Animal Science Papers and Reports vol. 21 (2003) no. 4, 251-263
Institute of Genetics and Animal Breeding, Jastrzębiec, Poland

Carcass quality, meat traits and chemical composition of meat in ducks of paternal strains A44 and A55*

Adam Mazanowski[1,2], Tomasz Kisiel[2], Ewa Gornowicz[3]

[1] Department of Poultry Breeding, University of Technology and Agriculture, Mazowiecka 28, 85-084 Bydgoszcz, Poland

[2] Department of Poultry Breeding, Dworzyska, National Research Institute of Animal Production, 62-035 Kórnik, Poland

[3] Poultry Research Branch Zakrzewo, National Research Institute of Animal Production, Poznańska 11, 62-069 Palędzie, Poland

(Received July 3, 2003; accepted November 5, 2003)

Analysed were 8-week-old males and females of duck paternal strains A44 and A55. The *in vivo* weights of meat and fat with skin were estimated based on live body weight, breast bone length and breast muscle thickness. Heritability coefficients for meat production traits and genetic and phenotypic correlations between them were calculated. Carcasses were measured and dissected. In breast and leg muscles the pH and water holding capacity as well as water, protein, fat and ash were determined. Simple correlation coefficients were calculated between carcass weight with neck and carcass components, and body measurements. A55 ducks of both sexes showed greater meat and fat weight, but lower meat and higher fat content of carcass compared to A44 ducks. Based on the correlation coefficients between body measurements and body weight and carcass components, it is suggested that in order to increase the meat weight in the carcass, both strains should be selected for body weight, and strain A44 additionally for breast bone length and breast muscle thickness. Chest depth – which is positively and significantly correlated with the weight and content of breast and leg muscles of carcass, and negatively with the weight and content of subcutaneous fat with skin – can be used in selection for increased muscling and decreased carcass fatness. Also breast bone length and shank length, as well as chest and shank circumference can be used in the selection for increased meat weight and decreased fat weight in duck carcass. It is concluded, based on the pH, water holding capacity and chemical analyses of breast and leg muscles, that the culinary value of strain A55 meat is higher than of strain A44.

---

* Conducted within the statutory activity of the National Research Institute of Animal Production, Poland, Project no. 1106.2.

KEY WORDS: carcass / chemical composition / duck / heritability / meat

Meat traits in ducks are of medium to high heritability [Kosba *et al*. 1997], what ensures successful selection. Useful guidelines on how to carry out such selection are provided by simple correlations calculated between tissue components and *in vivo* body dimensions [Książkiewicz 1993ab, Książewicz and Kontecka 1993].

The best slaughter age of ducks was found between 7 and 8 weeks of life [Bochno *et al*. 1988]. Within this range, the meat content of carcass was the highest and meat to fat ratio proved the most favourable [Bochno *et al*. 1984]. When the age of the ducks exceeds 8 weeks the muscles no longer gain in weight, while the gain of skin with subcutaneous fat increases [Górski 1990, 1997ab]. These conclusions can be drawn indirectly from the body measurements, which are good indicators of the birds' growth, as well as from the direct dissection data [Witkiewicz 2000, Wołoszyn *et al*. 2002].

Water holding capacity, pH and chemical composition, usually determined in breast and leg muscles are crucial for the culinary value and technological properties of duck meat and have been investigated by many authors in relation to the birds'origin, age and nutrition [Pikul *et al*. 1987, Knust and Pingel 1992, Witkiewicz 2000, Wołoszyn *et al*. 2002]. In no publication, however, described was the meat quality of Polish paternal duck strains selected for body weight over 20 years. This has been the subject of the present report, that aimed at characterizing comprehensively the meat traits of ducks from paternal strains A44 and A55, in terms of direct indicators and genetic parameters of their carcasses and chemical composition of the breast and leg muscles.

Material and methods

In 2002 two strains of meat-type ducks A44 and A55 were investigated at the Waterfowl Breeding Farm, Dworzyska, Poland, belonging to the National Research Institute of Animal Production. Eight-week-old males and females were examined for body weight, breast bone length, and breast muscle thickness. The weight of meat (Y) and fat with skin (U) was estimated with multiple regression equations derived by Bochno *et al*. [1988], as follows:

$$Y = 0.193\ X_1 + 45.778\ X_2 + 14.267\ X_3 - 61.445 \text{ and}$$
$$U = 0.247\ X_1 + 62.091\ X_2 - 32.036\ X_3 + 168.369$$

where:

X_1 – live body weight at the age of 8 weeks (g);

X_2 – thickness of breast muscle with skin at the age of 8 weeks, measured with a needle catheter 4 cm from the top of breast bone and 1.5 cm laterally from its edge (cm);

X_3 – length of breast bone at the age of 8 weeks (cm).

