41 STUDY ON BOTH THE COLOUR AND METABOLITE TYPE OF FIBRES IN MUSCLES OF LAMBS SLAUGHTERED AT DIFFERENT AGE

A.Pinkas, P.Marinova
Institute of Animal Breeding - Kostinbrod, Bulgaria

The meat quality is known to be formed from physico-chemical, morphological and metabolite properties of muscular tissue being now under intense investigation Cassens and Cooper /1971/, Anderson and Parrish /1972/, Ashmore /1974/, Hunt and Hedrick /1977/ et al., have studied the relationship between meat quality and metabolite type ratio of muscular fibres, mainly in both sheep and cattle. Limited are the investigations treating this question in sheep slaughtered at different age.

The present study is a final stage in studying the metabolite type of muscular fibres in lambs at different age and determining the dependence to some traits characterizing the meat quality.

The study was carried out on 30 male lambs, slaughtered consecutively at 90, 120 and 180 days of age. Immediately after slaughtering samples were taken /1m³/ from m.longissimus dorsi /LD/ and m.semimembranosus /MS/, frozen and kept in liquid nitrogen. Histological analyses were carried out on consecutive cuts /10 μ / for determining SDH, αGDOH, alkaline ATP-ase activity of single muscular fibres. The type of fibres, after the Ashmore's and Doerre's /1971/ nomenclature, was determined on the basis of the activity of single enzymes according to the following scheme:

	βR	αR	αW
SDH	+	+	-
αGPOH	-	+	+
ATP-ase at 10.2	-	+	+

At the same time, cross-section of both red /R/ and white /W/ fibres was measured. Physico-chemical properties of those muscles were analyzed 24 h post mortem. The colour of muscles was determined objectively by means of three-coloured co-ordinates according to Hunter's system through tricolorimetre "Momocolor D". Simultaneously, the concentration of pigments was determined after the Hornsey's method /1956/, pH of muscles was measured directly on freshly cut muscle through combined electrode. Water Binding Capacity /WBC/ of meat was determined after the method of Gram and Haum /1952/. Intra-

muscular fats were extracted with ether.

Results and discussion: - Analyses for the ratio of single types of muscular fibres in LD and MS of lambs slaughtered at age of 90, 120 and 180 days, are given in table 1.

Table 1. - Ratio of the three types of muscular fibres in LD and SM

Muscular fibres	90 days /age/	120 days /age/	180 days /age/
	m.longissimus dorsi		
% βR	8,75	10,53	10,85
% αR	51,98	54,45	50,03
% αW	39,27	34,65	39,13
	m.semimembranosus		
% βR	12,86	12,02	14,39
% αR	60,62	51,89	40,76
% αW	26,52	36,15	44,85

In both muscles studied, the intermediary / αR / type of muscular fibres predominates, confirming our previous investigations /Pinkas et al., 1983/. Therefore, in lambs both muscles have a glycolitic character with a prevalent percentage of red / R / fibres and may be characterized as red ones with a fast contraction, which coincides with the Talmant's /1979/ classification. In LD this ratio is kept in the three age groups which is also observed in the investigations of Lacourt and Arnal /1974/ and Solomon et al., /1981/. In SM, however, a decrease is established /$p < 0,05$/ of βR fibres with the growing of animals, being this observed by Solomon et al., /1981/ in the same muscle, while Moody et al., /1980/ find a decrease of βR fibres in LD with growing of lambs.

In contrast to LD, in SM a great part of αR is transformed /$p < 0,01$/ into αW fibres, i.e.increases the glycolitic character of the muscle, which is also observed by Holmes and Ashmore /1972/ and Ashmore et al., /1972/ in certain muscles of cattle, pigs and sheep.

In pigs, increased content of intermediary / αR / and white / αW/ fibres is manifested in PSE muscles /de Bruin, 1971/; Swatland and Cassens 1973/. In SM case, irrespective of high percentage of glycolitic / $\alpha R + \alpha W$/ fibres, such visible deviations in lamb's quality are not observed.

Data concerning the size of muscular fibres /table 2/ show established differences by many authors between the diameter of both red / R / and white / W / fibres./Holmes and Ashmore, 1972; Hendricks et al., 1973; Hunt and Hedrick, 1977b.

