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# FATTY ACIDS PROFILE AND THE EATING QUALITY OF SELECTED BEEF MUSCLES

*Marzena Zając[1], Krystyna Palka[1], Brendan Murray[2], Declan Troy[2]*

*[1]Animal Products Technology Department, Agricultural University of Kraków, Poland; [2]The National Food Centre, Dublin, Ireland*

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Because of the increased interest of fatty acids profile in meat, their amount in different beef muscles was analyzed and connected with the eating quality of those muscles, which were heated using different methods (grilling, roasting, frying). The percentage of fatty acids was analyzed by gas chromatography. The sensory analysis was made using hedonic scale. There were differences between muscles in fatty acids content, however oleic, palmitic and stearic acids were the most abundant in all muscles. The amount of all saturated fatty acids was the highest in *m.serratus ventralis* and *m.longissimus dorsi* and the lowest in *m.semimebranosus*. The amount of all monounsaturated fatty acids was the highest in *m.pectoralis profundus* and the lowest in *m.semimebranosus*, which was reach in polyunsaturated fatty acids. In contrary *m.pectoralis profundus* contained the lowest amount of the latter. The heating method influenced only juiciness. The most juicy were the grilled muscles, but irrespectively of the heating method *m.infraspinatus, m.serratus ventralis*, and *m.triceps brachii* were the most and *m.semitendinosus* and *m.semimbranosus* were the least juicy muscles. *M.infraspinatus, m.longissimus dorsi, m.serratus ventralis* and *m.triceps brachii* were the most flavoursome muscles and *m.semimembranosus* and *m.biceps femoris* the least flavoursome. *M.infraspinatus, m.longissimus dorsi, m.serratus ventralis and m.triceps brachii* were graded as the most tender muscles and *m.pectoralis profundus* and *m.semimembranosus* were the least tender. *M.triceps brachii, m.infraspinatus, m.longissimus dorsi* and *m.serratus ventralis* were the most acceptable muscles and *m.pectoralis profundus, m.semimebranosus* as well as *m.biceps femoris* were the least acceptable. From the healthcare point of view, the best fatty acid composition was in *m.semimembranosus,* which contained the highest level of polyunsaturated fatty acids, that are beneficial for health and favorable n-6 to n-3 fatty acids ratio. However, panelists graded the same muscle as one of the lowest quality. The differences in fatty acids content of analyzed muscles did not influence the eating quality of those muscles after heating.

## INTRODUCTION

Meat contains some amounts of essential fatty acids. They are important components of cell membranes, mitochondrion and other organelle that are metabolically active. The ruminants' meat naturally contains favorable n-6 to n-3 fatty acids ratio (3:1) and CLA (conjugated linoleic acid) [Wood *et al*., 2003; Scollan *et al*., 2006]. Those acids assure proper functioning of the organism. The recommended n-6 to n-3 fatty acids ratio is 5:1 [Stołyhwo-Szpajer *et al*., 2001]. It is claimed that n-6 fatty acids increase and n-3 acids decrease the growth of prostanoids, whose high levels were found in tumors [Karmali, 1987]. Essential fatty acids protect from the coronary disease and different types of cancer. Those acids take part in regulating the disease states which cause different disorders in lipid metabolism. Nutritionists also recommend lowering the saturated fatty acids intake and increasing the polyunsaturated fatty acids (PUFA) intake. As meat and meat products are consumed in considerable amounts there has been an interest in modeling the fatty acids composition to increase the essential fatty acids level. Scientists try to enrich the feeds by addition of the essential fatty acids or their precursors. One of the solutions is incorporating them in special capsules so that they can be transferred unchanged [Lee *et al*., 2004; Baublits *et al*., 2006; Cerdeño *et al*., 2006; Elmore *et al*., 2005; Serrano *et al*., 2005]. The results of these researches are not coherent because of various difficulties in modeling fatty acids composition. Irrespectively of feeding factors the effect of type of muscle on fatty acids profile is interesting. The aim of this work was to determine fatty acids composition in selected beef muscles and to investigate their eating quality using three cooking methods. There has been also an attempt to find the effect of fatty acid profile on the quality traits, especially flavour, of those muscles.

