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Comparison of some meat traits in ducks from two conservative flocks

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Abstract

Eighty Pekin ducks from P11 and P22 conservative flocks (40 birds of each strain, including 20 males and 20 females) were investigated. Ducks were raised in a confinement building and fed *ad libitum* standard diets for waterfowl. At 7 weeks of age, 5 males and 5 females from each strain were slaughtered and dissected. Breast and leg muscles were sampled to determine fatty acid profile and selected minerals. Compared to P22 ducks, P11 ducks showed higher body weight at 7 weeks of age and higher rate of growth paralleled by better feed conversion ratio (kg feed/kg gain), higher dressing percentage, lower proportion (%) of leg muscles and lower proportion of all carcass muscles. Differences in these traits were not significant. Breast muscles of P11 ducks had significantly more $C_{24:0}$ and $C_{20:4}$ acids and leg muscles contained significantly more $C_{14:0}$, $C_{16:1}$, $C_{18:1}$ and $C_{20:4}$ acids compared to P22 ducks. In addition, leg muscles of P11 ducks had a significantly lower proportion of $C_{17:0}$, $C_{18:0}$, $C_{24:0}$ and $C_{22:4}$ compared to the same muscles of P22 birds. Leg muscles of P11 ducks had significantly more monounsaturated fatty acids (MUFA), higher unsaturated to saturated fatty acid (UFA/SFA) and polyunsaturated to saturated fatty acid ratios (PUFA/SFA), and significantly less saturated fatty acids (SFA) compared to P22 ducks. The Na, K, Mg, Fe, Cu and Zn content of duck muscles was similar in both lines. Compared to leg muscles, breast muscles of P11 and P22 ducks were found to contain significantly more iron (Fe) and copper (Cu), and less zinc (Zn).

Keywords: ducks, conservative flocks, growth, tissue composition, fatty acids

Zusammenfassung

Vergleich einiger Fleischmerkmale bei Enten aus zwei Erhaltungszuchten

Verglichen wurden je 40 Pekingenten (20 männliche und 20 weibliche Tiere) der Erhaltungszuchten P11 und P22. Die Haltung erfolgte in einem geschlossenen Stall bei Fütterung mit Standardmischfutter für Wassergeflügel *ad libitum*. Im Alter von 7 Wochen wurden 5 Enteriche und 5 Enten je Stamm geschlachtet und zerlegt. Die Proben zur Bestimmung der Fettsäureprofile und ausgewählter Mineralbestandteile wurden Brust- und Beinmuskeln entnommen. P11-Enten zeigten im Vergleich zu P22 tendenziell höhere Körpergewichte, bessere Tageszunahmen bei geringerem Futterverbrauch je kg Körpergewicht, einen besseren Ausschlachtungsgrad, geringeren Beinmuskelanteil sowie einen geringeren Muskelanteil im Schlachtkörper. Die Brustmuskeln der P11-Tiere wiesen einen signifikant höheren Anteil an $C_{24:0}$ und $C_{20:4}$, die Beinmuskeln einen höheren Anteil an $C_{14:0}$, $C_{16:1}$ $C_{18:0}$ und $C_{20:4}$ als die gleichen

Muskeln bei P22-Tieren auf. Allerdings wiesen die Beinmuskeln der P11-Tiere im Vergleich zu den P22-Tieren einen signifikant geringeren Anteil an $C_{17:0}$, $C_{18:0}$, $C_{24:0}$ sowie $C_{22:4}$ auf. In den Beinmuskeln der P11 fanden sich mehr MUFA, ein engeres PUFA/SFA Verhältnis sowie ein signifikant niedrigerer SFA-Anteil. Der Mineraliengehlt beider Populationen unterschied sich kaum. Verglichen mit den Beinmuskeln hatten die Brustmuskeln sowohl der P11- als auch der P22 Tiere einen signifikant höheren Eisen- und Kupfergehalt und einen geringeren Zinkgehalt.

Schlüsselwörter: Enten, Erhaltungszucht, Wachtsum, Gewebezusammensetzung, Fettsäuren, Mineralstoffgehalt

Introduction

Maintenance of conservation poultry flocks of different origin and genotype seems necessary for biological, economic, cultural and historical reasons. In Poland, the idea to preserve genetic reserves of ducks dates back to the early 1970s (KSIĄŻKIEWICZ 2003, 2006).

