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EGG QUALITY FROM DOMESTIC AND FRENCH GUINEA FOWL

Summary. The eggs of the guinea fowls from flock I (French, meat type) were characterized by a greater (by 14.6 g, $p \leq 0.05$) mean weight in comparison with the eggs from flocks II (domestic). Birds from flock I laid eggs with a greater egg-shell weight (by 1.7 g). Eggs from flock I were characterized by a significantly higher (by 3.2 g) mean yolk weight and the percentage content of the egg albumen (by 3.5 percentage points) and lower (by 2.7 percentage points) proportion of the yolk in the egg. Significant positive correlations were found between the weight of eggs and the weight of the yolk, albumen and eggshell, percentage content of the albumen, eggshell thickness and its surface (r_p from 0.363 to 0.989). Egg specific gravity was correlated positively with egg-shell traits. Significantly positive correlations were also found between the weight of yolk and albumen and the weight, thickness and surface of eggshells (r_p from 0.312 to 0.975) as well as between the eggshell weight and its content in the egg, thickness and surface (r_p from 0.448 to 0.810). The shape of guinea fowl eggs constituted a trait which was significantly negatively correlated with their weight as well as the weight of the yolk, albumen and shell as well as the eggshell surface (r_p from –0.424 to –0.561). Eggs derived from French guinea fowls were characterized by greater weight of egg, yolk, albumen and eggshell and greater eggshell surface and water vapour conductance.

Key words: guinea fowl, egg quality, correlation

Introduction

Intensive development of rearing and breeding of guinea fowls in Europe, including Poland, took place in 1960s. Unfortunately, in 1970s, the rearing of these birds on large scale was abandoned in Poland and, at the present time, they are kept, primarily, in

small household flocks. On the other hand, in France the selection of these birds, which has been going on for years, is focused mainly on the increase of their body weight, rapid growth, good feed conversion and very good meat quality as well as the improvement of reproductive traits and chick quality (VO et AL. 1986, JAMENOT and GALOR 1994).

As demonstrated by BEDNARCZYK (1991), the selection (e.g. focused on body weight, rate of reaching reproductive maturity) as well as a number of environmental factors (e.g. nutrition, lighting) can exert a significant influence on the traits of hen eggs. Similar results were also reported by TARASEWICZ et AL. (2004) with reference to Japanese quails. However, such egg traits as: their weight, egg specific gravity as well as the eggshell thickness may be associated with hatchability results (RÓŻYCKA and WĘŻYK 1985, SZCZERBIŃSKA 1996). The available domestic literature on the subject deals only with problems associated with egg quality and hatching results of guinea fowls reared in extensive conditions (BERNACKI and HELLER 2003, KUŹNIACKA et AL. 2004). Similar articles can also be found in foreign literature (OKE et AL. 2003, ADEYEMO and OYEJOLA 2004).

It is evident from the quoted articles that the egg quality of poultry can vary depending on the breeding work. So far no information concerning eggs quality of guinea fowl according to origin has been found in the literature. It inspired the authors to undertake investigations aiming to compare the quality of guinea fowl eggs depending on the origin of these birds.

Material and methods

The experimental material comprised eggs derived from one-year-old birds (flock I – French meat type breeders and flock II – domestic flock). Each flock included 150 layers. The French guinea fowls 'Essor' (Hubbard) was purchased in France as one-day-old chicks. Simultaneously, eggs of domestic guinea fowl were purchased from private farms situated in Wielkopolska Voivodeship. These eggs were used for hatching carried out at the Experimental Station of Animal Nutrition in Gorzyń which belongs to the Poznań University of Life Sciences. Both the purchased (flock I) and hatched (flock II) chicks were reared in the same conditions at the Experimental Station of Animal Nutrition in Gorzyń. Guinea fowls began laying in May at mean body weights of 3,200 and 1,466 g in flocks I and II, respectively. Both flocks were kept in identical conditions, in outdoor, partially roofed, aviaries and fed *ad libitum* complete diet containing (per 1 kg) 11.25 MJ metabolic energy, 16.0% crude protein, and 3.3% total calcium. In the course of the laying period lasting 20 weeks (Fig. 1), 86 eggs were obtained on average from one guinea fowl from flock I and 68 eggs – from one guinea fowl derived from flock II.

