

COMPARISON OF THE GROWTH AND BODY CONFORMATION OF DUCKS REARED IN SEMI-INTENSIVE OR INTENSIVE SYSTEMS

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ABSTRACT

The aim of the study was to compare the growth and body conformation of ducks raised in a semi-intensive and an intensive system. The material for the research was Pekin Star 53 H.Y. crossbred meat ducks of French origin. The ducks were reared for 8 weeks. The birds from group I were reared in an intensive system and the birds in group II in a semi-intensive system. At the completion of the rearing period, at 8 weeks of age, the mean body weight of the birds in group I, reared intensively, was 3480.3 g, while that of the group II birds, reared in the semi-intensive system, was 3000.2 g. The results indicate had irrespective of sex, young ducklings, i.e. in the first 3 weeks, had the fastest growth rate. The massiveness index in the birds' first week of life was on average 1.7% for males and females in both groups. In the eighth week it was 11.4% and 11.0% in groups I and II. In both study groups the males had higher or significantly higher massiveness indices on all weeks of live. It should be noted that females had a lower massiveness index than the males and a higher compactness index. The compactness index, defined as the percentage ratio of the chest circumference to the trunk length, continually decreased as the ducks grew older: it was on average 144.7% in group I and 142.6% in group II in the first week and 117.7% and 119.3% in the eighth week.

Key words: ducks, growth rate, body measurements body indices

INTRODUCTION

Numerous studies on the growth of birds in successive weeks of life [Adamski and Bernacki 2002, Biesiada-Drzazga et al. 2011] indicate that the relative greatest weight gains occur in the first weeks of the life of ducks and drakes and are at a relatively high level irrespective of the rearing system. The growth rate of ducklings exceeds that of other poultry species, and in 8 weeks their body weight increases on average 55 times [Retailleau 1999, Biesiada-Drzazga et al. 2011]. Pekin ducks attain an average body weight of 3200–3400 g after a 7-week rearing period [Farhat and Chavez 2000, Murawska et al 2008, Kokoszyński 2011] and 3600–3700 g during rearing lasting an additional seven days, i.e. to the age of 8 weeks. It should be emphasized that irrespective of the length of the rearing period, the body weight of females is lower than that of males, which is characteristic of most poultry species. Clear sexual dimorphism in ducks has previously been noted by other researchers [Bernacki and

Adamski 2001, Omojola 2007, Biesiada-Drzazga et al. 2011, Stęczny et al. 2017].

In addition to body weight, which is often determined by individual weighing of birds, in scientific research the growth and development of birds are often evaluated using numerous mathematical techniques [Baumgartner et al. 1982, Lewczuk et al. 1984, Kniże et al. 1986, Mazurowski et al. 2016, Stęczny et al. 2017]. Zoometric measurements are commonly used to calculate body indices [Janiszewska et al. 1986, Janiszewska 1993, Biesiada-Drzazga 2007, Kokoszyński 2011]. Zoometric measurements, usually taken on live birds, make it possible to determine their growth rate, correctness of conformation, and degree of somatic development. The depth and circumference of the chest indicate the trunk size and body weight of the birds, as well as the development of internal organs, and thus characteristics indirectly influencing overall development and productivity. Studies on body measurements of ducks are relatively numerous [Górski 1991, Książkiewicz 1993, Książkiewicz and Kontecka

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1993]. Body measurements of birds and the indices calculated from them provide information on the growth of individual body parts of the body, changes in their ratios, and correctness of conformation. This is particularly important in light of the use of new, foreign crossbred sin Poland.

Achieving a specific weight in birds depends not only on genetic factors [Górski 1992, Bernacki et al. 2006], but to a very great extent on the environmental conditions in which they are raised. Their diet during this time is the most important environmental factor determining production results, including health and the economic efficiency of rearing [Terčić et al. 2000, Castellini et al. 2002, Lawlor et al. 2003, Kim et al. 2009]. Diet during rearing also plays a major role in the growth and development of ducks raised for meat [Faruga and Mikulski 1992, Powell 1992, Bagliacca et al. 1997, Romboli et al. 1997, Mazanowski et al. 1998].

