SHELF-LIFE EXTENSION AND COLOUR STABILIZATION OF BEEF PACKAGED IN A LOW O_2 ATMOSPHERE CONTAINING CO: 2.- GROUND MEAT.

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INTRODUCTION

The aim of this research was to investigate a new atmosphere for ground meat packaging combining low concentration of O_2 (highly interesting for industry because mixtures with more than 24% of O_2 have a risk to explode spontaneously), intermediate concentration of CO_2, with the known benefits in terms of bacterial growth inhibition, and very low concentration of CO (1%), which improves colour stability.

MATERIALS AND METHODS

Samples. A portion of *Longissimus lumborum* was removed from the carcass 48 h post-mortem. It was diced and ground using a convectional mincer (Moulinex Mincer). Thus, samples of uniform weight (50 ± 1 g) and thickness (1.5 cm) were formed.
Packaging. Microbiological analyses. Instrumental colour measurement. Sensory analyses. As described in "SHELF-LIFE EXTENSION AND COLOUR STABILIZATION OF BEEF PACKAGED IN A LOW O_2 ATMOSPHERE CONTAINING CO: 1.- BEEF STEAKS". M. Luño, J.A. Beltrán & P. Roncalés.

RESULTS AND DISCUSSION

Microbiological analyses. Fig. 1 shows the evolution of aerobic psychrophilic bacteria during ground beef storage at 1 ± 1°C. Inicial counts were about 10^5 and there was an increase with time with an initial plate of 7 d in all samples. LO-CO atmosphere was the best in controlling microorganisms and flora evolution differed significantly from HO-CO and CMA. The fact that CMA and HO-CO counts were similar indicates that 1 % CO had no effect on psychrophilic flora, and the difference with LO-CO should be explained by the higher concentration of CO_2 in this latter atmosphere (50 %). From a microbiological point of view and according to Ayres (1960) and Dainty et al. (1983) who fixed log ufc/g = 7.5 as the point where off-odours appear, control samples were aceptable up to 17 d, samples packaged in HO-CO atmosphere up to 21 d and LO-CO samples were aceptable until the end of the experiment (29 d).
Colour instrumental measurement. As several researchers (El-Badawi et al. in 1964, Besser and Kramer in 1972, Clark et al. in 1976 and Gee and Brown in 1978) have already demonstrated, CO stabilises red colour of meat by the high stable complexe carboxymioglobin (CO-Mb). a* values showed in Fig. 2 differed significantly between control and CO-samples. After 29 d of storage, a* value was 6,48 for control samples, 14.25 for HO-CO samples and 17.56 for LO-CO samples. Hue angle and Chroma evolution are represented in Fig. 3; values were similar up to 8 d for every atmosphere, but from this point there were very clear differences between control and CO-samples.
MetMb. percentage evolution shown in Fig. 4 revealed a marked difference between control and CO packaged samples. MetMb value after 29 d. storage was 78.1 % for samples packaged in control atmosphere while values for samples in atmospheres containing CO were clearly lower, about 28 % and 16.7 % for HO-CO and LO-CO respectively. It is not well known which Met-Mb concentration is needed for brown colour appearance. Greene et al. (1971) reported that 40 % Met-Mb caused meat rejection by consumers and Solberg (1970) stated that 50-75 % Met-Mb gave to meat the undesirable brown colour. In this experiment, meat packaged in control atmosphere would be refused (if we consider 50 % Met.-Mb as a limit for aceptance) at about 23 d while samples packaged in atmospheres containing CO will not be rejected at 29 d (end of the experiment).
Sensory analyses. Table 1 summarizes the results obtained for several sensory parameters. The most noticeable difference between control samples and those packaged in atmospheres containing CO was colour evolution. Red colour increased as a consequence of the inclusion of CO into the atmosphere and brown colour appearance was delayed for HO-CO or it did not occurred for LO-CO. Odour intensity increased during storage period for all studied atmospheres but not at the same level, control samples had the highest values, in contrast panel members gave better odour quality to samples packaged in atmospheres containing CO.

CONCLUSION

An atmosphere containing 1 % CO, 25 % N_2, 24 % O_2 and 50 % CO_2 combines a number of worthwhile effects for ground meat storage. 1 % CO stabilizes meat colour for a long time period (29 d). 50 % CO_2 caused a strong microorganism growth inhibition. Gas mixtures with 24 % O_2 do not present the risk of spontaneous exlosion. In conclusion, this atmosphere appears to be a fitting choice for ground meat packaging.

