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Effect of Breed and Caponisation on the Growth Performance, Carcass Composition, and Fatty Acid Profile in the Muscles of Greenleg Partridge and Polbar Breeds

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ABSTRACT

The aim of the study was to determine the impact of caponisation of Polbar (Pb) and Greenleg Partridge (Zk) breeds on the production performance, carcass composition, and the nutrient content and fatty acid profile in the breast and thigh muscles and abdominal fat. From 18 weeks of age to the end of the experiment, the Zk capons were significantly heavier than the cocks. The Zk capons had higher ($p \leq 0.05$) weight and share of breast and leg muscles. At 24 weeks of age, we noted an increase in the total content of *n-3* PUFA and linolenic acid $C_{18:3}$ in the breast muscles of the Zk and Pb capons. The content of PUFA and *n-3* PUFA in thigh muscles and the n6/n3 ratio were reduced in the Pb capons at 24 weeks of age, compared with the Zk cocks. Caponisation of the Pb cocks had a beneficial effect on the final body weight, feed intake, and slaughter characteristics, in comparison with the non-caponised birds of this breed. A tendency towards an increased total share of PUFA and MUFA, a significantly higher content of *n-3* PUFA, and a lower ($p \leq 0.05$) *n-6/n-3* ratio were found for the breast muscles of the Pb capons. Both breeds are a good material for production of capons. The meat of the capons of both breeds exhibited a beneficial, higher PUFA/SFA ratio, higher *n-3* PUFA and MUFA content, and a more favourable *n-6/n-3* ratio.

INTRODUCTION

The increasing intensification of poultry production and breeding excludes the use of native chicken lines due to their poor performance (Połtowicz & Doktor, 2012). Despite their poor performance, native lines exhibit a number of distinct production, functional, and phenotypic traits, e.g. taste and nutritional values of eggs and meat. These traits have been preserved in pure lines, which have not been selected over many generations due to the implementation of programs of conservation of genetic resources. In Poland, the genetic potential is based on pure lines of Greenleg Partridge, Yellowleg Partridge, Polbar, Sussex, Rhode Island Red, Barred Rock, and New Hampshire breeds. They can be used as a source of meat or material for production of slow-growing broiler chicken hybrids (Sokołowicz *et al.,* 2016). Besides their unique genetic profile, native breeds are a source of unique quantitative and qualitative traits, which cannot be found in high-performance breeds (Krawczyk *et al.,* 2011). Given the consumers' preferences for meat with low fat content and an agreeable flavour and odour (Van Loo *et al.*, 2010; Walley *et al.*, 2015; Sokołowicz *et al.*, 2016), an interesting alternative in poultry production based on native breed flocks is the tradition of caponisation (Calik, 2014; Kwiecień *et al.*, 2015; Franco et al., 2016; Calik *et al.*, 2017). An additional advantage of this procedure is the use of superfluous numbers of cocks among birds that are intended for rearing. In Italy, France, China, and the United States, capons are

sold as high-quality products (Sirri *et al.*, 2009). The meat of the native Greenleg Partridge breed contains less fat and cholesterol and is more delicate, juicy, and tender than the meat of non-castrated cocks (Sirri *et al.*, 2009; Calik *et al.*, 2015; Guo *et al.*, 2015).

Removal of cocks' tests results in deficient production of androgens, which is reflected in a smaller size of the comb and wattle, a decreased level of aggressiveness (Chen *et al.*, 2007), and reduced sexual drive (Chen *et al.*, 2006). In turn, the energy retained contributes to increased efficiency of feed conversion into growth (Rikimaru *et al.*, 2009; Volk *et al.*, 2011), fat deposition, and improved quality of meat (Volk *et al.*, 2011;Calik *et al.*, 2015; Kwiecień *et al.*, 2015; Zawadzka *et al.*, 2016).

The use of the native Zk breed for production of capons has been investigated by few researchers (Calik *et al.* 2015; Kwiecień *et al.*, 2015; Adamski *et al.*, 2016; Zawadzka *et al*., 2016; Gesek *et al.,* 2017). As indicated in a study conducted by Kwiecień *et al.* (2015), Zk capons exhibited a beneficial weight gain of the breast muscle, increased content of fat (abdominal, intramuscular), and favourable changes in thigh muscles, i.e. an increase in the total content of MUFA and PUFA as well as $PUFA_{n-6}$. The results reported by Calik *et al.* (2015) and Zawadzka *et al.* (2016) demonstrate that Zk capons are characterised by higher body weight, dressing percentage, and share of breast and thigh muscles, stomach, and abdominal fat. Another native breed that can be used for production of capons and, simultaneously, high-quality poultry meat is the Polbar (Pb) breed (Gryzińska *et al.,* 2014). The result of caponisation of Pb cocks is interesting, since this is a synthetic breed originating from crossing of the Greenleg Partridge breed with cocks of the heavy breed Barred Plymouth Rock (Muszyński *et al.,* 2017).

The objective of the study was to determine the effect of caponisation of the Pb and Zk breeds on the production performance, carcass composition, nutrient content, and fatty acid profile in muscles and abdominal fat.

MATERIAL AND METHODS

Bird management and experimental design

All procedures applied in the research were approved by the Local Ethics Committee on Animal Experimentation of the University of Life Sciences in Lublin, Poland (No. 33/2013; 16 April 2013). The study material comprised Greenleg Partridge cocks from the Zk line and Polbar cocks from the Pb line reared at the University of Life Sciences in Lublin. The experiment was conducted on 200 Zk and 200 Pb cocks, which were individually weighed, labelled, and randomly assigned to the groups. 8-week-old birds weighing over 600 g underwent the castration procedure carried out by a veterinary doctor and his assistant, as described in detail by Tomaszewska *et al.* (2016). Afterwards, the cocks were divided into two groups as described above (capons and non-castrated cocks). At 8 weeks, the chickens of each breed were assigned to a control group (50 birds in 10 pens with 5 birds in each) and a caponised experimental group (50 birds in 10 pens with 5 birds in each). The birds were reared to 24 weeks of age in a litter system with controlled temperature and humidity.

Throughout the experimental period, all caponised and non-caponised cocks of both breeds were fed *ad libitum* with standard complete diets for multi-purpose hens corresponding to the periods of rearing, i.e. from 1 to 8 weeks of age, from 8 to 18 weeks of age, and above 18 weeks of age. The diets were based on corn, wheat, and oat middlings as wellpost-extraction soybean meal and sunflower seeds. The composition and nutritive value of the diets are presented in Table 1.