Apart from industrial production of broilers, raising ducks on small farms is very common in Poland and abroad, as ducks are extremely well suited to semi-intensive, backyard systems [Faruga and Mikulski 1992, Mazanowski et al. 2001]. This provides justification for the present study, particularly since Pekin Star 53 H.Y. ducks have not been the subject of this type of research. The aim of the study was to compare the growth and body conformation of ducks raised in a semi-intensive and an intensive system.

MATERIAL AND METHODS

The material for the research was Pekin Star 53 H.Y. crossbred meat ducks of French origin. Day-old, sexed ducklings were purchased at the poultry hatchery in Międzyrzec Podlaski. A total of 300 ducks were studied – 150 males and 150 females. The ducks were assigned to two experimental groups of 150 each, divided into subgroups of females and males with 75 birds each. The ducks were reared for 8 weeks. The birds from group I were reared in an intensive system and the birds in group II in a semi-intensive system. Group I ducks were housed in a closed facility according to instructions for raising a flock [Instructions for raising Pekin ducks 2005], while the ducks in the second group had access to an free range from the third week. Stocking density and temperature in building during the rearing period :

	Weeks of rearing – Tygodnie odchowu		
	0–3	4–6	7–8
Stocking density, head per m ² Obsada, osobniki na m ²	10	8	5
Temperatura, °C Temperature, °C	32–24	24–18	Ambient temperature Temperatura otoczenia

The ducks in group I were fed concentrate mixtures for the entire rearing period, while the ducks in group II initially received concentrate mixtures, which were then gradually replaced with on-farm feed (Table 1). All birds were fed ad libitum.

The body weight of the ducks was determined during the rearing period. The day-old ducklings were individually tagged on the left wing, weighed in subgroups, and then from the seventh day of rearing weighed individually at weekly intervals. The results were used to calculate the growth rate of the ducks and drakes according to a commonly used formula [Janiszewska 1993]. In addition, from the age of one week the male and female ducks were measured with atape measure. The following zoometric measurements were taken according a description given by Biesiada-Drzazga [2007]:

Trunk length Długość tułowia	Between shoulder joint and posterior edge of ischium Między wypukleniem stawu barkowego, a tylną krawędzią kości kulszowej
Chest girth Obwód klatki piersiowej	Behind wings through anterior edge of keel and middle thoracic vertebra Za skrzydłami przez przednią krawędź grzebienia mostka i środkowy krąg piersiowy
Shank length Długość skoku	Between hock joint and bottom surface of fourth toe at its base Między stawem skokowym, a dolną powierzchnią czwartego palca u jego nasady

The measurements were used to calculate the body indices of the ducks and drakes [Kokoszyński and Korytkowska 2003]:

Massiveness index Indeks masywności	Percentage ratio of body weight in kg to trunk length in cm Procentowy stosunek masy ciała w kg do długości tułowia w cm
Compactness index Indeks zwięzłości	Percentage ratio of chest circumference to trunk length in cm Procentowy stosunek obwodu klatki piersiowej do długości tułowia w cm

Statistical analysis of the results consisted in calculation of means and standard deviations for traits. Significance of differences between groups was determined by Tukey's test Statistica 10.0.

RESULTS AND DISCUSSION

Table 2 presents the mean body weights of the ducks and drakes during the rearing period. The ducklings at the start of the rearing period had similar body weights, ranging from 54.0 to 55.7 g. As early as the third week of rearing variation was observed in the body weights of the birds, both between groups and between sexes within groups. The group I ducks attained a significantly higher body weight during rearing than the birds in group II. In