Eggs for investigations were collected from guinea fowls at the peak of laying during one day (5^{th} week). The performed assessment comprised 60 eggs from each flock (the total of 120 eggs). The following traits were evaluated:

– egg weight (g) with 0.01 g accuracy with the assistance of the WPS 360C type balance,

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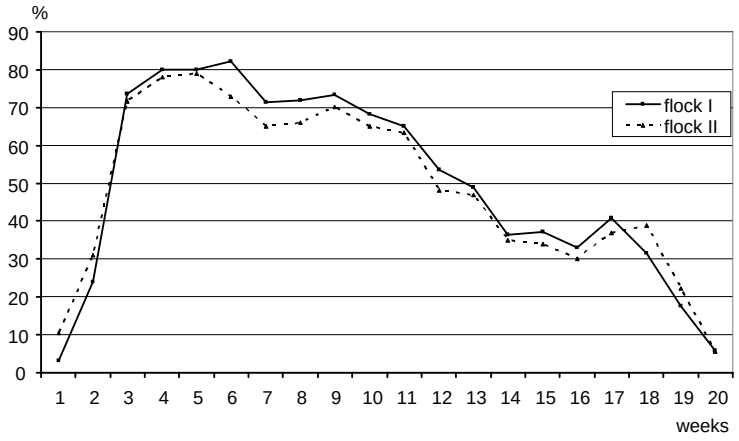

Fig. 1. Guinea fowls' laying rate
Rys. 1. Przebieg nieśności perlic

- egg shape index (%) on the basis of measurements of the egg length and width using for that purpose slide callipers, with 0.02 mm accuracy,
- egg specific gravity (g/cm^3) using for this purpose a set for the density determination of solids and liquids,
- eggshell weight (g) after drying at the temperature of 105^{o}C until reaching constant weight with 0.01 g accuracy with the assistance of the WPS 360C type balance,
- percentage content of the eggshell in the egg,
- eggshell thickness together with shell membranes at the equatorial part of the egg using for this purpose a micrometre screw,
- shell water vapour conductance determined on 30 eggs from each guinea fowl flock according to the method developed by AR et AL. (1974) and calculated according to the formula:

$$P = \frac{\text{mg } H_2O}{\text{day} \times \text{torr}}$$

where:

P – eggshell water vapour conductance,
mg H_2O/day – mean daily egg weight loss in the form of water vapour,
torr = 23.756 – value read from Tables – pressure of saturated water vapour at the temperature of 25°C (ACHMATOWICZ 1954),

- yolk weight (g) with 0.01 g accuracy with the assistance of the WPS 360C type balance,
- percentage content of the yolk in the egg,
- albumen weight (g) after subtracting the weight of yolk and eggshell from the egg weight,

– percentage content of the albumen in the egg,
– the yolk to albumen ratio (%) calculated in accordance with the formula:

$$\text{the yolk/the albumen} = \text{yolk weight/albumen weight} \times 100$$

The obtained results were elaborated statistically using the SAS v. 9.1 statistical package. The significance of differences between guinea fowl flocks regarding egg quality traits was verified by the Student's t-test and statistical differences were established at the level of $p \leq 0.05$.

Results

The results of the egg quality assessment are presented in Table 1. Eggs of guinea fowls from flock I were characterised by a statistically significantly (by 14.6 g) greater weight and greater, by 1.7 g, mean eggshell weight in comparison with the eggs derived from flocks II. The examined guinea fowl flocks differed significantly with regard to their mean eggshell surface. This surface was the greatest in flock I. The eggshell

Table 1. Mean values ($\bar{x}$) and standard error of the mean (SEM) of examined traits in guinea fowl eggs
Tabela 1. Wartości średnie ($\bar{x}$) i błąd standardowy średniej (SEM) badanych cech jaj perlic

