SLAUGHTER AGE, WEANING AND SEX EFFECTS ON CARCASS AND MEAT COMPOSITION IN LAMB

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Abstract – Eighty lambs (males and females) from Rasa Aragonesa breed were used to assess the effects of slaughter age, weaning and sex on carcass and meat composition. Half of the lambs were weaned at 40 days old (do), while the rest remained with their mothers. Half of the animals were slaughtered at 70 do and the other half at 100 do. All animals received concentrate plus cereal straw *ad libitum*. Carcass characteristics, proximate composition of the muscle *Longissimus thoracis* and intramuscular fatty acid composition were analyzed. Age of slaughter was the most important factor, showing 100 do animals the heavier carcasses (9.1 *vs* 14.4 kg), with the highest intramuscular fat content (2.8 *vs* 3.5) and monounsaturated fatty acids percentage ($P \leq 0.001$). Unweaned animals also showed larger body size and less moisture in the meat than weaned animals. Males were heavier than females at the same slaughter age, but no differences were found either in fatness score or in intramuscular fat. However, animals should be slaughtered younger than 100 days old since they produce heavy carcasses that would not be classified as light lambs. Sex should not be taken into account while checking these parameters, unless heavier carcasses want to be obtained.

I. INTRODUCTION

Lamb production is worldwide spread, especially because of its adaptation to different resources in difficult environments (1). In many Mediterranean countries, new fattening units have been developed in order to homogenize the product increasing the farmer's income by marketing larger number of animals. These units are intermediate between the producer and the abattoir, being part of a farmer's association. The feeding is based on concentrates plus cereal straw. The animals are reared together according mainly to their initial weight, being common to have animals in the same batch from both sexes that have been born in different farms with different age and management at the beginning of the fattening period. At the same time, slaughter is fixed at a certain live weight, independently of the growing rate of the animal, which implies that animals in the same batch might have been in the fattening unit for different lengths of time. Among those differences in management, weaning is a critical point. Some farmers keep the lambs with the mothers until slaughtering remaining unweaned, while other lambs are weaned at different ages. This variability in management might affect the quality of the final product that is commercialized. Therefore, the aim of this work was to assess the effects that age at slaughter, weaning and sex have on carcass quality and meat composition in lamb.

II. MATERIALS AND METHODS

Eighty lambs from Rasa Aragonesa breed (41 females and 39 males) were randomly selected at the same farm between the animals prepared to be finished in a large cooperative (Pastores Group). All animals were kept with their mothers until they reached 40 days of age. At that point, half of the animals from both sexes were weaned, and transported to the fattening unit. The rest were still kept with the mothers, with specific access to their feeding different from their mothers. Both groups of animals were fed with the same concentrate based on cereals, with free access to cereal straw. At 70 days of age, half of the unweaned animals and half of the weaned animals (from both sexes) were slaughtered at an EU-licensed abattoir. At 100 days of age, the remaining animals were also slaughtered. The abattoir was less than 15km from the fattening unit.

Carcasses were weighed hot after an hour from slaughtering, before entering the cooling room. At 24 h after slaughtering, conformation (1, very poor

– 15 very good) and fatness (1, very lean – 15, very fat) were assessed (2). External carcass length and rump perimeter were also obtained. From the left side carcass, the muscle *Longissimus thoracis* was excised, vacuum packaged, immediately frozen and kept at -18º C until analyzed.

Proximate composition was assessed by international standards (3, 4, 5, 6). Fatty acids were extracted with chloroform: methanol (7). Methyl esters were form with KOH in methanol and analyzed in a GC 6890 with nitrogen as carrier gas (8).

A General Linear Model was used with SPSS (19.0) with slaughter age, weaning and sex as main effects.

Table 1 Significance of age of slaughter, weaning and sex effects on carcass characteristics

	Slaughter age	Weaning	Sex
n	80	80	80
HCW	.000	.000	.000
Conformation	.000	.000	.005
Fatness	.000	.000	.203
Carcass length	.000	.227	.000
Rump perimeter	.000	.001	.000

III. RESULTS AND DISCUSSION

Table 1 shows the significance of age at slaughter, weaning and sex effects on carcass characteristics. All studied effects had a high influence ($P \leq 0.001$), except for sex on conformation ($P \leq 0.01$), weaning on carcass length and sex on fatness score ($P > 0.05$). No significant interactions were found.

Table 2 Effect of age of slaughter, weaning and sex effects on carcass characteristics

	Slaughter age		Weaning		Sex	
	70d	100d	yes	no	fem	male
n	40	40	40	40	41	39
CCW kg	9.1	14.4	10.5	12.0	10.6	11.9
Conform [1]	5.2	8.0	5.8	7.4	6.2	7.0
Fatness[2]	4.9	7.5	5.4	6.9	6.0	6.3
Carcass length *cm*	50.2	57.2	53.5	54.0	52.6	54.8
Rump perim. *cm*	45.3	50.4	47.1	48.6	47.0	48.7

[1] 1-15 (1, very por – 15, very good)

[2] 1-15 (1, very lean – 15, very fat)

As expected, animals slaughtered at 100 days old had higher carcass weight, superior conformation and fatness scores, and larger carcass length and rump perimeter, showing a better morphology (Table 2), more typical of heavy carcasses than light lambs. At this age, none of the 100 do animals would have fit within the category of light lambs (<13 kg of carcass weight), typical of Mediterranean countries. This is the reason why the quality labels of light lamb in Spain consider only animals younger than 90 do. Weaning produced lighter carcasses (10.5 *vs* 12.0 kg), which implied lower conformation and fatness scores. The milk intake that unweaned animals have while suckling directly from the mothers contributes to this heavier animals, due to the higher energy of their diet. Males also showed heavier carcasses and superior conformation and morphology than females. Only fatness score was not affected by sex, due to the slaughter of the animals at the same age. If the slaughtering was at the same slaughter weight, then differences would have appeared since females have lower daily gains and are more precocious than males.