Sampling and measurements

Between 6 and 24 weeks of age, the birds were weighed individually every 2 weeks, the collective feed intake was assessed, and the birds' health status was analysed. After the rearing period, i.e. at 24 weeks of age, 10 birds with body weight corresponding to the mean value were selected from each group. Ten hours before the slaughter (Council Regulation (EC) No. 1099/2009; 24 September 2009), the selected birds were given no feed but were provided with unlimited access to water. The birds were slaughtered by decapitation after mechanical stunning. Next, the carcasses were subjected to simplified dissection analysis (Ziołecki & Doruchowski, 1989) and livers, hearts, stomachs, breast and leg muscles, femora, tibias, andabdominal fat were collected. The individual carcass elements were weighed, which allowed determination of their percentage share in the chilled carcass weight, packed into labelled plastic bags, and frozen (at – 25 °C) until analysis.

Feed analyses

The chemical composition of the breast and thigh muscles sampled from each group was analysed by determination of the content of dry matter, total protein, and crude ash using the AOAC method (2000).

Table 1 – Composition and nutrients content of the diet fed during the trial.

Item	Complete mixture		
	1-8 week old	8-18 week old	> 18 week old
Ingredients (%)			
Corn	44.15	43.80	28.64
Wheat	20.0	20.0	20.0
Oat	5.0	10.0	20.0
Soybean meal	20.0	10.0	10.0
Sunflower meal	5.0	10.0	15.0
Soybean oil	2.40	2.50	2.00
Monocalcium phosphate	1.30	1.40	1.90
Limestone	0.76	0.89	1.50
$NaHCO_3$	0.12	0.14	0.16
NaCl	0.27	0.27	0.25
Mineral-vitamins premix	1.0[a]	1.0[b]	1.0[b]
Calculated nutrient content:			
Metabolizable energy (MJ kg^{-1})	11.20	11.30	11.00
Crude protein, %	17.32	15.24	16.72
Crude fat, %	4.00	4.00	3.40
Crude fibre, %	5.50	6.20	7.15
Crude ash, %	4.45	4.52	5.00
Na, %	0.18	0.18	0.17
Ca, %	1.00	1.30	4.00
Available P, %	0.35	0.32	0.40
Lysine, %	0.80	0.55	0.88
Metionine, %	0.30	0.25	0.35
Fatty acids content (g/100 g of total fatty acids)			
14:0	0.57	0.61	0.59
16:0	20.2	20.8	19.9
18:0	8.57	9.26	9.48
$18:2_{n-6}$	23.4	22.6	23.1
$18:3_{n-3}$	1.28	1.30	1.29

[a]1 kg of premix for a period of 1-8 weeks contained: vitamin A (retinol), 3.60 mg; vitamin D3 (cholecalciferol), 0.0625 mg; vitamin E (alpha-tocopherol), 25 mg; vitamin K3 (menadione), 3 mg; vitamin B1 (thiamine), 2 mg; vitamin B2 (riboflavin), 6 mg; vitamin B6 (pyridoxine), 5 mg; vitamin B12 (cyanocobalamin), 0.02 mg; nicotic acid 30 mg; pantothenic acid 15 mg; folic acid 2 mg; biotin 0.2 mg; choline 700 mg; Fe 70 mg; Zn 60 mg; Mn 70 mg; Cu 8 mg; J 1 mg; Se 0.3 mg.

[b]1 kg of premix for a period of nine weeks from the end of the rearing contained: vitamin A (retinol), 3.0 mg; vitamin D3 (cholecalciferol), 0.05 mg; vitamin E (alpha--tocopherol), 25 mg; vitamin K3 (menadione), 2 mg; vitamin B1 (thiamine), 2 mg; vitamin B2 (riboflavin), 4 mg; vitamin B6 (pyridoxine), 4 mg; vitamin B12 (cyanocobalamin), 0.02 mg; nicotic acid 25 mg; pantothenic acid 15 mg; folic acid 1 mg; biotin 0.2 mg; choline 300 mg; Fe 50 mg; Zn 50 mg; Mn 60 mg; Cu 7 mg; J 0.7 mg; Se 0.2 mg.

Qualitative composition of fatty acids muscles and abdominal fat

The qualitative composition of fatty acids was analysed in ten 24-week-old birds from each group. Gas chromatography was performed in a Varian CP-3800 GC-FID apparatus (Varian, Netherlands) using Supelco 37 FAME Mix 47885-U standards (Sigma, UK) to determine the content and identify fatty acids in the feed mixtures, breast and thigh muscles, and abdominal fat after previous extraction of fat with Folch's method in a Velp SER apparatus (Velp, Italy) (Winiarska-Mieczan & Kwiecień, 2015). The characteristic of the capillary column were as follows: type CP WAX 52CB, DF 0.25 mm x 60 mm, flow rate of gas (helium) carrier-1.4 ml/min, column temperature 120 °C gradually increasing by 2 °C/min up to 210 °C, determination time 120 min, detector FID temperature 260 °C, other gases-hydrogen and oxygen. Fatty acids were expressed as a percentage of total fatty acids and grouped into saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA). The atherogenic (AI) and thrombogenic (TI) indices (Ulbricht & Southgate, 1991) and hypocholesterolemic/hypercholesterolemic ratio (h/H) (Fernández *et al.*, 2007) were calculated as follows:

$$AI = (C12:0 + 4 \times C14:0 + C16:0) / [\sum MUFA + \sum(n\text{-}6) + \sum(n\text{-}3)]$$

$$TI = (C14:0 + C16:0 + C18:0) / [(0.5 \times \sum MUFA + 0.5 \times \sum(n\text{-}6) + 3 \times \sum(n\text{-}3)) + (\sum(n\text{-}3)/ \sum(n\text{-}6))]$$

$$h/H = (C18:1\ n\text{-}9 + C18:2\ n\text{-}6 + C20:4\ n\text{-}6 + C18:3\ n\text{-}3 + C20:5\ n\text{-}3 + C22:5\ n\text{-}3 + C22:6\ n\text{-}3) / (C14:0 + C16:0)$$

Statistical analysis

The mean body weight values, weight gain, slaughter characteristics, basic chemical composition of muscles, and fatty acid profiles were analysed with a two-way analysis of variance with interaction (GLM), and the significance of differences between the means in the analysed groups was determined with Tukey's test at $P \leq 0.05$ (Model 1). A two-way analysis of variance was used to assess the effect of the breed and caponisation on the analysed traits. One-way analysis of variance was only used in the case of the assessment of the fatty acid profile in the abdominal fat, where the effect of the breed was examined (Model 2). Statistical SAS software was applied (version 9.4 SAS Institute Inc. Cary, NC). The following models were used:

Model 1:

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk}$$

where: y_{ijk} - k^{th}observation from the $i^{th}$and j^{th} groups, μ – mean value of the trait in the population, α_i – effect of the i^{th} group, β_j – effect of the j^{th} group, e_{ijk} - error = effect related to individual variability and measurement error, $(\alpha\beta)_{ij}$ – effect of the interactions between the factors.

