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Assessment of egg quality and hatch results of two show hen breeds raised for fancy

Ocena jakości jaj i wyników lęgu dwóch ras kur ozdobnych użytkowanych w chowie amatorskim

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Abstract

Growing interest in fancy breeding of hens motivates people to undertake research regarding their performance traits. The purpose of this research is to evaluate the quality of eggs and results of hatch of the following breeds: polish miniature crested bearded hens – gold variety with frizzy (CzZSz) and normal (CzZ) feather structure, silver (CzS), chamois (CzW) and silkie (Si). Eggs were evaluated in three periods of egg production. Hatching was carried out with the use of eggs from the production peak. The qualities of eggs changed according to the period of production. The largest differences were observed for the thickness of shells, percentage share of the yolk and albumen in an egg and the yolk color as well as its height and index. Among the examined breeds, the biggest statistically significant differences were found for the egg weight and the shell surface and thickness. Eggs with the largest weight and with the largest surface shell were characteristic for gold crested (CzZ) - 43.37 g and 58.59 cm^2, whereas eggs with the smallest weight and with the smallest surface, for chamois crested (CzW) - 35.64 g and 51.49 cm^2. The lowest fertilization was observed for eggs of silver crested hens (CzS) - 86.7%, whereas the highest for eggs of chamois crested hens (CzW) - 100%. The highest percentage share of dead embryos in relation to set eggs was found for gold crested hens with frizzy feather structure (CzZSz) - 16.7%, whereas the lowest for silver crested hens (CzS) - 3.3%.

Keywords: crested, egg quality, hatch, hen, silkie

Streszczenie

Rosnące zainteresowanie chowem kur ras ozdobnych skłania do prowadzenia badań z zakresu oceny ich cech użytkowych. Celem badań była ocena jakości jaj i wyników lęgu kur rasy: czubatka polska brodata miniaturowa odmiana barwna złota o szurpatej (CzZSz) i normalnej (CzZ) strukturze upierzenia, srebrna (CzS), wielbłądzia (CzW) oraz silka (Si). Jaja poddano ocenie w trzech terminach nieśności. Lęgi

przeprowadzono na jajach pochodzących ze szczytu produkcji. Cechy jakości jaj zmieniały się w zależności od terminu nieśności. Największe różnice zaobserwowano w grubości skorupy, procentowym udziale żółtka i białka w jaju oraz w barwie żółtka, jego wysokości i indeksie. Wśród badanych grup ptaków największe statystycznie istotne różnice stwierdzono w masie jaja oraz powierzchni i grubości skorupy. Jaja najcięższe i o największej powierzchni skorupy znosiły czubatki złote (CzZ) – 43,37 g i 58,59 cm^2, a najlżejsze i o najmniejszej powierzchni czubatki wielbłądzie (CzW) - 35,64 g i 51,49 cm^2. Najmniejsze zapłodnienie cechowało jaja czubatek srebrnych (CzS) - 86,7%, a największe jaja czubatek wielbłądzich (CzW) - 100%. Największy procentowy udział zarodków zamarłych w stosunku do jaj nałożonych zaobserwowano u czubatek złotych o szurpatej strukturze upierzenia (CzZSz) - 16,7%, a najmniejszy u czubatek srebrnych (CzS) - 3,3%.