Table 3 Significance of age of slaughter, weaning and sex effects on *Longissimus thoracis* proximate composition

	Slaughter age	Weaning	Sex
n	80	80	80
Moisture	.000	.037	.297
Protein	.301	.967	.659
Fat	.001	.188	.738
Ashes	.003	.424	.514

Table 3 shows the significance of age at slaughter, weaning and sex effects on *Longissimus thoracis* muscle proximate composition. Slaughter age was the effect with the highest influence on moisture and fat % ($P \leq 0.001$) and ashes ($P \leq 0.01$), whereas weaning only influenced moisture ($P \leq 0.05$) and sex did not have any significant influence in any parameter.

Older animals showed less moisture in the muscle probably due to their higher intramuscular fatness (2.8 *vs* 3.5, Table 4). Intramuscular fat is a late deposition tissue. Therefore, those animals intensively reared would increase its deposition the older they get. Previous findings in Rasa

Aragonesa breed (9) have found similar fat content in the *Longissimus* muscle (2.41%) than the animals slaughtered at 70 do, but larger percentages if considered other cuts, such as the leg (10). Weaned animals showed slight higher moisture in the muscle that, since there were no significant differences in the rest of components, might have been due to a random finding. As males and females were slaughtered at the same age, the same lack of differences found in carcass fatness appeared in the muscle proximate composition.

Table 4 Effect of age of slaughter, weaning and sex on *Longissimus thoracis* proximate composition (%)

	Slaughter age		Weaning		Sex	
	70d	100d	yes	no	fem	male
n	40	40	40	40	41	39
Moisture	75.3	74.3	74.9	74.6	74.7	74.9
Protein	20.8	21.0	20.9	20.9	21.0	20.9
Fat	2.8	3.5	3.0	3.3	3.2	3.1
Ashes	1.1	1.2	1.1	1.1	1.1	1.1

Table 5 shows the significance of age at slaughter, weaning and sex effects on intramuscular fatty acid composition. Slaughter age was the most important effect in all groups of fatty acids ($P \leq 0.001$), except for saturated fatty acids (SFA, ($P > 0.05$), whereas weaning had an influence on polyunsaturated (PUFA) and PUFA/SFA ($P \leq 0.01$) and on *n*-6 and *n*-6/*n*-3 fatty acids ($P \leq 0.001$).

Table 5 Significance of age of slaughter, weaning and sex effects on *Longissimus thoracis* fatty acid composition

	Slaughter age	Weaning	Sex
n	80	80	80
SFA	.485	.091	.936
MUFA	.000	.541	.119
PUFA	.000	.007	.113
n-6	.000	.001	.084
n-3	.000	.213	.693
PUFA/SFA	.000	.005	.180
n-6/*n*-3	.000	.000	.015

Animals slaughtered at 100 do showed higher monounsaturated fatty acids percentage (45.9 *vs* 41.6%) and *n*-6/*n*-3, and lower PUFA (9.2 vs 12.7%), *n*-6, *n*-3 and PUFA/SFA than those slaughtered at 70 do. This is related to longer period of time that they have been fed the concentrate. Unweaned animals had lower PUFA (10) (10.4 *vs* 11.6), *n*-6 fatty acids and *n*-6/*n*-3 than weaned animals. It is known that suckling animals consume less concentrates than weaned animals because part of their feeding is based on milk. This explains the data found in this work, since concentrates were based on cereals, which are rich in *n*-6 fatty acids.

IV. CONCLUSION

Age of slaughter is an important factor to be controlled due to its influence in carcass quality and lipid composition. However, animals should be younger than 100 days old since they produce heavy carcasses that would not classify as light lambs. Weaning reduces the size of the animal, although increases polyunsaturated fatty acids percentage in the meat due to the higher rate of short saturated fatty acids in the muscle of unweaned animals, coming from the mother's milk. Sex should not be taken into account while checking these parameters, unless heavier carcasses want to be obtained.

Table 6 Effect of age of slaughter, weaning and sex on *Longissimus dorsi* fatty acid composition (% of total fatty acids)

	Slaughter age		Weaning		Sex	
	70d	100d	yes	no	fem	male
n	40	40	40	40	41	39
SFA	42.3	42.1	41.8	42.6	42.2	42.2
MUFA	41.6	45.9	43.3	43.9	44.2	43.3
PUFA	12.7	9.2	11.6	10.4	10.6	11.4
n-6	11.0	8.0	10.2	8.9	9.1	9.9
n-3	1.2	0.7	1.0	0.9	1.0	1.0
PUFA/SF/	0.3	0.2	0.3	0.2	0.2	0.3
n-6/*n*-3	9.1	10.7	10.4	9.4	9.7	10.2

SFA: Saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: Polyunsaturated fatty acids; *n*-6: *n*-6 PUFA; *n*-3: *n*-3 PUFA

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