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Influence of lamb fattening method and weight standard on carcass and meat quality

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SUMMARY – In two experiments carried out on a total of 64 ewe- and ram-lambs, the influence of the fattening method (intensive and semi-intensive) and weight standards on carcass quality and muscle tissue quality and composition was investigated. Both, fattening methods and weight standards significantly influenced slaughter performance, fatness indices, the results of carcass classification according to the conformation and musculature, as well as according to the fatness in the case of the weight standard. All values were higher in intensive fattening and in higher weight standards. No significant influence on muscle tissue composition and quality was observed, including the profile of fatty acids and the cholesterol content. Although the weight standards were lower for ewe-lambs than ram-lambs, the fatness of the ewes' carcasses was higher, but there were no significant differences in meat composition and quality.

Key words: Lamb, fattening methods, weight standards, carcass, meat.

RESUME – *"Influence de la méthode d'engraissement des agneaux et du poids standard de la carcasse sur la qualité de la viande". Dans deux expériences faites sur 64 agneaux et agnelles on a étudié l'influence de deux modes d'engraissement d'agneaux de boucherie: intensif et semi-intensif et de deux differents niveaux de poids d'abattage sur la conformation de la carcasse et la qualité de la viande. On a constaté que le mode d'engraissement et le poids ont influencé nettement le rendement (poids de la carcasse), l'état d'engraissement et les résultats de classification EUROP. On n'a pas constaté d'influence nette sur les composants et la qualité de la viande y compris la composition des acides gras et le contenu de cholestérol. Les agnelles étaient plus grasses, indépendamment du poids et les animaux d'engraissement intensif étaient plus lourds.*

Mots-clés : *Agneaux, mode d'engraissement, niveaux de poids, carcasse, viande.*

Introduction

The investigations carried out so far (Osikowski *et al*., 1997) have shown the possibility of serious improvement of local sheep breeds' prolificacy by means of crossing them with prolific breeds. However, considering the fact that prolific breeds generally worsen the crossbreds' slaughter value (Osikowski and Borys, 1996), prolific breeds are usually used in multistage schemes of commercial crossbreeding.

European consumers prefer well-tasting meat of young lambs, with high content of muscle and low of fat tissue, at the same time they expect dietetically favourable composition of fatty acids and low cholesterol content. The lambs' slaughter value and meat quality is significantly affected by many zootechnical factors. The most important ones are the genotype, sex, fattening method, age and weight standard of the slaughtered lambs (Borys and Osikowski, 1998; Osikowski *et al.*, 1997; Rowe *et al*., 1999; Vergara *et al*., 1999).

The experiments were carried out to find out to what extend the fattening method and weight standard can affect carcass quality and meat composition and quality in housed lambs from crossing prolific-type ewes and meat-breed rams.

Material and methods

The experimental fattening was repeated twice (I in 1998 and II in 1999), on a total of 64 lambs

from crossing Suffolk rams and ewes of the prolific line Merinofinn Mf-40 (Osikowski and Borys, 1977). The experimental fattening were carried out beginning after weaning at 56 days up to the intended final body weight. The lambs were fattened in two weight standards, the lower (L, ewe-lambs to 20-25, ram-lambs to 25-30 kg) and the higher (H, ewe-lambs to 30-35, ram-lambs to 35-40 kg).

Two fattening methods were used (Osikowski *et al*., 1993). One intensive (I) aimed at daily gains of 250–300 g, with all-mush fed *ad libitum* (6,3 MJ NE and 160 g of crude protein per 1 kg) and the structural addition of hay (70 g per 1 kg all-mash). The semi-intensive method (SI) was used in the limited feeding system for reach daily gains of 200-250 g and based on maize silage, hay and dry mash.

The slaughter, measurements and the division of the half-carcass into cuts, as well as the partial dissection of the right half-carcass were completed according to the simplified methods used in the National Research Institute of Animal Production (Nawara *et al*., 1963). The conformation and fatness of the carcasses were evaluated according to the European Union standards EUROP (Anonymous, 1992). The contents of the muscle and fat tissues in the half-carcass were estimated by means of regression equations (Osikowski, 1977).

The basic physical and chemical values of muscle tissue were measured in the *M. adductor*: dry matter – the method of drying in 105°C temperature; protein – the Kjeldahl method; fat – the Soxhlet method; water-holding-capacity – Grau-Hamm method; and the muscle colour ("L") with a Chroma Meter CR-300 apparatus.