Słowa kluczowe: jakość jaja, lęgi, kura, czubatka, silka

Detailed abstract

Materiał doświadczalny stanowiły jaja kur rasy: czubatka polska brodata miniaturowa odmiana barwna złota o szurpatej (CzZSz) i normalnej strukturze upierzenia (CzZ), srebrna (CzS), wielbłądzia (CzW) oraz silka (Si). Ptaki utrzymywano w murowanych budynkach z dostępem do wybiegów. Kury i koguty żywiono *ad libitum* mieszanką pełnoporcjową przeznaczoną dla kur niosek chowu przyzagrodowego. Ptaki korzystały również z zielonki znajdującej się na wybiegach. Ocenę cech fizycznych i składu morfologicznego jaj przeprowadzono w trzech terminach nieśności (początek, szczyt, koniec). Cechy jakości jaj zmieniały się w zależności od terminu nieśności. Największe różnice zaobserwowano w grubości skorupy, procentowym udziale żółtka i białka w jaju oraz w barwie żółtka, jego wysokości i indeksie. W miarę trwania cyklu produkcyjnego grubość skorupy, barwa żółtka i procentowy udział białka w jajach badanych ras kur zmniejszał się. Czubatki i silki jaja o największym procentowym udziale żółtka znosiły w końcowym terminie nieśności, a o najmniejszym na początku. Analizując cały okres nieśności największe statystycznie istotne różnice między badanymi grupami kur stwierdzono w masie jaja oraz powierzchni i grubości skorupy. Jaja najlżejsze i o najmniejszej powierzchni skorupy znosiły czubatki wielbłądzie (CzW) - 35,64 g i 51,49 cm^2, a najcięższe i o największej powierzchni skorupy czubatki złote o normalnej strukturze upierzenia (CzZ) - 43,37 g i 58,59 cm^2. Największa grubość skorupy cechowała jaja czubatek złotych szurpatych (CzZSz) – 0,34 mm, a najmniejsza jaja kur silek (Si) – 0,29 mm. Lęgi przeprowadzono na jajach pochodzących ze szczytu nieśności. Zapłodnienie jaj w ocenianych grupach ptaków wynosiło od 86,7% u czubatek srebrnych (CzS) do 100% u czubatek barwy wielbłądziej (CzW). Najmniejszy procentowy udział piskląt zdrowych z jaj zapłodnionych i nałożonych uzyskały czubatki złote szurpate (CzZSz), a największy czubatki wielbłądzie (CzW). U czubatek srebrnych (CzS) stwierdzono największy udział w stosunku do jaj nałożonych piskląt niewyklutych, kalekich i słabych – 12,5%. Natomiast największy udział zarodków zamarłych w stosunku do jaj nałożonych uzyskały czubatki złote szurpate (CzZSz).

Introduction

For a few last years, in Poland, there has been observed growing interest in raising birds of show breeds. Numerous associations and societies have been founded and they have been operating successfully, uniting people raising show birds.

Traits of particular breeds of show hens differ in terms of: color, structure of feathers and their arrangement, shape of the comb, color and size of ear muffs and wattles, color of shanks, shape and body posture. Among them there are breeds with unfeathered necks, feathered shanks and with characteristic crest on their heads (Świerczewska, et al., 2008).

Polish crested bearded hens occur in different colors: black, white, blue, gold, silver and chamois**.** There are also crested bearded with frizzy feather structure.

A distinctive feature of this breed is a big, full round crest and no comb. Ear muffs are small, invisible covered with a beard. The rooster's crest consists of long lancet shaped feathers, evenly distributed backwards and onto the sides. Hens have crests consisting of short feathers rounded at the end. Body mass of an adult rooster is 2.0 - 2.5 kg, and hen 1.5 - 2.0 kg. Egg production of polish crested bearded hens is up to 120 eggs yearly, which are characterized by white shell color (Pudyszak, 2004). In case of the miniature form, a rooster weighs nearly 0.9 kg, and hen 0.8 kg (Schmidt, 2007).

Silkie hens are one of the most beautiful and most eagerly raised breeds of chickens all over the world. They owe their popularity to several characteristic traits including: silky feathers, crest, five fingers, blue skin and ear muffs as well as a dark violet comb (Roszkowski and Wysocki, 2007).

The body mass of silkie hens is quite variable and depending on the country they are raised it may range from 1.0 to 1.6 kg (Verhoef and Rijs, 2006). Silkie chickens lay nearly 80 eggs yearly (Zniszczyńska, 2003). The morphological content of particular components in an egg is affected by: origin of birds, age, egg laying period, feeding, system of breeding and the environmental conditions. (Świerczewska, et al., 1999).

Nowadays there are not many scientific publications concerning production traits of show breeds of hens, intended for extensive use**.** Thus, it seems to be justified to conduct experiments in this field. The purpose of this research is to evaluate the quality of eggs and hatch results of breeds such as: miniature polish crested bearded and silky hens.

