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The study of intensive fattening of youth sheep from different breeds in Romania

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Abstract. Young rams of Merino of Cluj (M), Tsigai and Turcana breed (n=15) were submitted to an 100 days intensive fattening, in order to obtain superior quality carcasses. The fattening unrolled during two consecutive years, and included three successive phases: accommodation (15 days) – 16% CP, growing-fattening (65 days) – 15% CP, respectively finishing (20 days) – 13% CP. At the end of fattening period, the appreciation of carcasses and meat quality has been done (n=5), using subjective and objective methods: the carcass estimation using EUROP system, the analysis of slaughter yield, muscular fiber diameter and chemical composition of meat. The Merino of Cluj breed presented superior fattening qualities and a higher score to subjective and objective appreciation.
Key words: Romanian sheep, fattening.

Introduction. The exploitation of the sheep in many directions and the growth of a relatively high number of sheep breeds allow us to appreciate the production of this species as an extremely diversified one. Since the domestication of sheep, the productions of meat, milk, wool, leather and fur were represented in different percentage of the whole production and on total populations, as a function of geographical, historical, cultural and social factors. The request of the market at a certain moment or period greatly influences the amount and the type of products. Intensive fattening is a technology that can be applied in different variants; these kind of actions and experiences were made in Romania mainly along with the organization of huge sheep fattening cooperatives, in the context of directing the sheep breeding towards meat production, starting from the '60-'70's (Pop et al 1983; Taftă et al 1997). Experiments of fattening, application of different types of technologies or systems were performed in Romania by many authors (Călătoiu 1972, 1980; Dinescu 1972; Mireşan & Pop 1982; Pascal 1997; Mierliţă 1998; Dărăban 2004; Coroian 2006), studying the aptitude of fattening as daily gain average, specific intake, carcass and meat quality, economical efficiency etc.

The quality of a carcass is given by many characteristics, from which the main are: carcass weight, carcass conformation, tissue composition, chemical and physical composition etc. (Mochnacs et al 1978; Pop et al 1983; Taftă et al 1997). A further bench-mark is the consumers' preferences, by the given price (Hammond 1974).

The carcass conformation and fat covering EUROP system appreciation is recently being used in Romania. Until now, the subjective evaluation of the carcasses has been done only in experimental purposes.

Fiber diameter of striated muscle can fluctuate between 22-38 μm. There is a strong correlation between fiber diameter and fibrillarity, which is a very important characteristic of meat quality. This is usually assessed on transversal muscle section, in function of the diameter of muscular fiber. Fibrillarity increases with animal age and depends of sampling region. There is a positive phenotypic correlation between fiber diameter (sampling from *Longissimus dorsi* muscle – LD) and live weight, r_p = *0.60* (Taftă et al 1997).

The proportion of water and dry matter in meat varies in function of many factors, from which the breed and the administered fodder play an essential role. The origin region of analyzed sample also proves that there are qualitative differences regarding these proportions (Mochnacs et al 1978; Pop & Mireşan 1991; Mireşan 1996; Mierliţă 1998; Dărăban 2004; Coroian 2006). These three variation factors were analyzed in this experiment, on samples taken from the most important slaughter pieces: the cutlet (*Longissimus dorsi* – LD muscle), the leg of mutton (*Biceps femoris* – BF muscle) and the shoulder (*Supraspinatus* – S muscle).

Materials and Methods. Male lambs chosen from three sheep breeds (Merino of Cluj, Tsigai and Turcana) were organized in three groups, and they were put to intensive fattening for a period of 100 days. The chosen breeds constitute the main breeds of sheep grown in Romania (Tsigai and Turcana breed), as well as a newly created breed, accommodated to the agro-pedo-climatic conditions of the creating zone and surroundings.

Each group of animals consisted of a number of 15 youth sheep, with an initial average weight of 15.46 kg in the Merino of Cluj breed, 15.14 kg in the Tsigai breed and 15.54 kg in the Turcana breed. The accumulation of the daily average weight during the whole fattening period of the three breeds was between 233-245 g.