The mass losses during roasting was measured in the *M. semimembranosus* (at a temperature of 160°C and 82°C inside the muscle), and the tenderness after roasting was measured with the Warner-Bratzler apparatus and collectively evaluated by the 5-grade sensorial method elaborated by Tilgner (1957).

The fatty acids profile and the cholesterol content were estimated in the *M. semitendinosus* intramuscular fat by the gas chromatography with a Hewlett Packard s.II apparatus with the BPX70 column 50 m x 0.22 mm x 0.25 m for fatty acid and a Hewlett Packard 5890 s.II with the HP-1 column 25 m x 0.2 mm x 0.11 m for cholesterol content.

The results were analysed separately for the ram-lambs and ewe-lambs, by means of a three-factor variance analysis (fattening method, weight standard, repetition) model with interaction (Ruszczyc, 1978).

Results and discussion

The intensive fattening compared with semi-intensive, improved the dressing percentage of both sexes (by 2.6 percent units, significant for both sexes at P 0.01), enlarged the surface of the loin "eye" (by 13.6% respectively, for ram-lambs at P 0.05) and the fat thickness over loin "eye" (by 32.4%, NS) and had an influence on the carcass conformation classification – most carcasses in the intensive fattening belonged to the U and R classes (82% on the average), while in the semi-intensive system to the R and O (79%) (Tables 1 and 2).

Evident differences in muscle composition and quality caused by the fattening method were not observed, except for less intensive muscle colour and higher MUFA content in the intensively fattened rams – by 6.6 and 4.8% respectively (Table 3).

Fattening the lambs of both sexes to higher weights primarily caused higher fatness and higher dressing percentage (Table 1). The carcasses of the heavier lambs were given higher classes for the conformation (most carcasses of H group in U and R classes, and of L group in R and O ones), and at the same time belonged to the higher fatness classes – in H groups to IIIL and IIIH, and in L to II and IIIL (Table 2).

In general, the weight standard caused larger differences of fatness in ewe- than in ram-lambs. Likewise, the differences in the quality and composition of the muscle tissue were also more distinct in

ewe-lambs (Table 3). The statistically significant dry matter content in the muscles was higher in the heavier ewes and rams, the protein in the rams and the fat content in the ewes – all differences significant at P 0.05. In the ewe-lambs however, the differences in the sensoric estimation of meat palatability (higher in H groups), the SFA content (higher in L), and the PUFA 6: 3 ratio (higher in H) were statistically significant (Table 3).

Table 1. Slaughter value

	Sex	Fattening method†				Weight standard††				Repetition			
		I		SI		L		H		I		II	
		$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%
No. of lambs	Ewe	16		16		16		16		16		16	
	Ram	16		16		16		16		16		16	
Mass at the end of fattening (kg)	Ewe	33.1	14.5	31.4	15.8	27.9B	8.5	36.6A	6.0	32.6	16.4	31.8	14.1
	Ram	28.8	15.5	27.9	16.8	24.0B	5.6	32.7A	4.5	28.5	17.1	28.2	15.3
Dressing (%)	Ewe	44.2A	3.9	41.4B	5.5	41.7B	6.1	43.9A	4.1	42.1	6.3	43.4	4.7
	Ram	45.2A	5.3	42.8B	7.3	42.6B	7.4	45.8A	4.4	43.1b	8.5	45.2a	4.3
Content in half-carcass (%)													
Muscular tissue	Ewe	60.4	7.1	62.5	6.5	61.3	7.4	61.7	6.5	61.3	8.6	61.7	4.8
	Ram	62.4	6.7	62.0	8.5	63.5	6.3	60.8	8.4	63.8	6.1	60.5	8.2
Fat tissue	Ewe	18.6	17.2	18.0	15.7	17.3	19.2	19.4	11.7	17.9	18.9	18.7	13.8
	Ram	19.8	12.8	19.6	19.9	18.0B	14.5	21.4A	14.0	18.6	19.7	20.9	11.4
Fat-meat ratio	Ewe	0.31	24.0	0.27	18.0	0.28	26.3	0.32	15.5	0.29	25.9	0.31	17.4
	Ram	0.32	15.9	0.32	26.5	0.28B	14.8	0.36A	20.4	0.29	23.7	0.35a	17.1
Loin "eye" area (cm^2)	Ewe	11.0a	14.2	9.5b	17.7	9.2B	16.4	11.3A	13.0	10.2	19.7	10.3	15.1
	Ram	10.7	15.5	9.6	17.5	9.0B	15.1	11.4A	11.2	10.1	19.2	10.2	15.3
Fat layer over loin "eye" (mm)	Ewe	2.2	48.9	1.6	32.4	1.5b	43.7	2.3a	40.2	2.0	35.9	1.9	56.0
	Ram	2.7	48.2	2.1	55.0	1.6B	35.1	3.2A	39.3	2.3	48.6	2.5	55.7