The heritability coefficients of the meat traits were estimated with hierarchic analysis of variance from dam component (h^2_D), sire component (h^2_S) and dam and sire components (h^2_{DS}). Standard errors (SE) for heritability coefficients [Żuk 1979] were computed and coefficients of dam effect c^2 [Wężyk 1971] estimated. The coefficients of genetic (r_G) and phenotypic (r_P) correlations between the meat traits were estimated using the analysis of variance and covariance, with the same model as for estimating h^2.

For dissection, five males and five females aged 8 weeks were chosen randomly from each strain. Their body weights were close to the strain means for each sex. Selected birds were tape-measured with an accuracy of 1 mm for the length of trunk with neck, length of trunk, breast bone length and length of shank. Chest and shank circumferences were tape-measured, chest depth was measured with slide caliper and thickness of breast muscle with a needle catheter. After plucking and cooling for about 20 hours, the carcasses were eviscerated and divided into breast muscles, leg muscles, skin with fat, and abdominal fat [Ziołecki i Doruchowski 1989]. Simple correlation coefficients were calculated between the weight of carcass with neck and dressing percentage, weight and per cent of breast and leg muscles, weight of skin with subcutaneous fat, and body dimensions.

The pH of breast and leg muscles was determined 15 min post-slaughter (pH_{15}) and after 20 h carcass cooling (pH_{24}). Measurements were performed with a spear tip electrode combined with a pH meter CP-401 (ELMETRON). The electrode was placed at an angle of 45°, halfway through the muscle, and pH values were read from an LCD display with an accuracy of 0.01. Water holding capacity was determined according to Grau and Hamm [1952]. To determine the meat chemical composition, breast muscles as well as leg and lower thigh muscles of the same leg were taken from each carcass side and then analysed individually. Breast and leg muscles were minced separately and homogenized in a food processor (Cucina HR 2831/6, PHILIPS). Chemical composition of the breast and leg muscles (water, protein, fat, ash) was determined with routine procedures. The results were evaluated statistically with variance analysis and estimation of significance of differences between strains and sexes.

Results and discussion

At the age of 8 weeks live body weights of birds of both sexes were greater in strain A55 than in A44 (Tab. 1) with SDs similar in both strains. A higher body weight of A55 birds may be attributed to introducing the genes of P8 ducks into the A44 genotype [Książkiewicz 1993b]. The 8-week-old Peking ducks, which were selected abroad for increased body weight, showed similar body weight [Pingel 1999]. Breast bone length and breast muscle thickness with skin in Peking and A55 were similar, both in males and females. Peking ducks, selected in Germany, showed thicker breast muscles at the age 8 weeks [Pingel *et al*. 1997, Pingel 1999].

The weight of meat and fat with skin as calculated from the multiple regression equations, appeared greater in A55 males and females, as was per cent of fat with skin.

Table 1. Means and their standard deviations (SD) for body weight, body dimensions and estimated carcass meat and fat weight and content in 8-week-old ducks of two paternal strains

Trait[1]		Strain A44		Strain A55	
		males (n=109)	females (n=389)	males (n=162)	females (n=384)
Live body weight (g)	mean	3019.9	2751.9	3137.5	2842.2
	SD	201.0	193.8	191.3	204.5
Breast bone length (cm)	mean	13.8	13.3	13.8	13.3
	SD	0.5	0.5	0.5	0.4
Breast muscle thickness (cm)	mean	1.5	1.5	1.4	1.5
	SD	0.2	0.1	0.1	0.1
Carcass meat weight (g)	mean	784.8	727.1	804.8	743.8
	SD	49.1	47.8	43.2	46.5
Carcass fat weight (g)[2]	mean	561.5	512.7	587.4	532.8
	SD	44.9	41.4	46.3	48.0
Meat content of carcass (%)	mean	26.0	26.4	25.7	26.2
	SD	0.3	0.3	0.4	0.4
Fat[2] content of carcass (%)	mean	18.6	18.6	18.7	18.7
	SD	0.5	0.4	0.5	0.5

n – number of birds.
[1]Significance of differences was not found.
[2]Including skin.