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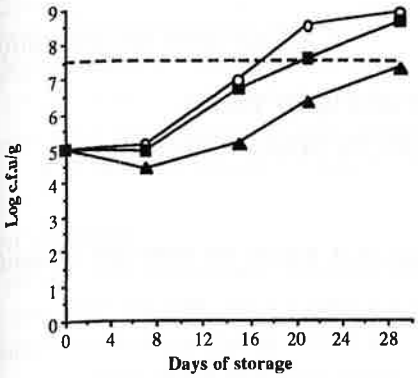

Fig. 1.- Psychrotrophics flora counts in ground beef during storage at 1 ± 1°C. ○ CMA (70% O2+20%CO2+10%N2); ■ HO-CO (70% O2+20% CO2+10% N2 +1% CO); ▲ LO-CO (24% O2+50% CO2+25% N2+1% CO).

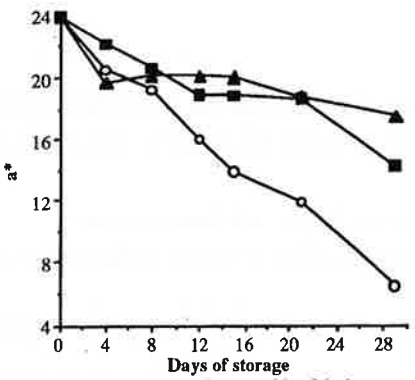

Fig. 2.- Evolution of a* parameter in ground beef during storage at 1 ± 1°C. ○ CMA (70% O2+20%CO2+9%N2); ■ HO-CO (70% O2+20% CO2+9% N2 +1% CO); ▲ LO-CO (24% O2+50% CO2+25% N2+1% CO).

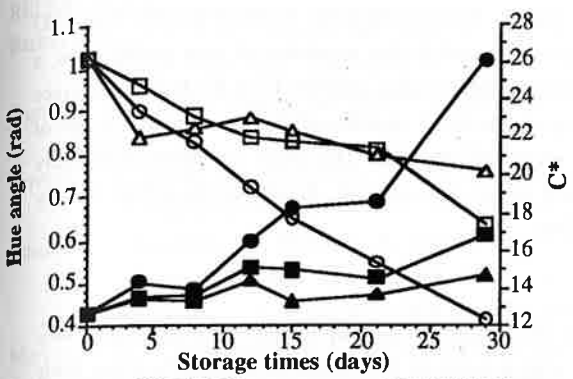

Fig. 3.- Evolution of Hue angle (closed symbols) and C* (open symbols) parameters in ground beef during storage at 1 ± 1°C. Symbols as in Fig. 1.

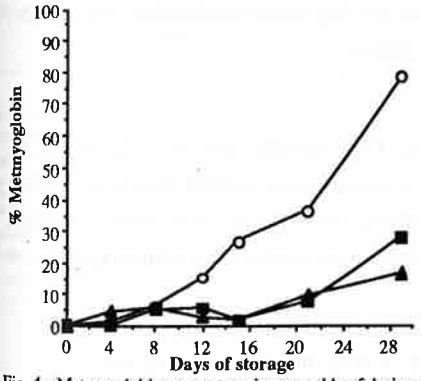

Fig. 4.- Metmyoglobin percentage in ground beef during storage at 1 ± 1°C. ○ CMA (70% O2+20%CO2+10%N2); ■ HO-CO (70% O2+20% CO2+9% N2+1% CO); ▲ LO-CO (24% O2+50% CO2+25% N2+1% CO).

TABLE 1

Mean sensory values of ground meat packaged in different gas atmospheres. CMA (70% O_2 + 20% CO_2 + 10% N_2); HO-CO (70% O_2 + 20% CO_2 + 9% N_2 + 1% CO) and LO-CO (24% O_2 + 50% CO_2 + 25% N_2 + 1% CO).

Parameter	Gas atmosphere	Days of storage							
		0	2	4	8	12	15	21	29
Ext. Humidity	CMA	5	4,9	4,8	4,6	4,5	4,4	4,3	4,3
	HO-CO	5	5	4,9	4,8	4,4	4,3	4,3	4,3
	LO-CO	5	5	5	4,7	4,4	4,3	4,3	4,3
Red Colour	CMA	6,8	7,5	7,5	7,5	7,5	7,5	7,5	7,5
	HO-CO	6,8	8,5	8,5	8,5	8,5	8,5	8,5	8,5
	LO-CO	6,8	8,4	9	9	9	9	9	9
Brown Colour	CMA	1	1	1	1	1,4	2,4	5,6	7,8
	HO-CO	1	1	1	1	1	1	1,2	1,8
	LO-CO	1	1	1	1	1	1	1	1
Odour intensity	CMA	2	ND	1,1	2,2	4,8	5,6	7,7	7,8
	HO-CO	2	ND	1,1	1,1	1,7	2,2	3,7	5
	LO-CO	2	ND	1,1	1,1	1,9	2	3	3,3
Odour quality	CMA	7	ND	7	5,8	5,5	5	2,2	1
	HO-CO	7	ND	7	7	7	6,7	4,4	4,2
	LO-CO	7	ND	7	7	7	7	6,3	6,3

ND.- Not Determined.