†I: intensive; SI: semi-intensive.
††L: lower; H: higher.
^{AB}P 0.01; ^{ab}P 0.05.

Table 2. Carcasses classification according to EU standards (% of carcasses) †

Class	Fattening method				Weight standard				Repetition			
	Ram		Ewe		Ram		Ewe		Ram		Ewe	
	I	HI	I	HI	L	H	L	H	I	II	I	II
Conformation												
E	–	–	6	6	–	–	–	13	–	–	13	–
U	44	13	50	13	6	50	6	56	25	31	25	38
R	31	63	38	44	56	38	50	31	50	44	38	44
O	25	25	6	25	38	13	31	–	25	25	13	19
P			–	13	–	–	13	–	–	–	13	–
Fatness												
II	13	31	38	38	44	–	75	–	25	19	31	44
IIIL	69	44	38	38	56	56	25	50	56	56	50	25
IIIH	19	25	25	25	–	44	–	50	19	25	19	31

†Symbols of the groups as in Table 1.

The technological factors investigated (fattening method, weight standard) did not have of greater influence on the profile of fatty acids or cholesterol content, very important in respect of dietetic value

of the meat.

Table 3. Physical and chemical characteristics and sensory evaluation of lamb meat

Item†	Sex	Fattening method (F)				Weight standard (W)				Repetition (R)			
		I		SI		L		H		I		II	
		$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%	$\bar{x}$	Cv%
Water holding capacity (%)	Ram	26.9	10.1	26.5	12.6	26.1	10.5	27.4	11.7	26.9	10.0	26.6	12.7
	Ewe	26.4	12.2	25.0	10.2	26.0	13.9	25.4	8.4	25.9	10.4	25.4	12.6
Colour "L"	Ram	42.2a	7.7	39.6b	5.8	41.6	5.8	40.2	8.8	40.7	7.8	41.1	7.4
	Ewe	40.1	5.8	40.4	7.1	41.1	6.7	39.4	5.5	40.9	7.3	39.6	5.0
Tenderness (kg)	Ram	13.1	25.6	11.8	34.5	13.5	28.1	11.4	30.7	12.0	34.4	12.9	26.0
	Ewe	13.5	28.4	14.3	23.6	13.7	26.7	14.1	25.5	12.8	25.2	15.0	24.6
Chemical composition (%)													
Dry matter	Ram††††	24.1	2.9	24.0	4.6	23.7b	3.3	24.4a	3.9	23.8	4.0	24.2	3.5
	Ewe	24.2	4.7	24.6	4.2	24.0b	4.2	24.9a	4.0	24.3	4.6	24.6	4.3
Protein	Ram†††††	19.6	5.2	19.8	3.7	19.4b	4.8	20.0a	3.5	19.4	5.4	19.8	3.3
	Ewe	19.9	6.1	19.5	4.6	19.7	5.9	19.6	5.1	19.4	5.6	20.0	5.1
Fat	Ram	2.6	28.1	2.3	26.6	2.5	30.8	2.3	24.1	2.5	27.6	2.4	28.6
	Ewe	2.4	16.3	2.2	26.5	2.1a	22.7	2.5a	18.3	2.2	21.3	2.4	21.5
Sensory evaluation (pnt.)													
Flavour	Ram	4.4	6.6	4.2	5.5	4.3	7.2	4.4	4.9	4.4	4.4	4.2	7.4
	Ewe	4.4	4.3	4.4	5.8	4.4	5.1	4.4	5.1	4.3	5.3	4.4	4.6
Tenderness	Ram†††††	4.2	6.8	4.1	9.4	4.2	8.8	4.1	7.3	4.3	8.8	4.1	6.7
	Ewe	4.1	5.4	4.2	7.4	4.1	5.3	4.2	7.1	4.1	6.3	4.2	6.6
Juiciness	Ram	4.2	5.9	4.1	5.6	4.1	6.3	4.1	5.4	4.1	6.0	4.1	5.7
	Ewe	4.2	5.7	4.3	3.7	4.2	5.8	4.3	3.5	4.3	4.7	4.3	5.0
Palatability	Ram	4.3	8.8	4.2	5.0	4.2	7.7	4.4	6.2	4.3	5.1	4.2	8.7
	Ewe	4.3	5.8	4.3	6.4	4.2b	6.9	4.4a	4.2	4.3	5.9	4.3	6.4
SFA (%)	Ram††	42.2	4.2	43.7	6.4	42.7	5.2	43.2	6.1	42.5	5.4	43.4	5.7
	Ewe	41.6	3.9	42.9	4.4	42.9a	4.1	41.6b	4.2	42.4	4.6	42.1	4.2
MUFA (%)	Ram†††	46.0a	5.7	43.9b	6.7	44.5	7.8	45.4	5.0	43.8b	6.9	46.1a	5.2
	Ewe	45.3	5.1	44.3	3.6	45.1	4.2	44.4	4.8	44.5	4.9	45.1	4.2
