ACTA SCIENTIARUM POLONORUM *Acta Sci. Pol., Zootechnica 10 (1) 2011, 41–48*

QUALITY OF EGGS FROM GAME PHEASANTS FED DIETS OF DIFFERENT NUTRITIONAL VALUE

Dariusz Kokoszyński, Zenon Bernacki, Kamil Ławski

University of Technology and Life Sciences in Bydgoszcz, Poland

Abstract. Eggs from game pheasants receiving a diet containing 19.0% crude protein and 11.7 MJ ME (control) or 15.0% crude protein and 12.6 MJ ME were studied. Analysis was made of 60 eggs (30 eggs from each group) collected during the 5th week of egg production. Eggs were examined within 24 h of collection. Pheasants receiving the experimental diet laid eggs with lower ($P \leq 0.05$) weight (26.3 g), length (42.1 mm) and width (33.5 mm) compared to the eggs from pheasants fed the control diet (30.8 g, 43.8 mm and 35.6 mm, respectively). The eggs from pheasants receiving the experimental feed had shells that were significantly ($P \leq 0.05$) lighter (2.5 g), thinner (0.280 mm), weaker (shell deformation 31.3 μm) and smaller in area (42.1 cm^2). The eggs had the same percentages of albumen (52.9%) and similar percentages of yolk (37.4 : 37.6%) in both groups, with albumen and yolk weight being significantly lower in eggs from pheasants receiving the experimental diet. The change in diet composition increased the pH ($P \leq 0.05$) of fresh egg contents.

Keywords: albumen, egg, feed, pheasant, shell, yolk

INTRODUCTION

The morphological composition and quality characteristics of pheasant eggs were studied by Tserweni-Gousi and Yannakopoulos [1990], Kirikçi et al. [2004], Kuźniacka et al. [2004, 2005] and Garip et al. [2010], who showed that in the first period of lay, weight of pheasant eggs averaged from 29.6 to 31.8 g, shape index from 79.9 to 80.9%, and shell thickness from 0.252 to 0.293 mm. Shell accounted for 9.9 to 12.1% of the egg, yolk for 31.3 to 35.2%, and albumen for 52.3 to 58.7%.

The effects of using different protein and energy content in the diets of game pheasants on reproductive traits were investigated by Giebel et al. [1984] and Jamroz et al. [1984, 1985]. Jamroz et al. [1985] reported that supplementing in-lay game pheasants fed a low-protein diet (15.6%) with methionine, lysine, Ca, P and with 0.3% NaCl added at the requirement level ensured similar production results to those obtained in birds receiving a complete diet con-

Corresponding author – Adres do korespondencji: Dr inż. Dariusz Kokoszyński, Department of Poultry Breeding, University of Technology and Life Sciences in Bydgoszcz, Mazowiecka 28, 85-084 Bydgoszcz, Poland, e-mail: kokoszynski@gmail.com

taining 20.0% crude protein. Feeding parent pheasants with a diet low in crude protein (15.48 instead of 19.76%) and high in energy (2778 instead of 2576 kcal ME) [Jamroz et al. 1984], obtained as a result of reducing the proportion of soybean meal (from 10 to 6%), excluding meat-and-bone meal and increasing the proportion of ground maize (from 30 to 41.5%) caused decreases in egg production (by 6 eggs), mean weight of egg (by 0.37 g), and total weight of egg per layer in the laying season (by 204 g). Feed intake per layer per egg and per kg of eggs as well as the biological value of eggs increased (improved egg fertility and hatchability). Replacing imported feeds (ground maize, soybean meal, fish meal) with Polish raw materials (ground wheat, blood meal, meat-and-bone meal) while decreasing dietary crude protein from 19.76 to 15.40% and increasing energy value from 2576 to 2658 kcal ME reduced egg number (by 3 eggs) and weight (by ~ 100 g) in the first period of lay.