## MATERIALS AND METHODS

Hereford Cross Friesian heifers (n=6) of average age 22 months were slaughtered. Average hot weight of the carcasses was 250 kg. The carcasses were chilled at 10°C for 10 h and then 2°C until excision 48 h *post mortem*. On second day *post mortem* muscles were excised from left side of the carcass: *m.longissimus dorsi (thoracis et lumborum) (LD)*; *m.biceps femoris (BF), m.semimembranosus (SM), m.semitendinosus (ST) m.pectoralis profundus (PP), m.infraspinatus (IS), m.triceps brachii (TB)* and *m.serratus ventralis (SV)*. The average pH of the muscles was 5.6. Muscles were vacuum packed and aged until 14th day *post mortem*. Steaks (2.54 cm thick) for sensory

Author's address for correspondence: Krystyna Palka – Animal Products Technology Department, Agricultural University of Kraków, ul. Balicka 122, 30-149 Kraków, Poland; e-mail: rrpalka@cyf-kr.edu.pl

analysis were cut on day 14 *post mortem,* vacuum packed and frozen in –20°C. On the day of analysis steaks were thawed in circulating water-bath of temperature 10°C. Sensory analysis was carried out based on AMSA [1995]. Steaks grilled, roasted or fried to internal temperature of 70°C. Steaks were cut into 2.5 cm x 1.5 cm x 1.5 cm squares and given to panellists, who evaluated: tenderness (on a scale 1-8 with 1 being extremely tough and 8 being extremely tender); juiciness (on a scale 1-8 with 1 being extremely dry and 8 being extremely juicy), chewiness (on a scale 1-6 with 1 being extremely chewy and 6 being not chewy), overall flavour (1-very poor and 6-extremely good), overall acceptability (1-not acceptable and 6-extremely acceptable).

Samples for fatty acids analysis were taken on day 14 *post mortem*. They were frozen in –20°C and stored until analysed. Meat was minced before cooking and heated in 140°C for 30 min. To 1 g of homogenized sample 100 $\mu$g of hexane with internal standard C23:0 (10 mg/mL). The saponification solution (0.5 g quinone 140.3 g KOH, 250 mL methanol, water to 500 mL) was added, the tubes were flushed with $N_2$, vortexed for 10 minutes and placed in water bath at 60°C for 60 min, shaking them every 15 min. Every sample was diluted with 12 mL of 0.5% NaCl. 5 mL of petroleum ether (PE) was added and the samples were vortexed for 5 minutes, followed by centrifugation at 800 g for 5 min at 20°C to separate two phases. The top layer was removed and discarded. Commercial glacial acetic acid (3 mL) was added and mixed. Petroleum ether (5 mL) was added, samples were vortexed for 10 min and centrifuged at 800 g for 5 min at 20°C to separate the two phases. This time the top layer of PE was kept and transferred to clean glass tubes. The volume of the samples was reduced by half under nitrogen at the temperature of 40°C. Next 5 mL of PE was added to the samples and vortexed for 5 minutes. The samples were centrifuged at the same conditions as previously. The top PE layer was kept and transferred to the same tubes as used previously and the samples were dried under nitrogen at the temperature of 40°C (about 40 minutes). To dry non-polar phase 2.2-dimethoxypropane was added in excess to each tube and the tubes were vortexed for 2 min. At this stage samples were stored until methylation was carried out. The samples were taken from cold storage and reduced to a thick oily film under nitrogen. The fatty acids were dissolved in methanol:toluene (2:1) and vortexed for 5 min. Trimethylsilyl-diazomethane (2 mol/L) was added to each sample in excess and allowed to react at 40°C for 10 minutes in $N_2$ atmosphere. After that 2 mL of n-hexane containing 50 ppm BHT was added to each tube and vortexed for 5 min. The samples were centrifuged at 20°C and 20.000 g for 5 min. Supernatants were transferred into vials. GC separation of the resulting fatty acid methyl esters was carried out using Varian Star 3400 CX model gas chromatograph fitted with a flame-ionisation detector. Samples were injected using a Varian 8200 CX sampler onto a BPX-70 (SGE U.K Ltd) fused silica capillary column (120 m x 0.22mm id. x 0.2 $\mu$m film thickness). The carrier gas was $H_2$ at a split ratio of 50:1. The injector port temperature was 270°C and the detector was set at a temperature of 300°C, while the column was set at an initial temperature of 50°C. Samples were injected along with set of standards containing different fatty acid methyl esters (Sigma-Aldrich, Supelco). After GC analysis the standards were used to identify peaks on meat samples' chromatograms. The areas of appearing peaks were compared to obtain quantities of fatty acids present in samples. The analyses were carried out in triplicates. The statistical analysis was made by STATISTICA 5.0 software. Data were subjected to analysis of variance (ANOVA), using Tukey's test (HSD). A significance level of $p<0.05$ was used. The results are presented as average values ± standard deviations.