In Polish studies [Witkiewicz 1998, Mazanowski *et al*. 1999a], A55 ducks created with the share of A44 and P8 strains, achieved at week 7 greater or similar weight of carcass meat (737-761 g) and a lower weight of fat with skin (480-524 g) compared to the results of the present study achieved at week 8. Therefore, A55 ducks of both sexes are characterized by greater body weight and greater weight of both meat and fat in carcass than A44 ducks. However, A55 had a lower meat content, and a higher fat content of carcass compared to A44 ducks (Tab. 1).

In strain A44, the dam's effects on body weight, breast bone length, breast muscle thickness and weight of meat and fat in the carcass were greater than those of sires ($h^2_D > h^2_S$) – Table 2. Thus, the body weight of progeny ducks of A44 at 7 weeks of age was more affected by dams than by sires, as also evidenced by the positive maternal effects (c^2). In strain A55 the dam effect was manifested in breast bone length and breast muscle thickness, and the sire effect in body weight and weight of fat with skin. In A55 the maternal effect appeared very small or even negative. The h^2_{DS} coefficients in strain A44 reached predominantly moderate values except for the thickness of breast muscle

Table 2. Heritability coefficients (h^2_D from dam component, h^2_S from sire component and h^2_{DS} from dam and sire components), their standard errors (±SE), and maternal effects (c^2) in ducks of two paternal strains

Trait	Strain A44				Strain A55			
	h^2_D	h^2_S	h^2_{DS}	c^2	h^2_D	h^2_S	h^2_{DS}	c^2
Live body weight	0.954 ±0.248	0.295 ±0.138	0.449 ±0.170	0.164	0.471 ±0.166	0.525 ±0.175	0.606 ±0.188	-0.013
Breast bone length	0.677 ±0.209	0.354 ±0.151	0.463 ±0.172	0.081	0.450 ±0.162	0.272 ±0.126	0.349 ±0.143	0.044
Breast muscle thickness	0.400 ±0.160	0.171 ±0.105	0.236 ±0.123	0.057	0.324 ±0.139	0.193 ±0.106	0.248 ±0.121	0.033
Carcass meat weight	0.909 ±0.242	0.305 ±0.140	0.452 ±0.170	0.151	0.464 ±0.165	0.493 ±0.170	0.572 ±0.183	-0.007
Carcass fat weight[1]	0.814 ±0.229	0.213 ±0.17	0.345 ±0.149	0.150	0.402 ±0.153	0.677 ±0.199	0.745 ±0.209	-0.069

[1]Including skin.

(h^2_{DS} = 0.236).

In strain A55 the h^2_{DS} coefficients for body, meat and fat weights were high, while those for breast bone length and breast muscle thickness appeared moderate. In the earlier studies, the coefficients of heritability for body weight in A44 and A55 ducks were found lower [Mazanowski *et al*. 1999ab]. The h^2_{DS} coefficients for breast bone length, estimated by Mazanowski *et al*. [1999a] in progeny of both sexes were 0.308 and 0.323 in A44 and A55, respectively, *i.e*. lower than reported here, while the h^2_{DS} values for breast muscle thickness appeared similar.

The heritability coefficients and the estimated effects of dams show that when selecting A44 ducks for increased muscling, more attention should be paid to the choice of dams for the selection flock. In strain A55, the effect of dams on meat traits of their offspring was small and mostly similar to that of sires. The h^2_{DS} coefficients for body, meat and fat weights were the highest.

In the 8-week-old males and females of A44, body weight was highly correlated with breast bone length and weight of meat and fat in carcass, breast bone length with breast muscle thickness, meat and fat weights, and meat weight with fat weight. (Tab. 3). In both sexes of A55 the coefficients of genetic correlation were high between body weight and meat and fat weights, and between meat weight and fat weight. The other r_G between the meat traits as well as the r_P appeared lower. In the earlier studies, both the r_G and r_P in A44 and A55 ducks were found similar [Mazanowski 1999a]. To ensure successful selection for meat weight, both strains should be selected for body weight, and strain A44 additionally for breast bone length and breast muscle thickness.