The protein level of the sole fodder differs according to the phase of the fattening: in the phase of accommodation (15 days) it was 16% BP, in the phase of growing-fattening (65 days) - 15% BP, and in the final phase – finishing phase (20 days) the level of proteins was 13% BP.

The slaughter yield was measured at 24 hours after slaughtering by weighing (n=15), meantime the carcasses were refrigerated to 4°C. The difference between warm and cold carcass weight represents slaughter yield.

Regarding the objective appreciation of the carcass, the usual measurements were performed and other extra data were obtained by surface appreciation of the muscle *Longissimus dorsi* (LD) – an important criteria for first quality meat (cutlet with bone and boneless). Muscle samples were collected from the 5-6th thoracic intervertebral space and from the articulation of the last dorsal vertebrae (the cutting site of the chop with bone from the boneless chop). LD surface determination was performed by planimetry.

The chemical composition of the meat was established using Weende scheme, in order to determinate the proportion of water, dry matter (DM), crude protein (CP), crude fat (CF), crude ashes (CA) and non-nitrogenous extractive substances (NES), from three muscles: *Longissimus dorsi* – LD, *Biceps femoris* – BF, and *Supraspinatus* – S. DM was determinate gravimetric, CF using Soxhlet method and CP in accordance with Kjeldahl method. The data were processed with WINSTATISTIC program, in order to determine interracial differences regarding the muscles and parameters analyzed.

Results and Discussion. The first appreciation of the carcass is the conformation and fat coverage. The EUROP system of carcass appreciation was used in Romanian sheep breeds for the first time. This method is highly conditioned by the experience of the examiner and less by other factors such as: slaughter method, carcass clamping, the moment of the examination, cooling conditions etc. The carcass conformation is slightly influenced by the genetic quantification (h^2=0.21±0.067); alike is fat carcass covering (h^2=0.26±0.073)(Hanrahan 1999). The most important factors which contribute to a better carcass conformation are the fattening technology and alimentation (Pop et al 2003). In our breeds we identified the major class R of carcass conformation, and for fat covering of the carcass the grade was 3. These confirm the possibility to obtain good carcasses of youth sheep for Romanian consumers and also for the European market.

The slaughter yield of the Romanian breeds used in this experiment was studied by many authors: Pop & Mireşan (1982); Mireşan & Mireşan (1997); Mierliţă (1998); Pădeanu (2002); Dărăban (2004); Pascal (2004); Coroian (2006). The slaughter yield was analyzed as follows: warm slaughter yield, cold slaughter yield and commercial slaughter yield. The best cold slaughter yield was recorded in Merino of Cluj (47.32%), followed by Tsigai (46.90%) and Turcana (46.42%). These values were in the ranges

quoted by the literature for our country and can be considered medium. The interracial differences are not significant (P >0.05).

The biggest fineness of muscular fiber (Table 1, Figures 1-6) was observed in LD muscle and interracial differences (Table 2) were non-significant (P > 0.05). The biggest diameter was present in Merino of Cluj breed, followed by Tsigai and Turcana breed. Similar results were registered for BF and S muscles.

Table 1

Variation of muscle fiber diameter (μm) in youth sheep submitted to intensive fattening

Muscle	**Breed** (n=5)	$\overline{X} \pm s_{\overline{X}}$	**s**	**V %**
Longissimus dorsi (LD)	Merino of Cluj	31.60 ± 1.78	3.99	5.64
	Tsigai	31.34 ± 2.03	4.54	6.48
	Turcana	31.52 ± 1.99	4.45	6.31
Biceps femoris (BF)	Merino of Cluj	32.76 ± 1.93	4.31	5.89
	Tsigai	31.91 ± 1.92	4.29	6.01
	Turcana	32.21 ± 1.34	2.99	4.15
Supraspinatus (S)	Merino of Cluj	32.12 ± 2.24	5.01	6.98
	Tsigai	32.41 ± 2.54	5.68	7.84
	Turcana	31.97 ± 2.19	4.89	6.84