## RESULTS AND DISCUSSION

The amounts of fatty acids are presented in Table 1. There has been six saturated, six mono- and seven polyunsaturated fatty acids (PUFA) detected. The analysis of variance showed significant differences between muscles except of C15:0. The most abundant acids in all analysed samples were oleic (average 36.5%), palmitic (average 22.4%) and stearic (average 14.3%) acids. The amount of saturated acids was the highest in SV and LD muscles (44.4% and 43.5% respectively) and the lowest in SM (36.4%). The percentage of monounsaturated fatty acids was the lowest in SM (42.6%) and the highest in PP (53.4%). SM muscle had the highest (21.0%) and PP the lowest (6.9%) amount of polyunsaturated fatty acids. It is claimed that fatty acids profile influences meat flavour. Samples with higher amounts of PUFA compose of their derivatives (aldehydes, ketones, alcohols). A lot of them have C18:1, C18:2 and C18:3 fatty acid origin. Excessive quantity of linoleic acid in diet increases the danger of breast, colon and prostate cancer [Sommer *et al*., 2002]. The n-6 to n-3 fatty acids ratio in analysed muscles varied from 1.6 in LD, BF, ST and PP to 1.9 in IS. The amount of linoleic acid in muscles was the highest in SM (8.5%) and the lowest, and favourable at the same time, in PP (2.3%). Aldai and coworkers [2006] found only one form of CLA (9cis, 11trans) in beef. This acid is produced in rumen mainly by bacterial hydrogenesis [Wahle *et al*., 2004]. Linoleic and α-linolenic acids are the main CLA precursors [Whetsell *et al*., 2003]. It is claimed that CLA may be beneficial for health. Kritchevsky and co-workers [2000] found that CLA in the diet of rabbits was one of the causes of decreasing the atherosclerosis process. Its anticancerogenic influence was also noted. In Finland there has been less cases of breast cancer because of high intake of milk which naturally contains CLA. Also, in animal tests it has been confirmed that adding this acid to feeds lowers the increase of this type of cancer [Sommer *et al*., 2002; Whigham *et al*., 2000]. Similarly to CLA, EPA (eicosapentaenoic acid), DPA (docosapentaenoic acid) and DHA (docosahexaenoic acid) are anticancerogenic. EPA also lowers the danger of coronary disease. Fish contain large amounts of these acids. It is claimed that Inuits rarely suffer coronary diseases despite the fact that their diet is rich in fatty products. Considering high meat intake, especially beef or lamb, it is claimed that they are good source of EPA and DPA acids even though their abundance in the whole amount of fatty acids is low [Stołyhwo-Szpajer *et al*., 2001; Howe *et al*., 2006]. Arachidonic acid is antiflammatory but its amount in beef is usually low, below 0.5% of the whole

