Body conformation and morphometry of some internal organs of Pharaoh quail of different ages

Ukształtowanie ciała i morfometria wybranych narządów wewnętrznych przepiórek Faraon w różnym wieku

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Abstract

The effect of age of Pharaoh quail on body weight, body conformation and development of internal organs, including the digestive tract, was determined. At the age of 35 days, Pharaoh quail were characterized by significantly lower body weight, length of trunk with neck, and length of trunk compared to 45-day-old birds. Younger quail had slightly shorter breast bone and lower thighs, smaller chest girth, and the same length of shanks. Body conformation indices were significantly ($P \leq 0.05$) higher in 35-day-old birds. Pharaoh quail, evaluated at 35 and 45 days of age, did not differ significantly in the length of the oesophagus and crop, the length of intestine and its segments, and the weight and proportion of gizzard, proventriculus and heart. As birds aged, liver weight increased significantly, as did the weight and proportion of testicles in males.

Keywords: Pharaoh quail, age, body weight, digestive tract

Streszczenie

Określono wpływ wieku przepiórek Faraon na masę i ukształtowanie ciała, rozwój narządów wewnętrznych, w tym przewodu pokarmowego. Przepiórki Faraon w wieku 35 dni cechowały się istotnie mniejszymi: masą ciała, długością tułowia z szyją i długością tułowia w stosunku do 45-dniowych ptaków. Młodsze przepiórki miały nieznaczne krótszy mostek, podudzia, mniejszy obwód klatki piersiowej i taką samą długość skoków. Indeksy ukształtowania ciała były istotnie ($P \leq 0,05$) większe u ptaków 35-dniowych. Oceniane przepiórki w wieku 35 i 45 dni nie różniły się statystycznie istotnie pod względem długości przełyku z wolem, długości jelita i jego segmentów oraz masy i udziału żołądka mięśniowego, żołądka gruczołowego i serca. Z wiekiem ptaków nastąpiło istotne zwiększenie masy wątroby, a u samców także masy i udziału jader.

Słowa kluczowe: przepiórka Faraon, wiek, masa ciała, przewód pokarmowy

Detailed abstract

Badania przeprowadzono na 28 przepiórkach mięsnych Faraon. W wieku 35 i 45 dni wybrano po 14 osobników o masie ciała zbliżonej do średniej populacji liczącej początkowo 90 sztuk. Przez cały okres badań (45 dni) ptaki przebywały w pomieszczeniu zamkniętym o regulowanych parametrach środowiska. Przepiórki żywiono *ad libitum* przemysłowymi mieszankami paszowymi. W 35. i 45. dniu ptaki zważono, a następnie zmierzono: długość tułowia z szyją, długość tułowia, długość grzebienia mostka, obwód klatki piersiowej, długość podudzia oraz długość skoku. Po przeprowadzonym uboju, odpierzaniu i patroszeniu wyodrębniono przewód pokarmowy i inne ważniejsze organy i narządy wewnętrzne. Przy użyciu taśmy mierniczej wykonano pomiary długości przełyku z wolem, jelita cienkiego, obu jelit ślepych, jelita końcowego, natomiast za pomocą wagi Medicat 160M określono masę wątroby, serca, żołądka mięśniowego, żołądka gruczołowego, a u samców dodatkowo jąder.
Na podstawie uzyskanych wyników obliczono indeksy ukształtowania ciała - masywności, zwięzłości, wysokonożności, procentowy udział poszczególnych odcinków przewodu pokarmowego oraz wybranych narządów wewnętrznych przepiórek w różnym wieku.
Stwierdzono, że przepiórki w wieku 35 dni charakteryzowały się, w porównaniu do 45-dniowych, istotnie mniejszą masą ciała (odpowiednio: 157,4 i 173,5 g). Młodsze ptaki charakteryzowały się ponadto istotnie krótszym tułowiem z szyją i bez szyi. Indeksy ukształtowania ciała obliczane na podstawie masy i wymiarów ciała były statystycznie istotnie większe u 35-dniowych przepiórek. Pod względem długości odcinków przewodu pokarmowego i ich procentowego udziału, stwierdzono nieistotne różnice między 35- i 45-dniowymi przepiórkami.
Starsze przepiórki w porównaniu do młodszych, cechowały się istotnie mniejszą wartością krotności długości jelita do długości ciała (odpowiednio: 6,2 i 5,6). Masa wątroby była istotnie większa u 45-dniowych ptaków. Stwierdzono ponadto brak istotnego zróżnicowania pod względem masy serca, żołądka mięśniowego i gruczołowego u przepiórek w wieku 35 i 45 dni.
Procentowy udział wątroby i żołądka mięśniowego był zbliżony, a udział serca i żołądka gruczołowego, u przepiórek w różnym wieku, był taki sam. Masa i udział jąder były statystycznie istotnie większe u 45-dniowych samców.

