EFFECT OF MODIFIED ATMOSPHERES PACKAGING ON THE HYGIENIC AND ORGANOLEPTIC QUALITY OF "CECINA DE LEON" KEPT FOR EXTENDED STORAGE

Rubio, B.; Molinero, C.; Martínez, B., González-Fernández, C. and García-Cachán, M.D.

Estación Tecnológica de la Carne. Instituto Tecnológico Agrario de Castilla y León. C/ Filiberto Villalobos s/n. 37770 Guijuelo (Salamanca). Spain

Background

Spanish "Cecina" is a salted, dried, and smoked beef meat product manufactured traditionally in the province of Leon (north-western Spain). The preparation method is similar to that used in dry-cured ham manufacture. The final product has a typical red colour, smoked flavour and a characteristic slight salty taste.
During the last years many conservation procedures have been developed, such as vacuum packaging, packaging in CO_2/N_2 atmosphere, etc., in order to increase the shelf-life period of meat products to guarantee its sanitary and organoleptic quality. However, no studies have been carried out on packaging of "Cecina de Leon".

Objectives

The aim of the present study was to investigate the shelf life of commercial "Cecina de Leon" packaged in CO_2/N_2 atmosphere and vacuum under refrigeration for an extended storage period.

Materials and methods

Samples. The study was carried out on 12 pieces of "Cecina de Leon" provided by Protected Geographical Indication (PGI) "Cecina de Leon". Each piece was divided in 5 portions: one portion was used for initial analyses and the other portions were packaged.
Packaging and storage. The "Cecina" portions were individually packaged either: (a) in plastic bags (polyamide/polyethylene) which were subjected to vacuum (VP) and sealed using a packer TECNOS.CVP mod: A-300 or (b) in polystyrene rigid trays which, after gassing with a mixture of 20/80% CO_2/N_2 (MAP), were closed by heat-sealing with a packer TECNOVAC mod: Linvac 400 with a high barrier film. Packages had a headspace volume ratio of 1:1. The gas content of each pack was controlled using a Servomex model 1450 B3 gas analyzer. The packages were stored at 6ºC. Four packs of each treatment were opened for subsequent analysis after 15, 30, 60, 90, 150 and 210 days of storage. The entire experiment was replicated twice.
Microbiological analysis: 10 g of each sample were taken aseptically and were homogenised with 90 ml of tryptone water for 2 min in a PK 400 Masticator. Serial decimal dilutions were made in sterile tryptone water and plated onto growth in duplicate. The samples were analysed for aerobic mesophilic bacteria (Plate Count Agar (Scharlau, Spain) at 30 ºC for 72 h), psychrotrophic bacteria (Plate Count Agar (Scharlau, Spain) at 7 ºC for 10 days), anaerobic bacteria (Schaedler Agar (Scharlau, Spain) at 37 ºC for 48 h), enterobacteria (Violet Red Bile Glucose Agar (VRBGA, Scharlau, Spain) at 37 ºC for 24h), enterococci (Slanetz Bartley Agar (Scharlau, Spain) at 37 ºC for 24 h), pseudomonas (Pseudomonad Agar (Oxoid, Spain) supplemented with Cetrimide, Fucidine and Cephaloridine (CFC, Oxoid, Spain) at 30 ºC for 48 h), lactic acid bacteria (LAB) (MRS Agar (Scharlau, Spain) at 30 ºC 72 h), micrococci (MSA (Scharlau, Spain) at 37 ºC for 48 h), yeasts and molds (Agar OGYEA (Oxoid, Spain) supplemented with Oxytetracicline (Oxoid, Spain) at 25 ºC for 5 days).
Physicochemical analysis: Water activity (a_w) was measured by CX2 AQUA LAB equipment. The pH values were determined by puncture with a pH meter equipped with a glass electrode. Objective measurement of colour was performed at the surface of "Cecina" portions using a reflectance spectrophotometer (Minolta CM-2002). Colour coordinates were determined in the CIE-LAB system and the results were expressed as lightness (L*), redness (a*) and yellowness (b*). Instrumental Texture Profile Analysis (TPA) (Breene, 1975) was performed with a TA-XT2 Texture Analyzer (Stable Micro Systems Ltd.). Six cubes of "Cecina" (1x1x1 cm) were compressed twice with a cylindred probe of 1 cm in diameter, at 1 mm/min speed and the