Conservative flocks of ducks, maintained unselected since 1977 at the Waterfowl Genetic Resources Station in Dworzyska using the in situ method, are a source of genetic variation and were used to create new breeding strains and synthetic groups (WAWRO *et al.* KSIĄŻKIEWICZ 2006). Similar activities were conducted in other counties of the world (BESSEI 1989, CRAWFORD 1992) where poultry breed conservation centres were established.

In 2008, ten flocks of ducks were included in the genetic resources conservation programme in Poland. The flocks maintained at the Waterfowl Genetic Resources Station in Dworzyska near Poznań were: P8 (Danish Pekin), P9 (French Pekin) and P33 (Polish Pekin), as well as KhO1 (Khaki Campbell drakes × Orpington ducks), K2 Mini Ducks, and LsA synthetic line. The other four conservative flocks, designated as P11, P22, P44 and P55 (Polish Pekin) were kept on a private farm at the Duck Breeding Centre in Lińsk near Tuchola. A new breeding programme developed in Poland to conserve genetic resources of the duck population examines the origins of different flocks and justifies the need for their protection while describing flock standards, programme objectives, the extent of performance recording, and the breeding methods used (KSIĄŻKIEWICZ *et al.* 2007).

P11 Polish Pekin ducks have been raised in Poland since the 1950s. The breed standard requires white feathers and yellow-orange legs and beak. Seven-week-old birds weigh about 2 750 g (males) and about 2 500-2 600 g (females). P11 ducks are well adapted to varying environmental and feeding conditions and perform well in extensive systems. P22 Polish Pekin ducks have been maintained since 1952. They have white plumage, yellow-orange legs and beak, and broad and bulging breast. At 7 weeks of age, males weigh 2 650 g and females 2 450-2 500 g. P22 ducks have fine muscle fibres, are resistant to adverse environmental and feeding conditions, and are efficient in farm feed conversion (KSIĄŻKIEWICZ *et al.* 2007).

The recent interest in functional foods as well as changes in broadly defined environmental and feeding conditions of the ducks imply that the productive traits of ducks from conservative flocks should be evaluated on a regular basis. The aim of the study was to compare ducks from P11 and P22 conservative flocks for body weight, feed conversion, dressing percentage and carcass composition, as well as fatty acid profile and selected minerals in breast and leg muscles.

Material and methods

Subjects were 80 ducks from P11 and P22 conservative flocks (40 birds of each strain, including 20 males and 20 females), reared up to and including 7 weeks of age. Ducks were confined in a controlled environment facility and fed *ad libitum* standard commercial diets for waterfowl. For the first 21 days (1-3 weeks) of age, both flocks received a diet containing 21 % crude protein and 12.35 MJ (2 950 kcal) ME, and from 22 days (4-7 weeks) of age a diet containing 17.5 % crude protein and 12.5 MJ (2 985 kcal) ME. Feed intake was recorded systematically and feed refusals were weighed at 7 weeks of rearing. From 8 days of age, ducks received supplemental minerals in the form of MM-D mixture, fodder chalk and gravel mixed in a 1 : 2 : 4 volume ratio.

All birds were individually weighed at 1 day and 7 weeks of age. Their growth rate was calculated using Brody's formula:

$$t_w = \frac{m_k - m_p \cdot 100\,\%}{0.5\,(m_k + m_p)} \qquad (1)$$

where t_w is the growth rate index, m_k is the final body weight and m_p is the initial body weight.

At 7 weeks of rearing, 5 males and 5 females with body weight similar to the mean body weight for a given sex, were selected for dissection. After killing, plucking and evisceration, carcasses were cooled at 4 °C for 18 h and dissected (ZIOŁECKI and DORUCHOWSKI 1989). Each carcass was dissected into breast muscles, leg muscles, wings, neck without skin, skin of neck, skin with subcutaneous fat, and abdominal fat. After dissection, breast and leg muscle samples were taken to determine the fatty acid profile of muscle lipids and selected mineral components.

When determining the fatty acid profile, muscle samples were lyophilized using a GT2 Finn-Aqua freeze-dryer and shaken (fat extraction) for an hour using a chloroform-methanol extraction mixture (2 : 1). Methyl esters of fatty acids were then prepared by methylation of fat with 0.5 M sodium methoxide for 22 h at 37 °C and isooctane was introduced to extract methyl esters of fatty acids. Methyl esters of fatty acids were analysed using a Varian 3 800 GC gas chromatograph with FID detector. Esters in the analysed samples were identified using Supelco PUFA-2 Animal Source and Supelco 37 component FAME MIX standards.