Table 1. Diet of the ducks

Tabela 1. Schemat żywienia kaczek

Group Grupa	Week of rearing – type of feed – content in 1 kg Tygodnie odchowu – rodzaj paszy – zawartość w 1 kg		
	0–3	4–6	7–8
I	Concentrate mixture I (<i>ad libitum</i>) Mieszanka treściwa I (do woli)	Concentrate mixture II (<i>ad libitum</i>) Mieszanka treściwa II (do woli)	Concentrate mixture III (<i>ad libitum</i>) Mieszanka treściwa III (do woli)
II	Concentrate mixture I (<i>ad libitum</i>) Mieszanka treściwa I (do woli)	Mixture consisting of: wheat meal wheat bran pea meal oat meal cooked potatoes cut green forage (<i>ad libitum</i>) Mieszanka złożona z: śruta pszena otręby pszenne śruta grochowa śruta jęczmienna parowane ziemniaki młoda pocięta zielonka (do woli)	Mixture consisting of: wheat meal oat meal maize meal pea meal wheat bran cooked potatoes green forage (<i>ad libitum</i>) Mieszanka złożona z: śruta pszena śruta jęczmienna, śruta kukurydziana śruta grochowa otręby pszenne parowane ziemniaki zielonka (do woli)
I-II			
Crude protein, % Białko ogólne, %	22.0	20.0	17.5
EM, kcal · kg ⁻¹	2940	3000	3000
Crude fibre, % Włókno surowe, %	4.0	4.5	5.0

Table 2. Means (x in g) and standard deviation (Sd) for body weight of drakes and ducks during the rearing period

Tabela 2. Wartości średnie (x w g) i odchylenie standardowe (Sd) masy ciała kaczorów i kaczek w okresie odchowu

Week of rearing Tydzień odchowu	Group I – Grupa I			Group II – Grupa II		
	♂	♀	♂ and ♀	♂	♀	♂ and ♀
1 day 1 dzień	55.7 ±2.8	54.5 ±9.8	55.1 ±6.7	54.5 ±1.0	54.0 ±7.9	54.2 ±7.1
1	221.1 ±11.9	195.2 ±21.9	208.2 ±17.3	248.0 ±32.0	236.0 ±13.7	242.1 ±12.1
2	628.3 ±27.7	504.6 ±31.0	566.5 ±69.2	587.0 ±25.8	556.1 ±41.8	572.0 ±13.0
3	1.275.1 ±78.1 ^a	1.091.2 ±77.8 ^b	1.183.2 ±87.4 ^{**}	842.9 ±56.0	811.1 ±98.0	826.9 ±12.4
4	1.860.4 ±67.0 ^a	1.595.6 ±98.0 ^b	1.728.0 ±82.9 ^{**}	1.482.1 ±77.3 ^a	1.300.9 ±83.1 ^b	1.392.0 ±23.9
5	2.580.7 ±67.8 ^A	2.061.1 ±96.0 ^B	2.320.9 ±69.0 [*]	2.035.9 ±98.9	1.979.0 ±73.0	2.007.0 ±34.1
6	3.128.2 ±99.8 ^A	2.755.2 ±56.2 ^B	2.941.7 ±39.7 [*]	2.473.0 ±72.7 ^a	2.275.1 ±56.7 ^b	2.374.0 ±33.1
7	3.410.7 ±92.5 ^a	3.098.3 ±78.4 ^b	3.254.5 ±89.9 ^{**}	2.897.9 ±89.1 ^A	2.494.9 ±97.9 ^B	2.697.0 ±33.7
8	3.672.0 ±91.2 ^a	3.288.5 ±98.9 ^b	3.480.3 ±67.1 ^{**}	3.216.9 ±34.9 ^A	2.783.0 ±24.1 ^B	3.000.2 ± 45.1

a, b – significant differences between sexes within a group at a given age at P ≤ 0.05.

A, B – significant differences between sexes within a group at a given age at P ≤ 0.01.

*significant differences between groups at a given age at P ≤ 0.05.

**significant differences between groups at a given age at P ≤ 0.01.

a, b – różnice istotne między płciami w obrębie grupy w danym wieku przy P ≤ 0,05.

A, B – różnice istotne między płciami w obrębie grupy w danym wieku przy P ≤ 0,01.

* różnice istotne między grupami w danym wieku przy P ≤ 0,05.

** różnice istotne między grupami w danym wieku przy P ≤ 0,01.

the final weeks of rearing, these differences reached 17% in the 7 week and 14% in the 8 week. At the completion of the rearing period, at 8 weeks of age, the mean

body weight of the birds in group I, reared intensively, was 3480.3 g, while that of the group II birds, reared in the semi-intensive system, was 3000.2 g (P ≤ 0.01). The

standard deviation for the body weight of the birds indicates minor variation within groups and subgroups. The body weight observed in the present study was somewhat lower than the results obtained by Kokoszyński [2011] in Star 53 H.Y. ducks. In that study the body weight of 7-week-old ducks was 3177 and that of drakes was 3482 g, while at 8 weeks the corresponding weights were 3374 and 3772 g, respectively. According to ‘Instructions for raising Pekin ducks, 2005’ [2005], ducks should reach a mean body weight of 206 g at 8 days of age, 1870 g at 28 days, 3500 g at 49 days, and 3800 g at 56 days.