level of compression was 60% of the thickness of the sample (1 cm). The test was accomplished always at room temperature and the parameters determined was: hardness, springiness, cohesiveness and chewiness.
Sensory evaluation was carried out on "Cecina" slices after each storage time by an experienced 8-member sensory panel. The sensory attributes (colour, odour, flavour, hardness, juiciness and overall acceptance) were scored using 5-points scales, 5 denoted extremely high and 1 denoted extremely low.
Statistical analysis of data was carried out by one-way analysis of variance, and means were separated by Tukey- honest significant difference test at 5% level (Statistica software package).

Results and discussion

Figure 1 shows results of the microbiological analysis, except enterobacteria and enterococci counts, which were always $<10^2$ cfu/g. Aerobic mesophilics and anaerobes counts were similar to psychrotrophs counts. Psychrotrophs numbers in VP remained constant for up to 210 days. However, a significant increase ($p<0.05$) was noted in MAP after 210 days of storage ($>10^7$ cfu/g). Among the undesiderable microbial strains, Pseudomonas were subjected to a significant growth inhibition under 20/80% CO_2/N_2. This fading is caused by the bacteriostatic effect of CO_2. The typical microflora of "Cecina" (LAB, yeasts and molds and micrococci) remained constant for up to 210 days in VP but a significant increase ($p<0.05$) was noted at the end of storage in MAP.

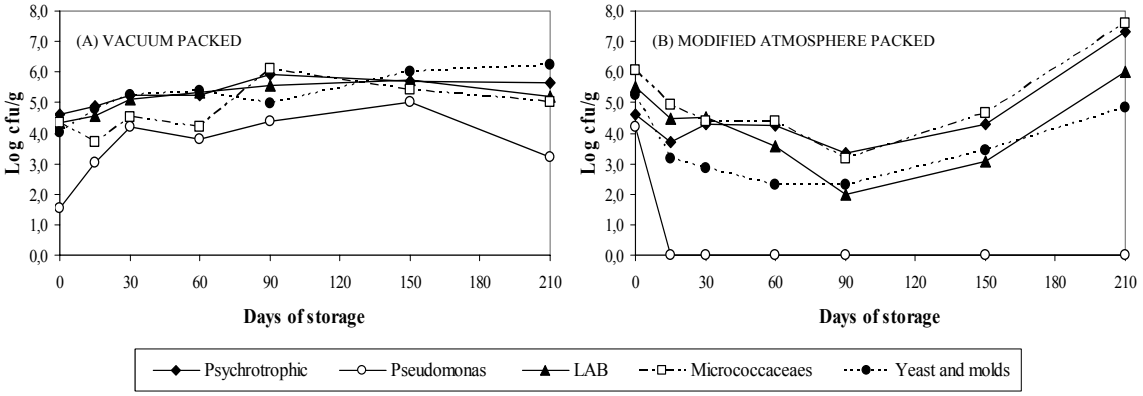

Figure 1: Evolution of microbiological parameters of "Cecina" packed under vacuum (A) and under 20/80% CO_2/ N_2 (B) during storage.

Regarding pH and a_w values, these parameters remained constant during storage. No differences in pH and a_w were found from VP and MAP samples. The pH values in all samples were in the range 5.8-6.1 and the a_w values were typical of the intermediate moisture foods (0.878-0.903).
Results of colour measurement are shown in Figure 2. No differences ($p>0.05$) in lightness (L*) and yellowness (b*) values were found between treatments at any given storage times. With regard to redness (a*), which has been used as an indicator of colour stability in meat and meat products, a pronounced initial fading was seen within the first 15 days for VP samples and within the second month for MAP samples. Presence of white film on surface of "Cecina" portions is a probable explication for discolouration. The later appearance of white film in MAP samples can be attributed to presence CO_2. Arnau *et al*., (1988) found that CO_2 delayed white film formation in Iberian ham packed in modified atmosphere