Materials and Methods

The research was carried out on a private farm in Rzadkwin, Strzelno commune, kujawsko-pomorskie province – and in the Department of Poultry Breeding of the University of Technology and Life Sciences in Bydgoszcz. The research material were eggs of hens in the first year of their being in use: polish miniature crested bearded hens, in a variety of colors: gold (CzZ), gold with frizzy feather structure (CzZSz), silver (CzS), chamois (CzW) and silkie (Si).

Throughout the experimental period the birds were kept in brick hen houses, on a bedding, with access to walks. Hens and roosters were fed *ad libitum* with a full value food mix designed for laying hens of backyard rising with 16% of protein content and metabolic energy 2600 kcal. Additionally, during the experiment the hens and roosters used green fodder on the walks. Lighting program was not applied.

The first stage of the research involved assessment of the morphological composition and physical traits of eggs during three periods of production (early, peak and end).

The evaluation of eggs was performed 24 hours after egg laying. At the beginning of egg production, 25 eggs of polish miniature gold crested bearded hens (CzZ) were analyzed, 20 from gold frizzy (CzZSz) and 20 from silver (CzS), 15 from chamois crested (CzW) and 15 from silky (Si) breeds. At the peak of egg production: 15 eggs of silver crested, 15 of chamois crested and 15 of silky were examined as well as 20 from gold crested with normal and 20 with frizzy feather structure. At the end of the egg production period, 15 eggs of silky hens and 15 from each variety of color crested hens were evaluated.

The weight of an egg (g) was marked on an electronic scales produced by Steinberg company. An electronic caliper was used for measuring the long axis (length) and the short axis (width) of an egg. The ratio of the egg width to its length, given in percentage, is the egg shape index. The surface of the egg shell (cm²) was calculated by the formula (Paganelli, et al., 1974):

$$P_s = 4.835 \times W^{0.662}$$

where: W – egg weight

After being emptied the shell was dried for 24 hours, then its weight (g) was measured with the use of an electronic scales. A micrometric screw was used for measurement of the shell thickness at its blunt end (mm).

After pouring the egg content onto a glass tray the height of yolk (mm), was measured and the yolk diameter was measured (mm) along the chalazae line by an electronic caliper. The ratio of the height of yolk to its diameter was its yolk index. The color of yolk was defined according to a 15 degree scale of La Roche. The yolk weight was measured with accuracy to 0.01 g by means of an electronic scales of Steinberg company. The weight of albumen was calculated from the difference between the egg weight and the weight of yolk and the shell. The percentage share of yolk, albumen and shell in the egg weight was calculated as well.

The results hatch of hen of the analyzed breeds was evaluated too. Eggs from the peak production period used for hatch were less than 7 days old. The hatches were carried out in two cycles. 30 eggs from polish miniature crested bearded gold frizzy (CzZSz), 30 from silver (CzS) and 30 chamois crested (CzW), 40 eggs from crested gold (CzZ) and 35 eggs from silkie hens (Si) were subject to incubation. The hatch was carried out in a brooder in Bios Midi in the Department of Poultry Breeding at the UTP in Bydgoszcz. Before setting eggs to the brooder they ware disinfected with a solution of 0.5% Virkon S.

The brooder chamber was provided with temperature 37.7^{o}C, with humidity 55-60%, and during hatching, the temperature was 37.4^{o}C, with humidity 70-80%. The eggs were x-rayed two times on the 7th and 18th day of incubation order to eliminate unfertilized eggs and those with dead embryos. After finishing the hatch, the percentage of egg fertilization and healthy hatched chickens from fertilized and set eggs were calculated. Also the share of unhatched, lame and weak chickens and dead embryos was calculated for the set eggs.

The obtained data was processed statistically by means of a spreadsheet of Excel program and system SAS. Average values of the analyzed traits ($\bar{x}$) were calculated as well as their standard errors (SEM). Significance of the differences between the traits analyzed in the successive periods of egg laying for one breed and for different breeds was verified by Univariate Analysis of Variance and Duncan test.

Results and Discussion

The carried out research has proved that polish miniature crested bearded silver (CzS) and chamois crested (CzW) hens laid eggs with the largest weight at the beginning of the production period, whereas with the smallest weight at the end of the production period (Table 1). Eggs of polish miniature crested bearded gold hens with frizzy feather structure (CzZSz) had the largest weight at the end of the egg laying period - 41.47 g, and the smallest weight in the peak of the production cycle - 37.95 g. An average egg weight of crested golden (CzZ) and silky (Si) hens did not differ statistically significantly in the successive periods of the egg laying. Analyzing the whole time of egg production it was found that eggs with the largest average weight were characteristic for polish miniature crested bearded gold hens (CzZ) - 43.37 g, and with the smallest, for chamois crested hens (CzW) - 35.64 g.