In a study by Murawska et al. [2008], P55 ducks in the 7th week of rearing attained a mean body weight of 3321.3 g, and in another study by this author [Murawska et al. 2010] Pekin ducks fed standard compound feeds ad libitum attained a body weight of 3314 g at 7 weeks. Studies conducted on Pekin ducks by Retailleau [1999] and by Farhat and Chavez [2000] also showed that the body weight of these ducks exceeded 3400 g at 7 weeks of age. In a study by Adamski and Bernacki [2002], the body weight of 8-week-old ducks of the A55 strain was 2824 g. Łukaszewicz et al. [2011] reported markedly higher body weights for ducks and drakes of the A55 strain at 8 weeks of age.

In both group I and group II the males had significantly higher body weight than the females on all evaluation days (Table 2). After the rearing period was completed the females in groups I and II had average final body weights of 3288.5 and 2783.0, respectively, as compared to 3672.2 and 3216.9 g for the males. Pronounced sexual dimorphism in ducks has previously been shown by other researchers [Górski 1992, Bernacki and Adamski 2001, Omojola 2007, Biesiada-Drzazga et al. 2011].

Table 3 presents the growth rate of the ducks in the experimental groups during the rearing period. The results indicate that irrespective of sex, young ducklings, i.e. in the first 3 weeks, had the fastest growth rate. In the first week the growth rate exceeded 112.2–134.0%, in the second it was over 80%, after which it markedly

decreased. In the group fed only concentrate feed (group I) the growth rate decreased gradually, whereas in group II, which received on-farm feed after the third week, the growth rate in subsequent weeks was uneven. It appears that not all feeds were readily consumed by the birds. The low growth rate of ducks and drakes in the final week of the rearing period in group I suggests that it would be more beneficial to complete their rearing at 7 weeks, while for group II rearing could be extended to the eighth week. Fairly similar growth rates to those obtained for the group I ducks were reported by Bernacki and Adamski [2001] in ducks from two domestic breeding strains. The results of the present study indicate a pronounced effect of the ducks’ diet during rearing on their growth rate.

Tables 4–6 present the mean values for selected body measurements of ducks and drakes during rearing. During the 8-week rearing period the trunk length of the drakes increased from 10.3 (group I) and 10.2 cm (group II) in the first week to 31.2 (group I) .

and 27.5 cm (group II) in week 8, and in the female ducks from 9.7 to 30.1 cm (group I) and from 10.0 to 27.0 cm (group II). These figures are higher than those obtained by Kokoszyński and Korytkowska [2003] in A55 and P77 ducks and by Bernacki and Adamski [2001] in ducks of the A44 and P66 strains, but similar to those reported by Kokoszyński [2009]. The birds in group I had a statistically trunk length than the birds of group II and at the same time, irrespective of group, the males generally had longer trunks than the females. The standard deviation ranged from 0.7 (week 1) to 7.2 (week 8). Overall, all the trunk length of birds increased nearly threefold during rearing (Table 4).

Chest circumference is indicative of the degree of development of the internal organs and of muscle and fat tissue. In the present study the chest circumference increased in the group I birds from 14.4 in the first week of life to 36.0 cm in week 8, and in group II from 14.4 to 32.9 cm (Table 5). On generally valuation days the group I birds, irrespective of sex, had higher values for this trait than the