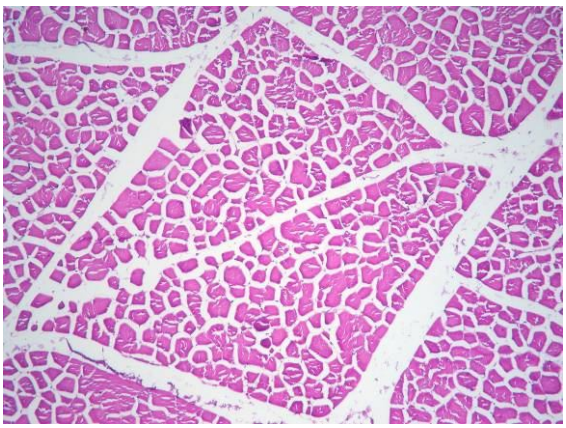

Figure 1. Loin fiber diameter (Ob.x10)

Figure 2. Loin fiber diameter (Ob.x20)

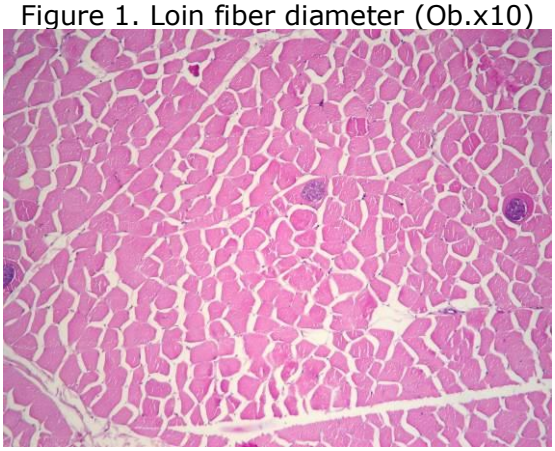

Figure 3. Shoulder fiber diameter (Ob.x10)

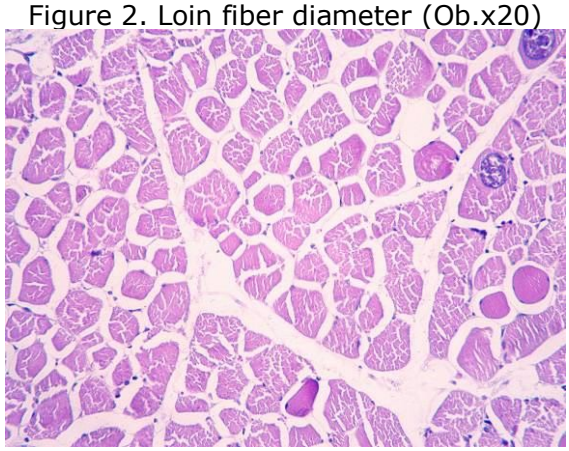

Figure 4. Shoulder fiber diameter (Ob.x20)

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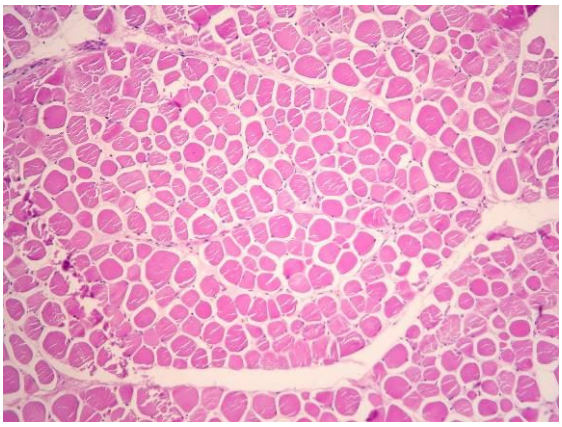

Figure 5. Leg of mutton fiber diameter (Ob.x10)

Figure 6. Leg of mutton fiber diameter (Ob.x20)

The largest diameter of muscular fibers was observed in the leg of mutton; S muscle showed intermediate values for this parameter. Our data are comparable to similar results in the same breeds (Mireşan 1982; Mireşan 1996; Dărăban 2004; Coroian 2006).

