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*Quality of Meat from Lambs out of Kamieniecka Ewes
and Crossbreeds by Charolaise Rams*

Jakość mięsa tryczków owcy kamienieckiej i mieszańców
po ojcach rasy charolaise

Meat quality is a key criterion while evaluating the effectiveness of studies aimed at determining the possibility of using ewes of local breeds for commercial crossing with rams of mutton breeds. Meat from lambs slaughtered up to 100 days of age is known for its high dietary value. Carcasses of young slaughter lambs are characterized by lower fatness than those of older ones. That is why they are popular among consumers who prefer a low-calorie diet (Ciuryk and Kaczor 1996). However, the role played by fat – especially intramuscular – is important as it affects physicochemical and sensory properties of meat. The threshold values of its content have been determined, below which the number of points for the sensory desirability of meat decreases considerably. Meat palatability depends, to a great degree, on intramuscular fat – the higher its content (often referred to as the effect of “marbling”), the better consumer quality of meat, with respect to taste and juiciness. Its higher proportion is also connected with loosening of tissue microstructure, leading to better water-holding capacity of meat (Hamm et al. 1980). However, not only the amount of fat is important, but also its quality, since both these factors affect the nutritive value, sensory characteristics and technological suitability of meat (Kędzior 1991, Pearson et al. 1973). Fat quality depends on fatty acids. Niedźwiadek et al. (1997) emphasize that their kind and quantity determine not only the nutritive and technological value of meat, but also its health properties. That is why consumers look for

meat characterized by high concentration of unsaturated fatty acids, as they are believed to reduce the risk of blood clot formation. The composition of fatty acids in intramuscular fat in sheep is of particular importance, because it affects the so called "tallow-like taste" of meat. According to Hornstein and Crowe (1963), the taste and aroma of mutton are determined by a high content of saturated acids, mainly palmitic – $C_{16:0}$ and stearic – $C_{18:0}$, but a too low proportion of mono- and polyunsaturated acids (oleic – $C_{18:1}$, linoleic – $C_{18:2}$ and linolenic – $C_{18:3}$) has an adverse effect. Studies are currently conducted on the possibility of modifying fatty acid composition. Taking into account consumer's health, this research area is a first priority Patkowska-Sokoła et al. 1994). It seems that positive results may be also achieved by proper selection of breeds for crossing, due to differences between them in this respect (Kędzior 1991, Ciuryk and Kaczor 1996, Brzostowski et al. 1997, Radzik-Rant 1999).

The aim of the present studies was to compare some quality indices, including the fatty acid content of meat, in young rams of Kamieniecka ewes and crossbreeds by Charolaise rams.

MATERIAL AND METHODS

The research was carried out at a sheep shed located at the Production-Experimental Station Bałcyny, belonging to the University of Warmia and Mazury in Olsztyn. Young rams of Kamieniecka ewes (group I – 6 animals) and their crossbreeds (F_1) by Charolaise rams (group II – 6 animals) constituted the experimental material.

They were fed traditionally, and the level of feeding was consistent with the norms for sucking lambs (Standards of Cattle and Sheep Nutrition in a Traditional System, Institute of Animal Husbandry, 12th edition, Cracow 1998).

The lambs were slaughtered at the age of 100 days, when their body weights amounted to 30 (± 1.5) kg. The quality of meat and intramuscular fat was evaluated on the basis of an analysis of samples taken from the dorsal muscle (*m. longissimus dorsi*), determining: the dry matter content – by sample drying at a temperature of 378⁰K (105⁰C), the crude protein content – by the Kjeldahl method, the crude fat content – by the Soxhlet method, the crude ash content – by combustion at a temperature of 823⁰K (550⁰C), pH – with a pH-meter PHM 22 (Radiometer), water-holding capacity – by the Grau and Hamm method (1953), color brightness – with a spectrophotometer "Spekol" with a remission attachment R 045, at a wavelength of 560 nm. The composition of fatty acids in intramuscular fat was determined by estrification and gas chromatography, with a chromatograph Pye Unicam, series 104, with a flame ionization detector, in a glass column 2.1 m in length and 4 mm in diameter.