Model 2:

$$y_{ijk} = \mu + \alpha_i + e_{ijk}$$

gdzie: y_{ijk} - k^{th}observation from the $i^{th}$and j^{th} groups, μ – mean value of the trait in the population, α_i – effect of the i^{th} group, e_{ijk} - error = effect related to individual variability and measurement error.

RESULTS

Growth performance

The caponisation procedure induced changes in the appearance and behaviour of the capons in both breeds. The capon cocks became less aggressive and quieter, they stopped crowing, and their combs and wattles were light yellow.

No differences in the body weight were found between the capons and non-caponised cocks in the Zk breed before 18 weeks of age (Table 2). At 10 weeks of age, the Pb capons had lower body weight than the cocks. Between 18 and 24 weeks of age, the Zk capons were significantly heavier than the cocks. In the Pb group, significantly higher body weight of the capons than that of the cocks was noted at 24 weeks of age.

After caponisation (week 8-10), a lower weight gain was noted in the capon groups (Table 2). In the subsequent rearing periods, there was a reverse tendency in favour of the capons. Between weeks 18-20 and 22-24, significantly higher weight gains were noted in the capons than in the cocks in both breeds. At weeks 20-22, the Pb and Zk cocks achieved the lowest and the highest weight gains, respectively, and the difference between them reached 410%. The body weight of the Zk cocks declined between week 18 and 20, while the Pb cocks exhibited the lowest weight gain between week 20 and 22, which may have been associated with establishment of a hierarchy in the flocks of the sexually maturing males. The aim of the study was not the observation of birds' behaviour, however during routine controls of all the groups, increased aggression against each other was noted in the groups of roosters, who were fully hormonally active, while no aversive behaviour in capons was observed, irrespective of the breed. During the last 2 weeks prior to the slaughter, the highest weight gain values were noted in the Pb capons and the lowest in the intact Zk cocks. The mean daily weight gain over the rearing period (weeks 8-24) was higher in the capons of both breeds than in the non-caponised cocks, with significant differences noted only in the Zk group.

Table 2 – Average body weight and weight gains of capons and cocks in respective breeding periods.

Age (weeks)	Zk($\bar{x}$)		Pb ($\bar{x}$)		SEM	Influence of		
	Capons	Cocks	Capons	Cocks		Breed	Caponization	Interaction breed x caponization
Body weight (g)								
8*	652.8	613.0	628.3	616.3	5.67	0.349	-	-
10	861.4^{a}	884.3^{a}	782.9^{b}	859.9^{a}	8.10	<0.001	0.001	0.078
12	1122.4^{ab}	1142.2^{a}	1049.6^{b}	1108.9^{ab}	9.97	0.007	0.044	0.314
14	1338.0^{ab}	1359.1^{a}	1267.1^{b}	1325.3^{ab}	10.60	0.013	0.059	0.374
16	1532.8	1534.4	1461.9	1514.5	10.88	0.038	0.214	0.241
18	1728.2	1689.6	1687.1	1732.3	12.13	0.973	0.893	0.089
20	1856.0^{a}	1670.3^{b}	1819.0^{a}	1810.8^{a}	14.28	0.052	<0.001	0.001
22	1915.7^{a}	1787.2^{b}	1896.3^{a}	1833.6^{ab}	13.68	0.611	<0.001	0.217
24	2056.5^{a}	1841.6^{b}	2097.1^{a}	1927.9^{b}	16.35	0.026	<0.001	0.419
Weight gain (g)								
8-10	218.2^{b}	271.3^{a}	156.2^{c}	251.6^{ab}	5.57	<0.001	<0.001	0.015
10-12	257.1	263.7	262.8	248.9	3.69	0.547	0.627	0.173
12-14	216.8	215.6	217.5	203.0	3.84	0.442	0.396	0.316
14-16	194.8	175.3	194.8	189.1	4.37	0.433	0.153	0.433
16-18	195.4^{a}	155.2^{b}	225.2^{a}	217.9^{a}	5.12	<0.001	0.012	0.078
18-20	127.8^{a}	-19.3^{c}	131.9^{a}	78.4^{b}	7.36	<0.001	<0.001	<0.001
20-22	63.6^{b}	116.9^{a}	81.8^{b}	22.9^{c}	5.60	<0.001	0.774	<0.001
22-24	140.8^{b}	59.6^{c}	200.7^{a}	106.2^{b}	6.89	<0.001	<0.001	0.536
Average daily gain overall								
8 - 24 week	12.68^{a}±0.41	11.13^{b}±0.34	13.15^{a}±0.38	11.82^{ab}±0.40		0.133	<0.001	0.769

SEM - standard error of the means.

*-weight before caponization.

$^{a, b, c}$- mean values in rows with different letters differ significantly at $p<0.05$ (Tukey test).

During weeks 12-14, the highest feed intake was observed in the non-caponised Pb cocks, in comparison with the other groups (Table 3). This was similar between weeks 16 and 18; in turn, between 18 and 20 weeks of rearing, the non-caponised Zk cocks exhibited the lowest feed intake rates. In the last period

Table 3 – Average daily feed intake (g) per birds of capons and cocks in respective breeding periods.

Age (weeks)	Zk (x̄)		Pb (x̄)		SEM	Influence of		
	Capons	Cocks	Capons	Cocks		Breed	Caponization	Interaction breed x caponization
10-12	84.3	86.9	82.6	91.2	3.49	0.696	0.114	0.396
12-14	92.9^{b}	94.1^{b}	88.6^{b}	111.4^{a}	3.51	0.068	0.001	0.003
14-16	101.3	100.2	97.9	98.5	1.98	0.207	0.872	0.685
16-18	108.0^{ab}	94.0^{b}	104.0^{b}	120.7^{a}	3.63	0.003	0.721	<0.001
18-20	104.4^{a}	79.5^{b}	104.3^{a}	109.9^{a}	3.68	<0.001	0.011	<0.001
20-22	117.0	110.6	115.5	120.7	3.07	0.166	0.845	0.065
22-24	94.2^{c}	105.2^{bc}	112.5^{b}	127.7^{a}	3.36	<0.001	<0.001	0.535

SEM - standard error of the means.

