period			
		beginning	peak	end	total
Egg weight (g)	x	71.7^{c}	82.7^{b}	86.7^{a}	80.7
	v	11.2	7.0	5.7	6.6
Egg length (mm)	x	61.9^{b}	64.1^{a}	65.1^{a}	63.8
	v	4.9	3.9	3.6	3.9
Egg width (mm)	x	45.0^{c}	47.7^{b}	48.8^{a}	47.2
	v	4.3	2.6	2.4	3.1
Egg shape index (%)	x	72.8^{b}	74.5^{a}	75.0^{a}	74.1
	v	4.7	4.3	3.8	4.3
Eggshell area (cm^2)	x	81.7^{c}	89.9^{b}	92.7^{a}	88.3
	v	6.0	4.7	3.8	4.4

Means in the rows with different letters differ significantly (P≤0.05)
Średnie w rzędach z różnymi literami różnią się istotnie (P≤0,05)

Table 2. Eggshell traits of Peking duck
Tabela 2. Cechy skorupy jaj kaczek Pekin

Trait		Egg laying period			
		beginning	peak	end	total
Eggshell weight (g)	x	7.2[a]	8.1[b]	8.3[b]	7.9
	v	11.7	8.4	7.0	8.1
Eggshell proportion in egg (%)	x	10.1[a]	9.9[ab]	9.6[b]	9.8
	v	7.6	7.7	5.5	7.1
Eggshell thickness (mm)	x	0.379[a]	0.391[a]	0.387[a]	0.387
	v	9.4	7.6	6.6	8.0
Eggshell deformation(μm)	x	25.2[a]	23.2[a]	22.9[a]	23.7
	v	19.3	18.4	19.2	19.2
Eggshell colour (% of white)	x	58.6[a]	57.2[a]	56.6[a]	57.4
	v	6.1	7.6	7.3	6.7

Means in the rows with different letters differ significantly (P≤0.05)
Średnie w rzędach z różnymi literami różnią się istotnie (P≤0,05)

Eggshell thickness of the evaluated pedigree strains ranged from 0.379 to 0.391 mm. In the research by Górski et al. [2] duck eggs from the strain A44 and A55 were characterised by a greater eggshell thickness (0.400 mm), similarly to duck eggs from the reserve flock P22 (0.430 do 0.450 mm) evaluated by Sochocka and Różycka [12].

Eggshell deformation was the greatest at the beginning of the reproductive period - 25.2 μm and it was decreasing with the age to 22.9 μm. In a different experiment [8] the greater eggshell deformation values were reported (from 26.8 to 29.4 μm) which suggested a lower eggshell deformation resistance. During the duck egg laying period the eggshell colour darkened and this was confirmed by the decreasing values of whiteness percentage in the subsequent evaluations - from 58.6 to 56.6%.

The egg content analysis (Tab. 3) showed that the yolk weight and the percentage of yolk in the egg have increased during the reproductive period. The content of yolk in the egg (%) showed some significant differences between the evaluations. The percentage of yolk during the entire reproductive period was smaller (30.7%) than the results obtained by Górski et al. [2] and Mazanowski et al. [7] in eggs of Peking ducks from the pedigree strains A44 and A55, which were subjected to intensive selection. Whereas the a weight was increasing, while its percentage decreased with the duck age. The yolk height and its diameter were the highest in eggs obtained at the end of the laying season (respectively: 19.1 and 49.1 mm). The subsequent evaluations have shown decreasing variances of these traits. The yolk index ranged from 38.9 to 41% and was decreasing. A similar tendency was reported by Adamski [1] in ducks from the A44 strain.

Yolk colour intensity was low at 3.4 to 3.6 points. This trait depends mainly on the contents of carotenoids in duck fodder. Yolk intensity evaluated in earlier research [2, 4, 5] was higher.

