Animal Science Papers and Reports vol. 27 (2009) no. 3, 217-225
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Selected meat production traits in ducks from P11 and P22 conservative strains

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(Received December 7, 2008; accepted May 25, 2009)

Meat production traits were studied in ducks belonging to P11 and P22 conservative strains. Twenty males and 20 females from each strain were kept indoors on deep litter in a controlled environment, and fed *ad lib*. the standard commercial mixtures. Body weight on day 1 and week 7 of age as well as the amount of feed consumed to the end of week 7 (*i.e.* over the whole rearing period) were recorded. At the end of week 7, five males and five females of each strain were slaughtered and dissected. Samples of breast and leg muscles were taken to determine the content of six selected metals. Body weight of 7-week-old males and females was higher in strain P11 compared to strain P22. P22 males were significantly heavier than P22 females. Rate of growth was high (>190%) and occurred greater in males. Feed intake per kg weight gain (FCR) until the end of week 7 of age was lower in P11 than in P22 males and females. P11 birds (sexes pooled) had greater pre-slaughter body weight and dressing percentage than P22 birds. Moreover, P11 males showed significantly greater pre-slaughter body weight than P11 females, and P22 males significantly higher dressing percentage compared to females of the same strain. Percentage of breast and leg muscles of carcass with neck was greater in males (23.5%) and females (23.6%) of strain P22 than in those of strain P11 (22.5 and 22.6% muscles, respectively). The proportion of skin with subcutaneous fat ranged from 28.3 to 32.3% and in both strains was higher in females than in males. The breast muscles of females and males of both strains contained more iron and copper, and less magnesium and zinc compared to leg muscles.

KEY WORDS: ducks / conservative strain / feed conversion / metals / muscles / slaughter value

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As a result of intensification of animal production, many local breeds and varieties of poultry adapted to the local environment, were marginalized or eliminated at all [Hammond 1997]. The countermeasures were adopted to collect and create conservative and genetic reserve flocks of poultry that differed in origin, genotype and conformation. In Poland, waterfowl genetic resources have been conserved on a large scale since the 1970s by the Waterfowl Genetic Resources Station in Dworzyska near Kórnik. The conservative flocks of ducks, which had not been selected using the *in situ* method since 1977, are a source of genetic variation and were used to create new breeding and experimental strains or synthetic groups [Książkiewicz 2006]. Similar efforts were undertaken in other countries [Bessei 1989, Crawford 1992] by establishing conservation centres for poultry breeds.

Despite the efforts aimed at conserving old breeds and varieties of animals, the genetic erosion of the poultry population is continuing at an alarming rate. According to Evanson [1998], about 200 out of 600 breeds of chicken raised in Europe are threatened with extinction. In the case of ducks threatened are, as many as 25 out of 57 breeds.

In 2007, ten flocks of ducks included in the genetic resources conservation programme were kept in two centres in Poland. The Waterfowl Genetic Resources Station in Dworzyska near Kórnik kept the following strains: P8 (Peking of Danish origin), P9 (Peking of French origin), P33 (Polish Peking), KhO1 (Khaki Campbell males x Orpington females), K2 mini-duck and the LsA synthetic line. The other four conservative strains of ducks, designated as P11, P22, P44 and P55 (domestic Peking) were kept on a private farm at the Duck Breeding Centre at Lińsk near Tuchola.

In recent years, ducks kept at the Dworzyska Station were the subject of numerous studies [Książkiewicz and Kiełczewski 1998, Książkiewicz 2002, Wołoszyn *et al*. 2005, Okruszek *et al*. 2006, Witkiewicz *et al.* 2006]. Ducks from P11, P22, P44 and P55 strains (Lińsk Centre) were the subject of fewer studies, and were evaluated for productive traits quite a long time ago [Kontecka 1979, Mazanowski and Książkiewicz 1982, Sochocka 1984, Górski 1992]. Systematic evaluation of productive traits in ducks from conservative strains is important because of the need to increase genetic variation among Peking ducks and the possibility of using them in creating new, highly productive commercial hybrids.

The aim of this study was to compare ducks from P11 and P22 conservative strains for body weight, feed intake and conversion, dressing percentage, carcass composition and metal concentration of breast and leg muscles.

Material and methods

The study was carried out at the Experimental Farm of the Department of Poultry Breeding, University of Technology and Life Sciences in Bydgoszcz. Subjects were day-old sex-separate chicks of strains P11 and P22 (20 males and 20 females of each strain), reared to the end of week 7 of age.

