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# Fatty acids profile of muscles and abdominal fat in geese of Polish native varieties*

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**The objective of the research was to determine and compare the cholesterol content and fatty acid (FA) profile of muscles and abdominal fat of 17 week-old geese of Polish, native breeds – Kartuska (KA, n=18) and Lubelska (LU, n=18) maintained at the Research Station of Waterfowl Genetic Resources in Dworzyska, belonging to the National Research Institute of Animal Production in Cracow. The geese were fed *ad libitum* during the experimental period on the same complete feed. Genotype affected the fatty acids profile as well as fat and cholesterol content of muscles and abdominal fat. The type of muscle (breast or thigh) also influenced the investigated parameters. Lipids of KA muscles were characterized by more favourable level of n-6/n-3 ratio than LU ones. Breast muscles compared to thigh muscles were lower in total fat and monounsaturated FA while higher in cholesterol, saturated and polyunsaturated n-3 fatty acids. The KA geese abdominal fat showed lower percentage of polyunsaturated fatty acids but had more favourable value of n-6/n-3 ratio than the LU ones. Cholesterol content in the KA geese abdominal fat was lower than in LU ones. Overall, the nutritional value of KA muscles lipids and fat tissues were higher in comparison to the LU geese.**

**KEY WORDS: abdominal fat / cholesterol / fat / fatty acids / geese meat**

Recent studies indicate that in the prevention of coronary diseases the quality of fat in the human diet is more important than its quantity. Nutritionists recommend the

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limitation of animal fats intake because of higher, compared to plant, lipids content of saturated fatty acids (SFAs) [Webb and O'Neill 2008]. In muscle lipids, among saturated and monounsaturated (MUFA) fatty acids, the largest contribution have C16:0 (palmitic acid), C18:0 (stearic acid) and C18:1 (oleic acid). The research has shown that C14:0 (myristic acid) and C16:0 raise total and low-density lipoprotein cholesterol in blood but C18:0 has not been shown to elevate blood cholesterol and is rapidly converted to C18:1 *in vivo*. Moreover, C18:1 is nutritionally important monounsaturated acid as it lowers low-density lipoprotein and total/high-density lipoprotein cholesterol ratio when replacing SFA. Polyunsaturated fatty acids (PUFA), especially n-3, are somewhat more effective than monounsaturates in this respect. The n-3 fatty acids or a balanced n-6/n-3 ratio in the diet are critical for normal growth and development and decrease the risk of cardiovascular disease and diabetes [WHO/FAO 2002, 2008, Poławska *et al*. 2011].

Geese fat is regarded to be relatively safe for consumers, as it contains a high proportion of C18:1 as well as C 18:2 (linoleic), C 18:3 (linolenic) and C 22:4 (arachidonic acid): about 40-50, 10-15, 0.5-1, and 0.4-1%, respectively, all being products of enzymatic desaturation of C18:0 [Wężyk *et al*. 2003, Gumułka *et al*. 2006, Okruszek *et al.* 2007].

Tradition of breeding geese in Poland dates back to the seventeenth century. After years of oblivion, consumption of geese meat is growing thanks to initiated since 2010 poultry meat promotion campaign. The one of the aims thereof was to promote Polish geese on the European countries markets as products with identifiable specific characteristics linked to their geographical origin, so products which meet the requirements of Regulation (EU) No 1151/2012 of the European Parliament and of the Council of 21 November 2012 on quality schemes for agricultural products and foodstuffs (OJ L343, 14.12.2012. page 1).

The Kartuska (KA) and Lubelska (LU) geese, which muscles and fat were the material in this paper are old Polish breeds included in the genetic resources conservation programme. These international unique, native populations of commercial birds come from northern (KA) and southern (LU) Poland and are very well adapted to environmental conditions of these regions. The geese of native breeds are characterized by very good health, resistance to adverse climatic conditions and good conversion of cheap, farm-produced feeds [Książkiewicz 2007]. They used open range so they are able to handle the rigors of outdoor production. The KA and LU geese plumage is mostly white, sometimes spotted. Their carcasses are well-muscled and low-fattened. The birds are characterized by good feed efficiency and due to good meat traits can be used to produce commercial hybrids with increased meatiness [Mazanowski 2002]. Moreover they are characterized by better musculature and lower carcass fatness compared to the White Koluda® geese, which comprises up to 90% of total commercial production [Biesiada-Drzazga *et al*. 2011, Haraf 2011, Okruszek 2011].