Table 3. Coefficients of genetic (r_G) and phenotypic (r_P) correlation between meat production traits in ducks of two paternal strains (sexes pooled)

Trait	Strain	Live body weight		Breast bone length		Breast muscle thickness		Carcass meat weight	
		r_G	r_P	r_G	r_P	r_G	r_P	r_G	r_P
Breast bone length	A44	0.966	0.779						
	A55	0.423	0.639						
Breast muscle thickness	A44	0.658	0.590	0.923	0.538				
	A55	0.676	0.251	0.274	0.218				
Carcass meat weight	A44	0.990	0.987	0.960	0.842	0.759	0.685		
	A55	0.994	0.987	0.505	0.716	0.712	0.365		
Carcass fat weight[1]	A44	1.000	0.960	0.888	0.608	0.603	0.674	0.981	0.940
	A55	0.980	0.964	0.244	0.448	0.690	0.558	0.960	0.944

[1]Including skin.

At slaughter dissected A44 males and females had a significantly lower body weight as well as lower per cent of leg muscles, while higher dressing percentage, per cent of skin with subcutaneous fat and weight of abdominal fat than A55 males and females (Tab. 4). Sexual dimorphism only appeared in the body weight and carcass weight. There were no significant inter-strain differences in breast muscles content of carcass. In a previous study by Mazanowski *et al*. [2001], four-strain crosses of ducks with A44 and A55 share showed both dressing percentage and weight of abdominal fat to increase during the growth period. A similar proportion of skin with subcutaneous fat (from 28.1 to 32%) was characteristic of A55 males and females [Mazanowski 1999a]. A55 ducks of both sexes aged 8 weeks exhibited a greater weight of eviscerated carcass with neck, had well muscled legs and were less fatty than A44 ducks (Tab. 4).

Eviscerated carcass with neck was significantly and positively correlated with length of trunk with neck, length of trunk, breast bone length and chest circumference (Tab. 5). Breast and leg muscles contents (%) were significantly and positively correlated with the majority of body measurements except for a non-significant correlation with breast muscle thickness. Książkiewicz [1993b] in 7-week-old A44 ducks of both sexes found significant correlations between the weight of breast and leg muscles and the length of breast bone as well as breast muscle thickness. Moreover, he ascertained the significant and negative correlations appearing between the weight of skin with subcutaneous fat and breast bone length, shank length, and chest depth. In other studies, the correlation coefficients between weight of skin with subcutaneous fat and body measurements of A44 and A55 ducks of both sexes were not found significant and in most cases appeared negative [Książkiewicz 1993ab].

According to Table 5 the dressing percentage was significantly and negatively correlated with breast bone length and shank length, as well as with chest and shank cir-

Table 4. Means and their standard deviations (SD) for dressing percentage and principal carcass components in ducks of two genetic strains

Strain cross		Live body weight at slaughter (g)	Weight of eviscerated carcass with neck (g)	Dressing percentage	Breast muscles (%)[1]	Leg muscles (%)[1]	Fat including skin (%)[1]	Perirenal fat (g)
A44 (n=10)	mean	2855[a]	1966[a]	68.8[a]	17.9	12.7[a]	30.0[a]	41.9[a]
	SD	191	131	0.9	0.8	0.9	1.1	11.7
A55 (n=10)	mean	2936[b]	1987[b]	67.6[b]	17.7	12.0[b]	26.0[b]	31.7[b]
	SD	161	456	1.1	1.1	0.5	1.9	10.5
Males (n=10)	mean	3019**	2045**	67.7	17.7	12.6	27.1	37.6
	SD	187	115	0.7	0.9	0.8	1.6	11.6
Females (n=10)	mean	2771**	1901**	68.7	17.9	12.7	28.8	36.0
	SD	165	476	1.7	1.1	0.6	1.5	9.0
Sexes pooled (n=20)	mean	2895	1974	68.1	17.8	12.6	28.0	36.8
	SD	176	169	1.0	1.1	0.7	1.6	10.9

[1]Eviscerated carcass with neck = 100

[a,b]Within columns means bearing different superscripts differ significantly at P≤0.05

**Within columns means marked with asterisks differ significantly at P≤0.05

cumference. Breast and leg muscles contents of carcass were significantly and positively correlated with chest depth, while per cent of skin with subcutaneous fat significantly and negatively correlated with most of body measurements, except trunk length with neck and breast muscle thickness. Concluding, the chest depth, which is positively ($P \leq 0.05$) correlated with weight and per cent of breast and leg muscles of carcass, and negatively ($P \leq 0.05$) with weight and per cent of skin with subcutaneous fat, can be used in the selection for increased muscling and decreased fatness in ducks. Suitable for selection for increasing meat weight and decreasing weight and per cent of skin with subcutaneous fat are also breast bone length, shank length and chest and shank circumferences.