PUFA (%)	Ram†††	10.4	27.5	11.2	41.6	11.4	40.1	10.2	28.3	12.0	36.7	9.6	29.5
	Ewe	11.9	26.6	11.7	20.2	10.8	20.7	12.8	23.2	11.7	21.7	11.9	25.5
PUFA 6: 3	Ram	5.1	15.7	5.1	20.6	5.1	11.6	5.0	23.2	4.7b	16.6	5.5a	16.2
	Ewe	4.8	20.4	4.9	18.4	4.4B	12.9	5.4A	18.3	4.5b	15.2	5.2a	19.7
Cholesterol (mg/100 g)	Ram†††	60.5	13.6	58.5	12.8	58.0	12.5	60.9	13.6	55.1B	10.4	63.8A	11.6
	Ewe	58.6	12.4	61.1	14.8	59.4	11.9	60.3	15.5	57.3	14.7	62.4	11.7

†SFA: saturated fatty acid; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid.
††Interaction FxR significant at P 0.01.
†††Interaction WxR significant at P 0.01.
††††Interaction FxW significant at P 0.05.
†††††Interaction FxR significant at P 0.05.
††††††Interaction WxR significant at P 0.05.
^{AB}P 0.01; ^{ab}P 0.05.

The effect of the repetition on the meat quality and composition was generally small. Only the differences in the dressing percentage and the fat-meat ratio in ewe-lambs were statistically significant (P 0.05), while the estimated muscle tissue content was much lower, and fat tissue content much higher in the carcasses in the repetition II than in I (Table 1). The differences in the muscle tissue quality between the repetitions were more distinct only in the profile of fatty acids and the cholesterol content (Table 3). Higher MUFA content (P 0.05) and lower PUFA [NS] were observed in the ram-lambs muscles in repetition II, while in the lambs of both sexes unfavourably widened ratio of

PUFA 6: 3 was observed (P 0.05), as well as higher cholesterol content – by 15.8% in ram- (P 0.01), and by 8.9% in ewe-lambs (NS).

The influence of intensive fattening method and fattening to higher weight standards on the increase of lamb carcass fatness along with much less obvious influence on the quality and composition of the meat has been confirmed by numerous experiments (Borys and Osikowski, 1998; Rowe *at al.,* 1999; Vergara *at al.,* 1999).

Conclusions

Both the fattening method and the weight standard of housed lambs had a significant influence on the dressing percentage, fatness indicators and the carcass classification according to the conformation, and in the case of the weight standard also according to fatness degree (higher both in ram- and ewe-lambs fattened intensively up to higher weight standards). Greater influence on the composition and quality of the meat, including the profile of fatty acids and cholesterol content, was not observed.

In spite uses the lower weight standards of ewe-lambs, the fatness of their carcasses was higher than in the ram-lambs, but there were no more clearly differences between the sexes in respect of the meat composition and quality.

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