To determine mineral components (metals), samples were lyophilized and wet mineralized (weighted portion of 0.1 g, basic reagents HNO_3 and H_2O_2, duration 17 min) in an Ethos microwave system. The samples were analysed by atomic absorption spectrometry in a Unicam 969 Solaar equipment.

The numerical data were analysed using generally accepted methods (means, standard error). Significance of differences between the means was verified using Tukey's test (SAS/STAT 1995).

Results

The lower body weight of day-old P11 males and females compared to P22 birds had no effect on the body weight of the analysed birds at 7 weeks of age. After 7 weeks of rearing, the body weight of P11 ducks (3 176 g) was 59 g higher than in P22 ducks (Table 1). Growth rate, measured using an index of growth rate, was high in both flocks and exceeded 190 %. A slightly higher rate of growth was found in P11 compared to P22 ducks.

Table 1
Body weight and growth rate of P11 and P22 ducks
Körpermasse und Wachtstumrate von Enten P11 und P22

Trait	P11		P22	
	x	SE	x	SE
Body weight of day-old ducks, g	49.7	1.14	50.7	1.14
Body weight of 7-week-old ducks, g	3 176	59.89	3 117	70.56
Growth rate, %	193.8	-	193.6	-

Feed intake by a P11 duck up to 7 weeks of age was 9 775 g, being 25 g higher than in P22 ducks. However, feed conversion (kg feed/kg gain) was more efficient in P11 compared to P22 ducks. The European Production Index (EPI) was also higher in P11 compared to P22 birds (Table 2), which shows that P11 birds are more profitable to raise than P22 birds.

The average body weight of 7-week-old P11 ducks selected for dissection was greater than in P22 birds. A similar pattern was found for dressing percentage and carcass proportion (%) of breast muscles. As regards the percentage of leg muscles and total breast and leg muscles in carcass, higher values were noted for P22 than for P11 ducks. The proportion of skin with subcutaneous fat was the same in both lines (30.3 %).

The breast and leg muscles of ducks from both strains had the highest proportions of palmitic ($C_{16:0}$) and linoleic ($C_{18:1}$) acids. There were statistically significant differences between the strains in the $C_{24:0}$ and $C_{20:4}$ content of breast muscles and in all analysed acids except $C_{16:0}$ and $C_{18:2}$ in leg muscles. In addition, both strains exhibited statistically significant differences in the content of $C_{14:0}$, $C_{16:0}$, $C_{17:0}$, $C_{18:0}$, $C_{16:1}$ and $C_{20:4}$ acids between breast and leg muscles.

Table 2
Feed intake and utilization, and European Production Index of P11 and P22 ducks
Aufnahme, Verbrauch von Futter und europäische Leistungswerte von Enten P11 und P22

Trait	Age, weeks	P11	P22
Feed intake by a duck, g	1-7	9 775	9 750
Feed intake per kg of body weight, g	1-7	3 127	3 180
European Production Index, pts.	7	211	203

Table 3
Slaughter traits of P11 and P22 ducks
Schlachtmerkmale von Enten P11 und P22

Trait	P11		P22	
	x	SE	x	SE
Live weight at slaughter, g	3 158	40.26	3 102	31.49
Dressing percentage, %	68.9	0.38	67.7	0.54
Breast muscles, %	10.9	0.35	10.7	0.19
Leg muscles, %	12.0	0.28	12.8	0.25
Breast and leg muscles, %	22.9	0.51	23.5	0.19
Skin with subcutaneous fat, %	30.3	0.66	30.3	0.76

In the breast and leg muscles of ducks from both strains, the proportion of unsaturated fatty acids (UFA) was higher than that of saturated fatty acids (SFA). However, unsaturated acids were more abundant in leg muscles (P11 – 61.61 %, P22 – 52.67 %) than in breast muscles (P11 – 54.39 %, P22 – 51.94 %). Compared to P11 ducks, the leg muscles of P22 ducks had a significantly higher concentration of SFA. Meanwhile, the leg muscles of P11 ducks contained significantly more monounsaturated fatty acids (MUFA) compared to the leg muscles of P22 birds. The breast and leg muscles of P11 ducks had higher UFA:SFA and PUFA:SFA ratios compared to P22 ducks, with statistically significant differences for leg muscles.

