

QUALITY OF EWE CARCASSES AND POSSIBILITIES OF USAGE OF THEM TO MANUFACTURING OF SALAMI TYPE SAUSAGES

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Abstract. The purpose of the study was determination the usefulness of the meat of adult sheep – ewes rejected from the breeding flock, to manufacturing of salami type sausages, taking into particular consideration the age and the fatty grade. Animal materials were 1-year and 4-years old East Frisian ewes and carcasses obtained from them (40 pieces). Referring to fatty grade there were given off 4 groups essentially varying in meat-to-fat proportion. The quality of carcasses, quality of meat and finished product were evaluated. Statistical significant differenced were found in percentage of round-kidney fat and covering fat contents of carcasses. In the age groups the level of carcass fat contents was increasing with ewes' bodies' weights. Values of pH of searched muscles were on medium, not differing standards, level. Losses arising during storing and cooking were directly increasing according to meat maturation period. Losses levels were higher in *M. semimembranosus* than in *M. longissimus*. Significant influence of age group on losses was found during storage of *M. longissimus* after 4 days of maturation. Values of sharing force measured in 11-th day p.m. for *M. longissimus* were 2.8 or 3.1 kg/cm². These values are characteristic for delicate meat comparable to lamb meat. Sharing force measured after 11 days of maturing for *M. semimembranosus* was higher and was 3.9 to 4.1 kg/cm². Salami produced in two flavoring versions, independently on the maturation period, met the high acceptance of consumers. As a rule salami matured during 28 days was better assessed. Sausage made of carcasses of ewes of higher fat content had better sensory assess. Age of animals had negligible influence, statistical insignificant, on results of carried out evaluation.

Key words: sheep, carcass, meat, salami, quality

INTRODUCTION

Nowadays the consumption of mutton is almost unequivocally associated with consumption of lambs meat. Consumers in Germany and in many other European countries usually do not accept the meat of older animals because of its specific taste and aroma. In breeding of sheep, independent to type production, big part of slaughter animals are ewes rejected from the flock. In sheep livestock population of number 1 660 000 of ewes in Germany, it gives about 330 000 ewes yearly. Selling of these animals is difficult, and is often carried out with very low prices. Until now, meat of that group was refined by processing and sausages manufacturing in small range. In the research of Schnäckel et al. [2000] uncooked sausages with 60% rate of mutton, as well as products of ham, of ewes rejected from the herd, was positively assessed by the majority of testing consumers. Only a small part of the surveyed people, mainly of older respondents, resolute skeptically assessed sensory features of this kind of meat.

The purpose of the study was determination the usefulness of the meat of ewes rejected from the breeding flock, to manufacturing of salami type sausages, taking into particular consideration the age and the fatty grade. To avoid additional costs of refining of the product with other kinds of meats, the sausage was manufactured exclusively of mutton. The searching materials were carcasses and meat of East Frisian ewes rejected from the flock of Scientific-Searching Centre of Breeding Animals of Halle University in Merbitz (Germany).

MATERIAL AND METHODS

Animal materials were 40 adult sheep: 1-year (20 animals) and 4-years (20 animals) old East Frisian ewes. Animals were kept in bedding sheep shed, and were fed with all-mash feed and meadow hay. Lambing took place since February till March 2004. Lambs were taken away from their mothers 75 days after lambing and then the slaughter of ewes was carried out.

Fattening of carcasses was evaluated basing on the round-kidney fat, reticular fat and pelvis fat. Thickness of covering fat was evaluated on the highness of the last rib. Proportion of meat, fat and bones tissues were calculated basing on dissection of loin of veal taken from the right half-carcass.

Quality features of the meat were assessed basing on pH determined in 45 min and 48 hours *post mortum* (*p.m.*) in *M. longissimus* and in *M. semimembranosus*. These muscles taken from both half carcasses were packed to vacuum bags and kept in temperature of 4°C from 4 to 11 days *p.m.*

Next quality features were evaluated basing on:

- losses during storage (packings of 120 g);
- tri-chromatic value Minolta L^* , a^* , b^* ;
- losses during cooking (meat from packs of 50 g was cooked for 60 min in water bath of 75°C);
- shearing force of cooked meat samples. Tests were carried out on measuring apparatus for strength tests with shearing plates type Warner-Bratzler, Zwick Roell AG, (Ulm, Germany).

Sensory assessment of meat samples of *M. Longissimus*, heated up to temperature of 75°C with electric warming plate grate in point system according to standard DLG (Deutsche Landwirtschaftliche Gesellschaft), giving scores from 1. (unsatisfactory) up to 6. (excellent note). Intensity of sheep aroma was evaluated in three-scores from 1 score (intensive sheep aroma) up to 3 scores (no sheep aroma).