Values of pH_{15} and pH_{24} (Tab. 6) were significantly higher in the breast muscles of A55 than A44 birds (both sexes), while pH_{15} in leg muscles was higher in A44. Pingel and Birla [1981a] in 8-week-old Peking ducks found the pH_{45} to range from 5.9 to 6.0, and pH_{24} from 5.8 to 5.9. The pH values cited appear lower than those found in the present study, while pH_{24} of leg muscles is greater (6.1 to 7.1) in 7-week-old Pekings [Pingel and Knust 1993, 1997].

Water holding capacity of breast and leg muscles appeared high in both strains. Drip loss in breast muscles ranged from 30.0 to 33.8% and was similar to that found by Pingel and Birla [1981ab]. In the leg muscles, however, drip loss was lower

Table 5. [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Table 6. Means and their standard deviations (SD) for pH, water holding capacity and chemical composition of breast (BM) and leg (LM) muscles in ducks of [illegible]

Season		Trait													
		pH1		pH24		water holding capacity (%)		water (%)		protein (%)		fat (%)		ash (%)	
		BM	LM	BM	LM	BM	LM	BM	LM	BM	LM	BM	LM	BM	LM
[illegible] (n=10)	mean	6.1[a]	6.6[a]	5.8[a]	6.4	11.8[a]	18.1	71.4[a]	67.6[a]	20.6[a]	18.6	1.7	4.5[a]	1.4	1.1
	SD	0.1	0.1	0.2	0.2	1.5	1.9	1.1	1.1	0.6	0.5	0.5	0.9	0.1	0.1
[illegible] (n=10)	mean	6.7[b]	6.4[b]	6.2[b]	6.1	10.8[b]	18.9	77.1[b]	77.1[b]	19.6[b]	18.1	1.8	7.7[b]	1.7	1.2
	SD	0.1	0.1	0.1	0.1	1.1	1.6	0.5	0.7	0.4	0.4	0.2	0.4	0.2	0.1
[illegible] (n=10)	mean	6.1	6.5	6.0	6.4	11.0	17.8	74.6	71.9	19.6**	18.5	1.8	4.0	1.4	1.2
	SD	0.1	0.1	0.1	0.2	1.1	1.1	1.1	1.2	0.5	0.5	0.4	0.7	0.2	0.1
[illegible] (n=10)	mean	6.2	6.6	6.0	6.1	11.6	19.1	74.1	71.8	20.6**	18.5	1.6	7.8	1.7	1.1
	SD	0.1	0.1	0.1	0.2	1.7	1.1	0.6	0.8	0.6	0.1	0.1	0.7	0.1	0.1
Season pooled (n=40)	mean	6.2	6.5	6.0	6.4	11.1	18.5	74.4	72.1	20.1	18.5	1.7	7.9	1.4	1.1
	SD	0.1	0.1	0.1	0.2	1.9	1.8	1.5	0.9	0.5	0.4	0.4	0.7	0.2	0.1

[a,b] Within columns means bearing different superscripts differ significantly at $P \leq 0.05$

** Within columns means marked with asterisk differ significantly at $P \leq 0.05$

(from 28.2 to 28.9%).

Water content of breast and leg muscles in A44 was significantly lower than in A55 strain. According to Witkiewicz [1998, 2000] water content of muscles of 7-week-old A44 and A55 birds ranged from 75.2 to 76.6 and was greater than reported here for 8-week-old ducks. An even greater water content of breast muscle in Peking ducks was reported by Smith *et al*. [1993]. The protein content of breast muscle and fat of leg muscles were both significantly lower in A55 birds. In terms of the protein proportion in leg muscles and fat proportion in breast muscles, no significant differences between males and females of both strains were observed.