Introduction

The Pharaoh quail is a meat breed characterized by the highest body weight of all known quail. Its pectoralis superficialis muscle is very well developed. What is more, Pharaoh quail are able to endure frost and snow, which makes them suitable for raising in hunting grounds (Jabłoński and Gorazdowski, 2004). Pharaoh quail were selected in the United States from Japanese quail (Kraszewska-Domańska, 1978). Japanese quail are significantly more often used as experimental animals in scientific research.

It was found that the weight, body conformation, and morphometry of internal organs of quail are influenced by many factors such as birds' age (Yalcin et al., 1995; Mihailov, 2006; Mihailov et al., 2008) and sex (Shata, 2001), type and composition of feed (Tarasewicz et al., 2007), type of feed additives (Aydin et al., 2004; Sarica et al., 2009; Bonos et al., 2010; Teshfam et al., 2011), rearing methods (Kul et al, 2006), stocking density (Abdel-Azeem, 2010) and ambient temperature (Özbey et al., 2004).

Mihailov et al. (2008) observed that the digestive tract of Japanese quail becomes morphologically and functionally mature between 7 and 14 days of age, after which the linear changes in the digestive tract are less significant. Meanwhile, Yalcin et al. (1995) showed that age had no significant effect on the weight of digestive tract, gizzard, liver and heart.

Other poultry species were also used to study how body weight, body conformation and the development of some organs are related to birds' age. Adamski and Kuźniacka (2006), who investigated the effect of age and sex on the carcass characteristics of pheasants, showed no significant differences between slaughter traits at 16 and 20 weeks of age in terms of the length of trunk, the length of trunk with neck, the length of keel, and the chest girth and width of pheasant carcasses. Liu et al. (2010) found a rapid increase in the duodenal length of Yangzhou ganders to 42 days of age. Jejunum and ileum length increased on subsequent evaluation dates, except day 42. Meanwhile, Gumułka and Wojtysiak (1999), who evaluated the effect of different feeding regimes on digestive tract morphometry of meat-type hens, confirmed that the digestive tract is a very "dynamic" system and birds can adjust its capacity to the quantity and quality of ingested feed.

The aim of the study was to determine the weight, body conformation and development of internal organs, including the digestive tract, in Pharaoh quail of different ages.

Material and methods

A total of 90 Pharaoh quail (*Coturnix Coturnix pharaon*) were studied in June and July 2010. They were reared for 45 days. Birds were kept at a poultry farm in Wierzchucinek belonging to the Agricultural Experimental Station Minikowo, which is part of the University of Technology and Life Sciences in Bydgoszcz.

Birds were kept in confinement under controlled environment conditions, in two boxes, each having an area of 1.05 m^2. The initial temperature of 30-38°C during the first days of chicks' life was gradually decreased to 21°C during the next weeks. Birds received a commercial feed containing 28% crude protein and 13.5 MJ ME to 7 days of age, a feed containing 24.0% crude protein and 13.85 MJ ME from days 8 to 28, and a feed containing 20.6% crude protein and 14.2 MJ ME/kg feed from day 29 to the end of the experiment.