Left half carcasses, destined for production of salami and with cut off lower segments of limbs (forelimbs cut in wrist-joint, and hind-limbs cut in ankle joint), were frozen and separately stored. Basing on proportion of meat to fat established during loin of veal dissection, half carcasses were divided into 4 groups of fat contents in each of age group, and there were 8 different groups of 5 pieces of half-carcasses each. Before the sausage filling, the meat was de-frozen and then tendons and inside and covering fats were removed. Depending on needs only intra-muscle fat was left. Such raw material was milled in cutter and mixed with pickling salt, sugar, spices and then without starter cultures filled into casing. After 2- days drying, sausage was smoked during 2 days. Process of salami maturation was carried out in a specially adopted compartment in temperature of 15°C and air relative humidity of 80%. After seven or 28 days of maturation of 12 sausages of each group, in variant of spice of grainy pepper or garlic, the meat quality was assessed. There were determined the value of: product's pH, weight losses during production process and shearing force. Sensory assessment of final product was carried out by the group of specialists working according to instructions of DLG and by the group of consumers consisting of 21 up to 35 persons, which were giving from 1 up to 5 scores.

Statistic evaluation of the received results was carried out using statistic program SPSS 10 for Windows (1999). Influence of age and fat content of carcasses on the meat quality was evaluated using variance analysis ANOVA. Significance of differences between means was determined by Duncan Test. Dependences between meat-to-fat proportion and meat quality were presented using Pearson correlation.

RESULTS

Carcass quality

Live body weight of young ewes at slaughter was 65.6 kg and was significantly lower than body weight of 4-years old animals of which weight was average 77.5 kg (Table 1). Besides they had less fat. The portion of round-kidney fat in this age group was only 2.0%, and for sheep of 4 years this portion was 4.7%. Covering fat measured on the height of last rib was adequately 3.3 and 4.5 mm. Proportion of meat to fat in loin of veal was 0.25 (young ewes) and 0.35 (4-years old animals). Established, in accordance to fat proportion, 4 groups of carcasses were not statistically significantly differing with muscle-to-fat proportion (Table 1). There were found statistical significant differences in percentage of round-kidney fat and covering fat contents. In the age groups the level of fat contents was increasing with ewes' bodies' weights (Table 1).

Table 1. Live body weight at slaughter and fattening of carcasses depending on age of ewe and meat-fat proportion of loin of veal

Tabela 1. Masa ciała przed ubojem oraz parametry otluszczenia tusz pogrupowanych w zależności od wieku maciorki i stosunku mięsno-tłuszczowego nerkówki

Ewe group Grupa matek	n	Body weight Masa ciała kg		Covering fat Tłuszcz okrywowy mm		Kidney fat Tłuszcz okołonerkowy %		Meat-to-fat proportion Stosunek mięsno- -tłuszczowy	
		\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	s
1 year old: 1-roczne									
1/1	5	62.2 ^a	4.7	1.6 ^a	0.9	0.9 ^a	0.4	0.12 ^a	0.04
1/2	5	61.0 ^a	6.2	2.4 ^a	0.9	1.9 ^{ab}	0.6	0.21 ^b	0.02
1/3	5	68.6 ^a	10.9	4.0 ^b	0.7	2.4 ^b	1.0	0.27 ^c	0.02
1/4	5	70.6 ^a	6.1	5.4 ^c	1.1	2.9 ^b	1.1	0.41 ^d	0.07
4 years old: 4-letnie									
4/1	5	70.9 ^a	5.7	1.4 ^a	1.1	2.8 ^a	1.5	0.15 ^a	0.05
4/2	5	79.1 ^a	9.4	3.8 ^b	1.9	4.2 ^{ab}	2.5	0.30 ^b	0.05
4/3	5	77.9 ^a	8.8	5.4 ^{bc}	1.1	5.4 ^{ab}	2.3	0.41 ^c	0.01
4/4	5	82.2 ^a	7.2	7.4 ^c	1.7	6.4 ^b	1.5	0.55 ^d	0.10

Means within columns marked with different letters are significantly different at $P < 0.05$.Średnie w rubrykach oznaczone różnymi literami różnią się statystycznie istotnie na poziomie $P < 0,05$.