Studies on fiber diameter variation in animals with muscular hypertrophy (callipyge) showed that there are no significant differences ($P > 0.05$) regarding this characteristic between normal and hypertrophic genotypes (Carpenter et al 1996).

Table 2

Statistic significance of the differences in fiber diameter (µm) of different muscles, in youth sheep intensively fattened

Muscle	Breed (n=5)	Breed (n=5)								
		Merino of Cluj			Tsigai			Turcana		
		d	t	Stat. sign.	d	t	Stat. sign.	d	t	Stat. sign.
Longissimus dorsi	Merino of Cluj	–	–	–	0.264	0.098	ns	0.084	0.031	ns
	Tsigai	-0.264	-0.098	ns	–	–	–	-0.180	-0.063	ns
	Turcana	-0.084	-0.031	ns	0.180	0.063	ns	–	–	–
Biceps femoris	Merino of Cluj	–	–	–	0.848	0.312	ns	0.544	0.232	ns
	Tsigai	-0.848	-0.312	ns	–	–	–	-0.304	-0.130	ns
	Turcana	-0.544	-0.232	ns	0.304	0.130	ns	–	–	–
Supraspinatus	Merino of Cluj	–	–	–	-0.288	-0.085	ns	0.156	0.050	ns
	Tsigai	0.288	0.085	ns	–	–	–	0.444	0.132	ns
	Turcana	-0.156	-0.050	ns	-0.444	-0.132	ns	–	–	–

ns = not significant ($P > 0.05$).

We noticed that the diameter of muscular fiber is correlated with the quantity of meat in the sampling piece of slaughter (Table 3); as fiber diameter is increasing, the meat quantity is higher. The proportion of the leg of mutton, the cutlet and the shoulder were bigger in Merino of Cluj breed, as well as the fiber diameter, when compared to the other two breeds. The phenotypical correlation is not statistically significant ($P > 0.05$), which suggests that the proportion of meat in the main pieces of slaughter is not determined

only by the fiber diameter (muscularity), but also by the amount of fat stored round about the internal and external perimysium.

Table 3

Phenotypic correlations (r_p) between fiber diameter and muscle weight

Correlation (r_p)	Breed (n=5)								
	Merino of Cluj			Tsigai			Turcana		
	$r_{(X,Y)}$	t	Stat. sign.	$r_{(X,Y)}$	t	Stat. sign.	$r_{(X,Y)}$	t	Stat. sign.
Fiber diameter of LD muscle – cutlet weight	-0.01	-0.01	ns	0.68	1.64	ns	0.22	0.40	ns
Fiber diameter of BF muscle – leg of mutton weight	-0.66	0.43	ns	-0.57	-1.21	ns	0.49	0.99	ns
Fiber diameter of S muscle – shoulder weight	-0.01	-0.01	ns	-0.76	-2.07	ns	-0.07	-0.13	ns

ns = not significant (P >0.05).

Comparative analysis of the chemical composition of the three muscles sampling of first quality meat, and the shoulder region (also considered of first quality by many authors) showed some differences for the main parameters. The higher proportion of water was observed in S muscle, and the lower in LD muscle. BF muscle showed intermediary values. The higher proportion of DM in LD muscle derived from its content in CF, which demonstrates a better perselation and marmoration of the muscle. The fat at this level is represented by the stores formed round about internal and external perimysium, process usually run into the final fattening phase, finishing (Georgescu et al 2000).

The LD muscle is also named fillet and it is recognized for its exceptional organoleptic qualities. Its chemical appreciation in the three breeds intensively fattened, as compared with BF and S muscles, demonstrated that LD muscle had a higher percent of CP and minerals (ashes) in DM, and a lower percent of NES. The highest proportion of CP was observed in Tsigai breed, followed by Merino of Cluj and Turcana breeds. The latest also had the most important proportion of NES related to DM.