There was also an increase in feed intake and a decrease in crude protein intake per egg and per kg of eggs. Decreasing the level of protein in the diets for laying pheasants had a positive effect on egg fertility and hatchability of chicks from fertile and set eggs.

The aim of this study was to determine the effect of using diets low in protein and high in energy in a multiplier flock of game pheasants on egg weight, morphometry, morphology, shell quality and egg content quality.

MATERIAL AND METHODS

The study was carried out at the Department of Poultry Breeding, the University of Technology and Life Sciences in Bydgoszcz, Poland. Eggs from game pheasants were studied. The eggs were collected from birds fed a commercial complete diet for in-lay pheasants which contained 19.0% crude protein and 11.7 MJ (2800 kcal) ME (control group) or a diet containing 15.0% crude protein and 12.6 MJ (3000 kcal) ME (experimental group), in which whole maize grain accounted for 40% and 60% of the control diet.

Eggs from each pheasant group of 35 females and 5 males were collected every day starting from the first week of May 2009. Analysis was made of 60 eggs (30 eggs from each feeding group) collected during the 5th week of egg production. Eggs were examined within 24 h of collection.

Eggs were weighed using a Medicat 160 laboratory balance (to the nearest 0.1 g). Egg length (long axis) and width (short axis) were measured with electronic calipers. The egg shape index was calculated as percent width (short axis) to length (long axis) ratio. Shell surface area (cm^2) was calculated using a formula given by Paganelli et al. [1974] for hen eggs:

$$P_s = 4.835 \cdot W^{0.662}, \text{ where W = egg weight}$$

Shell deformation (μm) was determined using a Marius instrument. Shell colour (whiteness) was determined using a reflectometer. The height of thick white and yolk was measured after emptying the egg contents onto a glass table using a QCD device (TSS). Electronic calipers were used to measure the length and width of thick albumen and the diameter of yolk (mm). The albumen index was calculated as the ratio of thick (structural)

albumen height to mean albumen length and width [Świerczewska et al. 2000], and the yolk index was calculated as the percentage ratio of yolk height to yolk diameter. Yolk colour was determined using the Roche colour scale of 1 to 15. Yolk, thick albumen and thin albumen were weighed on a Medicat 160 scales. The pH of yolk and both albumen fractions was measured with the aid of a CP-401 device.

After emptying the egg contents, the shell was dried for three hours at 105°C in a type SUP 100M drier. The weight of dry shell (g) was determined and its thickness was measured with a micrometer screw (mm). The percentage of yolk, albumen and shell was determined in relation to the weight of fresh egg.

The data were analysed statistically by calculating arithmetic means ($\bar{x}$) and variation coefficients (v%) of the analysed traits. Significant differences between the traits were verified by the t-test.

RESULTS AND DISCUSSION

The study showed that laying pheasants fed the complete (control) diet produced significantly heavier eggs than pheasants receiving the experimental diet low in crude protein and high in energy (30.8 vs 26.3 g) (Table 1). The weight of the analysed eggs did not vary by more than 10%. According to the Polish standard (PN-R-78565) on pheasants' hatching eggs, the eggs from hen pheasants fed the experimental diet failed to reach the minimum weight of 28 g and should not be used for hatching. When feeding hen pheasants low-protein diets supplemented with Ca, P and NaCl, Jamroz et al. [1985] determined that the levels of these components had no effect on the weight of pheasant eggs, with the mean weight of eggs from game pheasants (range of 31.4 to 32.0 g) being slightly higher than the weight of eggs from hen pheasants receiving a complete diet in our study. For pheasants fed a diet with 19% crude protein, higher egg weights were reported by Yannakopoulos [1992], Mróz and Pudyszak [2000] and Demirel and Kirikçi [2009] (33.99, 33.5–34.6 and 31.56–33.17 g, respectively) and lower egg weights were obtained by Tserweni-Gousi and Yannakopoulos [1990] and Song et al. [2000] (30.49 and 25.79 g, respectively).