Birds were kept in a confined building on deep litter and offered the waterfowl feed mixtures *ad libitum*. During the first 21 days of life (weeks 1-3), the diet for each strain contained 21.0% crude protein and 12.35 MJ (2950 kcal) ME/kg. From day 22 onwards (weeks 4-7) a diet containing 17.5% crude protein and 12.5 (2985 kcal) ME/kg was used. The amount of feed offered was recorded every day and refusals were weighed only at the age of 7 weeks. From day 8 of age, ducks were given mineral supplements *ad libitum* in the form of MM-D diet, fodder chalk and gravel, mixed at a volumetric ratio of 1:2:4. Deaths and cullings were recorded as they occurred. The European Performance Index (EPI) was calculated with the formula:

$$EPI = (bw \times s) \times 100/ t \times fi$$

where:

bw – mean body weight (kg);

s – survival (%);

t – duck's age (in days);

fi – feed intake per kg body weight gain (kg);

Ducks were weighed individually on day 1 and week 7 (day 49) of life. The rate of their growth (growth rate index – GRI) was calculated according to Brody [1945] as follows:

$$GRI = (bw_f - bw_i) \times 100\% / 0.5 (bw_f + bw_i)$$

where:

bw_f – final body weight;

bw_i – initial body weight.

On week 7 of life, five males and five females were selected with body weight near the mean weight for either sex in each strain. After slaughter, plucking and evisceration, carcasses were chilled for 18 h and dissection was performed of whole carcasses [Ziołecki and Doruchowski 1989]. After dissection, samples of breast and leg muscles were collected to determine the concentration of K, Na, Mg, Fe, Zn and Cu. Samples were freeze-dried and wet mineralized in a microwave apparatus (ETHOS PLUS). The samples were analysed using atomic absorption spectrometry with the Solaar 969 apparatus (UNICAM).

The numerical data were processed using standard statistical methods (computing means and SE). Significance of differences between the means was verified using Tukey's test [SAS/STAT 1995].

Results and discussion

The mean body weight of day-old males and females was greater in strain P22 than in P11 (Tab. 1). After 7 weeks of rearing, the body weight of P11 males was 3257.5 g, being 22.5 g higher than in P22 males, while P22 females weighed 2992.1

Table 1. Means and standard errors (SE) for body weight and growth rate in duck males and females

Trait		Males		Females	
		strain P11	strain P22	strain P11	strain P22
Body weight on day 1 of age (g)	mean	50.1	51.1	49.3	50.3
	SE	0.9	0.8	0.8	0.8
Body weight on week 7 of age (g)	mean	3257.5	3235.0	3097.6	2992.1*
	SE	41.5	44.8	36.0	35.5
Growth rate index for weeks 1-7 (%)	mean	193.9	193.8	193.7	193.4

*Asterisk indicates sex mean within the strain significantly different at P≤0.05.

g, *i.e.* almost 100 g less than P11 females. Mazanowski and Książkiewicz [1982] working on both conservative strains in question reported lower body weight of males (P11 – 2293 g, P22 – 2411 g) and females (P11 – 2249 g, P22 – 2340 g). In a study by Kontecka [1979], 8-week-old P11 males weighed 2213 g, and those of strain P22 – 2265 g. The respective values for females were 1986 g and 1969 g, which is much less than in the present study.

In current investigation, the rate of growth measured by the GRI (Tab. 1) occurred high and in birds of both sexes exceeded 190%. Slightly higher GRI was found in males.

P11 and P22 males did not differ in feed intake up to the end of week 7 of life. However, within females, feed consumption by P11 was higher than by P22 birds. Feed intake per kg weight gain over the period from 1 to 7 weeks of life was lower in males than in females and in P11 compared to P22 strain. In both strains the feed intake was higher in females compared to males. In an earlier study by Bochno *et al*. [1987], Peking ducks from A44, A1, P8 and P9 genetic groups consumed more feed (males 3.91, females 4.20 kg) per kg body weight to week 7 of age than was found in the current report. Also, Clayon and Powell [1979] reported higher feed conversion ratios in Peking males (3.65-3.73 kg/kg) and females (3.86-4.19 kg/kg) to day 51 of age. Retailleau [1999] obtained lower feed intake per kg weight gain in Peking males (2485 g) and females (2496 g), whereas Klemm and Pingel [1992] reported similar values (3070-3226 g) in ducks from heavy sire lines compared to those found in P11 and P22 ducks evaluated.

P11 males and females were characterized by higher EPI values (Tab. 2) compared to P22 birds, which is evidence that the former are more profitable to rear. Lower EPI values in A44, A55, P66 and P77 pedigree ducks at the age of 7 weeks (143-159 points) were reported by Kokoszyński and Korytkowska [2005].