Meat quality

Influence of sheep age on meat quality features is presented in Table 2. To ensure the comparable fat contents in carcasses, in this evaluation group 4/4 was not taken into consideration. Values of pH of the searched muscles were at the medium, not differing from standards, level. Determined values of pH after 45 min. p.m. were proper, far from acidity characteristic for meat PSE. However, during measurements of pH after 48 hours p.m. 15% of the results exceeded the value of 6.0 and 7.5% exceeded the level 6.2, which shows the predisposition of meat to DFD – meat. These high values of pH were found in muscles of both animals age groups, especially in carcasses with low fat contents level. Raw material for hard sausages needs lower pH values practically, lower than 5.80, because lowering of pH level of the sausage is relatively time-consuming. Quality defects of meat DFD can be compensated by mixing it with meat of proper quality.

Losses arising during storing and cooking were directly increasing according to meat maturation period (Table 2). Losses levels were higher in *M. semimembranosus* than in *M. longissimus*. Significant influence of age group on losses was found during storage of *M. longissimus* after 4 days of maturation. Tri-chromatic values L^* and b^* determined for *M. longissimus* were significantly higher, and for a^* lower than for *M. semimembranosus*. In cases of older ewes in both muscles and in both maturation periods the value of b^* was significantly higher, and it means that colors range is shifted to yellow (Table 2).

Table 2. Comparison of meat quality from two age groups of ewe carcasses with similar fattening level

Tabela 2. Porównanie jakości mięsa z tusz owiec-matek dwóch grup wiekowych o podobnym stopniu otluszczenia

Factor Czynnik	<i>M. longissimus</i> Age of ewes – Wiek maciorek				<i>M. semimembranosus</i> Age of ewes – Wiek maciorek			
	1 year 1- roczne		4 years 4-letnie		1 year 1- roczne		4 years 4-letnie	
	\bar{x}	s	x	s	\bar{x}	s	\bar{x}	s
n	20		15		20		15	
1	2	3	4	5	6	7	8	9
pH _{45 min}	6.60	0.24	6.56	0.16	6.42	0.21	6.41	0.28
pH _{48 h}	5.67	0.15	5.7	0.25	5.71	0.29	5.67	0.23
4. day of meat maturing 4. dzień dojrzewania mięsa								
Losses during storage, % Straty p. przechowywania, %	0.8	0.2	0.7	0.8	0.6	0.3	0.5	0.2
Losses during cooking, % Straty p. gotowania, %	28.2	2.4	29.3	1.6	36.9	1.3	38.3	2.3
L*	37.1	3.7	39.1	2.6	32.2	3.6	33.9	3.0
a*	17.5	1.1	17.3	0.8	18.6	1.4	18.9	1.6
b*	0.3 ^a	1.3	1.2 ^b	1.0	-0.6 ^a	0.9	0.5 ^b	1.1
Shearing force, kg/cm ² Siła tnąca, kg/cm ²	4.4	0.8	4.5	1.0	6.9	1.3	6.3	0.8
Tenderness ¹⁾ , pt. Soczystość ¹⁾ , pkt.	4.8	0.5	4.6	0.4				
Succulence ¹⁾ , pt. Delikatność ¹⁾ , pkt.	4.4	0.8	4.0	0.9				
Aroma ¹⁾ , pt. Aromat ¹⁾ , pkt.	3.9	0.9	3.9	0.7				
General appearance ¹⁾ , pt. Łączne wrażenie ¹⁾ , pkt.	4.0	0.9	3.9	0.7				
Sheep aroma ²⁾ , pt. Aromat owczy ²⁾ , pkt.	2.3	0.6	2.4	0.5				
11. day of meat maturing 11. dzień dojrzewania mięsa								
Losses during storage, % Straty p. przechowywania, %	3.1 ^a	1.3	2.2 ^b	1.0	2.7	1.3	2.6	1.0
Losses during cooking, % Straty p. gotowania, %	31.1	3.6	31.0	2.3	39.4	3.2	39.7	2.2
L*	35.8	4.3	38.0	3.9	32.7	3.7	33.5	2.8
a*	18.1	1.4	18.4	1.5	19.1	1.8	20.0	1.3
b*	0.1 ^a	1.1	1.5 ^b	1.3	-0.3 ^a	1.0	0.6 ^b	0.8
Shearing force, kg/cm ² Tiła tnąca, kg/cm ²	3.1	0.9	2.8	0.6	4.3	0.9	3.9	1.1
Tenderness ¹⁾ , pt. Soczystość ¹⁾ , pkt.	4.6	0.4	4.7	0.4				
Succulence ¹⁾ , pt. Delikatność ¹⁾ , pkt.	4.8	0.7	4.5	0.6				

	1	2	3	4	5	6	7	8	9
Aroma ¹⁾ , pt.		4.3	0.6	4.0	0.8				
Aromat ¹⁾ , pkt.									
General appearance ¹⁾ , pt.		4.4	0.7	4.1	0.7				
Łączne wrażenie ¹⁾ , pkt.									
Sheep aroma ²⁾ , pt.		2.8	0.3	2.6	0.5				
Aromat owczy ²⁾ , pkt.									