Table 3. Growth rate of ducks during rearing, %

Tabela 3. Tempo wzrostu kaczek w okresie odchowu, %

Week of rearing Tydzień odchowu	Group I – Grupa I			Group II – Grupa II		
	♂	♀	♂ and ♀	♂	♀	♂ and ♀
Days 1–7, Dzień 1–7	118.5 ±11.5	112.2 ±21.0	116.3 ±9.8	134.0 ±21.0	131.3 ±17.9	132.7 ±15.8
1–2	95.9 ±11.0	88.4 ±13.1	92.6 ±10.2	81.2 ±17.0	80.8 ±15.9	81.0 ±13.2
2–3	68.0 ±9.7	73.5 ±9.9	70.7 ±10.1	35.8 ±4.9	37.3 ±4.0	36.6 ±7.7
3–4	37.3 ±4.0	37.6 ±3.9	37.5 ±3.1	55.0 ±10.1 ^A	46.4 ±7.9 ^B	50.7 ±12.2
4–5	32.5 ±3.1	25.4 ±2.9	29.0 ±1.9	31.5 ±2.5 ^B	41.3 ±4.1 ^A	36.4 ±8.9
5–6	19.2 ±1.9	28.8 ±4.2	24.0 ±2.2	19.4 ±2.9 ^a	13.9 ±0.5 ^b	16.7 ±7.0
6–7	16.8 ±0.9	11.7 ±2.4	14.3 ±1.2	15.8 ±2.1 ^A	9.2 ±0.3 ^B	12.5 ±4.9
7–8	7.4 ±0.4	6.0 ±1.1	6.7 ±1.0	10.4 ±0.8	10.9 ±1.2	10.7 ±1.0

Table 4. Means (x in cm) and standard deviation (Sd) for trunk length of drakes and ducks during the rearing period

Tabela 4. Wartości średnie (x w cm) i odchylenie standardowe długości tułowia kaczorów i kaczek w okresie odchowu

Week of rearing Tydzień odchowu	Group I – Grupa I			Group II – Grupa II		
	♂	♀	♂ and ♀	♂	♀	♂ and ♀
1	10.3 ±0.7	9.7 ±2.0	10.0 ±1.2	10.2 ±0.9	10.0 ±0.8	10.1 ±1.1
2	14.2 ±1.7 ^a	10.7 ±2.1 ^b	12.5 ±1.9	14.7 ±3.1	13.9 ±2.1	14.3 ±2.2 [*]
3	18.7 ±1.9	18.2 ±4.1	18.5 ±2.3 [*]	16.2 ±0.7	15.2 ±2.1	15.8 ±1.4
4	19.7 ±2.4	19.2 ±3.7	19.5 ±3.1	17.7 ±3.1	17.2 ±0.9	17.5 ±2.2
5	23.1 ±4.2	22.5 ±2.8	22.8 ±3.2 ^{**}	19.9 ±2.0	19.1 ±1.1	19.5 ±2.2
6	27.5 ±3.1 ^A	24.8 ±3.1 ^B	26.2 ±1.9 ^{**}	22.8 ±2.8 ^a	21.2 ±2.0 ^b	22.0 ±1.9
7	29.9 ±3.7	28.3 ±2.6	29.1 ±4.1 ^{**}	23.9 ±3.1	23.2 ±2.8	23.5 ±3.0
8	31.2 ±4.7	30.1 ±7.2	30.7 ±5.2 [*]	27.5 ±2.2	27.0 ±1.0	27.3 ±2.6

a, b – significant differences between sexes within a group at a given age at $P \leq 0.05$.

A, B – significant differences between sexes within a group at a given age at $P \leq 0.01$.

*significant differences between groups at a given age at $P \leq 0.05$.

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a, b – różnice istotne między płciami w obrębie grupy w danym wieku przy $P \leq 0.05$.

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* różnice istotne między grupami w danym wieku przy $P \leq 0.05$.

** różnice istotne między grupami w danym wieku przy $P \leq 0.01$.

Table 5. Means (x in cm) and standard deviation (Sd) for chest circumference of drakes and ducks during the rearing period

Tabela 5. Wartości średnie (x w cm) i odchylenie standardowe obwodu klatki piersiowej kaczorów i kaczek w okresie odchowu

