EFFECT OF SLAUGHTER WEIGHT ON CARCASS COMPOSITION AND INSTRUMENTAL KID MEAT QUALITY

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Abstract— **The Bermeya goat is a local breed from Asturias (Spain) that is reared in the mountainous areas in the East of this region. This breed has a double purpose, dairy and meat, therefore, different kid types are been commercialized in the market. The objective of this study was to evaluate the effect of slaughter weight, associated to traditional products, on some meat quality characteristics. Twelve animals of one group and ten of the other one (light –milk reared *vs.* heavy – grass reared) were used. Carcass tissular composition was assessed, taking the shoulder as reference. pH, colour (L*a*b*, chroma and hue) and texture by a compression method (C20% and C80%) were studied in meat from *Longissimus dorsi* muscle. Texture samples were aged during 2, 4, 8 and 12 days. The results showed that there were differences in most quality variables analyzed except for the percentage of muscle, fat and bone, L* and b* values. The pH was greater in carcasses from heavy animals. A significant effect was observed on a*, C* and h* parameters (p<0,05). Redness and Chroma had higher values in heavy carcasses, which are typical from older animals; however, hue showed lower values in this type of carcasses. In terms of texture, significant differences at 80% of compression were found in only samples aged during 2 and 4 days, with light animas showing the higher values, although these differences between types disappeared at longer ageing periods. As conclusion, it can be said that in goats, the slaughter weight, associated to a specific production system, had lower effect on carcass composition than on their instrumental meat quality.**

Keywords— **kid, meat quality, weight carcass.**

I. INTRODUCTION

Since the beginnings of human civilization, goats have been used for different purposes (milk, meat, fibre, leather or work) under different conditions. Although goats are present around the world, the goat sector has been significantly less supported in terms of publicity and academics than other animal production sectors. Besides, goats are less appreciated economically and commercially in spite of real qualities [1].

Among all ruminant species reared in Spain, goats are the species with lower number of quality labels. Obtaining a larger number of such recognition could help improving the income of the producer, the subsistence of the different breeds and, at the end, the appreciation of the meat in this species.

II. MATERIALS AND METHODS

The study used twenty-two kid carcasses of Bermeya breed, a local breed from Asturias, in the north of Spain, at two different weights. Twelve of them were reared with its dam's milk (light animals) and the other ten kids were reared in a very traditional extensive production system, late weaned and finished with high mountain grass (heavy animals). All animals were slaughtered at an EU-licensed abattoir following standard protocols.

pH was measured after slaughtering using a portable CRISON 507 pH-meter equipped with penetrating electrode.

Forty-eight hours after slaughtering carcasses were split and the shoulder and muscle *Longissimus dorsi* were dissected.

Shoulders were vacuum-packed, frozen, and stored at -18ºC until the analysis. Tissue composition was assessed [2] calculating the percentages of bone, fat and muscle.

pH was measured again at 48 hours post-mortem on the LD muscle. The colour was assessed after 10 minutes of blooming. A portable Minolta CR 200B reflectance spectrophotometer with a standard illuminate D_{65} and a 10º standard observer, following the CIE-L*a*b* methodology [3], measured the colour of fresh meat on the cut surface of the 13th thoracic vertebra of the LT. The colorimetric index of chroma (C*) and hue (h*) were calculated. Final values were the average of three measurements.

Instrumental measurement of texture was assessed following the methods described by [4] using an Instron Universal testing machine, model 4301 equipped with a modified compression cell that avoids transverse elongation [5] when performing a compression test of raw meat. Samples were aged during 2, 4, 8 and 12 days at 0-4 ºC. Stress was assessed at 20% (C20) and 80% (C80) of the maximum compression.

III. RESULTS AND DISCUSSION

Table 1 shows the percentage of muscle, bone and fat related to the total tissues dissected. It could be expected higher level of fat in heavy animals because when the live weight rise the fat percentage increases, decreasing bone and muscle percentages [6]. However no significant differences between percentages were found, probably due to the low fat content in this species, as reported by [7] in comparison with other livestock species. The inferior energy level of the diet in these extensive grass fed animals, in comparison with unweaned animals, agree with [8] who, in lambs, found that unweaned animals were fatter than weaned because the milk has higher energy content than the substituted diet. Besides, [9] reported that aggressive weaned management and post-weaning nutrition may be the reason for these differences.

Thus, our results agree with those reported by [9], who found no statistical differences in percentage of muscle, bone and fat between different slaughter live weights (6, 10 and 25 kg) in Canary Caprine Group breed

Table 1 Means (± standard deviation) for tissue composition at different slaughter live weight.