BF muscle contained a lower CP percent than LD muscle, as well as a lower DM and CF. The highest percentage of CP was noticed in Merino of Cluj breed, and the lower in Turcana breed. S muscle contained the highest proportion of water. The smaller proportion of DM was correlated with a lower proportion of CP, CF and minerals. NES content was comparable to those of LD and S muscles. In these experimental breeds, Mireşan (1996) obtained similar values for the same characteristics; the cutlet had the highest proportions of DM and CP from all pieces of slaughter. The highest content in CF related to DM was observed to Tsigai breed.

Statistical analysis of the interracial differences (Table 4) for the main characteristics of LD muscle showed very significant differences (P < 0.001) for NES between Merino of Cluj and Turcana, as well as between Tsigai and Turcana breeds. Similar differences (P < 0.001) were found for the proportion of CF between Tsigai and Merino of Cluj breeds.

For BF muscle, very significant differences (P < 0.001) were founf in water content between Turcana and Tsigai breeds, and distinct differences (P < 0.01) for DM, between Tsigai and Turcana breeds. S muscle did not show significant interracial differences (P > 0.05) for none of the characteristics.

In a comparative study on the influence of alimentation and breed on chemical composition of meat in youth Merino of Cluj sheep, Tsigai and Romney-Marsh, Dărăban (2004) reported that the breed is the most important factor that influences the chemical composition of meat, followed by the sampling region of the muscle and the type of alimentation.

Table 4

The statistical significance of the differences in chemical composition of meat from intensively fattened youth sheep

The muscle	Chemical composition	Breed (n=5)	Breed (n=5)								
			Merino of Cluj			Tsigai			Turcana		
			d	t	Stat. sign.	d	t	Stat. sign.	d	t	Stat. sign.
Longissimus dorsi	**Water** (%)	Merino of Cluj	–	–	–	2.690	1.894	ns	2.270	0.849	ns
		Tsigai	-2.690	-1.894	ns	–	–	–	-0.420	-0.156	ns
		Turcana	-2.270	-0.849	ns	0.420	0.156	ns	–	–	–
	DM (%)	Merino of Cluj	–	–	–	-2.690	-3.165	*	-2.270	-1.122	ns
		Tsigai	2.690	3.165	*	–	–	–	0.420	0.202	ns
		Turcana	2.270	1.122	ns	-0.420	-0.202	ns	–	–	–
	NES (%)	Merino of Cluj	–	–	–	-0.040	-0.800	ns	-3.740	-6.684	***
		Tsigai	0.040	0.800	ns	–	–	–	-3.700	-6.001	***
		Turcana	3.740	6.684	***	3.700	6.001	***	–	–	–
	CP (%)	Merino of Cluj	–	–	–	-1.210	-1.862	ns	0.360	0.206	ns
		Tsigai	1.210	1.862	ns	–	–	–	1.570	0.887	ns
		Turcana	-0.360	-0.206	ns	-1.570	-0.887	ns	–	–	–
	CF (%)	Merino of Cluj	–	–	–	-1.170	-5.318	***	1.190	0.913	ns
		Tsigai	1.170	5.318	***	–	–	–	2.360	1.586	ns
		Turcana	-1.190	-0.913	ns	-2.360	-1.586	ns	–	–	–
	Ashes (%)	Merino of Cluj	–	–	–	-0.270	-3.375	**	-0.080	-0.134	ns
		Tsigai	0.270	3.375	**	–	–	–	0.190	0.308	ns
		Turcana	0.080	0.134	ns	-0.190	-0.308	ns	–	–	–
Biceps femoris	**Water** (%)	Merino of Cluj	–	–	–	0.710	0.322	ns	0.040	0.017	ns
		Tsigai	-0.710	-0.322	ns	–	–	–	-0.670	-3.529	**
		Turcana	-0.040	-0.017	ns	0.670	-3.529	**	–	–	–
	DM (%)	Merino of Cluj	–	–	–	-0.710	-0.380	ns	-0.040	-0.021	ns
		Tsigai	0.710	0.380	ns	–	–	–	0.670	2.994	*
		Turcana	0.040	0.021	ns	-0.670	-2.994	*	–	–	–
	NES (%)	Merino of Cluj	–	–	–	-0.570	-1.556	ns	-0.990	-2.502	*
		Tsigai	0.570	1.556	ns	–	–	–	-0.420	-1.271	ns
		Turcana	0.990	2.502	*	0.420	1.271	ns	–	–	–
	CP (%)	Merino of Cluj	–	–	–	0.470	0.248	ns	0.890	0.484	ns
		Tsigai	-0.470	-0.248	ns	–	–	–	-0.420	-1.068	ns
		Turcana	-0.890	-0.484	ns	0.420	1.068	ns	–	–	–
	CF (%)	Merino of Cluj	–	–	–	-0.830	-0.588	ns	-0.900	-0.677	ns