The geese of native breeds can serve as natural gene resource, e.g. for selection of improved qualitative traits of goose meat, which simultaneously would fulfill the requirements of an ecological product [Okruszek 2011, Wężyk *et al.* 2003].

There are no data published on fatty acid profile of lipids from muscles and abdominal fat of the KA and LU geese. The available data on the quality of the geese meat concern mainly the popular on the European market geese such as the Italian White or raised in Poland mainly for export the White Koluda® geese. That is why the main aim of the present investigation was to estimate and compare the fatty acid composition of breast and thigh muscles lipids and abdominal fat of two (KA and LU) indigenous Polish geese breeds. Additionally, total fat and cholesterol contents in muscles and abdominal fat were determined.

## Material and methods

### Animals, diets and experimental procedure

The study involved thirty six 17 week-old female geese of two indigenous breeds from two flocks: KA and LU – 18 birds from each flock. The KA and LU are maintained at the Research Station of Waterfowl Genetic Resources in Dworzyska (belonging to the National Research Institute of Animal Production in Cracow, Poland) as separate closed populations.

During the testing period geese were reared up to week 6 of age in a brooder house of controlled air temperature, and afterwards until week 17 of age they were kept in tightly enclosed yards (stocking density ≈ 0,75 – 0,85 per 1 $m^2$), covered with straw and partially roofed (with each flock being reared separately). The geese from both flocks were fed ad libitum on the same complete feeds – up to week 6 of age all-mash KBR-Z/1 and later from week 7 up to 17 all-mash KBR-Z/2 (Tab. 1).

Geese from each flock (n = 259 for KA and n = 229 for LU birds) were selected for investigations based on their body weight (BW) close to the arithmetic BW mean for a particular flock (KA ≈ 4445±290 g and LU ≈ 4125±200 g). Twelve hours before slaughter, birds were only allowed access to water. Birds were slaughtered by cervical dislocation in an experimental slaughterhouse, according to the relevant regulations applied in the Polish poultry industry. The carcasses were bled, scalded (approximately 1 min, at approximately 63°C), plucked, and eviscerated. The eviscerated carcasses were placed immediately into a 2 to 4°C cooler. After a 24-h chilling period the carcasses were jointed. Portions of breast (*pectoralis major*) and thigh (*biceps femoris*) muscles, without skin and subcutaneous fat, cut out from right side of the carcass as well as abdominal fat were vacuum packed and stored at -80°C until further chromatograph analysis. The total fat and cholesterol contents of breast and thigh muscles as well as abdominal fat were determined approximately 48 h post slaughter.

### Chemical analyses

Preliminarily grinded meat and abdominal fat tissues were homogenized in T 25 homogenizer (IKA ULTRA-TURRAX Corp.). Lipids extraction for cholesterol and fatty acids determination was carried out according to the procedure described by Folch *et al*. [1957]. The fatty acids composition of meat and abdominal fat were

**Table 1**. Diet composition

| Item | All-mash | |
|---|---|---|
| | KBR-Z/1 | KBR-Z/2 |
| Chemical composition (%/kg of all-mash) | | |
| Crude protein | 19.00 | 17.00 |
| Crude fat | 4.00 | 3.00 |
| Ash | 5.50 | 6.00 |
| Crude fibre | 3.50 | 5.00 |
| Lysine | 1.05 | 0.820 |
| Methionine | 0.49 | 0.46 |
| Calcium | 0.85 | 0.86 |
| Total phosphorus | 0.70 | 0.80 |
| Vit. A (IU/kg) | 15,000 | 14,000 |
| Vit. $D_3$ (IU/kg) | 3,500 | 2,000 |
| Vit. E (mg/kg) | 60 | 50 |
| Metabolizable energy (kcal/kg of all-mash)[1] | 2866 | 2699 |
| Fatty acid (% of a total fatty acids): | | |
| C 16:0 | 12.20 | 11.80 |
| C 16:1 cis-9 | 0.37 | 0.31 |
| C 18:0 | 5.60 | 4.95 |
| C 18:1 cis-9 | 29.40 | 32.20 |
| C 18:2 n-6 | 37.60 | 34.40 |
| C 18:3 n-3 | 2.58 | 4.26 |
| C 20:5 n-3 | 0.62 | 0.70 |
| C 22:6 n-3 | 0.54 | 0.62 |