TABLE 1. The composition of fatty acids in heated beef muscles (% of the total acids content).

| Fatty acids | Muscles | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | LD | BF | SM | ST | IS | PP | TB | SV |
| Saturated | | | | | | | | |
| C14:0 | 2.54±0.01c | 2.19±0.04bc | 1.33±0.18a | 1.81±0.11ab | 2.21±0.10bc | 3.12±0.24d | 2.10±0.16bc | 2.51±0.13c |
| C15:0 | 0.46±0.01a | 0.44±0.02a | 0.46±0.28a | 0.44±0.01a | 0.51±0.01a | 0.51±0.07a | 0.49±0.02a | 0.56±0.02a |
| C16:0 | 24.83±0.30c | 22.18±0.12b | 18.61±0.67a | 22.30±0.36b | 21.78±0.56b | 24.06±0.60bc | 22.74±0.26bc | 22.82±0.34bc |
| aC17:0 | 0.72±0.01b | 0.64±0.01b | 0.34±0.02a | 0.55±0.06ab | 0.66±0.02b | 0.73±0.03b | 0.59±0.04b | 0.76±0.01b |
| C17:0 | 0.94±0.01ab | 0.84±0.02a | 0.83±0.07a | 0.82±0.02a | 0.94±0.04ab | 0.76±0.01a | 0.93±0.02ab | 1.11±0.02b |
| C18:0 | 13.97±0.08bc | 13.48±0.02b | 14.84±0.27cd | 14.25±0.40bcd | 15.45±0.23d | 10.57±0.28a | 15.02±0.05cd | 16.66±0.05e |
| Total contribution | 43.46 | 39.77 | 36.41 | 40.17 | 41.55 | 39.75 | 41.87 | 44.42 |
| Monounsaturated | | | | | | | | |
| C14:1 | 0.54±0.07ab | 0.64±0.04ab | 2.50±1.02c | 2.02±0.30bc | 0.52±0.05a | 1.37±0.11ab | 0.48±0.02a | 0.52±0.02a |
| C16:1 9cis | 4.25±0.10bc | 4.40±0.07c | 2.82±0.15a | 3.60±0.13ab | 3.89±0.24bc | 6.78±0.24d | 3.73±0.05bc | 4.03±0.05bc |
| C17:1 | 0.90±0.05a | 0.87±0.01a | 0.96±0.14a | 0.81±0.01a | 0.88±0.05a | 1.01±0.04a | 0.83±0.04a | 0.86±0.01a |
| C18:1 11trans | 2.42±0.28b | 2.29±0.20b | 1.23±0.11a | 1.87±0.30b | 2.40±0.37b | 2.31±0.07b | 2.22±0.15b | 3.13±0.06c |
| C18:1 9cis | 39.44±0.08de | 36.07±0.31bc | 33.00±0.36a | 35.31±0.37bc | 34.57±0.17ab | 39.91±0.52e | 36.17±0.48bc | 37.34±0.42cd |
| C18:1 11 cis | 1.53±0.08 | 1.89±0.04 | 2.09±0.08 | 1.73±0.09 | 1.68±0.09 | 1.97±0.09 | 1.69±0.07 | 1.51±0.01 |
| Total contribution | 49.08 | 46.16 | 42.60 | 45.34 | 43.94 | 53.35 | 45.12 | 47.39 |
| Polyunsaturated | | | | | | | | |
| C18:2 n6 | 2.88±0.05a | 5.14±0.11b | 8.51±0.48c | 5.29±0.20b | 6.05±0.12b | 2.32±0.12a | 5.25±0.58b | 3.09±0.20a |
| C18:3 n3 | 1.44±0.04ab | 2.15±0.14ab | 3.46±0.17c | 2.25±0.05b | 2.44±0.10bc | 1.19±0.09a | 2.32±0.24b | 1.45±0.07ab |
| CLA 9cis, 11trans | 0.94±0.001c | 0.80±0.06bc | 0.21±0.03a | 0.72±0.09b | 0.77±0.01bc | 1.18±0.03d | 0.71±0.06b | 0.85±0.01bc |
| C20:3 n6 | 0.01±0.003a | 0.50±0.09c | 0.97±0.06d | 0.55±0.08c | 0.63±0.05c | 0.25±0.01b | 0.46±0.6bc | 0.26±0.03b |
| C20:4 n6 | 1.05±0.01a | 2.22±0.13b | 3.71±0.28c | 2.39±0.26b | 2.33±0.13b | 0.93±0.08a | 1.81±0.16b | 0.91±0.11a |
| C20:5 n3 | 0.59±0.01ab | 1.39±0.04cd | 2.14±0.13e | 1.53±0.17d | 1.16±0.07cd | 0.58±0.04ab | 1.02±0.08bc | 0.44±0.04a |
| C22:5 n3 | 0.50±0.02a | 1.29±0.18b | 1.96±0.12c | 1.41±0.29b | 1.11±0.22b | 0.44±0.04a | 0.89±0.09ab | 0.53±0.04a |
| Total contribution | 7.41 | 13.49 | 20.96 | 14.14 | 14.49 | 6.89 | 12.46 | 7.53 |