Table 4
Composition of fatty acids in breast and leg muscles of P11 and P22 ducks
Zusammensetzung der Fettsäuren in Brust- und Beinmuskeln von Enten P11 und P22

Fatty acids, %	Breast muscles				Leg muscles				Muscle effect	
	P11		P22		P11		P22		P11	P22
	x	SE	x	SE	x	SE	x	SE		
$C_{14:0}$	0.30	0.013	0.29	0.015	0.65*	0.035	0.51*	0.034	*	*
$C_{16:0}$	31.34	0.620	31.41	0.678	24.73	0.499	24.89	0.395	*	*
$C_{17:0}$	0.22	0.003	0.24	0.006	0.18*	0.003	0.21*	0.063	*	*
$C_{18:0}$	13.06	1.945	15.57	1.040	12.17*	1.028	20.96*	1.799	*	*
$C_{24:0}$	0.69*	0.035	0.56*	0.031	0.65*	0.044	0.76*	0.047	ns	*
$C_{16:1}$	1.18	0.056	1.14	0.088	3.21*	0.243	2.22*	0.148	*	*
$C_{18:1}$	25.79	1.964	28.68	0.800	38.67*	1.003	30.53*	1.505	*	ns
$C_{18:2}$	15.63	1.995	13.37	0.459	15.43	0.281	14.59	0.319	ns	*
$C_{20:4}$	9.76*	0.326	7.65*	0.395	0.49*	0.044	0.34*	0.025	*	*
$C_{22:4}$	2.03	0.775	1.10	0.076	3.81*	0.354	4.99*	0.269	ns	*

*$P \leq 0.05$, ns not significant

The breast and leg muscles of ducks from both strains had the highest content of potassium (14.29 to 15.47 g/kg DM) and sodium (4.28 to 4.77 g/kg DM), and the lowest content of copper (9.38 to 23.63 mg/kg DM). Iron and copper content was significantly higher, and sodium and potassium higher in breast muscles than in leg muscles of ducks from both strains. Only magnesium and zinc content was higher in leg muscles. No significant differences were found in the metal content of both muscles between P11 and P22 ducks.

Table 5
Fatty acid balance in breast and leg muscles of P11 and P22 ducks
Fettsäurenbilanz in Brust- und Beinmuskeln von Enten P11 und P22

Trait	Breast muscles				Leg muscles				Muscle effect	
	P11		P22		P11		P22		P11	P22
	x	SE	x	SE	x	SE	x	SE		
SFA, %	45.61	1.069	48.06	0.534	38.38*	1.493	47.33*	1.742	*	ns
MUFA, %	26.98	0.632	29.82	0.752	41.88*	1.562	32.75*	1.870	*	ns
PUFA, %	27.41	1.072	22.12	0.534	19.73	1.499	19.92	1.742	*	ns
UFA, %	54.39	0.053	51.94	0.566	61.61	0.487	52.67	0.405	*	ns
UFA/SFA	1.20	0.054	1.08	0.019	1.60*	0.092	1.11*	0.088	*	ns
PUFA/SFA	0.60	0.034	0.46	0.013	0.51*	0.022	0.42*	0.016	ns	ns

*$P \leq 0.05$, ns not significant

Table 6
Mineral content of breast and leg muscles (g/kg DM) of P11 and P22 ducks
Mineralstoffgehalt in den Brust- und Beinmuskeln (g/kg der TM) von Enten P11 und P22

Minerals	Breast muscles				Leg muscles				Muscle effect	
	P11		P22		P11		P22		P11	P22
	x	SE	x	SE	x	SE	x	SE		
Na	4.77	0.514	4.53	0.335	4.28	0.174	4.32	0.214	ns	ns
K	15.31	0.594	15.47	0.716	14.78	0.644	14.29	0.384	ns	ns
Mg	0.80	0.179	0.77	0.188	1.06	0.067	1.02	0.035	ns	ns
Fe	0.29	0.022	0.28	0.027	0.12	0.008	0.12	0.004	*	*
Zn	0.08	0.008	0.07	0.004	0.15	0.013	0.15	0.013	*	*
Cu, mg/kg DM	23.62	1.310	25.86	1.731	9.38	1.413	9.62	0.921	*	*