Table 1. Egg structure traits in hen at three dates of the egg- laying period
Tabela 1. Budowa jaj kurzych w trzech terminach nieśności

Trait	Date of laying	Hen breed									
		CzZSz		CzZ		CzS		CzW		Si	
		$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM
Egg weight, g	early	39.56^{ab}	0.52	43.38^{a}	0.78	41.81^{a}	0.62	36.99^{a}	0.25	40.11^{a}	0.94
	peak	37.95^{b}	0.76	43.07^{a}	0.80	41.67^{a}	0.54	35.65^{ab}	0.68	39.52^{a}	0.40
	end	41.47^{a}	0.60	43.95^{a}	1.55	37.71^{b}	1.47	34.67^{b}	0.28	39.09^{a}	0.46
	total	39.38^{C}	0.42	43.37^{A}	0.53	41.00^{B}	0.49	35.64^{D}	0.34	39.63^{CB}	0.36
Egg width, mm	early	36.63^{a}	0.38	38.27^{a}	0.33	37.62^{a}	0.25	36.10^{a}	0.59	37.23^{a}	0.38
	peak	36.36^{a}	0.29	38.10^{a}	0.34	37.44^{a}	0.21	35.80^{a}	0.29	37.75^{a}	0.19
	end	38.28^{b}	0.18	38.00^{a}	0.60	36.44^{b}	0.49	35.65^{a}	0.06	37.53^{a}	0.31
	total	36.90^{B}	0.22	38.16^{A}	0.22	37.33^{B}	0.17	35.82^{C}	0.18	37.55^{AB}	0.16
Egg length, mm	early	51.13^{a}	0.42	52.45^{a}	0.21	52.21^{ab}	0.37	48.43^{a}	0.43	52.06^{a}	0.57
	peak	50.79^{a}	0.30	52.19^{a}	0.34	52.94^{a}	0,37	48.95^{a}	0.38	49.86^{b}	0.28
	end	50.92^{a}	0.27	52.97^{a}	0.32	51.04^{b}	0.68	48.27^{a}	0.16	48.36^{c}	0.22
	total	50.96^{B}	0.21	52.45^{A}	0.17	52.28^{A}	0.26	48.57^{C}	0.19	50.28^{B}	0.33
Egg shape index, %	early	71.72^{a}	0.96	72.98^{a}	0.64	72.07^{a}	0.37	74.53^{a}	0.68	71.56^{a}	0.80
	peak	71.60^{a}	0.50	73.03^{a}	0.69	70.77^{a}	0.61	73.13^{b}	0.38	75.75^{b}	0.60
	end	75.18^{b}	0.28	71.73^{a}	0.94	71.39^{a}	0.37	73.68^{ab}	0.17	77.63^{b}	0.92
	total	72.44^{BC}	0.48	72.77^{BC}	0.42	71.43^{C}	0.30	73.77^{AB}	0.26	74.78^{A}	0.59
Eggshell area, cm^2	early	55.16^{ab}	0.48	58.60^{a}	0.70	57.22^{a}	0.57	52.78^{a}	0.24	55.66^{a}	0.87
	peak	53.65^{b}	0.71	58.33^{a}	0.72	57.09^{a}	0.50	51.50^{ab}	0.66	55.13^{a}	0.37

	end	56.92^{a}	0.54	59.08^{a}	1.39	53.40^{b}	1.38	50.56^{b}	0.27	54.75^{a}	0.43
	total	54.98^{C}	0.39	58.59^{A}	0.47	56.47^{B}	0.45	51.49^{D}	0.33	55.23^{BC}	0.33
Eggshell, thickness, mm	early	0.35^{a}	0.00	0.34^{a}	0.00	0.34^{a}	0.01	0.35^{a}	0.01	0.31^{a}	0.01
	peak	0.34^{a}	0.01	0.31^{b}	0.00	0.34^{a}	0.00	0.31^{b}	0.01	0.29^{b}	0.00
	end	0.32^{b}	0.01	0.29^{c}	0.01	0.29^{b}	0.01	0.30^{b}	0.00	0.29^{b}	0.00
	total	0.34^{A}	0.00	0.32^{BC}	0.00	0.33^{AB}	0.00	0.32^{C}	0.01	0.29^{D}	0.00