At both 35 and 45 days of the experiment, 14 quail with close to average body weight of the group initially numbering 90 birds, and next were selected and identified with band tags on the right wing. On the same days, the body of quail was tape-measured to an accuracy of 0.1 cm for the length of trunk with neck (between the first cervical vertebra and posterior edge of the ischium), length of trunk (between shoulder joint and posterior edge of the ischium), length of keel (from the anterior to the posterior edge), chest girth (behind wings through anterior edge of the keel and middle thoracic vertebra), length of lower leg (along the shin bone) and length of shank (between the hock joint and posterior area of the fourth toe at its base). Body weight and body measurement values of 35- and 45-day-old Pharaoh quail were used when calculating the conformation indices of massiveness (percentage proportion of body weight in kg to trunk length in cm), compactness (percentage proportion of chest circumference to trunk length in cm) and long-leggedness (percentage proportion of shank length to trunk length with neck in cm).

After the determination of body weight and body measurements, the birds were slaughtered, defeathered and eviscerated, and the digestive tract was separated. The lengths of the oesophagus and crop, small intestine, both caeca, and rectum

were tape-measured. A Medicat 160M scales was used at 35 and 45 days of the experiment to weigh the dissected organs to the nearest 0.1 g, i.e. liver, gizzard, proventriculus and heart, and additionally testicles in males. The percentage of these organs in the body weight of quail prior to slaughter was then calculated.
The numerical data were analysed statistically to determine the means (x) and coefficients of variation (v) for the traits studied. Significance of differences between mean values of the analysed traits was determined using Student's t-test.

Results and discussion

The mean body weights and body measurements of Pharaoh quail at the age of 35 and 45 weeks are listed in Table 1. The body weight of 35-day-old birds was significantly lower than that of 45-day-old quail (157.4 g vs. 173.5 g). An increase in body weight in aging Japanese quail was also reported by Škrobánek et al. (2004), who found lower body weight (119.13 g) in 45-day-old birds compared to quail studied in our experiment. Özbey et al.(2004), who investigated the effect of high temperatures on body weight, feed consumption, slaughter weight and dressing percentage of Japanese quail, found a similar body weight (159.69 g) in 35-day-old birds to that found in our study.

Table 1. Body weight and body dimensions of Pharaoh quail of different ages
Tabela 1. Masa ciała i wymiary ciała przepiórek Faraon w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days)- Wiek (dni)	
		35	45
Body weight (g)	x	157.4[a]	173.5[b]
Masa ciała (g)	v	1.8	3.7
Length of trunk with neck (cm)	x	12.4[a]	14.1[b]
Długość tułowia z szyją (cm)	v	6.3	4.0
Length of trunk (cm)	x	8.5[a]	10.2[b]
Długość tułowia (cm)	v	6.1	6.8
Length of breast bone (cm)	x	3.9	4.1
Długość mostka (cm)	v	6.2	8.1
Chest girth (cm)	x	14.0	14.9
Obwód klatki piersiowej (cm)	v	3.2	3.6
Length of lower thigh (cm)	x	4.8	5.1
Długość podudzia (cm)	v	14.0	9.4
Length of shank (cm)	x	3.7	3.7
Długość skoku (cm)	v	6.2	3.2

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

The length of trunk with neck and the length of trunk were lower in 35-day-old compared to 45-day-old birds, with significant differences in the mean values of these traits (P≤0.05). A study with game pheasants (Kokoszyński et al., 2011) showed the length of trunk with neck to increase between 4 and 20 weeks of age, from 15.3 cm to 29.6 cm in males and from 15.0 cm to 26.9 cm in females.