*$P \leq 0.05$, ns not significant

Discussion

Although no breeding work was conducted in the conservative flocks, P11 and P22 ducks are characterized by considerable genetic potential for meat traits, as evidenced by their high rate of growth and considerable body weight at the age of 7 weeks. WITAK (2008) found similar body weight of 7-week-old ducks from A44 Pekin strain. The lower body weight of 7-week-old ducks from P11 (2 271 g) and P22 (2 375 g) conservative flocks were reported by MAZANOWSKI and KSIĄŻKIEWICZ (1982). At 7 weeks of rearing, ducks from A44 and A55 pedigree strains improved for meat traits (MAZANOWSKI and KSIĄŻKIEWICZ 2004) and also weighed less than the birds studied in the present experiment (2 901 g and 2 985 g, respectively). Meanwhile, RETAILLEAU (1999) found higher mean body weight in 7-week-old Pekin ducks (3 569 g in males, 3 322 g in females).

Genetic reserve ducks are efficient in conversion of complete feeds for high-producing ducks, as evidenced by low feed intake per kg of body weight found in the analysis (3 127 and 3 180 g). Feed intake per kg of body weight was lower in P11 and P22 ducks reared to 7 weeks of age than in Pekin ducks from A44, A1, P8 and P9 strains (3.97-4.14 kg/kg) raised to the same age (BOCHNO *et al.* 1987). Meanwhile, BERNACKI *et al.* (2006) found similar feed intake per kg of body weight to 7 weeks of age in production hybrids of Star 63 ducks (3 141 g), and greater feed intake per kg of body weight in AP57 (3 346 g), PP54 (3 398 g) and Dworka (3 550 g) production sets.

Dressing percentage of the analysed ducks was high (over 67 %), probably resulting from high body fat content (over 30 % of skin with subcutaneous fat). Lower dressing percentage for the same strains of ducks (57.49 % for P11 and 58.17 % for P22) were reported by GÓRSKI (1992). Dressing percentage of ducks from maternal breeding strains (MAZANOWSKI and BERNACKI 2004) P66 (65.3 %) and P77 (66.6 %) was also similar, and that of ducks from paternal strains (MAZANOWSKI *et al.* 2003) A44 (68.8 %) and A55 (67.6 %) similar to those reported in the present analysis. KISIEL and KSIĄŻKIEWICZ (2004) found higher dressing percentage in Peking strain P33 (69.5 in males, 69.6 in females). The proportion of breast muscles in duck carcasses was similar in both strains (10.9 and 10.7 %) and lower than reported by THIELE (1995) for heavy (11.3-14.4 %) and medium-heavy (13.0-13.7 %) lines of ducks. Meanwhile, RETAILLEAU (1999) found a lower proportion of breast muscles (9.19 in males, 9.44 % in females) in the carcasses of Pekin ducks aged 7 weeks compared to the P11 and P22 ducks analysed.

The small proportion of breast muscles in the carcasses of the analysed ducks was partly compensated for by the greater proportion of leg muscles. Leg muscle percentage was slightly greater in the carcasses of P22 compared to P11 ducks. Earlier evaluations (MAZANOWSKI and BERNACKI 2004, MAZANOWSKI and KSIĄŻKIEWICZ 2004) of ducks from breeding strains, raised to 7 weeks, showed a greater proportion of legs in the carcass. Also the total proportion of breast and leg muscles was greater in ducks from A44 (30.2 %) and A55 (30.7 %) breeding strains at 7 weeks of rearing (MAZANOWSKI *et al.* 2003). Ducks from the analysed flocks had relatively high body fatness. The proportion of skin with subcutaneous fat in carcass was similar in both strains (30.3 %) and greater than that reported by MAZANOWSKI and BERNACKI (2004) for P66 (29.3 %) and P77 (29.5 %) ducks. The high carcass fatness of genetic reserve ducks was probably due to the fact that they had no outdoor access while showing natural propensity to fat deposition when fed complete diets ad libitum.

The breast and leg muscles of ducks from both strains had the greatest proportions (%) of oleic acid ($C_{18:1}$) among unsaturated fatty acids and of palmitic acid ($C_{16:0}$) among saturated fatty acids. These findings are in agreement with the previous results reported for other strains of Pekin ducks (KOKOSZYŃSKI *et al.* 2002, WOŁOSZYN *et al.* 2005). It is worth noting a relatively high proportion of palmitic acid ($C_{16:0}$), hazardous to human health, which was greater than in the muscles of ducks from other strains (BATURA *et al.* 1990, WOŁOSZYN *et al.* 2005). It was further shown that the proportion of this acid ($C_{16:0}$) was greater in the breast muscles than in the leg muscles of ducks from both flocks. The proportion of biologically neutral $C_{18:0}$ acid in both types of muscles in the analysed ducks was similar to other strains of Pekin ducks (BATURA *et al.* 1990) and markedly greater than in the same muscles of Mulard ducks (WOŁOSZYN 2002).