[1]The caloric value of all-mashes as calculated on the basis of percentage of some analytical components of feed, expressed in megajoules ME per 1.0 kg of mixture, with a level of nitrogen adjusted by the following method (Journal of Laws No. 63, item 589 of 24 March 2004): MJ/kg of ME = 0.1551 × % CP + 0.3431 × % crude fat + 0.1669 × % starch + 0.1301 × % total sugar content (expressed as sucrose).

determined by Capillary Gas Chromatography technique. For the determination of fatty acids composition the lipid samples were converted to their corresponding methyl esters by AOCS official method Ce 2-66 [AOCS 1997]. The fatty acids methyl esters were quantified by gas chromatography method using a fused silica capillary column HP 88 J and W Scientific series – 100 m×0.25 mm×0.20 μm film thickness – (Agilent Tech. Inc., St. Clara, USA) and flame-ionization detector (FID) in Agilent Tech. 7890 A series gas chromatograph (Agilent Tech. Inc., St. Clara, USA) at injection volume of 1.0 μL and split ratio 1/50, respectively. Helium was used as the carrier gas at a head pressure of 2.0 mL/min constant flow. Air, hydrogen and helium make-up gas flow rates by FID detector were: 450, 40 and 30 mL/min., respectively. The detector and injector temperatures were chosen as 280°C and 250°C, respectively. The initial column temperature of 120°C was held for 1 min, increased to 175°C at 10°C/min and held for 10 min. Then, it was increased to 210°C at 5°C/min, held 5 min, and finally increased to 230°C at a rate of 5°C/min, and maintained for 5 min. Quantification of fatty acid methyl esters of muscles and abdominal fat lipids was carried out using nonadecanoic acid (C 19:0) as an internal standard. The peaks were identified by

comparing the retention times to those of a mixture of external standard methyl esters (Supelco 37 F.A.M.E. Mix C 4–C 24 Component). The fatty acids were calculated as percentage of a sum of fatty acids with the ChemStation Agilent Technologies program (Agilent Tech. Inc., St. Clara, USA).

Total lipid contents of muscles and abdominal fat were analysed and quantified according to Soxhlet procedure with the Soxtec System HT4 1045 (TECATOR, Höganäs, Sweden) [AOAC 1990].

Total cholesterol concentration in muscles was determined enzymatically using commercially available reagent kit (Human Gesellschaft für Biochemica und Diagnostica mbH, Wiesbaden, Germany). The saponification was carried out by the Rhee *et al.* [1982] method.

#### Statistical

The two-way analysis of variance (ANOVA) was applied to assess the effect of genotype and kind of muscle on fatty acid, total fat and cholesterol contents in muscles. In abdominal fat the effect of genotype on the components mentioned were evaluated by one-way analysis of ANOVA. Significant differences between means were assessed by Duncan's multiple range test. The statistical analyses were processed with the Statistica data analysis software system, version 9.0 (StatSoft, Inc.,Tulsa, USA).

## Results and discussion

The fat and cholesterol contents as well as fatty acids profile of muscles lipids and abdominal fat are shown in Tables 2 and 3. The UFA were predominant in fatty acids profile of muscles lipids and abdominal fat of investigated geese. Especially important is the presence of C18:2n-6, C18:3n-3, C20:4n-6, EPA (C20:5n-3) and DHA (C22:6n-3), which belong to essential acids. The genotype and type of muscle significantly influenced fat, cholesterol and FAs contents of muscles.