Trait	Guinea fowl flock			
	I		II	
	$\bar{x}$	SEM	$\bar{x}$	SEM
Shape index (%)	73.7 a	0.34	74.7 a	0.39
Egg weight (g)	55.3 a	0.70	40.7 b	0.54
Egg specific gravity (g/cm^3)	1.109 a	0.003	1.115 a	0.002
Shell weight (g)	8.2 a	0.21	6.5 b	0.21
Shell content (%)	14.8 a	0.29	15.6 a	0.35
Shell thickness (μm)	518 a	11.39	522 a	14.60
Shell surface (cm^2)	68.9 a	0.58	56.2 b	0.49
Shell water vapour conductance (mg H_2O/day × torr)	8.3 a	0.25	5.8 b	0.23
Yolk weight (g)	15.9 a	0.21	12.7 b	0.29
Yolk content (%)	28.7 a	0.43	31.4 b	0.21
Albumen weight (g)	31.3 a	0.52	21.5 b	0.44
Albumen content (%)	56.5 a	0.37	53.0 b	0.42
Yolk:albumen ratio (%)	51.0 a	1.04	59.3 b	0.76

Means in rows marked with different letters differ significantly at $p \leq 0.05$.

derived from guinea fowls from flock I was characterized by significantly higher water vapour conductance by 2.5 g H_2O/day × torr. The mean yolk weight of eggs derived from flock I was statistically significantly higher (by 3.2 g) than that determined in the eggs from flocks II. The yolk content in eggs from flock I was statistically significantly lower (by 2.7 percentage points). On the other hand, eggs derived from these guinea fowls were characterised by 9.8 g higher mean albumen weight. The percentage content of albumen in eggs derived from flocks I was significantly higher (by 3.5 percentage points) than in eggs from flock II. Statistically significant differences were found between the examined guinea fowl flocks regarding the mean value of the yolk to albumen ratio. This ratio was found higher in the eggs from flock II by 8.3 percentage points. Phenotype correlation coefficients between the traits of guinea fowl eggs (Table 2) indicate significant positive relationships between the egg weight and the weight of the yolk, albumen and eggshell, percentage content of the albumen, eggshell thickness and its surface (r_P from 0.363 to 0.989). Egg specific gravity was positively correlated with

Table 2. Coefficients of phenotypic correlations between examined traits of guinea fowl eggs
Tabela 2. Współczynniki korelacji fenotypowych między badanymi cechami jaj perlic

Trait	Egg weight (g)	Egg specific gravity (g/cm^3)	Yolk weight (g)	Yolk content (%)	Albumen weight (g)	Albumen content (%)	Shell weight (g)	Shell content (%)	Shell thickness (μm)	Shell surface (cm^2)	Yolk: albumen ratio (%)
Shape index (%)	–0.424***	–0.148	–0.561***	0.164	–0.476***	–0.087	–0.451***	–0.038	–0.382**	–0.425***	0.152
Egg weight (g)		0,138	0,904***	–0,581***	0,975***	0,440***	0,811***	0,153	0,363***	0,989***	–0,570***
Egg specific gravity (g/cm^3)			–0.001	–0.153	0.042	–0.142	0.333**	0.222*	0.602***	0.137	–0.266
Yolk weight (g)				–0.185	0.824***	0.187	0.672***	–0.080	0.339**	0.907***	–0.214
Yolk content (%)					–0.684***	–0.699***	–0.501***	–0.004	–0.213	–0.578***	0.937***
Albumen weight (g)						0.625***	0.674***	–0.202	0.312**	0.975***	–0.719***
Albumen content (%)							–0.060	–0.712***	–0.100	0.441***	–0.900***
Shell weight (g)								0.672***	0.448***	0.810***	–0.282**
Shell content (%)									0.176	0.154	0.339**
Shell thickness (μm)										0.360***	–0.088
Shell surface (cm^2)											–0.569***

*Significant at $P \leq 0.05$.
**Significant at $P \leq 0.01$.
***Significant at $P \leq 0.001$.

the eggshell traits (weight, thickness and percentage content in the egg). Significant positive correlations were also demonstrated between the yolk and albumen weight and the weight, thickness and surface of the eggshell (r_P from 0.312 to 0.975) as well as between the eggshell weight and its content in the egg, thickness and surface (r_P from 0.448 to 0.810) and between the eggshell thickness and its surface. On the other hand, the egg shape of guinea fowls was significantly negatively correlated with its weight, yolk, albumen and eggshell weight as well as the eggshell surface (r_P from –0.424 to –0.561). Similarly, negative correlations were found between the percentage content of the yolk in the egg and the weight and content of the albumen and the eggshell thickness as well as between the value of the yolk to albumen ratio and the egg weight, eggshell weight and its surface (r_P from –0.282 to –0.570).