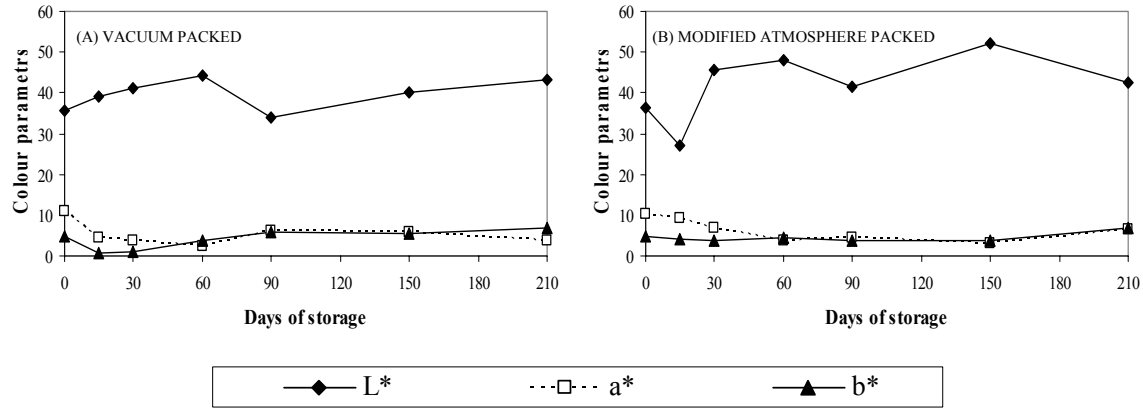

Figure 2: Evolution of colour parameters of "Cecina" packed under vacuum (A) and 20/80% CO_2/N_2 (B) during storage.

In relation to the texture parameters, no differences ($p>0.05$) were found between MAP and VP samples during the studied period. Values (means ± SD) found for different parameters were: hardness=2413.7±486.2 g; springiness=0.368±0.036 mm; cohesiveness=0.395±0.017; chewiness=375.09±111.76 g mm. Taking into account the normal variability found for these parameters, all values were considered normal for this type of product (García et al., 2004).

Table 1: Sensory parameters (mean ± S.D.) of "Cecina" slices packaged under different conditions during storage.