Concentrations of C16:1cis-9, C18:1cis-9, C20:1cis-9, EPA acids were higher while those of C18:2n-6 lower in the KA muscles lipids compared to the LU muscles ($P \leq 0.05$, Tab. 2). The KA lipids of muscles were also characterized by lower content of n-6 and higher of n-3 acids as well as lower thereby more favourable value of n-6/n-3 ratio than lipids of the LU goose. The KA muscles contained more fat but less cholesterol than LU ones ($P \leq 0.05$, Tab. 2).

Lipids of thigh muscles had higher percentage of UFA therein MUFA fatty acids as well as higher value of UFA/SFA ratio, while lower percentages of total SFA and n-3 fatty acids compared to breast muscles ($P \leq 0.05$, Tab. 2). This was largely due to higher C16:1cis-9 and lower C18:3n-3 concentrations in thigh muscles. Moreover breast muscles contained less total fat but more cholesterol than thigh muscles ($P \leq 0.05$, Tab. 2).

The genotype influenced also the contents of fat, cholesterol and fatty acid profile of abdominal fat. The abdominal fat of KA goose was higher in C18:0, C20:1cis-

**Table 2**. Total fat, cholesterol content and fatty acids profile of goose muscles

| Fatty acid (% of total fatty acids) | Genotype | | | | Muscle | | | |
|---|---|---|---|---|---|---|---|---|
| | KA (n=36) | | LU (n=36) | | breast (n=36) | | thigh (n=36) | |
| | mean | SD | mean | SD | mean | SD | mean | SD |
| C 14:0 | 0.55 | 0.05 | 0.62 | 0.06 | 0.55 | 0.10 | 0.62 | 0.08 |
| C 16:0 | 21.68$^{a}$ | 0.75 | 20.48$^{b}$ | 1.42 | 21.67$^{x}$ | 1.08 | 20.50$^{y}$ | 1.27 |
| C 18:0 | 8.87 | 0.91 | 9.47 | 0.95 | 9.34 | 0.99 | 9.00 | 0.91 |
| SFA | 31.11 | 1.61 | 30.57 | 1.61 | 31.56$^{x}$ | 1.74 | 30.12$^{y}$ | 1.52 |
| C 14:1cis-9 | 0.27 | 0.3 | 0.33 | 0.04 | 0.30 | 0.03 | 0.31 | 0.03 |
| C 16:1 cis-9 | 2.60 | 0.30 | 2.46 | 0.27 | 2.35$^{y}$ | 0.26 | 2.70$^{x}$ | 0.28 |
| C 18:1 cis-9 | 41.97$^{a}$ | 2.80 | 39.70$^{b}$ | 3.36 | 39.92 | 3.05 | 41.75 | 3.28 |
| C 18:1 trans-11 | 0.35 | 0.04 | 0.36 | 0.04 | 0.34 | 0.02 | 0.37 | 0.05 |
| C 20:1 cis-9 | 0.40$^{a}$ | 0.04 | 0.27$^{b}$ | 0.03 | 0.30 | 0.03 | 0.37 | 0.04 |
| MUFA | 45.60$^{a}$ | 3.02 | 43.11$^{b}$ | 3.56 | 43.21$^{y}$ | 3.31 | 45.50$^{x}$ | 3.37 |
| C 18:2 n-6 | 14.00$^{b}$ | 1.05 | 15.52$^{a}$ | 1.04 | 15.01 | 1.41 | 14.51 | 1.12 |
| C 18:3 n-3 | 1.43 | 0.10 | 1.35 | 0.13 | 1.50$^{x}$ | 0.19 | 1.28$^{y}$ | 0.15 |
| C 20:4 n-6 | 3.96 | 0.40 | 4.15 | 0.39 | 4.12 | 0.51 | 3.99 | 0.40 |
| C 20:5 n-3 (EPA) | 0.77$^{a}$ | 0.03 | 0.60$^{b}$ | 0.06 | 0.68 | 0.02 | 0.68 | 0.06 |
| C 22:4 n-6 | 0.81 | 0.18 | 0.80 | 0.16 | 0.80 | 0.10 | 0.82 | 0.09 |
| C 22:6 n-3 (DHA) | 0.42 | 0.09 | 0.41 | 0.05 | 0.41 | 0.08 | 0.42 | 0.04 |
| PUFA | 21.39 | 1.73 | 22.83 | 1.78 | 22.53 | 1.92 | 21.70 | 1.87 |
| UFA | 66.99 | 2.08 | 65.93 | 2.23 | 65.74$^{y}$ | 2.13 | 67.19$^{x}$ | 1.98 |
| PUFA/SFA | 0.69 | 0.05 | 0.75 | 0.05 | 0.72 | 0.06 | 0.72 | 0.07 |
| UFA/SFA | 2.16 | 0.18 | 2.16 | 0.15 | 2.06$^{y}$ | 0.14 | 2.21$^{x}$ | 0.16 |
| n-6 | 18.78$^{b}$ | 1.68 | 20.47$^{a}$ | 1.47 | 19.93 | 1.83 | 19.32 | 1.71 |
| n-3 | 2.61$^{a}$ | 0.27 | 2.36$^{b}$ | 0.30 | 2.60$^{x}$ | 0.22 | 2.39$^{y}$ | 0.30 |
| n-6/n-3 | 7.25$^{b}$ | 0.75 | 9.25$^{a}$ | 0.92 | 7.72 | 0.93 | 8.76 | 0.85 |
| Total fat (%) | 3.51$^{a}$ | 0.24 | 2.67$^{b}$ | 0.28 | 2.68$^{y}$ | 0.15 | 3.52$^{x}$ | 0.30 |
| Cholesterol (g/100g of muscle) | 62.51$^{b}$ | 5.51 | 73.85$^{a}$ | 2.36 | 71.95$^{x}$ | 6.51 | 61.50$^{y}$ | 6.12 |