The mean body weight of 7-week-old P11 males and females dissected was greater than in P22 males and females. In addition, the P11 strain was characterized by significant differences in body weight between males and females at week 7 of life.

Table 2. Feed consumption per bird and per kg body weight gain and European Production Index (EPI) in ducks

Trait	Week	Males		Females	
		strain P11	strain P22	strain P11	strain P22
Feed consumption per bird (g)	1-7	9775	9775	9775	9725
Feed consumption per kg body weight gain (g)	1-7	3047	3070	3206	3306
European Production Index (EPI, points)	7	222	219	198	188

No significant differences between means.

Table 3. Means and standard errors (SE) for dressing percentage and muscle and skin with fat content of carcass in ducks

Trait		Males		Females	
		strain P11	strain P22	strain P11	strain P22
Body weight at slaughter (g)	mean	3250.0	3184.0	3066.0*	3020.0
	SE	16.0	10.7	22.6	12.8
Dressing percentage (%)	mean	69.8[a]	68.5[a]	69.8[a]	66.8[b]
	SE	0.2	0.4	0.2	0.1
Breast muscles content of carcass (%)	mean	10.8	11.0	10.7	10.4
	SE	0.3	0.1	0.2	0.1
Leg muscles content of carcass (%)	mean	11.7	12.5	11.9	13.2
	SE	0.2	0.2	0.2	0.2
Breast + leg muscles content of carcass (%)	mean	22.5	23.5	22.6	23.6
	SE	0.4	0.1	0.4	0.2
Skin with fat content of carcass (%)	mean	28.5	28.3	31.4	32.3*
	SE	0.2	0.2	0.2	0.2

[ab]Means within rows bearing different superscripts differ significantly between the strains at P≤0.05.
*Asterisks indicate sex means within the strain significantly differing at P≤0.05.

Dressing percentage (Tab. 3) occurred high and ranged from 66.8 (P22 females) to 69.8% (P11 males and females). P22 males showed significantly higher dressing percentage compared to P22 females. Lower dressing percentage in P11 (57.49%) and P22 ducks (58.17%) was reported by Górski [1992], and by Mazanowski and Książkiewicz [2004] for ducks from pedigree strains A44 (66.4%) and A55 (65.6%). Meanwhile, dressing percentage (68.28-69.88%) in 7-week-old commercial hybrids of meat-type Peking ducks (AP57, PP54, Star 63 and Dworka) – Bernacki *et al*. [2006] – were similar to those of ducks from conservative strains.

Breast muscles of eviscerated carcasses with neck accounted for 10.8% in P11 males and 11.0% in P22 males compared to 10.7 and 10.4% in females, respectively (Tab. 3). These values were lower than those reported by Thiele [1995] for heavy (11.3-14.4%) or medium-heavy (13.0-13.7%) line of ducks, and lower than in A44

and A55 strains (15.8% in males, 15.5% in females) raised in Poland [Mazanowski and Książkiewicz 2004]. Retailleau [1999] found a lower content of breast muscles (9.19% in males, 9.44% in females) in carcasses without neck in Peking hybrids aged 7 weeks.

Leg muscles content of carcass in P11 males and females was lower than in P22 males and females (Tab. 3). In earlier studies by Retailleau [1999], Książkiewicz [2002] and Witkiewicz [2006], the carcasses of 7-week-old Peking ducks contained a greater proportion of leg muscles. The content of breast and leg muscles (pooled) was greater in the carcasses of P22 than P11 males and females (Tab. 3). On week 7 of age greater muscle content of carcass parts was found in A44 and A55 strains (males – 29.0%, females – 29.1%) by Mazanowski and Książkiewicz [2004], and in A44, A55, P66 and P77 strains (males – 24.3-26.7%; females – 25.4-27.5%) by Kokoszyński and Korytkowska [2005].

The carcasses evaluated were characterized by high fat content, as evidenced by a large proportion of skin with subcutaneous fat, which formed 28.3 to 32.3% of the carcass (Tab. 3) and in both strains was higher in females. Moreover, within the P22 strain a significantly greater content of skin with fat was found in females than in males. In pedigree strains of ducks [Mazanowski and Bernacki 2004] the skin with subcutaneous fat content of carcass of P66, P77 and K11 males was higher and averaged 29.1% compared to 28.7% in females. In a study by Witkiewicz *et al*. [2006] the proportion of skin with fat in the carcasses of 7-week-old pedigree ducks A44 and P66 and those from P33 and K2 conservative strains ranged from 29.4 to 31.0%. An even greater proportion of skin with fat (38.7%) in 50-day-old Peking ducks was reported by Stadelman and Meinert [1977].

Table 4. Selected metals content of breast and leg muscles in duck males and females (g/kg d.m.)