Heat treatment was carried out following Barylko-Pikielna (1975). A five-point evaluation scale was applied, taking into consideration the following quality factors: tenderness, juiciness, aroma (intensity and desirability), taste (intensity and desirability). The mean values obtained for particular factors were treated as a general evaluation.

The results were elaborated statistically employing a one-factor analysis of variance in an orthogonal design.

RESULTS AND DISCUSSION

The data presented in Table 1 indicate that the male line of breeding had an insignificant effect on the chemical composition and physicochemical properties of meat from rams of Kamieniecka ewes.

Meat from crossbreeds was characterized by a significantly lower ($P \leq 0.01$) fat content, compared with the control group, which is a positive result of the crossbreeding variant applied. This was connected with its worse water-holding capacity and a slightly lighter color, but these differences were not confirmed statistically.

Table 1. Chemical and physical properties of meat

Specification		Groups			
		I		II	
		<i>x</i>	<i>s</i>	<i>x</i>	<i>s</i>
Dry matter	%	23.33	0.61	22.06	0.35
Fat	%	2.57 ^A	0.61	1.40 ^B	0.38
Crude protein	%	20.21	0.33	19.86	1.58
Ash	%	0.98	0.05	1.00	0.06
Water-holding capacity	cm ²	9.12	1.02	10.34	1.76
Color	%	18.17	2.14	19.83	1.33
PH		5.25	0.14	5.18	0.07

A,B – $P \leq 0.01$

A lower fat content of meat from crossbreeds was accompanied by changes in the composition of fatty acids in intramuscular fat (Table 2). The content of saturated acids: palmitic – C_{16:0}, isopalmitic – C_{16:0 iso} ($P \leq 0.01$) and stearic – C_{18:0} ($P \leq 0.05$) decreased considerably, and the concentration of polyunsaturated acids: linoleic – C_{18:2}, linolenic – C_{18:3} and arachidic – C_{20:4} ($P \leq 0.01$) increased. As a result, the ratio between unsaturated and saturated acids (U : S) changed (0.94 in group I, 1.053 in group II). A significant increase in the level of unsaturated ($P \leq 0.05$) and polyunsaturated ($P \leq 0.01$) fatty acids is especially important from the perspective of dietary standards. The ratio between polyunsaturated and saturated acids (P : S) was 0.064 in the control group and 0.14 in the experimental one.

A sensory evaluation of meat (Table 3) indicated its high quality in both groups. The average number of points for particular properties varied from 4.25 to 5.0, reaching the maximum (5.0) in the case of aroma intensity and desirability. Meat from crossbreeds was characterized by somewhat better tenderness and juiciness, and received a higher total score.

Table 2. Composition of fatty acids in intramuscular fat of rams (%)

Fatty acids	Groups			
	I		II	
	<i>x</i>	<i>s</i>	<i>x</i>	<i>s</i>
Saturated (S)				
C _{12:0}	0.39 ^B	0.07	0.53 ^A	0.13
C _{14:0}	3.90	0.47	4.72	0.66
C _{15:0}	0.55	0.03	0.59	0.06
C _{16:0 iso}	0.45 ^A	0.13	0.29 ^B	0.09
C _{16:0}	26.64 ^A	1.29	24.92 ^B	0.73
C _{17:0}	1.50	0.14	1.41	0.13
C _{18:0}	17.79 ^a	1.53	16.08 ^b	1.13
C _{20:0}	0.24	0.12	0.15	0.04
T o t a l	51.58 ^a	9.92	48.71 ^b	9.21
Monounsaturated				
C _{14:1}	0.55	0.05	0.59	0.04
C _{16:1}	4.14	0.18	4.09	0.12
C _{17:1}	0.87	0.61	0.99	0.13
C _{18:1}	39.23	2.30	38.59	1.44
C _{20:1}	0.33	0.12	0.25	0.03
T o t a l	45.12	16.55	44.51	16.07
Polyunsaturated (P)				
C _{18:2}	2.95 ^B	0.71	5.40 ^A	0.60
C _{18:3}	0.18 ^B	0.14	0.53 ^A	0.09
C _{20:4}	0.17 ^B	0.08	0.85 ^A	0.35
TOTAL	3.30 ^B	1.59	6.78 ^A	2.67
Unsaturated (U)	48.42 ^b	12.98	51.29 ^a	13.05
P : S	0.06		0.14	
U : S	0.94		1.05	