KA – Kartuska goose, LU – Lubelska goose, SD – standard deviation.

$^{ab}$Within rows means bearing different superscripts differ significantly in relation to genotype at P≤0.05.

$^{xy}$Within rows means bearing different superscripts differ significantly in relation to kind of muscle at P≤0.05.

9 and lower in C18:2n-6 than in the case of the LU abdominal fat (P≤0.05, Tab. 3). In comparison with the LU goose the KA abdominal fat contained also lower percentage of PUFA but thanks to lower n-6 and higher n-3 fatty acids content had more favourable value of n-6/n-3 ratio. Cholesterol content of KA geese abdominal fat was lower than of LU. There was no significant difference in total fat content (P≤0.05, Tab.3). In abdominal fat of both analysed genotypes the long-chain PUFA, including EPA and DHA were not observed (Tab. 3).

Basic commercial cross for geese meat production in Poland is the White Koluda® W31. It is a hybrid of two pedigree strains, W33 and W11, which was bred from White

Italian goose being imported to Poland from Denmark in 1962. The lipids of the KA and LU muscles contained less MUFA (by ca 15 %) but more PUFA (by ca 11 %) than muscles of mentioned above intensively reared 10 week-old White Koluda® W31 broilers. The differences arose due to lower quantity of C18:1 by ca 15 % and higher of C18:2n-6 by ca 15 %, C18:3n-3 by ca 1 % and C20:4n-6 by ca 3 % in KA and LU muscles compared to White Koluda® geese broilers as reported by Biesiada-Drzazga [2006a,b].

Analysed in current study muscles of both genotypes were characterized by lower by ca 5 % content of total MUFA and C18:1 acid but higher by ca 5 % PUFA content than muscles of 17 week-old White Koluda® (W31) goose raised in semi-intensive system and fattened by oat *ad libitum* [Gumułka *et al.* 2006]. Compared to Łukaszewicz and Kowalczyk [2008] the muscles lipids of KA and LU geese were higher in UFA by ca 6 % as well as lower in SFA by ca 9 % than mentioned above for 17 week-old White Koluda® goose.