¹⁾ Scoring from 1 = unsatisfactory to 6 = excellent.

²⁾ Scoring from 1 = intensive sheep aroma to 3 = no sheep aroma.

Means within rows and given muscle marked with different letters are significantly different at $P < 0.05$.

¹⁾ Punktacja od 1 = niedostateczny do 6 = wyśmienity.

²⁾ Punktacja od 1 = mocny aromat owczy do 3 = brak owczego aromatu.

Średnie w wierszach oznaczone różnymi literami różnią się statystycznie istotnie w obrębie danego rodzaju mięsna na poziomie $P < 0,05$.

Table 3. Correlation between meat-fat proportion of loin of veal and meat quality from *M. longissimus* and *M. semimembranosus* depending on meat maturing period

Tabela 3. Korelacje pomiędzy stosunkiem mięsno-tłuszczowym nerkówki a jakością mięsa z *M. longissimus* i *M. semimembranosus* w zależności od czasu dojrzewania mięsa

Factor Czynnik	4 days meat maturing Dojrzewanie 4-dniowe		11 days meat maturing Dojrzewanie 11-dniowe	
	<i>M. long.</i>	<i>M. semimembr.</i>	<i>M. long.</i>	<i>M. semimembr.</i>
Losses during storage, % Straty p. przechowywania, %	-0.01	0.34*	0.25	0.33*
Losses during cooking, % Straty p. gotowania, %	0.09	-0.01	0.27	0.09
L*	-0.43**	-0.31	-0.33*	-0.14
a*	0.56**	0.32*	0.32*	0.15
b*	-0.31	-0.28	-0.25	-0.01
Shearing force, kg/cm ² Siła tnąca, kg/cm ²	-0.34*	-0.15	-0.31	-0.22
Tenderness ¹⁾ , pt. Soczystość ¹⁾ , pkt.	0.16		0.03	
Succulence ¹⁾ , pt. Delikatność ¹⁾ , pkt.	0.35*		0.10	
Aroma ¹⁾ , pt. Aromat ¹⁾ , pkt.	0.27		0.24	
General appearance ¹⁾ , pt. Łączne wrażenie ¹⁾ , pkt.	0.28		0.19	
Sheep aroma ²⁾ , pt. Aromat owczy ²⁾ , pkt.	0.32*		0.10	

¹⁾ Scoring from 1 = unsatisfactory to 6 = excellent.

²⁾ Scoring from 1 = strong sheep aroma to 3 = no sheep aroma.

* $P < 0.05$; ** $P < 0.01$.

¹⁾ Punktacja od 1 = niedostateczny do 6 = wyśmienity.

²⁾ Punktacja od 1 = mocny aromat owczy do 3 = brak owczego aromatu.

* $P < 0,05$; ** $P < 0,01$.

Values of shearing force measured in 11-th day p.m. for *M. longissimus* were 2.8 or 3.1 kg/cm². These values are characteristic for delicate meat comparable to lamb meat. Shearing force measured after 11 days of maturing for *M. semimembranosus* was higher and was 3.9 to 4.1 kg/cm². There were not statistically significant differences between meats of different age groups. Meat of 4 years old animals, after cooking, showed smaller shearing force. Whereas the assessment of tenderness of grilled meat samples from older sheep, in comparison to meat from young ewes, was less favorable. Number of scores given during assessing of tenderness and succulence was high and ranged from 4.0 to 4.8. Insignificantly lower sensory assessment, from 3.9 to 4.3 of scores showed for meat aroma. Assessed separately aroma intensity was directly lowering according to the time of meat maturing, and did not depend on animals age.

Correlations of meat-to-fat proportion and meat quality in dependence to the time of maturing are shown in Table 3. Bigger fat content was correlated with a higher loss during storage. Besides there were lowered values of L^* and b^* , and increased values of a^* . Fat contents had positive influence on the shearing force value and on sensory features. As a rule there were correlations on low level and statistically not significant.

In our research the intensity of sheep aroma was decreasing directly to increasing fat contents. For *M. longissimus* this correlation was statistically significant (Table 3).

Quality of mutton salami

Results of quality assessment of ready product, manufactured of extremely different fat contents in carcasses, of the age group are shown in Tables 4 and 5. Salami produced of carcasses of low fat contents (1/4 and 4/1) was characterized by higher weight losses during drying or maturation (Fig. 1). There was not noticed a significant influence of animals age on this feature ($P > 0.05$). Quicker drying of sausages, made of low fat contents carcasses, caused higher cutting strength (Fig. 2). This tendency, noticed already after 7 days of maturing period, was especially noticeable after next three weeks ($P < 0.05$). Whereas characteristics of salami produced of meat of 4 years old sheep, after 28 days of maturing, showed higher values of shearing force in comparison to products of 1 year old animals carcasses ($P < 0.05\%$).