Explanatory notes: a, b, c - mean values in columns within of traits with different letters differ significantly ($p \leq 0,05$)
Objaśnienia: a, b, c - wartości średnie w kolumnach w obrębie cechy oznaczone różnymi literami różnią się istotnie ($p \leq 0,05$)
Explanatory notes: A, B, C ... – mean values of traits in lines for the whole period of the egg laying with different letters differ significantly ($p \leq 0,05$)
Objaśnienia: A, B, C ... - wartości średnie cech w wierszach za cały okres nieśności oznaczone różnymi literami różnią się istotnie ($p \leq 0,05$)

Crested and silky hens from the author's own research were characterized by a larger average weight of eggs as compared to polish dwarfish hens – liliputians evaluated by Andres et al. (2008). According to the quoted authors, the average weight of eggs in the 46th week of a bird's life was 35.4 g. Hens of silky breed (44.0 g), evaluated by Adamski (2004), laid eggs with larger weight as compared to those laid by hens from the author's own research. However, white silky hens (30.0 g) miniature frizzy cochins (33.0-35.0 g) and modern game (30.0-33.0 g) described by Pudyszak (2004), laid eggs with smaller weight than silkies and miniature polish crested bearded hens throughout the production period, from the author's own research. The differences may have resulted from various origins of the hens and different environmental conditions they had been raised in.

Polish miniature crested bearded gold hens (CzZ) were characterized by a statistically insignificant increase in the egg shape index for the peak production periods as compared to the beginning, and a decrease in the index value at the end of the period as compared to the previous egg laying periods (Table 1). Silky (Si) hens and crested gold frizzy hens (CzZSz) laid more spherical eggs in the final part of the production cycle than at the beginning and in the peak period. However, more spherical eggs were obtained from polish crested silver (CzS) and chamois crested (CzW) hens at the beginning of egg laying than those laid the peak and final period.

Eggs with the highest shape index throughout the whole production period were characteristic for silky (Si) - 74.78%, whereas eggs with the lowest shape index were found for polish miniature crested bearded silver hens (CzS) - 71.43%. Crested and silky hens had eggs of shape similar to the eggs of white silky hens, polish white crested hens and sultans, described by Pudyszak (2004).

The largest shell surface was observed for hens of polish miniature crested bearded gold breed with frizzy feather structure (CzZSz) at the end of the egg laying period, whereas, for chamois crested (CzW) and silver (CzS) hens, at the beginning of the

egg production. The shell surface did not differ statistically significantly in the successive egg laying periods for silkies (Si) and crested gold (CzZ).

In the course of the egg production, shell thickness of the analyzed breeds was decreasing (Table 1). If we take into consideration the whole production period, eggs with the thickest shell were observed for crested gold frizzy hens (0.34 mm). It may result from the highest weight of their shell which was also found for crested frizzy hens (Table 2)**.** Dwarfish liliputian hens examined by Andres et al. (2008) laid eggs with thicker shells than silkies (Si), thinner than the silver (CzS) and gold frizzy crested (CzZSz) hens and with the same thickness as chamois crested (CzW) and gold (CzZ) hens from own research.

Crested gold (CzZ), silver (CzS) and chamois crested (CzW) hens had eggs with the lowest shell weight in the final period of the egg production cycle**.** In case of crested gold frizzy (CzZSz) and silky (Si) hens no statistically significant differences between successive production periods were observed.

