

EFFECT OF TYPE OF STUNNING ON LIPID OXIDATION AND COLOUR OF LIGHT LAMB MEAT

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Introduction

It is well known that pre-slaughter stress affects meat quality in small ruminants (Kannan *et al.*, 2003). In addition, some authors (Buckley *et al.*, 1995; Juncher *et al.*, 2003) have pointed out that some parameters such as colour and lipid oxidation could be more affected by stress. In the EU, stunning previous to slaughter is a legal procedure to ensure that animals remain in an adequate state of unconsciousness up to time of slaughter (Directive 93/119/EU). But the electrical stunning system, used for sheep, is found to have many disadvantages, such as hemorrhages, bone fractures or intense muscular activity (Vergara and Gallego, 2000), which can make stunning unadvisable. In some species (broilers or pigs) electrical stunning has been replaced by a gas method due to the numerous advantages both for meat quality and animal welfare (Gregory, 2005). In sheep, the effects of gas systems (mainly CO₂) are practically unknown, especially as regards lipid oxidation and colour coordinates, which are the aim of this study.

Materials and Methods

Twenty male lambs of the Manchega Spanish breed from the flock of the Experimental farm of Castilla-La Mancha University were slaughtered at 25 kg of weight. Animals were distributed in two groups (n= 10 each) according to type of stunning. In the first group, the animals were stunned using the gas method (GSL, 90%CO₂ for 90 sec). The other group was stunned electrically (ESL, 110 V 50 Hz for 5 sec). Immediately after stunning, lambs were slaughtered using standard commercial procedures. Carcasses were chilled at 4°C in a conventional chiller. The *Longissimus dorsi* (LD) muscle was removed (at 24 h post-mortem) from each carcass and cut into three samples that were placed in clear rigid trays and packed in a conventional atmosphere (30%CO₂+70%O₂). Samples were chilled at 2°C and were analysed (twenty samples per sampling time, ten from each group) at 7, 14 and 21 post-slaughter. Sample rancidity was determined in duplicate from 2 g of the LD muscle as described by Botsoglou *et al.*, (1994) by determining 2-thiobarbituric acid-reactive substances (TBARS). Colour measurements (*L**, *a**, *b**) were taken immediately after the packs were opened and the measurements were taken on the surface of the LD using a Minolta CR400 colorimeter. The data were analysed using an analysis of variance to determine the effects of type of stunning on colour coordinates and TBARS values.

Results and Discussion

Table 1 shows TBARS values for the two different types of stunning (GSL vs ESL). Rancidity level increased ($p < 0.001$) in both groups throughout time of storage, in agreement with Berruga *et al.*, (2005). The GSL group showed lower oxidation values than the ESL at all times ($p < 0.001$). The reason could be that CO₂ used in the gas stunning system may be a determinant in the reduction of O₂ availability in muscle cells, which then reduces the oxidative processes (Bekhit and Faustman, 2005).

Table 1: Effect of type of stunning of lamb on TBARS values (mg malondialdehyde/kg⁻¹ of meat) in meat packed in modified atmosphere (30%CO₂+70%O₂).

Time post-packaging (days)	GSL	ESL	ANOVA
7	0.82±0.3 ^a	4.96±0.42 ^a	***
14	1.18±0.33 ^a	4.2±0.22 ^a	***
21	3.48±0.39 ^b	7.57±0.45 ^b	***
ANOVA	***	***	

GSL: gas stunned lambs; ESL: electrically stunned lambs. *** Indicates significant differences ($p < 0.001$)

^{a,b} values in the same column with different superscripts are significantly different with time ($p < 0.05$) according to a Tukey test.

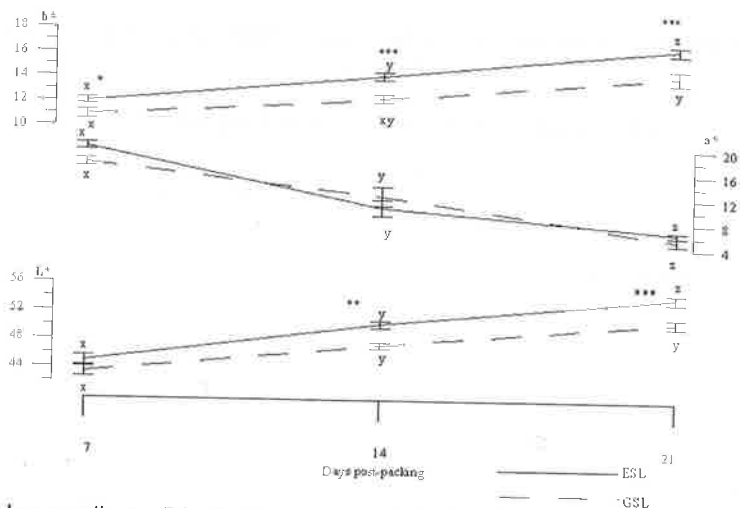


Figure 1: Colour coordinates (L^* , a^* , b^*) in gas-stunned lambs (GSL) and electrically stunned lambs (ESL). Values indicate significant differences due to the time of storage (7, 14 and 21 days) ($p < 0.05$). *, **, ***: indicate significant levels of 0.05, 0.01 and 0.001 respectively for the same time post-packing among the two groups of lambs from the different types of stunning.

L^* and b^* values increased (Figure 1) with time in both groups whereas the a^* values showed an opposite trend, in agreement with the results shown by Vergara and Gallego (2001). On the other hand, the oxidative process of meat (Table 1) was related to the instability of colour with time, according to Bekhit and Faustman (2005). In this sense, L^* and b^* colour coordinates were higher in the ESL than in the GSL samples, although there were no significant differences between groups with regard to the a^* parameter at any time of storage. As some authors mentioned (Guidera *et al.*, 1997), lipid and pigment oxidation in lambs are strongly related.

Conclusions

The type of stunning affects lipid oxidation as well as colour coordinates values. The stunning of lambs using gas can increase the shelf-life of the meat packed in a conventional modified atmosphere (rich in oxygen) since the TBARS values were less than in samples of lambs stunned electrically and this was related to a higher stability in colour.

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