Week of rearing Tydzień odchowu	Group I – Grupa I			Group II – Grupa II		
	♂	♀	♂ and ♀	♂	♀	♂ and ♀
1	14.3 ±1.3	14.5 ±2.7	14.4 ±2.2 ^a	14.7 ±1.1	14.2 ±0.4	14.4 ±0.3
2	17.9 ±2.7	17.0 ±2.5	17.4 ±2.0	15.3 ±1.5	15.1 ±0.6	15.2 ±1.1
3	23.8 ±1.9	22.8 ±2.5	23.3 ±2.2	21.2 ±0.5	20.8 ±0.4	21.0 ±1.2
4	27.2 ±2.8 ^a	25.3 ±3.4 ^b	26.3 ±3.0 [*]	25.0 ±1.1	24.3 ±1.1	24.9 ±0.6
5	29.8 ±3.1	28.5 ±3.5	29.2 ±4.1 ^{**}	26.9 ±2.0	26.1 ±0.7	26.5 ±0.9
6	32.7 ±2.1	31.9 ±4.0	32.3 ±1.9 [*]	29.5 ±2.1	30.2 ±1.9	29.9 ±1.9
7	34.8 ±2.9 ^a	32.1 ±4.1 ^b	33.5 ±3.3 [*]	31.3 ±3.0	31.7 ±3.2	31.5 ±2.7
8	36.7 ±2.3 ^a	35.2 ±2.8 ^b	36.0 ±4.1 ^{**}	33.5 ±4.0	32.5 ±3.3	32.9 ±3.6

a, b – significant differences between sexes within a group at a given age at $P \leq 0.05$.

* significant differences between groups at a given age at $P \leq 0.05$.

**significant differences between groups at a given age at $P \leq 0.01$.

a, b – różnice istotne między płciami w obrębie grupy w danym wieku przy $P \leq 0.05$.

* różnice istotne między grupami w danym wieku przy $P \leq 0.05$.

** różnice istotne między grupami w danym wieku przy $P \leq 0.01$.

Table 6. Means (x in cm) and standard deviation (Sd) for shank length of drakes and ducks during the rearing period

Tabela 6. Wartości średnie (x w cm) i odchylenie standardowe (Sd) długości skoku kaczorów i kaczek w okresie odchowu

Week of rearing Tydzień odchowu	Group I – Grupa I			Group II – Grupa II		
	♂	♀	♂ and ♀	♂	♀	♂ and ♀
1	2.4 ±1.7	2.2 ±0.3	2.3 ±0.9	2.0 ±0.2	2.0 ±0.9	2.0 ±0.7
2	4.0 ±1.4 ^a	2.9 ±1.1 ^b	3.5 ±2.2	3.9 ±1.2	3.3 ±0.3	3.5 ±1.1
3	5.4 ±0.9	5.1 ±1.7	5.3 ±1.9	5.2 ±0.7	5.0 ±0.6	5.1 ±1.0
4	5.7 ±0.7	5.3 ±2.1	5.5 ±2.9	5.9 ±0.9	5.7 ±1.0	5.8 ±1.1
5	6.1 ±0.5	6.0 ±2.1	6.1 ±0.3	6.4 ±1.1	6.5 ±2.0	6.5 ±1.1
6	6.5 ±1.9	6.3 ±3.1	6.4 ±1.1	6.4 ±0.7	6.5 ±1.0	6.5 ±0.4
7	6.6 ±0.2	6.3 ±1.1	6.5 ±0.6	6.8 ±0.3	6.5 ±0.6	6.7 ±1.2
8	6.6 ±1.1	6.4 ±2.9	6.5 ±0.7	6.7 ±1.2	6.5 ±1.1	6.6 ±0.4

a, b – significant differences between sexes within a group at a given age at $P \leq 0.05$.

a, b – różnice istotne między płciami w obrębie grupy w danym wieku przy $P \leq 0.05$.

Table 7. Means (x in %) and standard deviation (Sd) for the massiveness compactness indices of drakes and ducks during the rearing period

Tabela 7. Wartości średnie (x w cm) i odchylenie standardowe (Sd) indeksu masywności i zwięzłości kaczorów i kaczek w okresie odchowu