Table 2. Morphological composition of hen eggs at three dates of laying period
Tabela 2. Składniki morfologiczne jaj kurzych w trzech terminach nieśności

Trait	Date of laying	Hen breed									
		CzZSz		CzZ		CzS		CzW		Si	
		$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM
Yolk weight, g	early	12.85^{a}	0.24	14.52^{a}	0.21	15.75^{a}	0.43	12.30^{a}	0.24	13.51^{a}	0.58
	peak	13.99^{b}	0.40	15.70^{b}	0.34	16.35^{a}	0.24	12.27^{a}	0.38	14.64^{ab}	0.30
	end	17.58^{c}	0.39	16.65^{b}	0.50	15.90^{a}	0.45	12.43^{a}	0.17	15.61^{b}	0.24
	total	14.33^{B}	0.33	15.33^{A}	0.21	16.02^{A}	0.22	12.34^{C}	0.16	14.45^{B}	0.27
Yolk proportion, %	early	32.48^{a}	0.47	33.53^{a}	0.24	37.61^{a}	0.68	33.24^{a}	0.50	33.60^{a}	0.97
	peak	36.83^{b}	0.70	36.46^{b}	0.46	39.32^{a}	0.72	34.37^{ab}	0.56	37.11^{b}	0.89
	end	42.36^{c}	0.47	38.07^{c}	1.02	42.41^{b}	1.51	35.88^{b}	0.63	39.63^{b}	0.55
	total	36.32^{BC}	0.66	35.42^{BC}	0.36	39.17^{A}	0.55	34.63^{C}	0.41	36.51^{B}	0.68
Albumen weight, g	early	22.65^{a}	0.39	24.81^{a}	0.55	22.13^{a}	0.34	20.97^{a}	0.16	22.78^{a}	0.58
	peak	19.97^{b}	0.45	23.53^{a}	0.49	21.33^{a}	0.50	19.92^{ab}	0.48	21.04^{ab}	0.59
	end	19.94^{b}	0.24	23.88^{a}	1.10	18.45^{b}	1.16	19.03^{b}	0.31	19.69^{b}	0.34
	total	21.04^{B}	0.31	24.18^{A}	0.37	21.14^{B}	0.38	19.87^{C}	0.27	21.35^{B}	0.41
Albumen proportion, %	early	57.22^{a}	0.54	57.11^{a}	0.33	52.99^{a}	0.69	56.69^{a}	0.45	56.86^{a}	1.05
	peak	52.67^{b}	0.73	54.61^{b}	0.50	51.13^{ab}	0.70	55.83^{ab}	0.44	53.13^{b}	1.06
	end	48.12^{c}	0.46	54.18^{b}	0.87	48.66^{b}	1.46	54.90^{b}	0.61	50.35^{b}	0.44
	total	53.48^{B}	0.64	55.67^{A}	0.33	51.46^{C}	0.53	55.71^{A}	0.33	53.80^{B}	0.76

Eggshell weight, g	early	4.07^{a}	0.05	4.05^{a}	0.08	3.93^{a}	0.08	3.72^{a}	0.09	3.82^{a}	0.10
	peak	3.99^{a}	0.13	3.85^{a}	0.10	3.98^{a}	0.10	3.47^{ab}	0.12	3.85^{a}	0.11
	end	3.95^{a}	0.08	3.42^{b}	0.20	3.36^{b}	0.15	3.20^{b}	0.10	3.80^{a}	0.11
	total	4.01^{A}	0.06	3.86^{A}	0.07	3.85^{A}	0.07	3.44^{B}	0.08	3.83^{A}	0.06
Eggshell proportion, %	early	10.30^{a}	0.13	9.36^{a}	0.13	9.39^{ab}	0.10	10.07^{a}	0.25	9.54^{a}	0.23
	peak	10.50^{a}	0.24	8.93^{a}	0.16	9.55^{a}	0.17	9.79^{a}	0.52	9.76^{a}	0.33
	end	9.53^{b}	0.14	7.75^{b}	0.30	8.93^{b}	0.38	9.22^{a}	0.25	9.72^{a}	0.25
	total	10.21^{A}	0.12	8.91^{C}	0.13	9.37^{B}	0.11	9.65^{B}	0.23	9.69^{B}	0.18

Explanations, see table 1.
Objaśnienia jak w tabeli 1.

In the course of egg laying, polish miniature crested bearded gold (CzZ) and chamois crested (CzW) hens laid eggs with diminishing share of the shell (Table 2). The same dependence was found by Dudek and Rabsztyn (2011).The examined by them hens of greenleg partridge breed (Z-11), in the 26th week of life laid eggs with the share of shell - 10.6%, and in the 50th week - 9.4%.