Different letters in the same row indicate significant differences between muscles ($p<0.05$).

amount of fat [Whetsell *et al*., 2003]. In presented results CLA 9cis, 11trans was the only form of CLA. Its amount in muscles ranged from 0.2% (SM) to 1.2% (PP). There has been no DHA found in analysed muscles, but the EPA percentage ranged from 0.4% (SV) to 2.1% (SM). The amount of DPA varied from 0.4% in PP to 2.0% in SM. The quantity of arachidonic acid in SV muscle was 2.0% and in SM 3.7%. SM muscle contained the highest amount of polyunsaturated fatty acids. EPA, DPA, linolenic and arachidonic acids content was the highest in this muscle. Whereas PP muscle from the forequarter contained the least amounts of these acids. The polyunsaturated to saturated fatty acids ratio was the lowest (0.05) in LD, PP and SV muscles and the highest in SM (0.2). These results are comparable to those obtained by Raes and co-workers [2003] for Irish beef, where also those values were higher for SM muscle comparing to LD. Meat of other origin in the same research contained the higher amounts of polyunsaturated fatty acids.

The results of sensory analysis of the muscles are presented in Table 2. The effect of the muscle type on analysed quality traits was significant. Irrespectively of the heating method IS, LD, TB and SV were the most tender muscles, ST was graded as average and SM, BF, PP received the lowest grades. LD, IS, TB and SV were also the most flavoursome muscles and the least flavoursome ones were SM and BF. IS, SV and TB were the most juicy, the juiciness of PP, LD and BF was graded on average level and the least juicy were muscles ST and SM. Also Carmack and co-workers [1995] found IS and SV as the most juicy and SM and ST as the least juicy in sensory analyses of grilled beef muscles. LD, IS, TB, ST and SV were found to be of the most acceptable chewiness. The effect of heating method was significant only for juiciness, which was graded higher for grilled muscles ST and TB. For all the other muscles similar tendency was noticeable. The heating method did not influence the sensory acceptance of analysed muscles, however there was a tendency of higher grading the grilled muscles. There was significant effect of muscle type on the general acceptance. Muscles IS and LD were graded as the most acceptable, TB, SV and ST received average notes and the least acceptable muscles were SM, BF and PP. Three forequarter muscles IS, TB and SV were comparable to LD, which is considerable. The same muscles were also found as one of the best in other surveys [Grześkowiak *et al*., 2002; Kukowski *et al*., 2004].