		Tsigai	0.830	0.588	ns	–	–	–	0.070	0.097	ns
		Turcana	0.900	0.677	ns	-0.070	-0.097	ns	–	–	–
	Ashes (%)	Merino of Cluj	–	–	–	0.220	0.329	ns	0.960	1.513	ns
		Tsigai	-0.220	-0.329	ns	–	–	–	0.740	1.069	ns
		Turcana	-0.960	-1.513	ns	-0.740	-1.069	ns	–	–	–
	Water (%)	Merino of Cluj	–	–	–	1.400	0.527	ns	-1.520	-0.253	ns
		Tsigai	-1.400	-0.527	ns	–	–	–	-2.920	-1.014	ns
		Turcana	1.520	0.253	ns	2.920	1.014	ns	–	–	–
	DM (%)	Merino of Cluj	–	–	–	-1.400	-0.848	ns	1.520	0.261	ns
		Tsigai	1.400	0.848	ns	–	–	–	2.920	1.417	ns
		Turcana	-1.520	-0.261	ns	-2.920	-1.417	ns	–	–	–
	NES (%)	Merino of Cluj	–	–	–	0.270	0.602	ns	-0.170	-0.030	ns
		Tsigai	-0.270	-0.602	ns	–	–	–	-0.440	-0.930	ns
		Turcana	0.170	0.030	ns	0.440	0.930	ns	–	–	–
	CP (%)	Merino of Cluj	–	–	–	-1.490	-0.982	ns	0.130	0.022	ns
		Tsigai	1.490	0.982	ns	–	–	–	1.620	0.950	ns
		Turcana	-0.130	-0.022	ns	-1.620	-0.950	ns	–	–	–
	CF (%)	Merino of Cluj	–	–	–	-0.840	-0.847	ns	0.780	0.137	ns
		Tsigai	0.840	0.847	ns	–	–	–	1.620	1.852	ns
		Turcana	-0.780	-0.137	ns	-1.620	-1.852	ns	–	–	–
	Ashes (%)	Merino of Cluj	–	–	–	0.660	1.331	ns	0.780	0.138	ns
		Tsigai	-0.660	-1.331	ns	–	–	–	0.120	0.214	ns
		Turcana	-0.780	-0.138	ns	-0.120	-0.214	ns	–	–	–
Supraspinatus											

ns = $P > 0.05$; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

Conclusions. Romanian sheep breeds can be exploited for meat production, offering carcasses of a good quality, as well as meat of good quantity and quality. The subjective appreciation permitted us to classify the quality of the carcasses as medium, compared with other European sheep breeds. The slaughter yield is inferior to sheep breeds specialized for meat production; the same considerations are valid for the percent of first quality meat in the carcass. There are no significant differences of quality in the meat chemical composition and commercial aspect, as compared to other breeds exploited for meat production. No significant phenotypic correlations were noticed between the diameter of the muscle fiber and meat quantity obtained from the fiber's region.

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