The eggs from birds receiving a control diet for laying pheasants (19% protein) had a significantly greater length, width and shell area compared to the eggs produced by layers receiving a diet with modified protein and energy levels. Pheasants receiving the control diet laid eggs that were more rounded, as evidenced by higher shape index (81.3%). The shape index in pheasants fed the 19% crude protein diet was generally higher than in earlier reports by Mróz and Pudyszak [2000], 79.81–80.17%; Kirikçi et al. [2003], 80.69%; Kuźniacka et al. [2004], 79.9%; and Garip et al. [2010], 80.58%.

Shell weight (3.0 and 2.5 g) was significantly higher (Table 2) for eggs obtained form pheasants receiving the control diet. Egg shell percentage did not differ significantly in the analysed groups and was higher in the control group. Shell percentage in the pheasant egg was reported to be lower by Mróz and Pudyszak [2000] and Krystianiak et al. [2002] (9.08–9.35 and 8.93–9.37%, respectively), and higher by Kuźniacka et al. [2004] and Garip et al. [2010] (12.1 and 10.75%, respectively).

Table 1. Characteristics of egg weight and morphometry
Tabela 1. Charakterystyka masy i morfometrii jaja

Item Wyszczególnienie	Statistical measures Miary statystyczne	Experimental groups Grupy doświadczalne	
Protein content in egg, % Udział białka w jaju, %		19.0%	15.0%
Egg weight, g Masa jaja, g	$\overline{x}$ v%	30.8 [a] 7.0	26.3 [b] 9.0
Egg length, mm Długość jaja, mm	$\overline{x}$ v%	43.8 [a] 2.9	42.1 [b] 3.7
Egg width, mm Szerokość jaja, mm	$\overline{x}$ v%	35.6 [a] 2.2	33.5 [b] 3.2
Egg shape index, % Indeks kształtu jaja, %	$\overline{x}$ v%	81.3 [a] 3.1	79.6 [b] 3.8
Eggshell area, cm^2 Powierzchnia skorupy, cm^2	$\overline{x}$ v%	46.7 [a] 4.6	42.1 [b] 6.0

a, b – values of traits in rows with different letters differ significantly (P≤0.05).
a, b – wartości cech w rzędach, oznaczone różnymi literami, różnią się istotnie (P≤0,05).

Table 2. Characteristics of pheasant egg shell
Tabela 2. Charakterystyka skorupy jaj bażantów

Item Wyszczególnienie	Statistical measures Miary statystyczne	Experimental groups Grupy doświadczalne	
Protein content in egg, % Udział białka w jaju, %		19.0%	15.0%
Eggshell weight, g Masa skorupy, g	$\overline{x}$ v%	3.0 [a] 12.7	2.5 [b] 17.2
Eggshell proportion related to egg, % Udział skorupy w jaju, %	$\overline{x}$ v%	9.7 10.2	9.5 14.6
Eggsheell thickness mm Grubość skorupy, mm	$\overline{x}$ v%	0.310 [a] 10.7	0.280 [b] 15.4
Eggshell deformation, μm Elastyczne odkształcenie skorupy, μm	$\overline{x}$ v%	24.9 [a] 25.8	31.3 [b] 24.0
Eggshell colour, % white Barwa skorupy, % bieli	$\overline{x}$ v%	27.5 16.8	29.6 14.5

a, b – values of traits in rows with different letters differ significantly (P≤0.05).
a, b – wartości cech w rzędach, oznaczone różnymi literami, różnią się istotnie (P≤0,05).

Shell thickness in the eggs from pheasants receiving the control diet (0.310 mm) was 0.030 mm greater (P≤0.05) compared to the eggs produced by birds fed a low protein and high energy diet. Shell thickness in pheasant eggs was 0.202 – 0.230 mm [Kirikçi et al. 2005], 0.293 mm [Kuźniacka et al. 2005] and 0.265 mm [Garip et al. 2010]. The eggs with thicker shells had significantly smaller shell deformation (24.9 μm). Kuźniacka et al. [2004, 2005]

reported higher shell deformation (27.1 and 30.8 μm) compared to that of pheasant eggs analysed in our study. Eggshell colour was similar in both groups and whiteness did not exceed 30%. Darker shelled eggs, especially olive and brown, predominated. High variation in shell colour (v% > 14%) is considered a species-specific trait, and variation in shell deformation also results from the diets used.