Yolk density determined with the scales program WPS 360 C made by RADWAG ranged from 0.447 do 0.513 g/cm^3 and was greater than the density of both egg white fractions – 0.348 to 0.443. Research by Mazanowski et al. [8] showed lower yolk densities for Peking duck eggs (from 0.374 to 0.392 g/cm^3) and egg albumen (from 0.327 to 0.357 g/ cm^3). pH values of yolk and both thick and thin albumen were increasing in subsequent evaluations. The values of egg albumen pH (Tab.

Table 3. Egg content traits of Peking duck eggs
Tabela 3. Cechy treści jaj kaczek Pekin

Trait		Egg laying period			
		beginning	peak	end	total
Albumen weight (g)	x	43.9[a]	49.5[b]	49.6[b]	47.9
	v	11.0	9.7	6.4	7.7
Yolk weight (g)	x	20.7[c]	25.1[b]	28.7[a]	24.9
	v	16.3	11.2	8.7	11.6
Albumen proportion in egg (%)	x	61.2[a]	59.7[b]	57.1[c]	59.4
	v	4.0	5.3	4.7	4.3
Yolk proportion in egg (%)	x	28.7[a]	30.4[b]	33.1[c]	30.7
	v	8.6	9.6	6.8	7.5
Thick albumen height (mm)	x	7.6[a]	7.6[a]	6.6[b]	7.3
	v	15.4	15.1	19.5	15.7
Haugh units	x	84.1[a]	81.2[a]	73.5[b]	79.9
	v	9.0	9.2	12.4	9.6
Yolk height (mm)	x	18.7[b]	19.1[a]	19.1[a]	19.0
	v	4.0	1.6	1.6	2.6
Yolk diameter (mm)	x	44.9[c]	47.5[b]	49.1[a]	47.2
	v	7.7	4.8	4.6	5.7
Yolk index	x	41.6[a]	40.2[a]	38.9[a]	40.2
	v	5.2	4.4	7.2	6.0
Yolk colour (pt.) La Roche scale	x	3.4[a]	3.6[a]	3.4[a]	3.5
	v	17.3	14.9	14.7	15.4

Means in the rows with different letters differ significantly (P≤0.05)
Średnie w rzędach z różnymi literami różnią się istotnie (P≤0,05)

Table 4. Density and pH of yolk and albumen in Peking duck eggs
Tabela 4. Gęstość i odczyn żółtka i białka jaj kaczek Pekin

Trait		Egg laying period			
		beginning	peak	end	total
Density (g/cm^3):					
yolk	x	0.447^b	0.513^{ab}	0.469^a	0.476
	v	8.0	11.7	18.2	13.4
thick albumen	x	0.386^a	0.443^a	0.415^a	0.414
	v	12.7	31.3	20.2	23.7
thin albumen	x	0.348^a	0.402^a	0.352^a	0.367
	v	19.5	14.2	18.4	16.3
pH values:					
yolk	x	5.77^b	5.69^b	6.09^a	5.86
	v	2.3	2.5	1.7	2.1
thick albumen	x	8.06^c	8.22^b	8.67^a	8.32
	v	1.1	2.1	2.6	2.1
thin albumen	x	8.09^b	8.15^b	8.70^a	8.31
	v	2.3	2.7	1.8	2.3

Means in the rows with different letters differ significantly (P≤0.05)
Średnie w rzędach z różnymi literami różnią się istotnie (P≤0,05)

4) were lower, while the yolk pH values were higher than in Mazanowski et al. [7] research.

In contrast Mazanowski and Adamski [6] research on duck eggs from the maternal strains have shown lower values of yolk pH (from 5.46 to 5.50), while thick albumen pH (8.78 to 8.96) and thin albumen pH (8.77 to 8.89) were similar or higher than our results.

CONCLUSION

During the egg laying period of ducks from the reserve flock the egg weight, length, width and the eggshell area have increased. The egg shape was becoming more spherical and the colour slightly darkened along the laying period. The eggshell and the egg albumen percentage in the egg have decreased, while the yolk fraction has increased. With increasing duck age the quality of thick albumen (its height and Haugh units) and yolk quality (yolk index) have deteriorated.

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