**Table 3**. Total fat, cholesterol contents and fatty acid profile of goose abdominal fat

| Fatty acid (% of total fatty acids) | Abdominal fat | | | |
|---|---|---|---|---|
| | KA (n=18) | | LU (n=18) | |
| | mean | SD | mean | SD |
| C 14:0 | 0.54 | 0.04 | 0.53 | 0.02 |
| C 16:0 | 22.24 | 0.89 | 22.04 | 0.30 |
| C 18:0 | 7.27[a] | 0.56 | 6.56[b] | 0.16 |
| SFA | 29.39 | 1.29 | 28.84 | 0.98 |
| C 14:1cis-9 | 0.05 | 0.01 | 0.04 | 0.01 |
| C 16:1 cis-9 | 2.37 | 0.19 | 2.52 | 0.09 |
| C 18:1 cis-9 | 49.22 | 2.26 | 49.38 | 1.58 |
| C 18:1 trans-11 | 0.32 | 0.04 | 0.36 | 0.01 |
| C 20:1 cis-9 | 0.48[a] | 0.03 | 0.43[b] | 0.01 |
| MUFA | 54.84 | 2.21 | 54.71 | 0.44 |
| C 18:2 n-6 | 13.13[b] | 1.26 | 14.56[a] | 0.25 |
| α C 18:3 n-3 | 1.28[a] | 0.06 | 1.03[b] | 0.01 |
| C 20:4 n-6 | - | | - | |
| C 20:5 n-3 EPA | - | | - | |
| C 22:4 n-6 | - | | - | |
| C 22:6 n-3 DHA | - | | - | |
| PUFA | 14.52[b] | 1.23 | 15.52[a] | 0.25 |
| UFA | 69.46 | 2.08 | 70.29 | 0.29 |
| PUFA/SFA | 0.50[b] | 0.05 | 0.54[a] | 0.01 |
| UFA/SFA | 2.36 | 0.16 | 2.44 | 0.03 |
| n-6 | 13.28[b] | 1.26 | 14.49[a] | 0.25 |
| n-3 | 1.24[a] | 0.06 | 1.02[b] | 0.01 |
| n-6/n-3 | 10.74[b] | 1.40 | 14.19[a] | 0.30 |
| Total fat (%) | 97.3 | 9.10 | 97.2 | 8.45 |
| Cholesterol (mg/100g of abdominal fat) | 70.16[b] | 1.02 | 79.89[a] | 5.66 |

KA – Kartuska goose. LU – Lubelska goose. SD – standard deviation.
[ab]Within rows means bearing different superscripts differ significantly at P≤0.05.

Compared to the abdominal fat of 10- and 17 week-old White Koluda® (W31) analysed geese were characterized by lower C18:1 and total MUFA contents (by ca 8 and 5 % respectively) but total PUFA percentage therein the C18:3n-3 was higher (by ca 4 and 0,6 % respectively). The abdominal fat of 17 week-old White Koluda® strains (W11, W33) occurred also lower in C18:3 by 0,6 % than KA and LU fat [Rosiński *et al.* 1999, Skrabka-Błotnicka *et al.* 1999, Biesiada-Drzazga 2006a,b, Gumułka *et al.* 2006, Biesiada-Drzazga *et al.* 2011].

The total fat content in breast and thigh muscles of investigated geese is generally comparable or lower than those reported by other authors for White Italian and White Koluda® geese muscles (2.54 – 3.93 % for breast and 4.16 – 10.52 % for thigh) [Skrabka-Błotnicka *et al.* 1997, Gumułka *et al.* 2006, Puchajda-Skowrońska *et al.* 2006a, Puchajda-Skowrońska *et al.* 2006b].

Results of cholesterol determination indicate that breast muscles of investigated geese contained less cholesterol (by ca 11 mg/100g) than breast muscles of White Italian goose [Skrabka-Błotnicka *et al.* 1997] but more (by ca 20 mg/100g) compared to breast muscles of the White Koluda® strain W33 [Wężyk *et al.* 2003].

Compared to present results, Rosiński *et al.* [1999] and Skrabka-Błotnicka *et al.* [1999] stated the higher by ca 18 mg/100g cholesterol content of abdominal fat of the White Koluda® strains (W11, W33 and their hybrids W13 and W31).