At the age of 35 days, Pharaoh quail were also characterized by a shorter keel compared to 45-day-old birds. The difference in keel length between the age groups compared was 0.2 cm and was not significant. An earlier study with Pekin ducks aged 42, 45, 48 and 49 days showed a significant increase in keel length, from 4.81 cm to 5.21 cm in males and from 4.76 cm to 5.06 cm in females (Farhat, 2009). Compared to 45-day-old birds, quail evaluated at 35 days had lower chest girth (14.9 vs. 14.0 cm). The difference in chest girth between birds form the analysed age groups was not significant. A study (Adamski and Kuźniacka, 2006) with game pheasants aged 12, 16 and 20 weeks, showed chest girth to increase from 22.8 cm to 26.0 cm.

The length of lower thigh in 45-day-old birds (Table 1) was greater than in 35-day-old birds (4.8 cm and 5.1 cm, respectively). The difference between the arithmetic means of lower thigh length in quail of different ages was not significant. In game pheasants,

Table 2. Body conformation indices of Pharaoh quail of different ages
Tabela 2. Indeksy ukształtowania ciała przepiórek Faraon w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days) – Wiek (dni)	
		35	45
Index of massiveness (%)	x	1.9[a]	1.7[b]
Indeks masywności (%)	v	6.8	7.1
Index of compactness (%)	x	164.7[a]	146.1[b]
Indeks zwięzłości (%)	v	8.1	7.4
Index of long-leggedness (%)	x	29.8[a]	26.2[b]
Indeks wysokonożności (%)	v	12.0	4.8

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

Kokoszyński et al. (2011) showed lower thigh length to increase up to 12 weeks of rearing, from 7.4 cm to 13.4 cm in males and from 7.2 cm to 12.1 cm in females. Shank length (Table 1) in the quail analysed at 35 and 45 days was the same (3.7 cm). Ingram and Hatten (2001), who investigated the effect of skip-a-day feeding on some body dimensions of Arbor Acres cockerels, found shank length to increase from 3.5 cm to 6.1 cm between 7 and 18 weeks of age.

Table 2 lists the body conformation indices of Pharaoh quail of different ages. The differences in the indices of massiveness, compactness and long-leggedness between the compared age groups of quail were statistically significant (P≤0.05). In older quail, all the three indices had lower values. Like in our study, an experiment with broiler turkeys (Oblakova, 2007) showed that the indices of long-leggedness were lower in older birds. However, the same experiment found higher values of the indices of massiveness and compactness in older birds.

Table 3 shows data on the digestive tract length of the analysed Pharaoh quail of different ages. As birds became older, there were non-significant increases both in the length of the oesophagus with crop (from 8.4 to 9.1 cm) and in small intestinal length (from 55.1 to 57.0 cm). The experiment (Abdel-Azeem, 2010) which examined the effect of stocking density on physiological traits of 42-day-old Japanese quail, showed greater small intestinal length in both males and females (69.3 and 73.2 cm, respectively).

Table 3. Length of digestive tract segments in Pharaoh quail of different ages
Tabela 3. Długość odcinków przewodu pokarmowego u przepiórek Faraon w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days) – Wiek (dni)	
		35	45
Length of oesophagus with crop (cm)	x	8.4	9.1
Długość przełyku z wolem (cm)	v	19.6	8.8
Length of small intestine (cm)	x	55.1	57.0
Długość jelita cienkiego (cm)	v	8.6	11.0
Length of caeca (cm)	x	15.5	15.9
Długość jelit ślepych (cm)	v	16.5	21.1
Length of rectum (cm)	x	5.7	5.7
Długość jelita końcowego (cm)	v	16.3	25.6

The length of caeca in 35-day-old birds (Table 3) was smaller than in birds aged 45 days (15.5 cm and 15.9 cm, respectively). The difference in the mean values of this trait was not significant. Meanwhile, rectum length was the same in 35- and 45-day-old birds (5.7 cm). When analysing the growth and development of young game pheasants, Kokoszyński et al. (2011) found that birds had longer caecum and rectum at 20 compared to 18 weeks of age.