TABLE 2. Results of sensory analysis of heated beef muscles.

| Sensory trait | Heating method | Muscles | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | LD | BF | SM | ST | IS | PP | TB | SV |
| Tenderness | Grilling | 6.0±0.9a | 4.1±0.9bcd | 3.8±1.1cd | 5.4±0.3abc | 6.5±0.7a | 2.8±0.7d | 6.4±0.6a | 5.7±0.9ab |
| | Roasting | 6.0±0.9a | 4.0±0.7bcd | 3.5±0.8cd | 4.5±0.2abcd | 5.9±0.5a | 3.3±0.9d | 5.6±0.9ab | 5.3±0.8abc |
| | Frying | 5.8±1.0a | 3.5±0.5b | 4.8±1.3ab | 4.1±0.7ab | 5.7±1.1a | 3.8±1.2b | 5.4±0.8ab | 4.8±1.1ab |
| Flavour | Grilling | 3.9±0.4a | 3.5±0.4a | 3.4±0.2a | 3.6±0.3a | 3.9±0.6a | 3.8±0.1a | 4.1±0.2a | 4.0±0.5a |
| | Roasting | 4.2±0.2a | 3.5±0.4ab | 3.3±0.3b | 3.4±0.3ab | 4.0±0.3ab | 3.4±0.3ab | 3.7±0.5ab | 3.5±0.4ab |
| | Frying | 4.1±0.3ab | 3.4±0.4b | 3.6±0.5ab | 3.6±0.4ab | 4.3±0.6a | 3.7±0.3ab | 4.0±0.4ab | 3.9±0.5ab |
| Juiciness | Grilling | 5.3±0.8a1 | 5.1±0.3a1 | 4.6±0.7a1 | 4.9±0.4a1 | 6.1±0.6a1 | 5.2±0.3a1 | 6.3±0.5a1 | 6.2±0.7a1 |
| | Roasting | 4.1±0.7abc1 | 4.3±1.1abc1 | 2.9±0.4c1 | 3.0±0.5bc2 | 5.2±0.8a1 | 4.4±0.9abc1 | 3.9±1.1abc2 | 4.9±1.2ab1 |
| | Frying | 4.6±1.2a1 | 4.2±1.4a1 | 4.0±1.3a1 | 4.0±0.7a12 | 5.8±0.8a1 | 5.0±1.2a1 | 4.8±1.0a12 | 5.3±1.1a1 |
| Chewiness | Grilling | 3.8±0.6a | 2.5±0.5bc | 2.6±0.6bc | 3.7±0.3a | 4.0±0.6a | 2.2±0.4c | 4.0±0.5a | 3.4±0.4ab |
| | Roasting | 3.9±0.7a | 2.8±0.4bc | 2.7±0.6bc | 3.2±0.4abc | 3.6±0.5ab | 2.5±0.4c | 3.8±0.4ab | 3.3±0.4ab |
| | Frying | 3.9±0.8a | 2.4±0.4b | 3.4±0.5ab | 3.1±0.2ab | 3.8±0.7a | 2.6±0.5b | 3.5±0.4ab | 2.7±0.6b |
| Acceptability | Grilling | 4.1±0.6ab | 3.0±0.3bc | 3.0±0.6bc | 3.6±0.4ab | 4.2±0.6a | 2.7±0.5c | 4.4±0.4a | 4.0±0.6ab |
| | Roasting | 4.1±0.6a | 3.1±0.5abc | 2.6±0.2c | 3.3±0.3abc | 4.2±0.4a | 2.7±0.5bc | 3.8±0.7ab | 3.7±0.7abc |
| | Frying | 4.0±0.7ab | 2.8±0.5b | 3.5±0.6ab | 3.3±0.2ab | 4.3±0.6a | 2.9±0.8b | 3.9±0.7ab | 3.5±0.6ab |

Different letters in the same row indicate significant differences between muscles ($p<0.05$) heated in the same way. Different numbers in the same column indicate significant differences between heating methods for the same muscle ($p<0.05$) (juiciness only).