According to Witkiewicz [1998, 2000] in 7-week-old A44 and A55 ducks of both sexes, the protein content of breast muscles was 21.1 and 20.7%, respectively, being higher than reported in the present study. An even greater protein content of breast muscles (21.5%) and leg muscles (22.5%) of Peking ducks was noted by Bons *et al*. [1998, 1999]. The fat contents of breast muscle of 7-week-old A44 and A55 males (1.4 and 2.3%, respectively) and females (2.0 and 2.5%, respectively) as determined by Witkiewicz [1998, 2000], were similar or lower than shown in the present report. The fat content of breast muscles higher than reported here was found in Peking ducks by Bons *et al*. [1998, 1999], Pingel and Birla [1981ab] and Smith *et al*. [1993].

In the present study, the fat content of breast muscles was low (1.7%), while in leg muscles markedly higher (3.9%). The ash content of breast and leg muscles did not differ significantly between the two strains. Bons *et al*. [1999] in leg muscles of 7-week-old ducks reported a higher content of ash (1.4%) than in 8-week-old A44 and A55 ducks of both sexes (1.1%). In the present study, mean ash content of breast muscles (for both sexes and both strains, n=20) was 1.4%. Based on pH, water holding capacity and chemical analyses of breast and leg muscles, a higher culinary value of A55 than A44 meat can be anticipated.

The results presented here can be summarized as follows. Males and females of strain A55 are distinguished by higher live body weight and greater meat and fat weight in carcass, as well as better culinary value of meat compared to A44 strain. Based on the correlation coefficients between body weight, tissue components and body measurements, it is anticipated that increasing meat weight requires selection in both strains for body weight, and in A44 additionally for breast bone length and breast muscle thickness. Chest depth can be used to increase both the weight and content of meat, and decrease both the weight and fat content of carcass. Also breast bone length and shank length, as well and chest and shank circumference can be used in the selection for increased meat and reduced fat weight in a duck carcass.

REFERENCES

1. BOCHNO R., LEWCZUK A., JANISZEWSKA A., MAZANOWSKI A., WAWRO K., 1988 – Zastosowanie równań regresji wielokrotnej do oceny umięśnienia i otłuszczenia kaczek (Use of multiple regression equations for evalution of muscle and fat weight of ducks). In Polish with English summary. ***Acta Academiae Agriculturae ac Technicae Olstenensis*** 31, 197-203.
2. BOCHNO R., LEWCZUK A., WAWRO E., MAZANOWSKI A., 1984 – Tempo wzrostu ilości poszczególnych składników tkankowych w tuszkach kaczek (Growth rate of particular tissue components of ducks' carcasses). In Polish with English summary. ***Przegląd Naukowej Literatury Zootechnicznej*** 30 (3-4), 113-117.
3. BONS A., TIMMLER R., JEROCH H., 1998 – Changes in body composition and content of fat and protein in carcass of male and female Pekin ducks during growth. ***Zeszyty Naukowe Przeglądu Hodowlanego*** 36, 165-175.
4. BONS A., TIMMLER R., JEROCH H., 1999 – Changes in body composition and crude nutrient content of Pekin ducks during growth. Proceedings of First World's Waterfowl Conference, December 1-4, Taichung, 328-332.
5. GÓRSKI J., 1990 – Wzrost i proporcje podrobów, produktów ubocznych i składników tkankowych tuszki u kaczek rasy pekin w okresie odchowu (Growth and mutual ratio of giblets, offals and tissue elements in Pekin duck carcasses during rearing period). In Polish with English summary. ***Przegląd Naukowej Literatury Zootechnicznej*** 35, 147-154.
6. GÓRSKI J., 1997a – The effect of two-way crossbreeding of Pekin ducks of P-11, P-22, P-44 and P-55 strains on fleshing and fatness of crossbred ducks. Proceedings of 11th European Symposium on Waterfowl. September 8-10, Nantes, 354-360.
7. GÓRSKI J., 1997b – The effects of two-way crossbreeding of Pekin ducks of P-11, P-22, P-44 and P-55 strains of fat and protein content in the muscles of crossbred ducks. Proceedings of 11th European Symposium on Waterfowl. September 8-10, Nantes, 362-367.
8. GRAU R., HAMM R., 1952 – Eine einfache Methode zur Bestimmung der Wasser-bindung im Fleisch. ***Fleischwirtschaft*** 4, 295-297.
9. KNUST U., PINGEL H., 1992 – The effect of initial pH-value in duck breast and thigh muscle on other meat characteristics. Proceedings of the 19th World's Poultry Congress. September 20-24, Amsterdam, 3, 221-224.
10. KOSBA M.A., NEGM H. M., EL-SAYED T.M., 1997 – Selection for breast meat weight of ducks. Proceedings of the 11th European Symposium on Waterfowl. September 8-10, Nantes, 348-352.
11. KSIĄŻKIEWICZ J., 1993a– Zależności między składem tkankowym a niektórymi wymiarami tuszek kaczek angielskich i krajowych (Relationship between the tissue content and some carcass dimensions of ducks with English and native origin). In Polish with English summary. ***Zeszyty Naukowe Drobiarstwa COBRD* Poznań** 8, 57-65.
12. KSIĄŻKIEWICZ J., 1993b – Wskaźniki zawartości mięśni piersiowych lub nóg w tuszkach kaczek z dwóch rodów hodowlanych (Indices of carcass breast muscle and leg content in two breeding strains of ducks). In Polish with English summary. ***Roczniki Naukowe Zootechniki*** 20 (2), 65-75.
13. KSIĄŻKIEWICZ J., KONTECKA H., 1993 – Charakterystyka zależności między masą i wymiarami ciała a składem tkankowym tuszek kaczek mini, orpingtonów i z różnym udziałem khaki campbell (A characteristics of dependence between body weight, body measurements and carcass tissue composition of Mini-Duck, Orpington and duck with different content of Khaki Campbell). In Polish with English summary. ***Roczniki Akademii Rolniczej w Poznaniu*** 246, 45-56.
14. MAZANOWSKI A., KSIĄŻKIEWICZ J., KISIEL T., 1999a – Reproductive traits of ducks from paternal strains in two laying periods and meat traits of their offspring. ***Annals of Animal Science – Roczniki Naukowe Zootechniki*** 26 (4), 205-217.
15. MAZANOWSKI A., KSIĄŻKIEWICZ J., KISIEL T., 2001 – Ocena cech mięsnych czterorodowych kaczek mieszańców (Evaluation of meat traits in four-strain crossbred ducks). In Polish with English summary. ***Roczniki Naukowe Zootechniki*** 28 (1), 25-43.