The proportion of unsaturated fatty acids (UFA) in the breast and leg muscles of the analysed P11 and P22 ducks was greater than that of saturated fatty acids (SFA), with leg muscles containing more UFA than breast muscles (significant differences for P11 strain). In a study with ducks from breeding strains, breast and leg muscles had a greater proportion of UFA (BATURA *et al.* 1990). Breeding ducks fed a complete diet *ad libitum* had 59.4 % UFA in breast muscles and 67.2 % UFA in leg muscles. In ducks from A3 conservative flock, breast muscles were found to contain 54.77 % UFA and leg muscles 62.66 % (WOŁOSZYN *et al.* 2006). Lower proportions of UFA in breast muscles than in the analysed P11 and P22 ducks were reported by SMITH *et al.* (1993) and LESKANICH and NOBLE (1997) – 50.6 and 49.5 %, respectively. Among fatty acids, monounsaturated acids (MUFA) predominated in the muscles of ducks from the analysed strains. The proportion of these fatty acids in breast muscles of P11 and P22 ducks was similar to that reported by WOŁOSZYN *et al.* (2006) for ducks from A55 (29.96 %) and P66 (31.97 %) pedigree strains and by SALICHON *et al.* (1993) for Muscovy ducks (32.07 %). Much greater proportions of MUFA were found in the muscles of Mulard ducks (53 % in males, 53.3 % in females) by WOŁOSZYN (2002), and in Pekin ducks by WITKIEWICZ *et al.* 2006 (50.4-55.7 % in males, 48.9-52.3 % in females). The breast muscles of the analysed ducks contained more polyunsaturated fatty acids (PUFA) than leg muscles, with significant differences in strain P11. A similar relationship was found in other studies with Pekin ducks (BATURA *et al.* 1990, WOŁOSZYN *et al.* 2005). The proportion of PUFA in the breast muscles of the analysed P11 and P22 ducks was greater than reported by SMITH *et al.* (1993) and LESKANICH and NOBLE (1997) – 17.03 and 16.5 %, respectively. Similar or greater PUFA values in breast muscles were obtained by WOŁOSZYN *et al.* (2005, 2006) in ducks from P33, K2 and A3 conservative flocks (26.60-30.44) and from A55 and P66 pedigree strains (28.92 and 28.67 %).

The greater proportion of UFA in the muscles of P11 ducks compared to P22 ducks caused the UFA/SFA ratio to be greater in P11 ducks, in both breast and leg muscles. The UFA/SFA ratio calculated in the breast muscles of the analysed ducks was lower than in the breeding strains of Pekin ducks (1.46-1.49) evaluated by BATURA *et al.* (1990), in Muscovy ducks (~1.7) studied by ROMBOLI *et al.* (1997) and in Mulard ducks (1.6-2.1) investigated by WOŁOSZYN (2002) and CHARTRIN *et al.* (2003).

The content of selected minerals was also determined in the muscles of the genetic reserve ducks analysed. No significant differences were found in the content of the minerals between the duck strains analysed. Previously, the metal content of tissues and muscles from breeding ducks was determined by PROSKE *et al.* (1993) and LUCIA *et al.* (2008), and in wild ducks by SZYMCZAK and ZALEWSKI (2003) and WAŁKUSKA *et al.* (2006). In the analysed P11 and P22 ducks, zinc (Zn) content of breast muscles was similar, and Zn content of leg muscles greater than in Pekin ducks, while the copper (Cu) content of breast and leg muscles was greater than in Muscovy and mule ducks (LUCIA *et al.* 2008).

In summary, it is concluded that compared to P22 birds, 7-week-old P11 ducks show greater body weight and better feed conversion (kg feed/kg gain). P11 birds are also characterized by greater dressing percentage but lower proportion (%) of total breast and leg muscles in carcass. Breast and leg muscles of P11 ducks contain more UFA and less stearic acid ($C_{18:0}$), which may be indicative of their better health-promoting value compared to the muscles of P22 ducks. The breast muscles of P11 and P22 ducks contained significantly more iron (Fe) and copper (Cu), and less zinc (Zn) than leg muscles.

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