Metal		Males				Females			
		strain P11		Strain P22		strain P11		strain P22	
		BM	LM	BM	LM	BM	LM	BM	LM
Na	mean	5.48	3.97	4.75	4.41	4.07*	4.58	4.31	4.23
	SE	0.5	0.3	0.4	0.2	0.3	0.3	0.3	0.2
K	mean	15.57	14.30	15.17	13.70	15.05	15.28	15.77	14.69
	SE	0.7	0.6	0.9	0.4	0.5	0.7	0.6	0.3
Mg	mean	0.58	1.01	0.69	1.02	1.03	1.11	0.86	1.03
	SE	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1
Fe	mean	0.26	0.11	0.27	0.12	0.32*	0.10	0.29	0.12
	SE	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.01
Zn	mean	0.08	0.14	0.08	0.14	0.07	0.15	0.06	0.16
	SE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cu	mean	24.20	9.40	24.96	9.46	23.06	9.36	26.76	9.78
(mg/kg d.m.)	SE	1.7	1.8	1.7	1.0	0.9	1.1	1.8	0.9

Asterisks indicate sex means within the strain significantly different at $P \leq 0.05$.
BM – breast muscles; LM – leg muscles.

The metal content of breast and leg muscles is shown in Table 4. The breast muscles in males and females of both strains contained more potassium (except P11 females), iron and copper than leg muscles. The magnesium and zinc content of breast muscles was lower than of leg muscles. In addition, P22 males and females showed a greater accumulation of copper in breast and leg muscles than P11 ducks.

The metal contents of tissues and organs of pedigree ducks was examined by Proske *et al*. [1993] and Lucia *et al*. [2008]. The latter authors showed the effect of genotype (Muscovy duck, Peking, Mule), feeding (*ad libitum*, overfeeding) and type of biological material (muscle, kidney, liver, abdominal fat, feathers) on accumulation level and distribution of heavy metals such as zinc, copper, cadmium, and mercury. The accumulation of these metals in different tissues and organs was the lowest in Muscovy ducks.

In summary, compared to P22 strain, 7-week-old P11 males and females were characterized by greater body weight and dressing percentage, lower breast and leg muscles content (pooled) of carcass, lower feed intake per kg weight gain and lower copper content of breast and leg muscles. The carcasses of females of both strains were more fatty and contained more leg muscles than carcasses of males. The breast muscles of birds of both strains contained more iron and copper and less magnesium and zinc compared to leg muscles.

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Ocena wybranych cech mięsnych kaczek z dwóch rodów zachowawczych P11 i P22

S t r e s z c z e n i e

Badano cechy mięsne w dwóch stadach zachowawczych (rodach) kaczek – P11 i P22 – korzystając z 20 samców i 20 samic z każdego rodu). Ptaki utrzymywano w kojcach na głębokiej ściółce, w zamkniętym budynku z regulowanymi parametrami środowiska i żywiono *ad libitum* standardowymi przemysłowymi mieszankami paszowymi. Rejestrowano masę ciała w pierwszym dniu i siódmym tygodniu życia ptaków, a także ilość paszy pobieranej do końca 7 tygodnia życia. W końcu 7 tygodnia z każdego rodu ubito i poddano dysekcji pięć samców i pięć samic. Po rozbiorze tuszki pobrano próbki mięśni piersiowych i mięśni nóg do oznaczenia sześciu wybranych metali. Masa ciała 7-tygodniowych samców i samic w rodzie P11 była większa niż w rodzie P22. Samce P22 były istotnie cięższe niż samice tego rodu. Tempo wzrostu (%) przekraczało 190% i było większe w przypadku samców. Mniejsze zużycie mieszanek paszowych na przyrost 1 kg masy ciała (FCR) do końca 7 tygodnia życia stwierdzono w przypadku samców i samic z rodu P11 niż P22. Ptaki z rodu P11 miały większą masę ciała przed ubojem i wydajność rzeźną niż ptaki P22. Ponadto samce z rodu P11 były istotnie cięższe przed ubojem niż samice, a samce P22 charakteryzowała istotnie większa wydajność rzeźna. Udział mięśni piersiowych i mięśni nóg w tuszce z szyją był większy w przypadku samców (23,5%) i samic (23,6%) z rodu P22 niż P11 (odpowiednio 22,5 i 22,6%). Udział skóry z tłuszczem podskórnym wynosił od 28,3 do 32,3% i w obu rodach był większy w tuszkach samic niż samców. Mięśnie piersiowe samców i samic obu rodów zawierały więcej Fe i Cu, a mniej Mg i Zn niż mięśnie nóg.