Throughout the whole egg laying period, eggs with the highest statistically significant percentage share of the shell were observed for polish miniature crested bearded gold frizzy (CzZSz) – 10.21%, and eggs with the smallest statistically significant percentage share of the shell- 8.91% for crested gold with normal feather structure (CzZ). Comparing the examined by Andres et al. (2008) dwarfish hens- liliputians, with the considered crested and silky hens, it was found that the shell share in an egg was bigger for liliputians - 11.5%.

Eggs with the highest average yolk weight were found for crested silver (CzS) hens in the peak period of egg laying, whereas for birds of other breeds, at the end of egg laying (Table 2). Eggs with the heaviest yolks were also found by Bernacki et al. (2004) for Tetra SL hens, at the end of the egg production after induced molting. Taking into consideration the whole cycle of egg laying, the eggs of crested silver hens (CzS) were characterized by the largest weight of yolk, whereas eggs with the smallest weight of yolk belonged to chamois crested hens (CzW). The average largest weight of the albumen was observed for eggs of crested gold (CzZ), and the smallest was found for chamois crested (CzW).

In the course of egg laying the percentage share of yolk in the egg was increasing and the share of albumen was decreasing. It was found that throughout the production period, the eggs of polish miniature chamois crested bearded hens (CzW) were characterized by the lowest percentage share of yolk and the highest of albumen, whereas the eggs of crested silver (CzS) hens had the highest percentage share of yolk and the smallest of albumen. Comparing eggs of the examined breeds with the eggs of dwarfish hens, studied by Andres et al. (2008), it was observed that in the 46th week of life they laid eggs with a lower percentage share of yolk - 33.5%, than crested and silk hens analyzed in this research. In the author's own research, polish miniature chamois crested bearded (CzW) and gold hens (CzZ) laid eggs with a bigger percentage share of albumen than dwarfish hens from the research of

Andres et al. (2008), whereas the remaining crested hen groups and silk hens had eggs with a smaller share of albumen.

The above quoted authors link the high percentage share of the yolk in eggs of dwarfish hens with the necessity of providing developing embryos with sufficient amount of nutritious substances. They suppose that the size of yolk is a conservative trait and is connected with biological needs of the birds.

The yolks of eggs of all the color varieties of crested and silky hens were becoming more pale in the course of egg laying (Table 3). The color of yolk was losing its intensity throughout the production cycle which was expressed in points of La Roche scale, most likely due to significant loss of colors from the bird organism during the egg laying period.

Table 3. Egg content traits in hen at three dates of the laying period
Tabela 3. Cechy treści jaj kurzych w trzech terminach nieśności

Trait	Date of laying	Hen breed									
		CzZSz		CzZ		CzS		CzW		Si	
		$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM
Yolk color (la Roche)	early	9.11^{a}	0.16	9.84^{a}	0.09	9.94^{a}	0.17	9.80^{a}	0.20	10.33^{a}	0.01
	peak	7.47^{b}	0.19	7.90^{b}	0.30	6.73^{b}	0.25	8.57^{b}	0.43	7.27^{b}	0.01
	end	7.10^{b}	0.23	7.10^{c}	0.31	6.43^{b}	0.30	7.57^{c}	0.20	6.40^{b}	0.01
	total	8.04^{A}	0.17	8.64^{A}	0.20	8.03^{A}	0.30	8.53^{A}	0.27	8.07^{A}	0.01
Yolk height, mm	early	18.56^{a}	0.12	18.92^{a}	0.17	19.56^{a}	0.18	18.40^{a}	0.40	19.22^{a}	0.22
	peak	17.82^{b}	0.10	17.85^{b}	0.13	18.27^{b}	0.15	17.29^{b}	0.18	17.67^{b}	0.19
	end	17.50^{b}	0.17	18.60^{a}	0.22	18.29^{b}	0.18	17.43^{b}	0.20	17.60^{b}	0.24
	total	18.04^{B}	0.10	18.47^{AB}	0.12	18.82^{A}	0.15	17.63^{C}	0.17	18.14^{B}	0.18
Yolk diameter, mm	early	35.92^{a}	0.35	37.71^{a}	0.21	37.72^{a}	0.34	35.50^{a}	0.44	37.19^{a}	0.32
	peak	36.28^{a}	0.41	37.17^{a}	0.29	37.03^{a}	0.22	33.27^{b}	0.58	36.96^{a}	0.29
	end	38.77^{b}	0.43	36.96^{a}	0.18	37.21^{a}	0.65	34.75^{a}	0.23	37.29^{a}	0.31
	total	36.69^{A}	0.28	37.38^{A}	0.15	37.35^{A}	0.21	34.40^{B}	0.33	37.09^{A}	0.18
Yolk index, %	early	51.75^{a}	0.62	50.19^{a}	0.48	51.92^{a}	0.63	51.87^{a}	1.31	51.70^{a}	0.52
	peak	49.23^{b}	0.62	48.06^{b}	0.39	49.34^{b}	0.39	52.04^{a}	0.91	47.82^{b}	0.51
	end	45.19^{c}	0.71	50.33^{a}	0.56	49.18^{b}	0.55	50.16^{a}	0.62	47.20^{b}	0.41
	total	49.34^{BC}	0.53	49.44^{BC}	0.31	50.40^{AB}	0.38	51.30^{A}	0.54	48.92^{C}	0.47