$^{a, b, c}$ - mean values in rows with different letters differ significantly at $p<0.05$ (Tukey test).

of rearing (week 22-24), the Zk capons consumed significantly lower amounts of feed, i.e. by 19.4% and 35.6%, than the Pb capons and cocks, respectively.

Slaughter analysis of carcasses and organ weight

Significantly higher values of skin with subcutaneous fat were observed in the capons of both breeds than in the non-caponised cocks (Table 4). The slaughter analysis revealed that the capons were heavier than the cocks within the same breed, but the difference was statistically significant only in the Pb breed (Table 4). Caponisation did not have an impact on chilled carcass weight. Consequently, the cocks within the breeds were characterised by a higher dressing percentage than that of the capons, and this correlation was confirmed in the Zk breed. The caponisation surgery contributed to reduction of the weight and share of

Table 4 – Slaughter characteristics of capons and cocks at 24 weeks of age.

Item	Zk(x̄)		Pb (x̄)		SEM	Influence of		
	Capons	Cocks	Capons	Cocks		Breed	Caponization	Interaction breed x caponization
BW (g)	1956^{ab}	1748^{b}	2062^{a}	1824^{b}	52.68	0.092	<0.001	0.773
Weight carcasses chilled (g)	1349.1	1266.2	1400.5	1275.1	42.08	0.478	0.018	0.617
Dressing percent (g/100 g BW)	68.99^{b}	72.43^{a}	67.72^{b}	69.97^{ab}	0.657	0.008	<0.001	0.367
Percentage of carcass parts in body weight								
Liver	1.43	1.34	1.54	1.52	0.056	0.014	0.361	0.567
Gizzard	1.54	1.42	1.61	1.67	0.085	0.076	0.721	0.289
Heart	0.37^{b}	0.50^{a}	0.40^{b}	0.56^{a}	0.019	0.024	<0.001	0.581
Abdominal fat	3.09^{a}	0.00^{b}	3.96^{a}	0.00^{b}	0.321	0.025	<0.001	0.709
Breast meat	17.8^{a}	15.1^{b}	16.6^{ab}	14.7^{b}	0.494	<0.001	0.107	0.396
Leg meat	21.8^{b}	23.7^{a}	22.0^{ab}	23.3^{ab}	0.455	0.764	0.001	0.477
Leg bones	5.10^{b}	5.81^{a}	5.02^{b}	5.44^{ab}	0.138	0.112	<0.001	0.313
Total muscles	39.6^{ab}	40.3^{a}	37.0^{b}	37.9^{ab}	0.712	0.001	0.272	0.893
Skin with subcutaneous fat	15.5	15.1	15.6	15.0	0.453	0.123	0.534	0.258
Weight edible offal (g)								
Liver	27.9^{a}	23.5^{b}	31.5^{a}	27.6^{a}	0.989	<0.001	<0.001	0.802
Gizzard	30.3^{ab}	24.8^{b}	32.8^{a}	30.4^{ab}	1.666	0.020	0.023	0.359
Heart	7.2^{b}	8.8^{ab}	8.2^{b}	10.2^{a}	0.416	0.007	<0.001	0.634
Weight parts of the carcass (g)								
Skin with subcutaneous fat	209.2^{a}	196.9^{b}	218.3^{a}	195.2^{b}	7.246	0.055	0.004	0.425
Abdominal fat	42.0^{a}	0.0^{b}	56.4^{a}	0.00^{b}	4.514	0.015	<0.001	0.525
Breast meat	240.7^{a}	209.5^{ab}	210.1^{ab}	187.0^{b}	8.902	0.005	0.004	0.652
Thigh meat	161.8	169.0	168.4	160.2	6.144	0.859	0.936	0.218
Drumsticks meat	132.4	131.6	138.4	136.2	4.747	0.272	0.754	0.884
Femur bones	29.0	31.2	29.2	27.8	0.989	0.115	0.689	0.077
Tibia bones	39.8	42.2	40.6	41.4	1.333	1.000	0.238	0.552
Total meat	534.9	510.1	516.9	483.4	17.17	0.201	0.098	0.801

SEM - standard error of the means; Data are means of 20 birds (10 birds from each pen) per treatment.

$^{a, b}$-mean values in rows with different letters differ significantly at $p<0.05$.

the heart and to an increase in the weight and share of abdominal fat in the carcasses of both breeds ($p \leq 0.05$). The lowest weight of the liver and stomach was noted in the Zk cocks. The Zk capons were characterised by a higher ($p \leq 0.05$) share and weight of breast muscles, while the cocks of this breed exhibited the highest share of leg muscles. A higher share of bones was noted in the non-caponised Zk cocks, i.e. by 13.9% and 15.7% in comparison with the capons of both breeds, respectively.

Chemical composition and fatty acid profile in muscles and abdominal fat

Caponisation had an effect on the chemical composition of breast and thigh muscles in both breeds. In comparison with the other groups, the lowest dry matter and crude protein contents in breast muscles and crude fat in thigh muscles were determined in the non-caponised Zk cocks (Table 5). A significantly higher level of crude ash (by 5.5%) was found in the breast muscles of the Zk capons, in comparison with the cocks of this breed. The content of crude fat in the breast muscles of the Zk cocks was by 152.5% and 165% lower ($p \leq 0.05$) than that in the capons of this breed and non-caponised Pb cocks, respectively. In turn, significantly lower dry matter content was noted in the thigh muscles of the non-caponised Zk cocks than in the capons of this breed and Pb cocks.

At 24 weeks of age, higher contents of $PUFA_{n-3}$ and linolenic acid $C_{18:3}$ were noted in the breast muscles

Table 5 – Chemical composition (%) of the breast and thigh muscles of capons and cocks at 24 weeks of age.