## CONCLUSIONS

*M.semimembranosus* is characterised by favourable fatty acids content comparing to the other muscles analysed. The amount of fatty acids that are beneficial for health is the highest in this muscle, n-6 to n-3 fatty acid ratio is the lowest and polyunsaturated to saturated fatty acids ratio is the highest. The same muscle is one of the least flavoursome and juicy muscles, SM is also the toughest. *M.pectoralis profundus* muscle contains the lowest amounts of EPA, DPA, linolenic and arachidonic acids and flavour of this muscle is graded higher comparing to *m.semimembranosus*. The differences between muscles in fatty acids content do not influence the flavour or other quality traits, that are graded after heating.

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## SKŁAD KWASÓW TŁUSZCZOWYCH I JAKOŚĆ SENSORYCZNA WYBRANYCH MIĘŚNI BYDLĘCYCH

***Marzena Zając[1], Krystyna Palka[1], Brendan Myrray[2], Declan Troy[2]***

*[1]Katedra Przetwórstwa Produktów Zwierzęcych, Akademia Rolnicza im Hugona Kołłątaja, Kraków, Polska; [2]The National Food Centre, Dublin, Ireland*

W pracy określono skład kwasów tłuszczowych oraz jakość sensoryczną wybranych mięśni bydlęcych ogrzewanych różnymi metodami (grilowanie, pieczenie, smażenie). Udział kwasów tłuszczowych analizowano za pomocą chromatografii gazowej, a analizę sensoryczną wykonywano metodą punktową. Badane mięśnie różniły się pod względem zawartości kwasów tłuszczowych, chociaż we wszystkich kwasy oleinowy, palmitynowy i stearynowy znajdowały się w największych ilościach. Suma nasyconych kwasów tłuszczowych była największa w *m.serratus ventralis* i *m.longissimus dorsi*, a najmniejsza w *m.semimembranosus*. Udział kwasów mononienasyconych był najmniejszy w *m.semimembranosus*, który z kolei zawierał najwięcej kwasów polinienasyconych. Natomiast *m.pectoralis profundus* charakteryzował się najmniejszym udziałem kwasów polinienasyconych. Metoda ogrzewania mięsa nie wpływała istotnie na analizowane wyróżniki jakości z wyjątkiem soczystości. Do najbardziej soczystych zaliczono mięśnie grilowane, a niezależnie od metody ogrzewania najbardziej soczystymi były *m.infraspinatus, m.serratus ventralis* oraz *m.triceps brachii*, a najmniej *m.semitendinosus* i *m.semimembranosus*. Niezależnie od metody ogrzewania najwyżej oceniono smakowitość *m.infraspinatus*, *m.longissimus dorsi, m.serratus ventralis* oraz *m.triceps brachii,* a najniżej *m.semimembranosus* i *m.biceps femoris*. Najbardziej kruche w odczuciu oceniających były *m.infraspinatus*, *m.longissimus dorsi, m.serratus ventralis* oraz *m.triceps brachii*, a najmniej *m.pectoralis profundus* i *m.semimembranosus*. Najwyższe oceny, niezależnie od metody ogrzewania, otrzymały *m.infraspinatus*, *m.longissimus dorsi* oraz *m.serratus ventralis i m.triceps brachii*, a najniższe *m.pectoralis profundus, m.semimembranosus* i *m.biceps femoris*. Najbardziej korzystnym, ze względów zdrowotnych, składem kwasów tłuszczowych charakteryzował się *m.semimembranosus,* w którym stwierdzono największy udział polinienasyconych kwasów tłuszczowych o działaniu prozdrowotnym oraz korzystny stosunek kwasów typu n-6 do n-3. Jednak mięsień ten uzyskał najniższe noty w ocenie sensorycznej. Różnice w składzie kwasów tłuszczowych ogrzewanych mięśni nie miały istotnego wpływu na ich jakość ocenianą sensorycznie.