a, b – $P \leq 0.05$ A, B – $P \leq 0.01$

The results of the studies show high quality of meat in both groups, and are comparable with those of experiments performed on merino sheep (Milewski et al. 1995) and wool Kamieniecka sheep (Brzostowski et al. 1997), with rams slaughtered at the same time.

Table 3. Sensory evaluation of meat (points)

Specification	Groups			
	I		II	
	<i>x</i>	<i>s</i>	<i>x</i>	<i>s</i>
Tenderness	4.25	0.42	4.67	0.52
Juiciness	4.33	0.52	4.50	0.55
Aroma – intensity	5.00	0.00	5.00	0.00
Aroma – desirability	5.00	0.00	5.00	0.00
Taste – intensity	4.83	0.41	4.83	0.41
Taste – desirability	4.83	0.41	4.83	0.41
General evaluation	4.71	0.44	4.81	0.47

The quantitative and qualitative changes noted in fat as a result of crossing Kamieniecka ewes with Charolaise rams are beneficial. An increase in the level of polyunsaturated acids: linoleic and linolenic is especially important, as their too low content has an adverse effect on the taste and aroma of meat (Pearson et al. 1973). Linolenic acid may be a precursor in the process of formation of n-3 and n-6 fatty acids and their derivatives, which are believed to reduce the level of cholesterol in the blood (Connor et al. 1992). A positive effect of the Charolaise breed on the composition of fatty acids confirms the results of the investigations conducted by Ciuryk and Kaczor (1996), where Polish Pogórze wool ewes constituted the female line of breeding.

CONCLUSIONS

1. Crossbreeding of Charolaise rams with Kamieniecka ewes had a positive effect on meat quality, which was reflected by its lower fat content, somewhat better tenderness and juiciness, and a higher total score.

2. Favorable changes were observed in intramuscular fat of crossbreeds. They included a decrease in the proportion of saturated acids and an increase in the concentration of polyunsaturated acids, which allowed to improve significantly the ratios between unsaturated and saturated acids (U : S), and polyunsaturated and saturated acids (P : S).

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STRESZCZENIE

Badania przeprowadzono na 12 tryczkach polskiej owcy długowłnistej odmiany kamienieckiej i jej mieszańcach F_1 po ojcach rasy charolaise, poddanych ubojowi w wieku około 100 dni, przy masie ciała $30 (\pm 1,5)$ kg. W próbach mięśnia najdłuższego grzbietu (*longissimus dorsi*) określono: skład chemiczny, cechy fizykochemiczne i sensoryczne oraz skład kwasów tłuszczowych tłuszczu śródmięśniowego. Stwierdzono, że mięso mieszańców charakteryzowało się wyraźnie niższą zawartością tłuszczu oraz nieco jaśniejszą barwą w porównaniu z grupą kontrolną. Równocześnie odnotowano korzystne zmiany w składzie kwasów tłuszczowych tłuszczu śródmięśniowego. Nastąpiło istotne obniżenie zawartości kwasów nasyconych: palmitynowego ($C_{16:0}$), izopalmitynowego ($C_{16:0\text{ izo}}$) oraz stearynowego ($C_{18:0}$), przy jednoczesnym wzroście kwasów wielonienasyconych: linolowego ($C_{18:2}$), linolenowego ($C_{18:3}$) oraz arachidowego ($C_{20:4}$). W efekcie tych zmian ukształtowała się bardziej pożądana, z dietetycznego punktu widzenia, proporcja kwasów nienasyconych do nasyconych (U : S). Przy bardzo wysokiej sensorycznej ocenie jakości cech w obu badanych grupach mięso mieszańców uzyskało nieco wyższe noty za kruchość, soczystość i ocenę ogólną.