Explanations, see table 1.
Objaśnienia jak w tabeli 1.

Most of the analyzed groups of birds, at the beginning of the production period, had eggs with the highest percentage index of yolk. It must have been caused by high values of the yolk height which were observed for all the examined groups of birds in the initial production period. Analyzing the whole egg laying period the smallest index of yolk was characteristic for silky hens (Table 3).

High fertilization was characteristic for polish miniature crested bearded gold with frizzy (CzZSz) and normal feather structure (CzZ), chamois crested (CzW) and silky (Si). Chamois crested (CzW) had 100% of fertilized eggs like laying hens from backyard raising from Podkarpacie region with their body mass below 1.0 kg, in the first period of egg laying, examined by Andres et al. (2004). However, backyard raised hens being in the second season of egg laying and older ones, with body mass also below 1.0 kg, in the research of Andres et al. (2004), yielded worse fertilization results, than other hen breeds examined in this experiment. According to Pudyszak (2004) fertilization of eggs of crested sultan hens was 50-77%, which was a worse result than fertilization results observed for crested and silky hens.

Table 4.Hatch results of hen eggs
Tabela 4. Wyniki lęgu jaj kurzych

	Hen breed				
	CzZSz	CzZ	CzS	CzW	Si
Number of set eggs	30	40	30	30	35
Egg fertility (%)	96.7	95.0	86.7	100	91.4
Healthy chickens to egg fertilized (%)	72.4	78.9	88.5	93.3	81.3
Healthy chickens to egg set (%)	70.0	75.0	76.7	93.3	74.3
Share relatively to set eggs unhatched, crippled and weak chickens (%)	10.0	12.5	6.7	0.0	8.6
Share relatively to set eggs dead embryos (%)	16.7	7.5	3.3	6.7	8.6

Polish miniature chamois crested bearded (CzW) had the biggest percentage share of healthy hatched chickens from fertilized and set eggs. Hatch yield from fertilized eggs of dwarfish hens liliputians, in the research of Lis and Andres (2007) was 93.5%, being better than for the examined silky and crested hens.

The highest percentage share of dead embryos in set eggs was observed for crested gold with frizzy feather structure (CzZSz). They had also 10.0% of unhatched, crippled and weak chickens. Also a big share of unhatched, crippled and weak chickens in set eggs was found for silver crested (CzS) - 12.5%. Such results can be caused by a small biological value of the eggs used for hatch. In most of the hen groups the share of dead embryos in set eggs was bigger as compared to silky hens from Adamski research (2004).

In conclusion, eggs of the analyzed breeds of hens were characterized by different quality traits depending on the egg laying period. The biggest differentiation was observed for the shell thickness, percentage share of yolk and albumen in the egg, the color of yolk and its height and index. Among the examined groups of birds the most statistically significant differences were found for the egg weight, the shell surface and thickness. Fertilization percentage was the highest for chamois crested hens (CzW) and their percentage share of healthy chickens, hatched from both fertilized and set eggs, was the highest.

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