16. MAZANOWSKI A., KSIĄŻKIEWICZ J., SZUKALSKI G., 1999b – Reproductive traits of ducks from maternal strains in two laying periods and meat traits of their offspring. ***Roczniki Naukowe Zootechniki*** 26 (4), 191-203.
17. PIKUL J., DORUCHOWSKI W., TAŃSKI S., REKSIŃSKI T., 1987 – Porównanie wydajności poubojowej i dysekcyjnej, składu chemicznego oraz właściwości technologicznych mięsa kaczek piżmowych i Pekin (Slaughter yields, carcass composition, chemical analysis and technological properties of muscovy and Pekin ducks). In Polish with English summary. ***Zeszyty Naukowe Drobiarstwa*** 4, 73-92.
18. PINGEL H., BIRLA M., 1981a – Wpływ czynników przedubojowych na jakość tuszki u ptactwa wodnego (The effect of antemortem factors on the carcass quality of waterfowl). In Polish with English summary. ***Prace Badawcze Zakładu Hodowli Drobiu*** (Instytut Zootechniki) 9, 121-126.
19. PINGEL H., BIRLA M., 1981b – Poprawa jakości tuszki kaczek przez selekcję (Improvement of duck carcass quality by selection). In Polish with English summary. ***Prace Badawcze Zakładu Hodowli Drobiu*** **(**Instytut Zootechniki) 9, 127-131.
20. PINGEL H. 1999. Influence of breeding and management of the efficiency of duck production. ***Lohmann Information*** 22, 7-13
21. PINGEL H., KNUST U., 1993 – Review on ducks meat quality. Proceedings of the 11th European Symposium on the Quality of Poultry Meat. October 4-8, Tours, 26-38.
22. PINGEL H., KNUST U., 1997 – Review on duck meat quality. Proceedings of 11-th European Symposium on the Quality of Poultry Meat. October 4-8, Tours, pp. 26-38.
23. PINGEL H., MÜLLER J., LAM P.T., KNUST U., 1997 – Effect of selection for high feed efficiency on meat quality of Pekin ducks. Proceedings of the 13th European Symposium on the Quality of Poultry Meat. September 21-26, Poznań, Poland, 90-94.
24. SMITH D.P., FLETCHER D.L., BUHR R.J., BEYER R.S., 1993 – Pecking duckling and broiler chicken pectoralis muscle structure and composition. ***Poultry Science*** 72, 202-208.
25. WITKIEWICZ K., 1998 – Porównanie kaczek z dwóch rodów hodowlanych pod względem wybranych cech przyżyciowych i poubojowych (Comparison of ducks from two breeding strains with regard to some selected live and slaughter traits). In Polish with English summary. ***Roczniki Akademii Rolniczej w Poznaniu*** 302, 243-251.
26. WITKIEWICZ K., 2000 – Pomiary zoometryczne, wartość rzeźna i skład chemiczny mięśnia piersiowego u dwu rodów kaczek typu pekin (Zoometric measurements, slaughter value and chemical composition of the breast muscle in two strains of ducks of Pekin type). In Polish with English summary. ***Roczniki Akademii Rolniczej w Poznaniu*** 330, 231-240.
27. WOŁOSZYN J., KSIĄŻKIEWICZ J., ORKUSZ A., SKRABKA-BŁOTNICKA T., BIERNAT J., KISIEL T., 2002 – Preliminary evaluation of chemical composition of duck's muscles from two Polish conservative flocks. Proceedings of 48th International Congress of Meat Science and Technology. August 25-30, Rome, 374-375.
28. WĘŻYK S., 1971 – Metody szacowania odziedziczalności (Methods of heritability estimation). In Polish with English summary. Wyniki prac genetyczno-selekcyjnych Zakładu Hodowli Drobiu za rok 1968/69. Instytut Zootechniki, 252, 5-23.
29. ZIOŁECKI J., DORUCHOWSKI W., 1989 – Metody oceny wartości rzeźnej drobiu (Estimation methods of poultry slaughter value). In Polish. Published by COBRD, Poznań, Poland**,** pp. 1-22.
30. ŻUK B., 1979 – Metody genetyki populacji w hodowli zwierząt (Methods of population genetics in animal breeding). In Polish. PWRL Warszawa, II Edition.