Despite abandonment of starting cultures addition to product, values of pH were low (Tab. 4). Probably it was caused by high addition of sugar: average of 2.5%. Excluding group 1/1, values of pH determined as 7 were on this level till the end of maturation period. Low values of active acidity caused relatively strong acid taste of ready product, which was negatively assessed during sensory assessment by method DLG. It should be noticed that sourish taste is differently assessed in different regions and is preferred by some consumers.

Salami manufactured of 4 years old sheep, in most of cases was characterized with significantly higher level of pH ($P < 0.05$). Obtained lower values of pH of searched salami in the same age group was as a rule correlated to high level of carcasses fat contents and could be caused by lower protein contents and consequently lower buffer capacity of product.

During scores assessment carried out according to standard DLG, salami of sheep meat had relatively average scoring. Technology conditions are as follows: turbid sausage intersection, empty places, and wormholes and inclination to creating of dry edges and beads with tendons.

Table 4. Level of pH and sensory assessment (according to instructions of DLG) of sheep salami on 7 and 28 days after manufacturing

Tabela 4. Poziom pH i wyniki oceny organoleptycznej (wg standardu DLG) salami owczego po 7 i 28 dniach po wyprodukowaniu

Group of carcasses and days of salami maturing days Grupa tusz i okres dojrzewania salami dni	n	pH		Total scores assessment ¹⁾ Łączny wynik oceny ¹⁾		Intensity of sheep aroma ²⁾ Intensywność aromatu owczego ²⁾	
		\bar{x}	s	\bar{x}	s	\bar{x}	s
		7 days of maturing 7 dni dojrzewania					
1/1	6	4.58 ^a	0.03	3.20 ^a	0.15	1.42 ^a	0.56
1/4	6	4.61 ^a	0.02	3.40 ^b	0.00	2.33 ^b	0.26
4/1	6	4.81 ^b	0.03	3.18 ^a	0.20	1.85 ^{abc}	0.99
4/4	6	4.65 ^c	0.03	3.43 ^c	0.14	1.25 ^c	0.45
28 days of maturing 28 dni dojrzewania							
1/1	6	4.70 ^a	0.02	3.43 ^a	0.23	1.23 ^a	0.43
1/4	6	4.63 ^b	0.02	3.92 ^b	0.29	1.53 ^a	0.68
4/1	6	4.80 ^c	0.09	3.22 ^a	0.20	0.33 ^b	0.52
4/4	6	4.64 ^{ab}	0.04	3.78 ^b	0.24	0.33 ^b	0.52

¹⁾ According to instructions of DLG: with sensory assessment of visual property, consistency, aroma and taste, 1 = definitely negative, 5 = complete fulfillment of expectations.

²⁾ 0 = no sheep aroma, 3 = strong sheep aroma.

Means for given maturing period marked with different letters are significantly different at $P < 0.05$.

¹⁾ Wg standardu DLG: zawiera ocenę właściwości wizualnych i smakowych; konsystencja, zapach i smak: 1 = zdecydowanie negatywna, 5 = całkowite spełnienie oczekiwań.

²⁾ 0 = brak aromatu owczego, 3 = mocny aromat owczy.

Średnie oznaczone różnymi literami alfabetu w danym czasie różnią się istotnie na poziomie $P < 0,05$.

Inside of the same fat contents products groups, there were not noticed the influence of animals age on the results of sensory assessment of salami. As a rule salami matured during 28 days was better assessed. Inquired consumers group did not unequivocally assess any sausage group as the best (Table 5). In the same age group, better results of sensory assessment carried out by method DLG were obtained for meat of carcasses with more fat. The general appearance and look of these products were better assessed by the inquired consumers. Respondents often emphasized that the rate of connective tissue in salami made of meat of carcasses, of low fat content, was too high. Lower usability of younger animals meat to sausage manufacturing could not be confirmed this way. Meat defatting had much bigger influence on sausage quality than the age of animals.

Referring to persons assessing in accordance with criteria and rules of DLG, typical sheep aroma of product for meat of 4 years old animals was significantly lower than for salami manufactured of young ewes carcasses ($P < 0.05$). It was confirmed by the results of sensory assessment of aroma of grilled *M. longissimus* after 11 days of maturing.