Apart from KA and LU geese, among the Polish native breeds the Garbonosa and Zatorska (from southern Poland) can be found as well as Rypińska geese which has its origin in northern Poland. These geese are also included in the genetic resources conservation program in Poland. Okruszek [2011] stated higher contents of C16:1cis-9, C20:4n-6, EPA and lower C18:0 and C18:3n-3 in muscles of 17 week-old Rypinska and Garbonosa geese compared to KA and LU muscles (on average by 1; 3; 0,7; 2; and 1%, respectively). The UFA therein total PUFA, n-6 fatty acids contents and UFA/SFA ratio in muscles lipids of KA and LU occurred lower in comparison to Rypińska and Garbonosa geese (68.00 -72.50 %; 23.6 -27.7 %; 21.2 -24.8 % and 2.23-2.47 respectively). However the n-6/n-3 ratio in KA muscles was more favourable than in Rypińska and Garbonosa muscles (8.52-9.57) — Okruszek [2011]. The fatty acids content of muscle of Zatorska goose were comparable to KA and LU muscle lipids [Gumułka *et al.* 2006].

The abdominal fat of Rypińska and Garbonosa geese contained more total PUFA n-6 due to the presence of C20:4 n-6 (0.17 and 0.39 vs. trace) and higher level of C18:2n-6 (16.02 and 17.54 %) than both genotypes studied. The abdominal fat of KA was characterized by lower n-6/n-3 ratio than mentioned Rypińska (13.6) and Garbonosa geese (14.0) [Okruszek 2011]. Abdominal fat of KA and LU geese compared to Zatorska contained comparable amount of PUFA, higher by 2 % amount of SFA and lower by ca 2.5 % MUFA especially C18:1 (by ca 5 %) [Gumułka *et al.* 2006].

Arslan *et al.* [2004] determined lower contents of C18:2 (11.77 %) and C18:3 (0.54 %) in abdominal fat of similarly fed 12 week-old Turkish native breeds of geese.

The undertaken investigation showed that geese thigh muscles compared to breast muscles contain less SFA and more UFA due to higher MUFA percentage. Similar results were obtained by Gumułka *et al.* [2006], Biesiada-Drzazga [2006a] and Okruszek [2011, 2012]. The studies by Okruszek [2011, 2012] indicated also that goose thigh muscles are higher in PUFA than breast muscles.

On the basis of numerous studies it was established that the contemporary diet called western, is characterized by too high intake of saturated and n-6 fatty acids while insufficient supply of the n-3. Modern western diets typically have an n-6/n-3 ratio

of 15 – 20:1 [Simopoulos 2003, 2008]. According to earlier results the recommended ratio of n-6 to n-3 fatty acids intake should range from 4:1 [Simopoulos 2003] up to 5:1- 6:1 [Leskanich and Noble 1997]. In the present study, the n-6/n-3 ratios for muscles ranged from 7.25 (KA) to 9.25 (LU) and from 10.74 (KA) up to 14.19 (LU) for abdominal fat. The ratio for goose breast muscles came to 7.72 and for thigh muscles to 8.76. These values were higher than the recommended but n-6/n-3 ratio for KA muscles was the closest to value recognized as beneficial for human health. Nutritional recommendations for a healthy diet suggest also that the PUFA/SFA ratio should be 0.40 or higher, and intakes of n-3 fatty acids should be increased relative to n-6 [Mas *et al.,* 2010]. The lipids of breast and thigh muscles as well as abdominal fat of both investigated genotypes was characterized by higher PUFA/SFA ratio than the optimum values mentioned above.

The fatty acid profiles of the KA goose muscles and abdominal fat were more advantageous from nutritional point of view than the LU ones. This study has shown that KA muscles and abdominal fat contained less cholesterol and had lower and thereby more favourable value of n-6/n-3 ratio than did those from LU goose. Type of muscle has also affect the cholesterol and fatty acids concentrations, but it is difficult to say which muscle (breast or thigh) is healthier in this respect. Breast muscles were characterized by higher cholesterol and SFA concentrations compared to thigh muscles. On the other hand breast comprised more n-3 fatty acids and less total fat than thigh muscles.

In conclusion one can state that lipids of breast and thigh muscles of both analyzed geese genotypes were characterized by high content of PUFA, therein long-chain PUFA, what is beneficial regarding consumers' health. From the literature review appears that muscles of domestic geese breeds are equal or even more favourable in nutritive value of fat compared to other geese breeds.

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