Table 4. Percentage of individual segments of intestine in Pharaoh quail of different ages
Tabela 4. Procentowy udział poszczególnych odcinków jelita u przepiórek Faron w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days) – Wiek (dni)	
		35	45
Small intestine (%)	x	72.2	72.5
Jelito cienkie (%)	v	3.4	4.9
Caecum (%)	x	20.3	20.2
Jelita ślepe (%)	v	10.5	19.4
Rectum (%)	x	7.5	7.3
Jelito końcowe (%)	v	16.9	21.7

The analysis of results for the percentage of individual segments of the digestive tract in the Pharaoh quail of different ages (Table 4) showed that percentage of small intestine in the analysed birds was similar on both dates. It was 72.2% in younger birds and 72.5% in older birds. In another study (Sarica et al., 2009), which evaluated the effect of new feed additives (e.g. flavomycin, probiotic and prebiotic) on carcass quality, carcass yield and intestinal characteristics of 35-day-old male Japanese quail showed a higher percentage of small intestine (91.2%) than in our study.
The percentage of caeca in 35-day-old quail was not much higher than in 45-day-old quail, with a difference of only 0.1%. Younger birds also had a higher percentage of

rectum. The difference in this trait was 0.2% and, like for the percentages of small intestine and caeca, it was not significant.

Total intestine length (Table 5) was greater in 45-day-old compared to 35-day-old birds (78.7 and 76.3 cm, respectively). The difference in this trait between these groups was non-significant. An earlier study (Sarica et al., 2009) with 35-day-old Japanese quail showed a shorter small intestinal length (68 cm) compared to the birds evaluated in our study (Sarica et al., 2009).

Table 5. Total intestine length and intestine length to body length ratio in Pharaoh quail of different ages

Tabela 5. Całkowita długość jelita i stosunek długości jelita do długości ciała u przepiórek Faron w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days) – Wiek (dni)	
		35	45
Total intestine length (cm)	x	76.3	78.7
Całkowita długość jelita (cm)	v	9.1	10.5
Intestine length to body length ratio	x	6.2[a]	5.6[b]
Stosunek długości jelita do ciała	v	10.3	10.9

a, b – mean values of traits in rows with different letters differ significantly (P≤0.05)

a, b – wartości średnie cech w rzędach oznaczone różnymi literami różnią się statystycznie istotnie (P≤0,05)

In addition, 35-day-old quail were characterized by a greater intestine length to body length ratio compared to 45-day-old birds. The difference in this ratio (0.6) was significant (P≤0.05).

The arithmetic means and coefficients of variation for the weight of selected internal organs of Pharaoh quail aged 35 and 45 days are given in Table 6. The weight of liver in 35-day-old birds was significantly lower than in older birds (3.5 and 4.1 g, respectively). In an earlier study (Abdel-Azeem, 2010) with 35-day-old Japanese quail, both males and females had greater liver weight (4.94 and 5.88 g, respectively) compared to our study. Murawska et al. (2011), who analysed age-related changes in percentage of edible and non-edible carcass components of broiler chickens, found that the liver grew rapidly to 8 weeks of age.

The weight of gizzard (Table 6) in the analysed birds was similar on both evaluation dates (2.9 g in younger birds and 3.0 g in older birds). For Japanese quail aged 35 days, Abdel-Azeem (2010) showed a higher weight of gizzard (3.16 g in males, 3.78 g in females) than in our study.

No changes were found in the weight of proventriculus, which was 0.7 g in 35- and 45-days-old birds. Likewise, Yamamoto et al. (1993) observed no significant changes in the weight of proventriculus in aging quails.

At 35 days of age, Pharaoh quail had a non-significantly lower weight of heart compared to the birds aged 45 days (1.5 and 1.7 g, respectively). In a study by Kul et al. (2006), the weight of heart in quail slaughtered at the age of 42 days was higher (1.85 g) than in our study.

