LIPID OXIDATION AND SENSORIAL ACCEPTANCE OF GAS-STUNNED SUCKLING LAMB MEAT

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Introduction

Lamb meat is highly valued by consumers in Spain, even though it is considered as a luxury item in the daily diet due to its organoleptic characteristics and high price (Vergara and Gallego, 2001). However, the increased price factor is of secondary importance upon purchase, since consumers are more influenced by such factors as image and quality (Bernabeu and Tendero, 2005). Some processes such as lipid oxidation of muscle could contribute to a change in sensorial characteristics, mainly colour and odour (Liu *et al.*, 1995). Consumers in many countries complain of the rancid taste in meat packed in the habitual modified atmospheres rich in oxygen (Knut and Guy, 2006). It is therefore necessary to maintain an attractive visual colour of meat without off-odour even up to three weeks post-packing (Krause *et al.*, 2003) in order to reduce loss of freshness and to offer greater possibilities of commercialization.

Materials and Methods

Ten suckling lambs of the Manchego Spanish breed were slaughtered at 12.8 kg live weight by commercial procedure after gas stunning. The *Longissimus dorsi* (LD) muscle from both sides was removed from each chilled carcass (at 24 h post-mortem) and cut into 9 portions of similar size, giving a total of 90 samples. The samples were preserved in modified atmosphere (MA). Three types of gas mixtures were used, Type A: 30%CO_2+70%O_2; Type B: 30%CO_2+69.3%N_2+0.7%CO; Type C: 40%CO_2+60%N_2. Ten samples were analysed per atmosphere type and per sampling time (at 7, 14 and 21 days of storage at 2ºC). 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). A panel of five experts assessed sensorial colour and odour. Colour was categorised in closed packs, and odour immediately after opening the pack. For both colour and odour, samples were scored as 1= not acceptable, 2= acceptable or 3= very acceptable. Data were analysed using analysis of variance to determine the effect of atmosphere type on rancidity. When the differences among types of modified atmospheres were significant ($p < 0.05$), Tukey's test was carried out to check the differences between pairs of groups.

Results and Discussion

In general, acceptability of packs upon visual and odour evaluation was higher in Type B atmosphere (with CO) and lower in Type A (with oxygen) at all times of storage (Table 1). MA type C was intermediate.

Table 1: Percentage of acceptable packs according to sensorial colour[1] and odour[2].

	Time post-packaging	Type A	Type B	Type C
Colour	7 days	100	100	96
	14 days	36	100	83
	21 days	25	100	96
Odour	7 days	82	100	79
	14 days	25	93	79
	21 days	14	46	50

[1]Closed packs, [2]When packs were opened; Modified Atmosphere: Type A:30%CO_2+70%O_2, Type B:30%CO_2+69.3%N_2+0.7%CO, Type C:40%CO_2+60%N_2. Samples were categorised (for both colour and odour) as: 1 = not acceptable (strong off-odour/colour), 2 = acceptable (slight off-odour/colour) or 3 = very acceptable (no off-odour/colour).

Samples packed in Type B showed the lowest TBARS values and highest oxidative stability throughout time without significant differences at 7, 14 and 21 days post-packaging (Figure 1). According to Krause *et al.*, (2003) the use of a low concentration of CO could ensure the inhibition of the lipid oxidation while improving the visual appearance (colour) and odour of meat.

On the other hand samples from the MA type A (high O_2 concentration) obtained the highest rancidity levels. The increase in the TBARS level coincided with the slight off-odours detected by the sensory panellist at 14 days of storage.

The high oxygen concentration in the packs favours oxidative processes, while the products of lipid oxidation have been associated with off-odours, thus agreeing with Jeremiah (2001).
Samples packed with Type C (without O_2) raised the intermediate TBARS values and an adequate acceptance by panellists, although in general lower than Type B. The presence of a certain residual level of oxygen inside the packs could be enough to produce lipid oxidation and a slight but not excessive alteration of sensorial meat quality parameters such as colour and odour (Smiddy *et al.*, 2002).

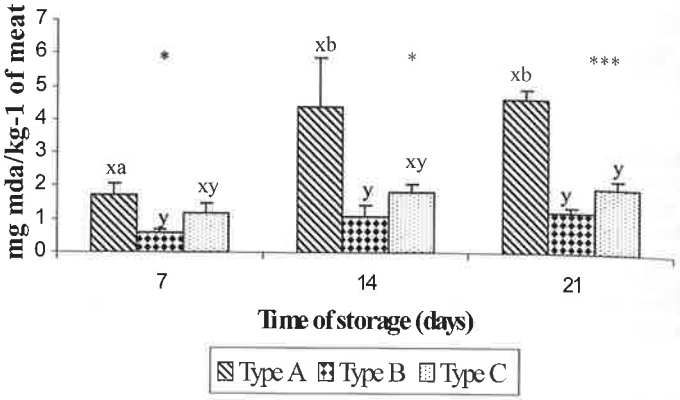

Figure 1: [a,b] indicate significant differences ($p < 0.05$) for the same type of modified atmosphere (Type A:70%O_2+30%CO_2; Type B:69.3%N_2+30%CO_2+0.7%CO; Type C: 60%N_2+40%CO_2) at different times of storage. [x,y] indicate significant differences ($p < 0.05$) between different types of modified atmosphere for the same period of storage. *, *** indicate significant levels at 0.05 and 0.001 respectively.

Conclusions

A low concentration of carbon monoxide could be a possible alternative to the packaging of fresh lamb meat since it can guarantee suitable colour and odour, along with minimum lipid oxidation.

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