Discussion

Both the French as well as domestic guinea fowls were found to have similar egg shape indices. The results of investigations concerning the relationship of this trait with the egg weight are ambiguous. However, in many studies carried out on chickens and Japanese quails researchers reported a negative, although not always significant, correlation between the egg shape index and its weight (RÓŻYCKA and WĘŻYK 1985, KUL and SEKER 2004) which would mean that heavier eggs are more elongated. Similar results were obtained in our investigations in which a negative dependence between these traits was found (r_p = –0.424). On the other hand, in their experiments on guinea fowls BERNACKI and HELLER (2003) found that heavier eggs were characterized by greater shape index, i.e. they were more ball-shaped. These results are further corroborated by research results obtained by KUŹNIACKA et AL. (2004) in guinea fowls, who found a significant positive correlation between the shape of eggs and their weight (r_p = 0.317). In our studies, guinea fowls laid eggs differing significantly with regard to their weight but their shape was similar. However, these birds differed considerably with regard to their body weights. BEDNARCZYK (1991) claims that the shape of eggs in chickens is characteristic for specific lines, or even for specific individual and is characterized by a high heritability coefficient reaching about 0.5. It is well known that selection of larger body weight and better muscularity causes decrease of reproduction traits. However, heavier guinea fowls laid 18 eggs more than the lighter domestic guinea fowls. So higher body weight and larger numbers of laid eggs in French guinea fowls may have been caused by carried out simultaneously selection for both meat and reproduction traits, in these birds.

The weight of eggs determined in the domestic flock of guinea fowls was similar to that found in studies carried out by AYORINDE (1991), BERNACKI and HELLER (2003), KUŹNIACKA et AL. (2004) as well as NAHASHON et AL. (2006). On the other hand, French guinea fowls laid eggs of higher weight (by about 14.6 g) in comparison with the eggs of domestic birds. This was caused most probably by the selection for body weight carried out in these birds, which was by nearly 1.7 kg higher in comparison with domestic birds, and which resulted in the increase of the egg weight. A significant correlation (r_p = 0.850) between the body weight of guinea fowls and the weight of their eggs was demonstrated, among others, by OKE et AL. (2004). Eggs derived from the

heaviest chickens were characterized by about 2.3 g greater weight in comparison with lighter chickens. Similar results were reported by CHENG et AL. (1995) who conducted investigations on Tsaiya laying ducks. However, according to BEDNARCZYK (1991), in the case of chickens, this dependence is not of linear nature, which means that a heavier layer need not always lay eggs heavier than those laid by a lighter layer. This fact was also corroborated by research investigations carried out on Japanese quails by TARASEWICZ et AL. (2004). Broiler type of birds ('Faraon') weighing approximately 206 g laid lighter (by about 1.2 g) eggs than white laying quails whose average weight was only 128 g. In their experiments in which they fed guinea fowls diets containing different levels of energy and protein (2650-2850 kcal EM/kg and 16-20% crude protein), OKE et AL. (2003) determined similar but by 5.2 g smaller egg weight in comparison with the results obtained for flock of domestic guinea fowls in our studies. Also NAHASHON et AL. (2007 b) using during the rearing period (0-16 weeks) of guinea fowls diet including different levels of metabolic energy (2900-3200 kcal/kg) and crude protein (17-21%) found similar egg weight of those birds in reproductive period (about 39.5 g). A large difference in the weight of French and domestic guinea fowl eggs can be attributed to the higher weight of their albumens, yolks and eggshells as confirmed, among others, by highly positive correlations between the egg weight and the weight of the albumen, yolk and eggshell (r_p from 0.811 to 0.975). Similar correlations (r_p from 0.350 to 0.580) were reported in pheasants (KIRIKÇI et AL. 2003). TARASEWICZ et AL. (2004) found similar eggshell weight in Japanese quails which differed significantly (by about 1 g) with regard to their egg weight. Therefore, it can be said that the increase in the egg weight need not always be associated with the increase in the eggshell weight.