Adam Mazanowski, Tomasz Kisiel, Ewa Gornowicz

Charakterystyka cech mięsnych, wartości tuszek i chemicznego składu mięsa kaczek z rodów ojcowskich A44 i A55

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

Analizowano cechy mięsne 8-tygodniowych kaczek obu płci z rodów ojcowskich A44 i A55. Obliczono wskaźniki odziedziczalności cech mięsnych oraz korelacji genetycznych i fenotypowych między nimi. Określono wymiary i podstawowe elementy tuszek. Między masą tuszki z szyją i jej elementami a wymiarami ciała obliczono wskaźniki korelacji prostej. Określono pH, wodochłonność i skład chemiczny mięśni piersiowych i mięśni nóg. Stwierdzono, że w 8 tygodniu życia, tuszki kaczek A55 obu płci cechuje większa masa mięsa i tłuszczu, ale mniejszy udział (%) mięsa i większy udział (%) tłuszczu niż tuszki kaczek A44.

Wskaźniki korelacji między masą ciała i elementami tuszki a wymiarami ciała pozwalają przypuszczać, że dla zwiększenia masy mięsa należy w obu rodach prowadzić selekcję na masę ciała, a w A44 także na długość mostka i grubość mięśni piersiowych. Głębokość klatki piersiowej, która jest dodatnio i istotnie skorelowana z masą i udziałem (%) mięśni piersiowych i mięśni nóg, a ujemnie z masą i udziałem (%) tłuszczu podskórnego ze skórą, nadaje się do wykorzystania w selekcji prowadzonej na wzrost umięśnienia i zmniejszenie otłuszczenia tusz kaczek.

W selekcji zmierzającej do zwiększenia masy mięsa, a zmniejszenia masy tłuszczu można by wykorzystać także długość mostka, długość i obwód skoku oraz obwód klatki piersiowej. Na podstawie pH, wodochłonności i zawartości wody, białka, tłuszczu i popiołu w mięśniach piersiowych i mięśniach nóg, autorzy wnioskują o wyższej wartości kulinarnej mięsa kaczek rodu A55 niż A44.