Table 5. Sensory assessment of salami carried out by the group of consumers on 7 and 28 days after manufacturing (% of respondents)

Tabela 5. Ocena sensoryczna salami po 7 i 28 dniach po wyprodukowaniu przeprowadzona wśród grupy konsumentów (% ankietowanych)

Maturing period Okres dojrzewania	7 days – 7 dni				28 days – 28 dni			
	1/1	1/4	4/1	4/4	1/1	1/4	4/1	4/4
Group of carcasses Grupa tusz								
General appearance Wygląd ogólny								
Very promising Bardzo obiecujący	19.1	23.8	18.7	21.8	17.4	21.7	24.0	28.0
Promising Obiecujący	71.4	66.7	65.6	75.0	69.6	78.3	64.0	72.0
Little promising Mało obiecujący	9.5	9.5	15.7	3.2	13.0	0.0	12.0	0.0
Share of connective tissue Udział tkanki łącznej								
Too high Za wysoki	42.9	28.6	50.0	9.4	26.6	0.0	28.0	12.0
Acceptable Akceptowalny	47.6	61.9	50.0	75.0	65.2	91.3	60.0	72.0
Too low Za mały	9.5	9.5	0.0	15.6	8.7	8.7	12.0	16.0
Share of fat Udział tłuszczu								
Too high Za wysoki	9.5	9.5	18.2	6.2	0.0	0.0	0.0	0.0
Acceptable Akceptowalny	71.4	76.2	75.8	78.2	82.6	91.3	84.0	72.0
Too low Za mały	19.1	14.3	6.0	15.6	17.4	8.7	16.0	28.0
Sheep aroma Aromat owczy								
No smell Nie wyczuwalny	57.1	57.1	43.8	59.4	47.8	39.1	36.0	44.0
Smell, but acceptable Wyczuwalny, ale akceptowalny	42.9	38.1	53.1	40.6	43.5	56.5	56.0	48.0
Too intensive Zbyt intensywny	0.0	4.8	3.1	0.0	8.7	4.3	8.0	8.0
General appearance of product Łączne wrażenie produktu								
Good to very good Dobre do bardzo dobrego	47.6	71.4	50.0	50.0	47.8	60.9	48.0	56.0
Acceptable Do zaakceptowania	47.6	28.6	43.8	50.0	39.1	39.1	48.0	36.0
Rather not acceptable Raczej nie do zaakceptowania	4.8	0.0	6.2	0.0	13.1	0.0	4.0	8.0

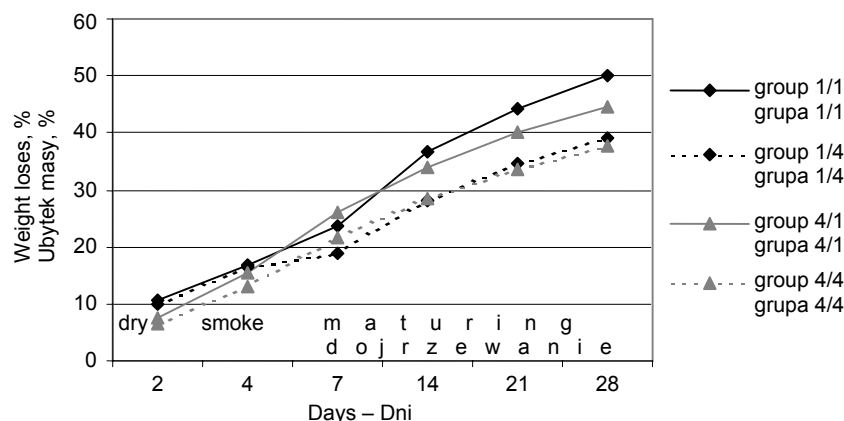


Fig. 1. Weight losses of salami during manufacturing
Rys. 1. Ubytek masy salami w procesie produkcyjnym

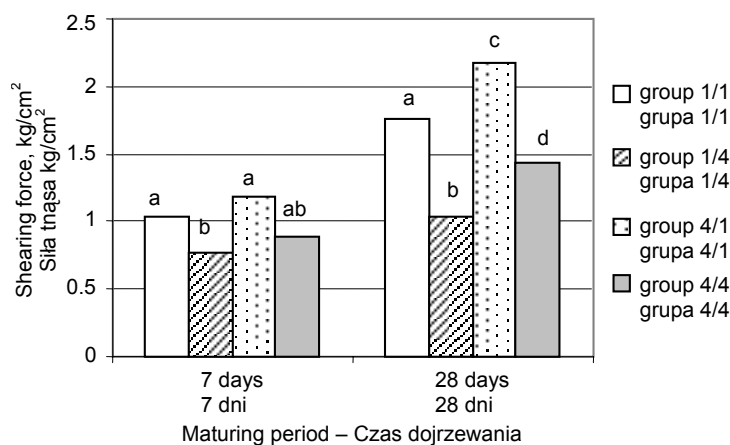


Fig. 2. Shearing force of salami after 7 and 28 days of maturing
Rys. 2. Siła tnąca salami po 7 i 28 dniach dojrzewania