	Light	Heavy	sig.
% Muscle	69,71 ±1,72	69,17 ± 2,52	ns
% Fat	5,31 ± 2,75	6,80 ± 3,51	ns
% Bone	24,99 ± 1,77	24,03 ± 1,83	ns

ns: not significant

The effect of slaughter live weight on initial pH, pH at 48 h and meat colour are summarised in Table 2.

Table 2 Means (± standard deviation) for instrumental measurements of quality of kid meat at different slaughter live weights.

	Light	Heavy	sig.
pH 0	7,01± 0,20	7,22± 0,75	**
pH 48	5,98 ± 0,30	5,95 ± 0,14	ns
L*	43,51 ± 2,91	43,21 ± 2,91	ns
a*	11,82 ± 2,09	16,19 ± 1,94	***
b*	4,09 ± 1,43	4,56 ±1,09	ns
C*	12,54 ± 2,37	16,83 ±2,14	***
h*	18,68 ± 4,12	15,56 ±2,04	*

ns: not significant; * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

The results showed that there were differences in the variables analyzed, except for pH 48 h and L* and b* values.

An initial greater pH in carcasses from heavy animals was observed, but not at the final pH. This pH at 48 h was lower than 6.0 but it was higher than the normal pH of lambs reared in similar conditions. As an example, [10] found a range from 5.50 to 5.58 when compared three slaughter weights (10-12 kg: suckling lambs; 20-22 kg and 30-32 kg) in three different lamb breeds. However, the results agree with [11] who found an ultimate pH from 5.7 to 5.9 in kids of six genotypes and two slaughter weights (14-22 kg and 30-35kg). Thus, it is known that kid's meat usually tends to have a high ultimate pH because goats are thought to be generally highly prone to stress. So this

fact is at least partly attributed to stressful peri-mortem handling and the consequential effects on glycogen metabolism. However, it is not clear why goats are so susceptible to pre-slaughter stress, although it might be related to an effect of particular goat's genotype which does these animals more excitable [12].

Also, a significant effect was observed on a*, C* and h* parameters ($p<0,05$). Redness and Chroma had higher values in heavy carcasses, which is typical of older animals. In the same way, the substitution of milk (feed with poor iron content) by grass was possibly other of the causes of these results. However, hue had lower values in the meat in heavier animals according to [9].

In Table 3 we can see the effect of slaughter live weight in terms of texture across ageing. The results show that there were not significant differences in C20, which is related with the myofibrillar component [5], between kids types or ageing times. These results show the age is not determinant criteria to affect texture in these types of animals or that older animals are not tougher as it could be expected and as it was found in lambs [13].

Also, it seems that ageing is not an important factor to produce appreciable textural changes. On the other hand, significant differences at 80% of compression (related to connective component) were found between goat types only in samples aged during 2 and 4 days, with light animals showing surprisingly the higher values, although differences between groups disappeared at longer ageing periods.

[14] suggested a minimum weight for slaughter to assure that that the carcass is large enough to prevent the occurrence of processing toughness. [15] reported that the collagen of sheep meat was also more soluble than that of goat meat. In general, the higher the insoluble collagen content, the tougher the meat, so probably in this study the results obtained could be attributed to differences in collagen content. However, more studies should be done.

[13] studied the texture of lambs from different production system. When comparing the values of suckling and light Spanish lambs with our results it can be observed that our results agree in terms of C20 because in both cases suckling lambs had higher values (6.50 N/cm^2 *vs* 11.79 N/cm^2). However in C80, suckling lambs were more tender (55.65 N/cm^2 *vs* 60.75 N/cm^2) [13] opposite to our results where heavy animals had lower values.

IV. CONCLUSIONS

The slaughter weight, associated to a specific production system, had lower effect on carcass composition than on instrumental meat quality. Nevertheless, increasing the live weight at slaughter could increase a farmer's profit margin.

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Table 3 Means (± standard deviation) for instrumental measurements of texture of kid meat at different slaughter live weights.

	Light		Heavy		Sig.	
Ageing time	C20	C80	C20	C80	C20	C80
2 days	7,27 ± 2,41	63,94 ± 14,87	7,05 ± 2,91	48,05 ± 15,95b	ns	*
4 days	7,93 ± 4,60	66,50 ± 11,73	5,69 ± 1,57	50,18 ± 14,85b	ns	**
8 days	5,77 ± 1,43	69,90 ± 15,60	6,33 ± 1,47	63,04 ± 13,37a	ns	ns
12 days	6,69 ± 2,21	76,38 ± 16,64	6,21 ± 1,29	65,29 ± 8,16a	ns	ns
Sig.	ns	ns	ns	*		

C20 and C80: Compression stress at 20% and 80% ($N/cm^{2)}$
ns: not significant; * $p \leq 0.05$; ** $p \leq 0.01$
abc: mean values with different letter in the same column are statistically different ($p \leq 0.05$)