Feature	Zk ($\bar{x}$)		Pb ($\bar{x}$)		SEM	Influence of		
	Capons	Cocks	Capons	Cocks		Breed	Caponization	Interaction breed x caponization Rasa x stan
Breast muscles								
Dry matter	26.5^{a}	25.3^{b}	26.8^{a}	26.9^{a}	0.163	<0.001	0.001	<0.001
Crude ash	1.14^{a}	1.081^{b}	1.096^{ab}	1.093^{ab}	0.013	0.291	0.03	0.051
Crude protein	24.46^{a}	23.69^{b}	24.78^{a}	24.67^{a}	0.114	<0.001	<0.001	0.006
Crude fat	1.01^{a}	0.40^{b}	0.84^{ab}	1.06^{a}	0.114	0.039	0.097	<0.001
Thigh muscles								
Dry matter	25.9^{a}	23.6^{b}	25.1^{ab}	25.8^{a}	0.413	0.116	0.065	<0.001
Crude ash	1.042	1.035	1.054	1.038	0.012	0.524	0.33	0.701
Crude protein	21.2	21.3	21.1	21.3	0.180	0.785	0.461	0.98
Crude fat	3.71^{a}	1.29^{b}	3.01^{a}	3.76^{a}	0.415	0.039	0.049	<0.001

SEM - standard error of the means; Data are means of 20 birds (10 birds from each pen) per treatment.

$^{a, b}$ mean values in rows with different letters differ significantly at $p<0.05$.

of the Zk and Pb capons and a higher *n-6/n-3* ratio was calculated for the cocks of both breeds (Table 6). Furthermore, there was an increase in the total content of saturated fatty acids (SFA) in the Pb breed (cocks and capons), in comparison with the Zk breed. A similar tendency was observed for lauric ($C_{12:0}$) and palmitic ($C_{16:0}$) acids. Anapprox. 19% higher level of pentadecanoic acid ($C_{15:0}$) was found in the Zk capons, in comparison with the Zk and Pb cocks. In turn, the content of myristic acid ($C_{14:0}$) in the breast muscles of the Pb capons was significantly higher, i.e. by 30.1% and 40.0%, respectively, than that in the muscles of the Zk capons and cocks. This difference between the cocks of both breeds reached 28.6%. Regardless of the caponisation procedure, a higher AI value in the breast muscle was noted in the Pb breed, and a higher h/H ratio was obtained for the Zk breed (Table 7). There was a statistically significant difference (21.3%) in the TI values for the breast muscles between the Zk capons and Pb cocks.

There was an impact of caponisation ($p \leq 0.05$) on the total content of monounsaturated fatty acids (MUFA) in the thigh muscles (Table 6). A significant increase in the content of oleic acid ($C_{18:1}$) was observed in the capons of both breeds. The caponisation procedure contributed to a reduced level of polyunsaturated fatty acids PUFA and $PUFA_{n-3}$ as well as a lower *n-6/n-3* ratio in the Pb capons, in comparison with the Zk cocks. A significant decrease in the content of eicosadienoic ($C_{20:2}$) and arachidoneic ($C_{20:4}$) acids was observed in the capons of both breeds, in comparison with the level noted in the cock groups. The AI ratio in the Zk cocks was by 29.4 % and 21.9% lower ($P \leq 0.05$) than that in the caponised and non-caponised Pb birds, respectively. In turn, the h/H ratio in the Zk cocks was significantly higher than in the other experimental groups (Table 7). Caponisation of the Pb cocks had a significant effect on the total content of saturated fatty acids (SFA), in comparison with the non-caponised Zk birds.

Table 6 – Fatty acid profile of breast and thigh muscles samples (g/100 g of total fatty acids) of capons and cocks at 24 weeks of age.

Item	Zk (x̄)		Pb (x̄)		SEM	Influence of		
	Capons	Cocks	Capons	Cocks		Breed	Caponization	Interaction breed x caponization
Fatty acids % ether extract								
Breast muscles								
12:0	0.138^{b}	0.091^{c}	0.205^{a}	0.182^{a}	0.009	<0.001	<0.001	0.179
14:0	0.594^{bc}	0.552^{c}	0.773^{a}	0.710^{ab}	0.032	<0.001	0.115	0.748
15:0	0.116^{a}	0.094^{b}	0.110^{ab}	0.094^{b}	0.005	0.536	<0.001	0.536
16:0	20.14^{c}	18.40^{d}	25.06^{a}	22.35^{b}	0.281	<0.001	<0.001	0.096
17:0	0.240	0.235	0.209	0.214	0.010	0.017	1.000	0.635
18:0	9.41	10.92	9.62	10.65	0.521	0.948	0.019	0.651
20:0	0.161	0.131	0.129	0.135	0.014	0.339	0.412	0.221
∑ SFA	30.85^{c}	30.48^{c}	36.19^{a}	34.39^{b}	0.442	<0.001	0.019	0.113
14:1 *n-5*	0.038^{b}	0.047^{b}	0.087^{a}	0.043^{b}	0.008	0.006	0.031	0.002
16:1 *n-7*	0.287	0.268	0.281	0.262	0.009	0.546	0.061	1.000
17:1	0.033	0.043	0.041	0.032	0.006	0.795	0.931	0.107
18:1 *n-9*	30.20	26.79	30.50	29.37	1.184	0.231	0.063	0.343
20:1 *n-9*	0.471	0.439	0.402	0.387	0.022	0.01	0.299	0.705
∑ MUFA	32.92	29.83	33.15	32.03	1.179	0.307	0.083	0.409
18:2 *n-6*	26.82	23.47	24.84	23.63	0.851	0.293	0.011	0.215
20:2 *n-6*	0.263	0.267	2.10	0.253	0.939	0.338	0.333	0.331
20:4 *n-6*	2.103	2.406	1.834	2.289	0.171	0.267	0.033	0.659
18:3 *n-3*	0.909^{a}	0.634^{b}	0.937^{a}	0.642^{b}	0.062	0.773	<0.001	0.873
∑ PUFA	30.13	26.80	29.74	26.85	1.442	0.907	0.038	0.883
∑ UFA	63.04	56.63	62.89	58.88	1.962	0.595	0.012	0.546
∑ $PUFA_{n-3}$	0.909^{a}	0.634^{b}	0.937^{a}	0.642^{b}	0.062	0.773	<.0001	0.873
∑ $PUFA_{n-6}$	29.18	26.14	28.77	26.17	1.413	0.895	0.053	0.876
Thigh muscles								
12:0	0.165^{b}	0.166^{b}	0.209^{a}	0.217^{a}	0.008	<0.001	0.599	0.683
14:0	0.667^{b}	0.550^{b}	0.885^{a}	0.853^{a}	0.036	<0.001	0.046	0.247
15:0	0.082	0.095	0.102	0.101	0.007	0.061	0.378	0.305
16:0	22.62^{a}	18.15^{b}	23.96^{a}	21.67^{a}	0.873	0.009	<0.001	0.221
17:0	0.159^{ab}	0.188^{a}	0.128^{c}	0.144^{ab}	0.012	0.004	0.074	0.598
18:0	8.251^{ab}	9.899^{a}	8.151^{b}	9.147^{ab}	0.419	0.316	0.003	0.442
20:0	0.131^{bc}	0.212^{a}	0.097^{c}	0.181^{ab}	0.014	0.028	<0.001	0.917
∑ SFA	32.25^{ab}	29.39^{b}	33.69^{a}	32.47^{ab}	1.021	0.033	0.053	0.428
14:1 *n-5*	0.089^{ab}	0.078^{b}	0.111^{a}	0.111^{a}	0.007	<0.001	0.447	0.447
16:1 *n-7*	3.14^{b}	2.38^{c}	4.28^{a}	3.57^{b}	0.15	<0.001	<0.001	0.856
17:1	0.051	0.046	0.045	0.047	0.004	0.568	0.732	0.426
18:1 *n-9*	34.31^{a}	28.87^{b}	34.61^{a}	29.54^{b}	0.861	0.58	<0.001	0.835
20:1 *n-9*	0.305	0.362	0.332	0.316	0.026	0.712	0.427	0.161
∑ MUFA	39.93^{a}	33.70^{b}	41.18^{a}	35.37^{b}	0.894	0.112	<0.001	0.816
18:2 *n-6*	23.72	25.73	22.63	25.63	1.078	0.585	0.026	0.652
20:2*n-6*	0.064^{b}	0.136^{a}	0.063^{b}	0.132^{a}	0.011	0.814	<0.001	0.888
20:4*n-6*	1.701^{b}	3.398^{a}	1.703^{b}	2.685^{a}	0.222	0.118	<0.001	0.116
18:3*n-3*	0.877	0.785	0.933	0.902	0.069	0.215	0.376	0.659
∑ PUFA	26.40^{ab}	30.10^{a}	25.36^{b}	29.39^{ab}	1.156	0.455	0.002	0.888
∑ UFA	66.33	63.80	66.54	64.76	1.398	0.679	0.131	0.79
∑ $PUFA_{n-3}$	0.877	0.785	0.933	0.902	0.069	0.215	0.376	0.659
∑ $PUFA_{n-6}$	25.48^{ab}	29.27^{a}	24.40^{b}	28.45^{ab}	1.147	0.412	0.002	0.909

SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; UFA – unsaturated fatty acids; SEM - standard error of the means; Data are means of 20 birds (10 birds from each pen) per treatment.

$^{a, b, c}$- mean values in rows with different letters differ significantly at $p<0.05$.

Table 7 – Fatty acid indices in breast and thigh meat of capons and cocks at 24 weeks of age.

Item	Zk ($\bar{x}$)		Pb ($\bar{x}$)		SEM	Influence of		
	Capons	Roosters	Capons	Roosters		Breed	Caponization	Interaction breed x caponization
Breast								
∑ PUFA/SFA	0.978^{a}	0.885^{ab}	0.825^{ab}	0.783^{b}	0.047	0.011	0.161	0.596
n-6/n-3[1]	34.23^{ab}	43.31^{a}	31.20^{b}	41.60^{a}	2.471	0.344	<0.001	0.792
AI[2]	0.360^{b}	0.372^{b}	0.456^{a}	0.432^{a}	0.013	<0.001	0.652	0.165
TI[3]	0.899^{b}	1.028^{ab}	1.060^{ab}	1.091^{a}	0.045	0.018	0.083	0.284
h/H[4]	2.893^{a}	2.804^{a}	2.253^{b}	2.429^{b}	0.069	<0.001	0.529	0.061
Thigh								
∑ PUFA/SFA	0.841^{b}	1.023^{a}	0.756^{b}	0.907^{ab}	0.045	0.030	<0.001	0.727
n-6/n-3[1]	31.07^{ab}	39.50^{a}	27.16^{b}	33.36^{ab}	2.964	0.099	0.018	0.708
AI[2]	0.386^{ab}	0.323^{b}	0.418^{a}	0.394^{a}	0.017	0.005	0.015	0.256
TI[3]	0.898	0.846	0.929	0.920	0.036	0.154	0.401	0.546
h/H[4]	2.690^{b}	3.194^{a}	2.422^{b}	2.623^{b}	0.127	0.002	0.009	0.241

SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; UFA – unsaturated fatty acids; SEM - standard error of the means; Data are means of 20 birds (10 birds from each pen) per treatment.

$^{a, b}$- mean values in rows with different letters differ significantly at $p<0.05$.

[1] - n-6/n-3 is in the PUFA n-6/PUFA n-3 ratio.

[2] – AI - Atherogenic Index.

[3] – TI - Thrombogenic Index

[4] – h/H - Hypocholesterolemic/hypercholesterolemic ratio.

However, higher ($P \leq 0.05$) levels of lauric ($C_{12:0}$) and myristic ($C_{14:0}$) acids were noted in the thigh muscles of the Pb cocks (caponised and non-caponised), in comparison with the Zk groups. In turn, the content of margaric ($C_{17:0}$), stearic ($C_{18:0}$), and arachidic ($C_{20:0}$) acids was significantly lower in the Pb capons in comparison with the Zk cocks.

Higher ($P \leq 0.05$) levels of saturated fatty acids, i.e. pentadecanoic ($C_{15:0}$), palmitic ($C_{16:0}$), margaric ($C_{17:0}$), and stearic ($C_{18:0}$) acids, were noted in the abdominal fat of the Pb capons, in comparison with that in the Zk capons (Table 8). Compared with the Zk capons, the abdominal fat of the caponised Pb cocks was characterised by a higher level of eicosadienoic and linolenic acids and lower content of oleic acid. The caponised Pb cocks exhibited a significantly higher proportion of SFA in the total content of fatty acids, which was by 11.9% higher than that in the Zk capons. In turn, the proportion of MUFA and UFA in the total fatty acids in the Zk capons was by 4.8% and 2.19% higher, respectively, in comparison with the Pb capons. The latter birds, compared with the Zk capons, exhibited significantly higher (by ca. 20%) levels of $PUFA_{n-3}$ by 12.8% and 13.1% and higher values of AI and TI, respectively. In turn, higher ($p \leq 0.05$) PUFA/SFA and *n-6/n-3* ratios and a 10.3% higher h/H ratio were calculated for the abdominal fat of the Zk capons, in comparison with the Pb caponised cocks.