Analysis of egg shell contents showed that laying pheasants fed the control diet produced eggs with significantly higher weights of albumen and yolk compared to birds receiving the experimental diet. Albumen and yolk percentage in the eggs from the analysed groups did not differ significantly (Table 3). Higher albumen percentages in pheasant eggs were found by Kirikçi et al. [2003], Kuźniacka et al. [2005] and Garip et al. [2010] (56.62, 58.7 and 56.2%, respectively). The authors cited above reported yolk content (32.87, 31.29 and 33.05%, respectively) to be lower than in our study. A study by Tarasewicz et al. [2006] revealed that Pharaoh quail fed a diet low in crude protein (19 instead of 21%) and higher protein to energy ratio (0.61 instead of 0.56) produced eggs with a higher yolk and lower albumen content compared to the control birds.

Table 3. Characteristics of pheasant egg contents
Tabela 3. Charakterystyka treści jaj bażantów

Item Wyszczególnienie	Statistical measures Miary statystyczne	Experimental groups Grupy doświadczalne	
Protein content in egg, % Udział białka w jaju, %		19.0%	15.0%
Albumen weight, g	$\overline{x}$	16.3 [a]	13.9 [b]
Masa białka, g	v%	17.2	18.7
Yolk weight, g	$\overline{x}$	11.5 [a]	9.9 [b]
Masa żółtka, g	v%	11.8	16.7
Albumen proportion related to egg, %	$\overline{x}$	52.9	52.9
Udział białka w jaju, %	v%	7.9	9.7
Yolk proportion related to egg, %	$\overline{x}$	37.4	37.6
Udział żółtka w jaju, %	v%	11.0	12.9
Thick albumen height, mm	$\overline{x}$	4.5	4.7
Wysokość białka gęstego, mm	v%	19.1	15.6
Thick albumen index	$\overline{x}$	0.068 [a]	0.081 [b]
Indeks białka gęstego	v%	21.0	16.4
Yolk diameter, mm	$\overline{x}$	34.7 [a]	32.6 [b]
Średnica żółtka, mm	v%	5.7	5.5
Yolk index, %	$\overline{x}$	44.1	45.7
Indeks żółtka, %	v%	7.4	6.6
Yolk colour, scores	$\overline{x}$	9.8 [a]	9.5 [b]
Barwa żółtka, pkt.	v%	5.2	5.4

a, b – values of traits in rows with different letters differ significantly (P≤0.05).
a, b – wartości cech w rzędach, oznaczone różnymi literami, różnią się istotnie (P≤0,05).

The higher values of thick albumen height, thick albumen index and yolk index for the contents of eggs from pheasants receiving the experimental diet may suggest that they are of better quality compared to the egg contents from pheasants fed the control diet. Yolk colour intensity was 9.8 and 9.5 points on the Roche scale of 1 to 15 and it was significantly higher compared to the eggs from pheasants receiving a high protein and low energy diet. The highest variation was characteristic of albumen and yolk weight and of thick albumen height and index. The high variation of thick albumen height (and index) was probably due to the smaller accuracy of the measurement, the fact that this trait was dependent on egg weight, and egg storage temperature before the evaluation. Pheasant eggs analysed by Kuźniacka et al. [2004] were characterized by smaller yolk colour intensity (6.3 points). The pH values of thin albumen, thick albumen and yolk were significantly greater (Table 4) for eggs laid by pheasants receiving the diet containing 19.0% crude protein and 11.7 MJ ME.