Week of rearing Tydzień odchowu	Group I – Grupa I			Group II – Grupa II		
	♂	♀	♂ and ♀	♂	♀	♂ and ♀
Massiveness index – Indeks masywności						
1	1.6 ±2.0	1.8 ±0.8	1.7 ±0.7	1.7 ±0.3	1.7 ±0.4	1.7 ±0.2
2	4.4 ±0.5	4.7 ±0.9	4.6 ±0.4	4.0 ±0.9	4.0 ±0.5	4.0 ±0.6
3	6.8 ±2.2	6.0 ±1.3	6.3 ±2.7	5.2 ±1.1	5.3 ±1.2	5.2 ±2.1
4	9.4 ±1.2	8.3 ±3.0	8.9 ±3.9	8.4 ±1.4 ^a	7.6 ±1.7 ^b	7.9 ±0.7
5	11.2 ±1.9	9.2 ±0.9	10.2 ±0.4	10.3 ±2.1	10.2 ±2.3	10.2 ±0.8
6	11.4 ±1.4	11.1 ±1.3	11.7 ±1.1 [*]	10.9 ±3.2	10.8 ±1.1	10.8 ±1.4
7	11.4 ±1.1	11.0 ±1.6	11.2 ±2.2	12.1 ±2.9 ^a	10.7 ±2.0 ^b	11.5 ±1.7
8	11.8 ±1.1 ^a	10.9 ±2.8 ^b	11.4 ±2.1	11.6 ±0.9 ^a	10.4 ±1.3 ^b	11.0 ±1.4
Compactness index – Indeks zwięzłości						
1	139.1 ±11.2 ^b	150.3 ±9.3 ^A	144.7 ±7.3	144.1 ±11.2	142.0 ±10.1	142.6 ±11.9
2	126.3 ±10.7 ^b	159.2 ±12.0 ^A	142.8 ±18.5 ^{**}	104.1 ±8.8 ^b	108.6 ±5.8 ^a	106.3 ±6.9
3	127.7 ±8.9	125.1 ±5.9	126.4 ±4.2	130.8 ±12.9 ^b	136.8 ±12.2 ^a	132.9 ±13.3 [*]
4	138.0 ±7.9 ^a	132.1 ±8.8 ^b	135.1 ±8.1	141.1 ±10.2	141.3 ±11.3	142.3 ±12.9 [*]
5	129.1 ±4.9	127.2 ±11.8	128.2 ±8.4	135.2 ±21.0	136.7 ±6.9	135.9 ±14.4
6	119.2 ±9.6 ^b	129.3 ±10.5 ^a	124.3 ±9.7	129.4 ±13.0 ^b	143.1 ±13.1 ^A	135.8 ±20.0 [*]
7	116.3 ±9.9	113.0 ±6.6	114.7 ±5.2	121.8 ±10.2 ^b	136.6 ±21.0 ^A	129.2 ±11.2 ^{**}
8	118.1 ±5.4	117.2 ±7.7	117.7 ±6.2	118.2 ±11.9	120.4 ±3.9	119.3 ±9.3 ^{**}

a, b – significant differences between groups at a given age at $P \leq 0.05$.

A, B – significant differences between groups at a given age at $P \leq 0.01$.

*significant differences between sexes within a group at a given age at $P \leq 0.05$.

**significant differences between sexes within a group at a given age at $P \leq 0.01$.

a, b – różnice istotne między grupami w danym wieku przy $P \leq 0,05$.

A, B – różnice istotne między grupami w danym wieku przy $P \leq 0,01$.

* różnice istotne między płcią w danym wieku przy $P \leq 0,05$.

** różnice istotne między płcią w danym wieku przy $P \leq 0,01$.

group II birds, and the females of both groups had smaller chest circumferences than the males. During the rearing period the chest circumference of the birds increased on average 2.5–3.0 times. In a study by Kokoszyński [2009] values for this measurement varied depending on the origin and sex of the ducks and the length of the rearing period. In A55 and P77 strains the chest circumference in weeks 3 and 8 was 23.4–30.5 and 20.0–30.1 cm, respectively, and the trunk length was 15.1–23.0 and 16.5–23.1 cm. In a study by Adamski and Bernacki [2002], the chest circumference of ducks of the A55 breeding strain in the 8th week of rearing was 30.8 cm. The present study showed that diet and housing conditions affected not only trunk length but also chest circumference.

Throughout the rearing period shank length was similar irrespective of group and sex (Table 6). In the first week of rearing it averaged 2.3 and 2.0 cm in groups I and II, and at the end of the rearing period 6.5 and 6.6 cm. The results were similar to those obtained by Kokoszyński et al. [2010], i.e. 6.5 cm in P44 ducks and 6.3 cm in P55, and by Kokoszyński and Korytkowska [2003] in A55 (6.0

cm) and P77 (5.9 cm) ducks. Thus the housing system did not significantly affect the shank length of the ducks, although the birds with access to a duck run had somewhat longer shanks than the ducks kept exclusively indoors.