DISCUSSION

The results of the present study show that the caponisation surgery had a significant effect on the final body weight of the birds. At week 24 of the experiment, the capons of both breeds exhibited higher body weight, i.e. by 215 g in Zk and by 169 g in Pb, in comparison with the weight of the non-caponised cocks. It was found that the lower mobility of the caponised birds resulted in an increase in the body weight, in particular from week 20 of rearing. It should be noted that, immediately after caponisation, the Pb capons had lower body weight than the Pb cocks (week 10, 12, 14), which was not observed in the Zk capons. This may have been related to the postoperative stress induced by the caponisation surgery. In the subsequent periods of rearing, the caponised cocks exhibited greater weight gains and reached higher body weight than the non-caponised birds on day 168. Furthermore, in the period between the caponisation surgery and week 24, there was a tendency towards higher feed intake in the Zk cocks than in the Zk capons, whereas a reverse trend was noted in the case of the Pb birds.

Many studies have demonstrated ambiguous effects of caponisation on birds' growth, and the results of such investigations are contradictory (Miguel *et al.*, 2008; Shao *et al.*, 2009; Symeon *et al.*, 2010). It can therefore be assumed that the impact of caponisation on body weight depends on many factors, e.g. age at

Table 8 – Fatty acid profile of abdominal fat samples (g/100g of total fatty acids) of capons at 24 weeks of age.

Item	Capons*		SEM	*p*-value
	Zk ($\bar{x}$)	Pb ($\bar{x}$)		
Fatty acids % ether extract				
12:0	0.251	0.250	0.0056	0.884
14:0	0.738	0.773	0.0071	0.094
15:0	0.087[b]	0.097[a]	0.0026	0.022
16:0	22.0[b]	24.1[a]	0.1515	<0.001
17:0	0.09[b]	0.13[a]	0.0039	<0.001
18:0	5.93[b]	7.26[a]	0.1357	<0.001
20:0	0.068	0.070	0.0025	0.548
∑ SFA	29.3[b]	32.8[a]	0.2271	<0.001
14:1*n-5*	0.13	0.15	0.0025	0.188
18:1*n-9*	38.4[a]	36.6[b]	0.1357	0.001
20:1*n-9*	0.062	0.064	0.0025	0.641
∑ MUFA	40.3[a]	38.4[b]	0.3123	0.001
$18:2_{n-6}$	22.6	22.9	0.2463	0.332
$20:2_{n-6}$	0.147[b]	0.158[a]	0.0037	0.038
$20:4_{n-6}$	0.106	0.110	0.0022	0.331
$18:3_{n-3}$	0.80[b]	0.96[a]	0.0085	<0.001
∑ PUFA	23.7	24.1	0.2409	0.127
Calculated analysis				
∑ UFA	63.9[a]	62.5[b]	0.47027	0.031
$\sum PUFA_{n-3}$	0.80[b]	0.96[a]	0.00849	<0.001
$\sum PUFA_{n-6}$	22.9	23.2	0.24438	0.309
∑ PUFA/SFA	0.81[a]	0.74[b]	0.00915	<0.001
n-6/n-3[1]	28.6[a]	24.3[b]	0.51589	<0.001
AI[2]	0.39[b]	0.44[a]	0.00376	<0.001
TI[3]	0.84[b]	0.95[a]	0.00828	<0.001
h/H[4]	2.72[a]	2.44[b]	0.02705	<0.001

SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; UFA – unsaturated fatty acids; SEM - standard error of the means; *P* - level of significance; Data are means of 20 birds (10 birds from each pen) per treatment.

[a, b]- mean values in rows with different letters differ significantly at $p<0.05$.

[1]- *n-6/n-3* is in the PUFA *n-6*/PUFA *n-3* ratio.

[2]–AI - Atherogenic Index.

[3]–TI - Thrombogenic Index.

[4]–h/H - Hypocholesterolemic/hypercholesterolemic ratio.

*The fatty acid composition is shown only in the capons, as there is no abdominal fat in cock carcass (Table 4).

caponisation, age at slaughter, breed, susceptibility to stress, and interactions between the factors.

In principle, reduced locomotor activity of caponised birds contributes to a higher feed conversion rate, which is associated with greater body weight gains and deposition of abdominal and intramuscular fat, leading to improved quality of meat (Jacob & Mather, 2000). Lower dressing percentage values were noted in the capons of both breeds in comparison with the Zk cocks. There are divergent results concerning the dressing percentage presented in various studies (Miguel *et al.*, 2008; Symeon *et al.*, 2012; Guo *et al.*, 2015), which is probably related to the differences between breeds used for caponisation. In the present study, we report an effect of caponisation on the weight gain and share of breast muscles in the Zk capons, which is in agreement with results of previous studies of this breed (Calik *et al.*, 2015; Kwiecień *et al.*, 2015).

Caponised birds have greater weight of internal organs, in particular that of the liver, as indicated in this study, as well as the stomach and intestines (Calik *et al.* 2015). A reverse tendency was reported by Miguel *et al*. (2008) and Symeon *et al.* (2012). The significant difference in the liver weight may result from the fact that this organ is the primary site of *de novo* synthesis of fatty acids in birds, and liver increment in heavy breeds is caused by enhanced lipogenesis processes (Chen *et al.*, 2007). The caponisation procedure resulted in an increase in the weight and share of abdominal fat, which may have been caused by the reduction of the testosterone level; this led to enhancement of lipogenesis processes and accumulation of fat in the organism (Chen *et al.*, 2005). The level of testosterone is negatively correlated with adiposity (Chen *et al.*, 2006). The increase in the amount of fat tissue and intramuscular fat, which is dependent on the capons' breed and age at slaughter, improves the flavour values of meat (Chen *et al.,* 2006; Sinanoglou *et al.*, 2011; Volk *et al.*, 2011). This is important to consumers, who seek products that are more attractive than the common poultry foods.