Table 4. pH of pheasant egg contents
Tabela 4. Odczyn pH treści jaj bażantów

Item Wyszczególnienie	Statistical measures Miary statystyczne	Experimental groups Grupy doświadczalne	
Protein content in egg, % Udział białka w jaju, %		19.0%	15.0%
Thin albumen Białko rzadkie	$\overline{x}$ v%	9.01 [a] 1.18	8.76 [b] 2.49
Thick albmen Białko gęste	$\overline{x}$ v%	9.07 [a] 1.20	8.75 [b] 2.47
Yolk Żółtko	$\overline{x}$ v%	6.40 [a] 3.46	6.26 [b] 1.06

a, b – values of traits in rows with different letters differ significantly (P≤0.05).
a, b – wartości cech w rzędach, oznaczone różnymi literami, różnią się istotnie (P≤0,05).

CONCLUSIONS

In summary, the eggs from pheasants receiving a diet low in protein and high in energy during the reproductive period had significantly lower weight, length, width and shape index compared to the eggs produced by pheasants fed a complete control diet. Pheasants given a low protein feed produced eggs whose mean weight was lower than optimal for hatching pheasant eggs, and the shell of these eggs was significantly lighter and thinner, with lower area and crushing resistance. Using the diet low in protein and high in energy caused a significant decrease in the weight of albumen and yolk while changing the pH of yolk and both albumen fractions.

REFERENCES

Demirel Ş., Kirikçi K., 2009. Effect of different egg storage times on some egg quality characteristics and hatchability of pheasants (*Phasianus colchicus*). Poult. Sci. 88, 440–444.

Garip M., Caglayan T., Kirikçi K., Günlü A., 2010. A comparison of egg quality characteristics of partridge and pheasant eggs, *P. colchicus, A. graeca*. J. Anim. Vet. Adv. 9 (2), 299–301.

Giebel O., Jamroz D., Mazurkiewicz M., 1984. Reproductive parameters of pheasants receiving low-protein diets made from domestic components [Wskaźniki reprodukcji bażantów żywionych mieszankami o obniżonej zawartości białka, sporządzonymi z komponentów krajowych]. Med. Weter. 40 (8), 479–481 [in Polish].

Jamroz D., Bartczak R., Giebel O., Mazurkiewicz M., Mróz A., 1984. Production results and health status of pheasants fed low-protein concentrates made from Polish raw materials [Efekty produkcyjne i stan zdrowotny bażantów żywionych niskobiałkowymi mieszankami treściwymi, sporządzonym z surowców krajowych]. Med. Weter. 40 (6), 357–360 [in Polish].

Jamroz D., Giebel O., Mazurkiewicz M., 1985. Laying performance of hen pheasants fed diets made of domestic components and supplemented with Ca, P and NaCl [Produkcja nieśna kur bażancich żywionych mieszankami sporządzonymi z komponentów krajowych uzupełnionych dodatkiem Ca, P i NaCl]. Med. Weter. 504–506 [in Polish].

Kirikçi K., Günlü A., Cetin O., Garip M., 2003. Some quality characteristics of pheasant (*Phasianus colchicus*) eggs. J. Food Agric. Environ. 1 (3/4), 226–228.

Kirikçi K., Cetin O., Günlü A., Garip M., 2004. Effect of hen weight on egg production and some quality characteristics in pheasants (*Phasianus colchicus).* Asian-Australian J. Anim. Sci. 17 (5), 684–687.

Kirikçi K., Günlü A., Garip M., 2005. Some quality characteristics of pheasant (*Phasianus colchicus*) eggs with different shell colors. Tur. J. Vet. Anim. Sci. 29, 315–318.

Krystianiak S., Kontecka H., 2002. Egg shell quality according to colour and egg production period in pheasants [Jakość skorupy jaj w zależności od barwy i okresu nieśności bażantów]. Rocz. Nauk. Zootech. 16 (Suppl.), 131–135 [in Polish].