Body measurements and their subsequent use to determine indices provide information on the growth of individual body parts, changes in their proportions, and correctness of conformation. In the present study we determined two basic indices of conformation in males and females (Table 7). The massiveness index in the birds' first week of life was on average 1.7% for males and females in both groups. In the eighth week it was 11.4% and 11.0% in groups I and II, respectively, and was somewhat lower than in studies by other authors [Bernacki and Adamski 2001, Kokoszyński and Korytkowska 2003] and similar to results reported by Mazanowski et al. [2001]. In both study groups the males had higher or significantly higher massiveness indices on all weeks of live.

The compactness index, defined as the percentage ratio of the chest circumference to the trunk length, continually decreased as the ducks grew older: it was on ave-

rage 144.7% in group I and 142.6% in group II in the first week and 117.7% and 119.3% in the eighth week. In group II, and on certain days also in group I, the females generally had a higher compactness index than males (statistically confirmed differences). The results indicate a marked increase in the chest circumference in relation to the trunk length of the ducks irrespective of group, which may suggest a more developed chest in females. In a study by Kokoszyński and Korytkowska [2003] on ducks of the A55 and P77 strains, the massiveness index increased between weeks 3 and 8 of rearing from 6.0 to 12.1 and from 5.2 to 12.5, respectively, while the compactness index decreased from 155.8 to 132.6 in the A55 ducks but increased from 121.5 to 130.8 in the P77 ducks. It should be noted that females had a lower massiveness index than the males and a higher compactness index.

CONCLUSION

1. At the completion of the rearing period, at 8 weeks of age, the mean body weight of the birds in group reared intensively, was 3480.3 g, while that of the group birds, reared in the semi-intensive system, was 3000.2 g
2. The massiveness index, defined as the percentage ratio of body weight in kg to trunk length, continually increases as the ducks grew older: it was on average 1.7% in group I and 1.7% in group II in the first week and 11.4% and 11.0% in the eighth week.
3. The compactness index, defined as the percentage ratio of the chest circumference to the trunk length, continually decreased as the ducks grew older: it was on average 144.7% in group I and 142.6% in group II in the first week and 117.7% and 119.3% in the eighth week.

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PORÓWNANIE WZROSTU I BUDOWY CIAŁA KACZEK ODCHOWYWANYCH SYSTEMEM PÓŁINTENSYWNYM I INTENSYWNYM

STRESZCZENIE

Celem badań było porównanie wzrostu i budowy ciała kaczek hodowanych w półintensywnym i intensywnym systemie. Materiałem do badań był Pekin Star 53 H.Y. kaczki mięsne mieszańce pochodzenia francuskiego. Kaczki odchowywano 8 tygodni. Ptaki z grupy I odchowywano systemem intensywnym, a ptaki w grupie II półintensywnym. Po zakończeniu okresu odchowu, tj. w wieku 8 tygodni, średnia masa ciała ptaki w grupie I wynosiła 3480,3 g, a w grupie II 3000,2 g. Wyniki wskazują, że niezależnie od płci, młode ptaki tj. w ciągu pierwszych 3 tygodni życia odznaczają się najszybszym tempem wzrostu, które stopniowo zmniejsza się z wiekiem. W obu grupach badawczych samce charakteryzowały się większym lub istotnie większym indeksem masywności we wszystkich tygodniach życia w porównaniu z samicami. Indeks zwężłości, określający procentowy stosunek obwodu klatki piersiowej do długości tułowia przyjmował wraz z wiekiem kaczek coraz mniejsze wartości, wynosząc w pierwszym tygodniu odchowu średnio dla grupy I 144,7, a dla grupy II 142,6% natomiast w ósmym tygodniu odpowiednio 117,7 i 120,5%. W grupie II, a w niektórych terminach również w grupie I samice charakteryzowały się przeważnie większym indeksem zwężłości niż samce (różnice potwierdzone statystycznie).

Słowa kluczowe: kaczki, tempo wzrostu, indeksy budowy ciała