The quality and chemical composition of poultry meat produced in an intensive breeding system depends largely on the genotype (Sirri *et al.*, 2010), but also on the locomotor activity, possibility of feeding, and age at slaughter (Bogosavljević-Bošković *et al.*, 2010). An important parameter influencing the quality of meat is the farming system (Meluzzi *et al.*, 2009). As suggested by Bancos (2010), organic production, which can contribute to the improvement of the sensory properties of meat, is a better alternative to intensive farming. The protein content in the breast and thigh muscles of the capons and non-caponised cocks of both breeds was similar to that reported by other authors (Sirri *et al.*, 2011). There were differences in the content of dry matter and total protein in the breast muscles, i.e. the capons of both breeds were characterised by a higher percentage content of these nutrients than the Zk cocks but did not differ in the levels of these components from the Pb cocks. A similar tendency was observed for the crude fat content in the thigh muscles, whereas higher amounts of this

component were found in the breast muscles of the Zk capons and Pb cocks, in comparison with the Zk cocks. Previous studies (Kwiecień *et al.*, 2015) demonstrated significantly higher fat contents in Zk capons than in cocks of this breed. Similarly, Sirri *et al.* (2009) showed lower levels on adiposity of breast muscles in cocks, compared with capons. Volk *et al.* (2011) reported greater amounts of abdominal fat in layer-type Slovenian hybrid Prelux-G cockerels caponised at 52 days of age and slaughtered on day 185. Studies conducted by Chen *et al.* (2007) and Calik *et al.* (2015) demonstrated a tendency towards higher fat content especially in leg muscles (Calik *et al.,* 2015).

Great importance in fat deposition is attributed to birds' age and hormonal status; greater amounts of fat are found in the muscles of hens and caponised cocks (Sirri *et al.,* 2009). The share of intramuscular fat can also increase with age. Breast muscles of 9-week-old chickens were found to have relatively low levels of adiposity (Marcinkowska-Lesiak *et al.,* 2013), whereas a considerably higher share of fat was detected in birds slaughtered at a later age (Eleroğlu *et al.,* 2013). The higher muscle fat content improves the sensory parameters, i.e. meat flavour, juiciness, and tenderness (Miguel *et al.,* 2008), which makes the meat more attractive to consumers and connoisseurs.

The fatty acid composition of meat depends on the composition of the diet and exerts an impact on the meat sensory properties and, indirectly, on human health. Furthermore, the fatty acid composition is also influenced by the breed and age at caponisation (Miguel *et al.,* 2008; Sirri *et al.,* 2009). The difference in the fatty acid composition between breeds may be related to the different fat content in muscles (Kwiecień *et al.,* 2015). The meat of slow-growing chickens is nutritionally healthier, as it contains lower amounts of fat and has higher *n-3* PUFA content (Sirri *et al.,* 2011); therefore, it can be preferred by consumers seeking healthy, organic products. During production of Greenleg Partridge and Rhode Island Red chickens, an increase in PUFA (both *n-3* and *n-6*) has been observed (Puchała *et al.,* 2015).

The present investigations indicate that linolenic acid was the major acid in the breast muscles of the capons although there were no statistical differences. This acid generally predominates in the meat of birds fed diets supplemented with sunflower oil (Crespo & Esteve-Garcia, 2001). Higher SFA content was detected in the Pb capons. Additionally, it was significantly higher in the breast muscles of the Zk capons than in the Pb cocks and lower in the thigh muscles of the capons of both breeds than in the Zk cocks. The greatest quantities of $C_{18:2}$, $C_{18:1}$, $C_{16:0}$, $C_{18:0}$, and $C_{20:4}$ acids were shown to be present in both

the breast and thigh muscles. In the thigh muscles, significantly higher content of $C_{18:1}$ was detected in the capons of both breeds, whereas a reverse tendency was noted in the case of $C_{20:4}$. The present study showed higher levels of MUFA in the Zk and Pb capons, which is advantageous for human health, as these acids improve resistance of the plasma LDL fractions to any changes caused by oxidation and reduce their atherogenic effects (Kris-Etherton *et al.,* 1988). In both muscles of the Pb capons, there was a lower *n-6/n-3* ratio, which is more favourable for health (Simopoulos, 2009). In turn, lower levels of $C_{20:4}$ synthesised from linoleic acid were detected in the abdominal fat of the capons, compared with its content in the intramuscular fat. This indicates that the capons and intact males probably synthesized arachidonic acid and deposited a lower percentage thereof in the lipid-rich tissues (abdominal fat) than in the meat. This difference was attributed to the inhibition of Δ^6-desaturase by caponisation.

Meat is the primary source of fat, in particular dietary SFAs, which plays an important role in lifestyle diseases, e.g. cancer, and cardiovascular diseases (Simopoulos, 2009). The recommended PUFA to SFA ratio is 0.45-0.65. There are continuous attempts to develop methods for the production of "healthy" meat, i.e. characterised by a higher PUFA:SFA ratio and a beneficial balance between n-6 and n-3 PUFA (Wood *et al.*, 2004). In the present study, the PUFA/SFA ratio was higher than the value reported by Wood *et al.* (2004).

The calculated AI and TI indicate the extent to which components of the human diet containing fatty acids can contribute to an increased incidence of coronary heart disease and atherosclerosis (Turan *et al.,* 2007). The lower the value, the lower the probability of development of atherosclerosis and formation of blood clots (Donovan *et al.,* 2000). In the present study, significantly higher AI values were observed in the fat from the breast and thigh muscles in the Pb breed (capons and non-caponised cocks). In turn, the TI value in the fat from the breast muscles was significantly lower in the Zk capons than in the Pb cocks. Sex hormones have an effect on the Δ^6-desaturase activity; these processes are highly complicated and necessitate further research to elucidate the interactions between sex hormones, breeds, and nutrition.

CONCLUSIONS

The present study indicates that caponisation of the Pb cocks has a beneficial effect on the final body weight, feed intake, and slaughter characteristics. Moreover, in the breast muscles of the Pb capons, there was a tendency towards a higher total share of PUFA and MUFA as well as significantly higher contents of *n-3*PUFA and a lower ($p \leq 0.05$) *n-6*/*n-3* ratio, which is advantageous from the consumer's point of view.

Based on the results of production performance, slaughter analysis, and chemical composition of the muscles, it can be concluded that the two breeds are a good material for production of capons. From the nutritional point of view, the meat of both breeds of the capons has a beneficial PUFA/SFA ratio, which is higher than the recommended value, high *n-3* PUFA and MUFA content, and an advantageous *n-6*/*n-3* ratio. Consumption of Zk capon meat seems to ensure a number of pro-health benefits due to the lower values of the atherogenic and thrombogenic indices and the higher h/H ratio in breast muscles, in comparison with the Pb capons. Nevertheless, these results should be corroborated in further research, which may offer new perspectives for production of birds with a fatty acid composition in meat that is favourable for consumers.

CONFLICT OF INTEREST

There are no known conflicts. Financial support for this work does no influence its outcome.

The manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. The order of authors listed in the manuscript has been approved by all authors.

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