Kuźniacka J., Adamski M., Bernacki Z., 2004. Comparison of morphological composition and physical characteristics of different farmed bird species [Porównanie składu morfologicznego i cech fizycznych różnych gatunków ptaków gospodarskich]. Pr. Komis. Nauk. Rol. Biol. BTN B53, 139–144 [in Polish].

Kuźniacka J., Bernacki Z., Adamski M., 2005. Quality of eggs and effect of egg and chick weight on the body weight of game pheasants during rearing [Jakość jaj oraz wpływ masy jaja i piskląęcia na masę ciała bażantów łownych w odchowie]. Pr. Komis. Nauk. Rol. Biol. BTN B55, 105–114 [in Polish].

Mróz E., Pudyszak K., 2000. Shell colour of game pheasant eggs and its effect on hatchability [Barwa skorupy jaj bażanta łownego i jej wpływ na wylęgowość]. Zesz. Nauk. Prz. Hod. 49, 459–466 [in Polish].

Paganelli C.V., Olszowka A., Ar A., 1974. The avian egg: surface area, volume, and density. The Condor 76, 319–325.

PN-R-78565, 1998. Hatching eggs from pheasants, Japanese quail and mallards [Jaja wylęgowe bażantów, przepiórek japońskich i kaczek krzyżówek] [in Polish].

Song K.T., Choi S.H., Oh H.R., 2000. A comparison of egg quality of pheasant, chukar, quail and guinea fowl. Asian-Australian J. Anim. Sci. 13 (7), 986–990.

Świerczewska E., Niemiec J., Riedel J., Siennicka A., Stępińska E., 2000. Poultry breeding and poultry farming technology [Hodowla drobiu i technologia jego chowu]. Wydaw. SGGW, Warszawa, 72 [in Polish].

Tarasewicz Z., Ligocki M., Szczerbińska D., Majewska D., Dańczak A., 2006. Different level of crude protein and energy-protein ratio in adult quail diets. Arch. Tierz. Dummerstorf 49 (Special Issue), 325–331.

Tserweni-Gousi A.S., Yannakopoulos A.L., 1990. Quality characteristics of pheasant eggs and effect of egg weight and shell quality on chick weight. Arch. Geflügelkd. 2, 54–56.

Yannakopulos A.L., 1992. Greek experiences with game birds. Anim. Breed. Abstr. 60, 3375.

JAKOŚĆ JAJ BAŻANTÓW ŁOWNYCH ŻYWIONYCH MIESZANKĄ O RÓŻNEJ WARTOŚCI POKARMOWEJ

Streszczenie. Badania przeprowadzono na jajach bażantów łownych żywionych mieszanką paszową zawierającą 19,0% i 11,7 MJ EM lub 15,0% białka ogólnego i 12,6 MJ EM. Ocenie poddano 60 jaj po 30 sztuk z każdej grupy, zebranych w 5. tygodniu nieśności. Badania wykonano w ciągu 24 godzin od ich pozyskania. Bażanty żywione mieszanką paszową doświadczalną znosiły jaja o mniejszej ($P \leq 0,05$) masie (26,3 g), długości (42,1 mm) i szerokości (33,5 mm), w porównaniu z jajami bażantów karmionych kontrolną mieszanką (odpowiednio: 30,8 g, 43,8 mm, i 35,6 mm). Jaja bażantów karmionych paszą doświadczalną miały istotnie ($P \leq 0,05$) lżejszą (2,5 g), cieńszą (0,280 mm), słabszą (elastyczne odkształcenie 31,3 μm), o mniejszej powierzchni (42.1 cm^2) skorupę. Procentowy udział białka jaja był taki sam (52,9%), a żółtka podobny (37,4 : 37,6%) w obu grupach, a masa białka i żółtka istotnie mniejsza w jajach bażantów karmionych mieszanką doświadczalną. Zmiana składu paszy spowodowała zwiększenie kwasowości ($P \leq 0,05$) treści świeżych jaj.

Słowa kluczowe: bażant, białko, jajo, pasza, skorupa, żółtko

Accepted for print – Zaakceptowano do druku: 10.01.2011