The mean eggshell weight of the French guinea fowls in our studies was similar to that reported by BERNACKI and HELLER (2003) and KUŹNIACKA et AL. (2004) but in their experiments the experimental material comprised domestic guinea fowls kept extensively. On the other hand, in their studies OKE et AL. (2004) found the eggshell weight ($\bar{x}$ = 6.7 g) similar to that obtained in our experiments for the domestic guinea fowls. The greater eggshell weight of the French guinea fowls could have been affected not only by their greater surface resulting from the egg size but also its thickness. The authors also found a significant positive correlation between the egg weight and the thickness of its eggshell. On the other hand, no such correlations were reported by KUŹNIACKA et AL. (2004), OKE et AL. (2004) and NAHASHON et AL. (2007 a, b) in guinea fowls. Also MOHAMMED et AL. (2005) reported identical eggshell thickness of 362.1 μm in chicken eggs differing (by about 2 g) with regard to their weight.

Experiments carried out by DOHNAL et AL. (1986) revealed that eggshell quality is associated with the egg specific gravity. The thicker the eggshell, the greater the egg specific gravity. Our investigations also showed highly significant correlation coefficients between these traits (r_p 0.602) as well as between the weight and the percentage content of the eggshell in the egg and its egg specific gravity (r_p from 0.222 to 0.333). These correlations were not reflected in the obtained results because the domestic guinea fowls had similar eggshell thickness and egg specific gravity to French birds. In the available literature on the subject, no data was found concerning the eggshell water vapour conductance in guinea fowls. However, the obtained results differ from those obtained by SZCZERBIŃSKA (1996) for chickens and by KRYSTIANIAK et AL. (2005) for pheasants. The above-mentioned researchers reported higher water vapour conductance for thinner eggshell.

Conclusions

Eggs derived from French guinea fowls were characterized by greater weight of egg, yolk, albumen and eggshell and greater eggshell surface and water vapour conductance.

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JAKOŚĆ JAJ PERLIC KRAJOWYCH I FRANCUSKICH

Streszczenie. Jaja perlic ze stada I (francuskie, typ mięsny) charakteryzowała większa o 14,6 g ($p \leq 0,05$) średnia masa w porównaniu z jajami ze stada II (krajowego). Ptaki ze stada I znosiły jaja o większej masie skorupy (o 1,7 g). Jaja ze stada I charakteryzowała istotnie większa (o 3,2 g) średnia masa żółtka i istotnie większy udział białka (o 3,5 jednostki procentowe) oraz mniejsza o 2,7 jednostek procentowych zawartość żółtka. Stwierdzono istotne dodatnie zależności między masą jaja a masą żółtka, białka i skorupy, procentowym udziałem białka, grubością skorupy oraz jej powierzchnią (r_P od 0,363 do 0,989). Masa właściwa jaj była dodatnio skorelowana z cechami skorupy. Istotnie dodatnie zależności wykazano także między masą żółtka i białka a masą, grubością oraz powierzchnią skorupy (r_P od 0,312 do 0,975), a także między masą skorupy a jej zawartością w jaju, grubością i powierzchnią (r_P od 0,448 do 0,810). Kształt jaja perlic był z kolei cechą istotnie ujemnie skorelowaną z jego masą, masą żółtka, białka i skorupy oraz powierzchnią skorupy (r_P od –0,424 do –0,561). Jaja pochodzące od francuskich perlic charakteryzowały się większą masą, większą masą żółtka, białka i skorupy oraz większą powierzchnią skorupy i przepuszczalnością pary wodnej.

Słowa kluczowe: perlica, jakość jaj, korelacja

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