In the same age group, the grade of fat contents had no significant influence on intensity of sheep aroma of salami after 28 maturing days. In matured for 7 days sausage, only in the case of 1 year old animals, there was noticed statistically significant aroma increasing direct to fat content increasing ($P < 0.05$). More than 95% of the inquired persons assessed that the specific aroma was impossible to notice or that it exists but does not cause problems and is completely acceptable. The influence of age nor fat content group during this assessment was not recognized by respondents. Results found during these investigations, concerning the maturing period influence on aroma intensity were inconsistent. When panel assessing the final product with DLG method, assessed the aroma in sausages, matured during 7 days, as stronger than in sausages of matured 28 days, consumers more often felt the sheep aroma in product of longer maturation.

DISCUSSION

Both after 4 days and 11 days of meat maturing of *M. longissimus* there were determined smaller values of shearing forces than of *M. Semimembranosus*. These results are compatible to literature data for lamb meat [Hopkins and Fogarty 1998, Boleman et al. 2003, Kerth et al. 2003]. In own research the shearing force lowered to 40% in both muscles according to maturing period. In professional literature shearing force values in *M. longissimus* of lamb meat after the short maturing period (1 to 2 days p.m.) were on relative high level, and amounted from 5.7 up to 8.8 kg/cm² [Koochmaraie et al. 1995, Scheeder et al. 1999, Wheeler and Koochmaraie 1999, Redmond et al. 2001, Hoffman et al. 2003, Veiseth et al. 2004]. Smaller values of this feature from 1.5 up to 2.2 kg/cm² are given by Carson et al. [1999]. According to literature data, after 7 to 14 days of maturing, the shearing force lowered and was 2.0 to 4.7 kg/cm² [Hopkins and Fogarty 1998, Taylor and Koochmaraie 1998, Scheeder et al. 1999, Wheeler and Koochmaraie 1999, Hatfield et al. 2000, Goodson et al. 2001, Safari et al. 2001, Boleman et al. 2003, Kerth et al. 2003, Shackelford et al. 2004]. Shearing force specified in Boleman et al. [2003] research of *M. Semimembranosus* which matured during 10 days, was 3.5 kg/cm².

During comparison of own results with literature data there should be taken into account that there can exist other factors having influence on shearing force such as breed, feeding intensity, cooling process, meat processing after sampling (freezing or analysis of fresh meat) or cooking method. Jeremiah et al. [1998] searching meat of sheep slaughtered in age of 6 up to 15 months stated that there is no influence of animal's age on this feature. While Hatfield et al. [2000] stated that there is significant increasing of shearing force of sheep meat from animals slaughtered between 7 and 15 months of life. Contrary dependence of lowering of shearing force for animals slaughtered between 2 and 10 or 3 and 8 months of life was correspondingly stated by Veiseth et al. [2004] and Duckett et al. [2000]. One of reasons of such a situation is lowering of calpastatine activity with simultaneously increasing of calpaine activity and elongation of sarcomer directly to ageing [Veiseth et al. 2004]. However, professional literature concerning the problems of tenderness changes of old aged sheep meat is lacking. The research of Smith et al. [1969] comprised meat taken from sheep slaughtered at age of 3 to 21 months, and the worst assessment of muscular tissue tenderness was for sheep at age over 19 months. In the research of the above mentioned authors there were not stated the relationship between animals age and shearing force nor tenderness of obtained meat of sheep slaughtered between 5 and 15 month of life. Losses during cooking of *M. Semimembranosus*, stated in own experiment, were bigger than of *M. Longissimus*. They confirm the tests of Yanar et al. [1999] carried out on ewe meat.

Evaluation of succulence and tenderness of meat tested for this elaboration, was similar to analogical tests on East-Frisian lambs [Quanz and Jatsch 2000]. Simultaneously it was stated that there was a positive influence of carcass fat contents on sensory features and shearing force. These results are confirmed by the research of Quanz [1995], where percentage ratio of fat in precious parts of lamb carcasses was in positive correlation with sensory assessment of meat quality. During study of Schönfeldt et al. [1993], meat from carcasses of higher fat contents was tenderer.