Table 6. Weight of selected internal organs in Pharaoh quail of different ages
Tabela 6. Masa wybranych narządów wewnętrznych przepiórek Faraon w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days) - Wiek (dni)	
		35	45
Liver (g)	x	3.5[a]	4.1[b]
Wątroba (g)	v	9.1	12.2
Gizzard (g)	x	2.9	3.0
Żołądek mięśniowy (g)	v	12.1	20.3
Proventriculus (g)	x	0.7	0.7
Żołądek gruczołowy (g)	v	21.4	17.1
Heart (g)	x	1.5	1.7
Serce (g)	v	13.3	11.2
Testicles (g)	x	0.4[a]	1.9[b]
Jądra (g)	v	175.0	98.9

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

Younger quail were characterized by significantly lower testicular weight, which was 0.4 g in 35-day-old birds and 1.9 g in 45-day-old birds. Tarasewicz et al. (2007), who investigated the effect of giving a low-protein feed on the growth and slaughter value of Pharaoh quail, found higher testicular weight in 42-day-old males (3.4 g).

Table 7. Percentage of selected internal organs in Pharaoh quail of different ages
Tabela 7. Procentowy udział wybranych narządów przepiórek Faraon w różnym wieku

Trait - Cecha	Characteristics Charakterystyki	Age (days) - Wiek (dni)	
		35	45
Liver (%)	x	2.2	2.4
Wątroba (%)	v	9.1	12.1
Gizzard (%)	x	1.8	1.7
Żołądek mięśniowy (%)	v	12.2	18.2
Proventriculus (%)	x	0.4	0.4
Żołądek gruczołowy (%)	v	22.5	20.0
Heart (%)	x	1.0	1.0
Serce (%)	v	11.0	11.0
Testicles (%)	x	0.3[a]	1.1[b]
Jądra (%)	v	146.6	142.5

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

The proportion of liver (Table 7) was lower in birds aged 35 days compared to 45-day-old birds (2.2 and 2.4%, respectively). The difference in this trait was not

significant. In another experiment with Japanese quail slaughtered at 8 weeks of age, liver percentage was 2.06% in males and 3.52% in females (Aydin and Cook, 2004). Yannakopoulos et al. (1990) found that liver percentage in 42-day-old Japanese quail was 3.50%.

At the age of 45 days, Pharaoh quail had a lower percentage of gizzard than 35-day-old birds (Table 7). The difference between birds from both groups in the percentage of gizzard (0.1%) was not significant. The percentage of proventriculus in the analysed quail (0.4%) was the same at both 35 and 45 days of age. In an earlier experiment (Teshfam et al., 2011) with Japanese quail, the percentage of gizzard was 1.83% and the percentage of proventriculus was 0.38%.

The proportion of heart in 35- and 45-day-old Pharaoh quail was the same (1.0%). Aydin and Cook (2004) reported a lower proportion of heart in the weight of 8-week-old Japanese quail (0.99% in males, 0.82% in females) compared to our study.

In a study by Bonos et al. (2010), who analysed the effect of mannan oligosaccharide (MOS), acidifier calcium propionate (CP) and sex of Japanese quail on the yield and quality of carcasses, heart percentage was 1.13% in males and 1.05% in females.

Younger quail were characterized by significantly lower percentage of testicles. It was 0.3% in 35-day-old birds and 1.1% in 45-day-old birds. In an earlier study (Tarasewicz et al., 2007), the proportion of testicles in 42-day-old male Pharaoh quail was greater (2.07%) than in our study.

Conclusions

At the age of 35 days, Pharaoh quail were characterized by significantly lower body weight, length of trunk with neck, and length of trunk compared to 45-day-old birds. Younger quail also had slightly shorter breast bone and lower thighs, smaller chest girth, and the same length of shanks. Older quail had significantly lower body conformation indices. Rectum length was identical in 35- and 45-day-old birds. In the analysed quail of different ages, the other segments of the digestive tract were similar in terms of length and percentage. Older quail were characterized by a significantly lower intestine length to body length ratio compared to younger quail. As birds aged, liver weight increased significantly, as did the weight and proportion of testicles in males.

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