Table 2. - Diameter of muscular fibres / μ /

Muscular fibres	90 days /age/	120 days /age/	180 days /age/
	m.longissimus dorsi		
red / R /	37,00	38,55	38,51
white / W /	42,23	44,01	43,48
	m.semimembranosus		
red / R /	37,38	38,88	39,82
white / W /	43,55	44,91	43,34

In all the three cases white / W / fibres are significantly greater than R fibres and that difference is significant / $p < 0,05$/ both for LD and for SM. No difference is established in growth intensity of both types of fibres, that being confirmed in other our investigations too / Pinkas et al., 1983/ Kiessling /1977/ finds a more intensive growth of αW fibres in sheep reared up to age of 18 months. For the period up to 6 months, however, growth intensity is practically the same, as in our case, showing tha those differences may be observed in a later stage of ontogenesis.

Objective data concerning the physico-chemical traits, characterizing the meat quality, are given in table 3.

The colour of meat which we are expressing in three forms show that in the first two ages no important differences exist. In the muscles of animals from the third group significant differences are observed / $p < 0,01$ / both in lightness and in colour saturation which is due to changes in redness/yellowness ratio and more especially, in increasing of "a" component, i.e. the red one. Obviously, those changes derive from the increasing concentration of hempigments, being significantly / $p < 0,01$ / higher than other two groups. Evidently, the concentration of

hempigments in lamb is a basic factor determining the meat colour, in contrast to both pork and beef, where an important role play the structural differences in muscular protein, determined through glycolitic process velocity post mortem.

Table 3. - Physical and chemical values of muscles

Traits	90 days /age/	120 days /age/	180 days /age/
	m.longissimus dorsi		
Lightness /L/	11,28	11,41	7,70
Redness:yellowness ratio a/b	0,87	0,71	1,53
Saturation /D/	9,88	9,71	11,84
Hempigments µFe/g	9,93	9,02	11,49
WBC /%/	36,71	37,71	36,87
Fats /%/	2,35	2,70	4,42
pH	5,66	5,68	5,73
	m.semimembranosus		
Lightness /L/	11,20	10,86	7,44
Redness:yelloness ratio a/b	0,92	0,80	1,76
Saturation /D/	10,74	10,11	12,59
Hem pigments µFe/g	9,97	9,44	13,71
WBC /%/	37,13	38,47	36,47
Fats /%/	1,97	2,96	3,43
pH	5,65	5,65	5,74

Water Binding Capacity of meat is not obviously influenced by the small age differences in our experiment. While the content of intramuscular fats increases in parallel with the growth of animals. There are no differences in pH values.

The values of physical and chemical traits are one-way for both muscles and there is no statistical significant difference between them.

The correlation between the type of fibres and both physical and chemical traits studied was calculated in total for the three age groups, and separately for both muscles. Obtained correlation coefficients are too different between both muscles. In LD are being established correlation coefficients of the order of 0,3 - 0,4, only between the concentration of pigments and the three coefficients characterizing the meat colour /L, a/b, D/. Between single types of fibres and physical and chemical traits studied, the coefficients have values near to O. In SM, however, higher correlation value are observed, as:

βR : L - 0,272	βR : pigments - 0,0477
αR : L - 0,473	αR : pigments 0,331
αW : L - 0,495	αR : pigments 0,390

Similar relatively low correlation values we also have obtained in other our investigations /Pinkas et al., 1983/, while Hunt and Hedrick /1977/ on studying the cattle do not establish correlation between the type of fibre and the traits characterizing the meat quality, but they find a higher percentage of red / βR + αR / fibres in muscles of soft watery and dark-dry consistence compared to normal muscles in cattle /Hunt and Hedrick, 1977b/. In sheep, however, such deviations in meat quality are an unusual phenomenon, resulting from stress-resistance of sheep, regardless of high percentage of α fibres in muscles. Probably, oxidative processes in fibres predominate over glycolitic ones, resulting in - even under strong stress conditions - a relatively high glycogen content in muscles /Pinkas et al., 1984/ allowing a normal course of glycolise process post mortem, and as a result, no visible deviations in meat quality are observed.

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