We are waiting for results of inside-muscle fat extraction, which should give us an answer to the question concerning its contents in loin of veal in correlation to fat-to-meat proportion of cut off portion. They will be the subject of a separate publication. During Süß's et al. [1998] research, these values were on low and medium levels. Contents of inside-muscle fat in pork and beef had advantageous influence on the meat

quality [Bejerholm and Barton-Gade 1986, Lütjens and Kalm 1995]. According to Heylen et al. [1998], samples of lamb meat of *M. longissimus* of inside-muscle fat contents 3.5-4.5% have the best taste features. Such high inside-muscle fat content was charged with higher total fat contents in lamb carcasses, and was difficult to accept by most consumers.

There is relatively scanty professional literature concerning correlation of fat contents to sheep aroma intensity. According to Crouse [1983] more fatty carcass is accompanied with more intensive sheep aroma. But Schönfeldt et al. [1993] did not find any differences of specific animal aroma between meat from animals of completely different fat constants. Such results enable to assume that the intensity of mutton aroma is caused not only by excessive fat contents. Crouse et al. [1982] and Purchas et al. [1986] searching the sheep adipose tissue did not find the appearance of chemical compounds or groups of fatty acids determining the sheep aroma intensity. Field et al. [1983] searching the meat of sheep slaughtered in the same age found that thickness of covering fat has no significant influence on sheep aroma. Brennand and Lindsay [1982] could point out the influence of volatile fatty acids with branched chain with 8 and 9 atoms of carbon, on specific aroma and taste of the given sort of lamb meat. But Young et al. [1997] searching fatty acids: 40-octane methyl, 4-nonan methyl extracted from covering fat, stated that the race of sheep influences their level.

CONCLUSIONS

Ewes of East-Frisian sheep, in spite of high variation of carcasses fat contents, are characterized by good meat quality, acceptable on the market. Alternative for selling of slaughter ewes can be its refining and purification by manufacturing of hard sausages, partially dried, and produced without other kinds of meat additives. Manufactured in two spice variants salami, independent of maturing period, was highly assessed and accepted by consumers. Sausages made of ewe carcasses of higher fat contents were sensory better assessed. Age of animals had negligible influence, as a rule statistically insignificant, on the results of the carried out evaluation.

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JAKOŚĆ TUSZ OWIEC DOROSŁYCH I MOŻLIWOŚĆ ICH WYKORZYSTANIA DO PRODUKCJI KIELBAS TYPU SALAMI

Streszczenie. Celem pracy było określenie przydatności mięsa owiec dorosłych – matek wybrakowanych ze stada do produkcji kielbasy typu salami, ze szczególnym uwzględnieniem wpływu wieku i stopnia otluszczenia. Materiał zwierzęcy stanowiły 1-roczone i 4-letnie matki fryzyjskie i pozyskane od nich tusze (40 sztuk). Wydzielone ze względu na stopień otluszczenia, 4 grupy tusz statystycznie istotnie różniły się stosunkiem mięsno-tłuszczowym. Oceniono jakość tusz, jakość mięsa oraz produktu gotowego. Stwierdzono statystycznie wysokoistotne różnice w procentowej zawartości tłuszczu okołonerkowego i grubości tłuszczu okrywowego tusz. W obrębie badanych grup wiekowych poziom otluszczenia tuszy wzrastał wraz z masą ciała maciorek. Wartości pH badanych mięśni były na średnio wysokim, nie odbiegającym od normy poziomie. Straty przy składowaniu i gotowaniu wzrastały wraz z okresem dojrzewania mięsa. Straty przy gotowaniu osiągnęły dla *M. semimembranosus* wyższe wartości niż dla *M. longissimus*. Istotny wpływ wieku stwierdzono tylko w stratach przy składowaniu *M. longissimus* po 4 dniach dojrzewania. Wartości siły tnącej określonej 11 dnia p.m. w *M. longissimus* wynosiły 2,8 bądź 3,1 kg/cm². Były to wartości charakterystyczne dla delikatnego, porównywalnego z jagnięciną mięsa. Siła ścinająca określona w dojrzewającym przez 11 dni *M. semimembranosus* była wyższa i wynosiła 3,9-4,1 kg/cm². Produkowane w dwóch wariantach przyprawowych salami, niezależnie od okresu dojrzewania, było akceptowane przez konsumentów. Z reguły salami dojrzewające przez 28 dni było oceniane wyżej. Kielbasa z tusz owiec o wyższym udziale tłuszczu została jednocześnie wyżej oceniona sensorycznie. Wiek zwierząt miał niewielki, z reguły statystycznie nieistotny, wpływ na wyniki przeprowadzonej oceny.

Słowa kluczowe: owca, tusza, mięso, salami, jakość

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