Parameter	Packaging	0 days	15 days	30 days	60 days	90 days	150 days	210 days
Colour	Vacuum	$^{a}_{B}$4.8 ± 0.2	$^{a}_{A}$4.5 ± 0.5	$^{a}_{B}$4.8 ± 0.5	$^{a}_{A}$4.4 ± 0.5	$^{a}_{A}$4.4 ± 0.5	$^{a}_{A}$4.4 ± 0.5	$^{a}_{A}$4.6 ± 0.5
	20/80	$^{a}_{A}$4.3 ± 0.2	$^{a}_{A}$4.4 ± 0.5	$^{a}_{A}$4.1 ± 0.4	$^{a}_{A}$4.3 ± 0.5	$^{a}_{A}$4.3 ± 0.7	$^{a}_{A}$4.3 ± 0.5	$^{a}_{A}$4.3 ± 0.5
Odour	Vacuum	$^{d}_{B}$5.0 ± 0.0	$^{bcd}_{A}$4.5 ± 0.5	$^{cd}_{A}$4.6± 0.5	$^{abc}_{A}$ 4.1±0.4	^{abc}3.9$_{A}$ ± 0.6	$^{ab}_{A}$3.8± 0.5	$^{a}_{A}$3.6 ± 0.5
	20/80	$^{b}_{A}$4.2 ± 0.3	$^{b}_{A}$4.1 ± 0.8	$^{b}_{A}$4.1 ± 0.6	$^{b}_{A}$3.9 ± 0.4	4.0 $^{b}_{A}$ ± 0.8	$^{ab}_{A}$3.4 ± 0.7	* $^{a}_{A}$2.9 ± 0.3
Flavour	Vacuum	$^{b}_{B}$5.0 ± 0.0	$^{ab}_{A}$ 4.4 ± 0.5	$^{b}_{B}$ 4.5 ± 0.5	$^{ab}_{A}$ 4.4 ± 0.5	$^{a}_{A}$3.8 ± 0.5	$^{a}_{B}$3.8 ± 0.5	$^{a}_{B}$3.8 ± 0.5
	20/80	$^{c}_{A}$ 4.1 ± 0.3	$^{bc}_{A}$ 3.8 ± 0.5	$^{bc}_{A}$ 3.8 ± 0.5	$^{c}_{A}$ 3.9 ± 0.6	$^{c}_{A}$ 4.0 ± 0.5	$^{ab}_{A}$ 3.0 ± 0.5	* $^{a}_{A}$ 2.8 ± 0.5
Hardness	Vacuum	$^{b}_{A}$ 5.0 ± 0.0	$^{ab}_{A}$ 4.5 ± 0.5	$^{ab}_{A}$ 4.4 ± 0.5	$^{a}_{A}$ 4.1 ± 0.4	$^{a}_{A}$ 4.0 ± 0.8	$^{a}_{A}$ 3.9 ± 0.6	$^{a}_{B}$ 3.8 ± 0.4
	20/80	$^{b}_{A}$ 4.6 ± 0.1	$^{b}_{A}$ 4.3 ± 0.5	$^{b}_{A}$ 4.3 ± 0.9	$^{b}_{A}$ 4.3 ± 0.7	$^{b}_{A}$ 4.1 ± 0.8	$^{ab}_{A}$ 3.9 ± 0.8	* $^{a}_{A}$ 2.9 ± 0.4
Juiciness	Vacuum	$^{b}_{A}$ 5.0 ± 0.0	$^{ab}_{A}$ 4.6 ± 0.5	$^{ab}_{A}$ 4.5 ± 0.5	$^{a}_{A}$ 4. ± 0.4	$^{a}_{A}$ 4.1 ± 0.8	$^{a}_{A}$ 4.1 ± 0.6	$^{a}_{A}$ 3.9 ± 0.2
	20/80	4 $^{b}_{A}$.6 ± 0.2	$^{ab}_{A}$ 4.4 ± 0.5	$^{ab}_{A}$ 4.3 ± 0.5	$^{ab}_{A}$ 4.1 ± 0.8	$^{ab}_{A}$ 4.1 ± 0.6	$^{ab}_{A}$ 3.9 ± 0.6	$^{a}_{A}$ 3.5 ± 0.5
Acceptance	Vacuum	$^{d}_{B}$ 5.0 ± 0.0	$^{bcd}_{A}$ 4.4 ± 0.4	$^{d}_{B}$ 4.6 ± 0.3	$^{cd}_{B}$ 4.5 ± 0.5	$^{a}_{A}$ 3.7 ± 0.5	$^{abc}_{A}$ 3.9± 0.4	$^{ab}_{B}$ 3.8 ± 0.4
	20/80	$^{b}_{A}$ 4.1 ± 0.1	$^{b}_{A}$ 3.9 ± 0.6	$^{b}_{A}$ 3.9 ± 0.4	$^{b}_{A}$ 3.9 ± 0.5	$^{b}_{A}$ 4.0 ± 0.5	$^{ab}_{A}$ 3.4 ± 0.6	$^{a}_{A}$ 3.1 ± 0.3

Means with different small letters indicate significant differences between storage times (Tukey test: $p<0.05$).
Means with different capital letters indicate significant differences between packaged treatments (Tukey test: $p<0.05$).
* Values below 3 means that "Cecina" was not accepted.

Table 1 shows the results of the sensory evaluation of "Cecina". According to panellists, MAP samples were slightly less acceptable (3.1) than VP samples (3.8) at the end of storage. As panellists evaluated odour, flavour and hardness in MAP samples below 3, it could be considered that colour and juiciness were the main factors which influenced the panellist in the evaluation of overall acceptance. This agrees with the conclusion of Ruiz *et. al.* (2002) who reported a relationship between juiciness and acceptance in Iberian ham. The sensory evaluation of colour did not confirm the instrumental results since sensory analysis was carried out on "Cecina" slices instead of portions.

Conclusions

On the basis of the results reported, in microbiological and sensory terms the shelf life of chilled vacuum packed "Cecina" in the conditions given in this study is 210 days, and the shelf life of chilled modified atmosphere packed (20/80% CO_2/N_2) "Cecina" is 150 days (based mainly on microbiological counts).

Acknowledgments:

This research was supported by the ITA project (2002/000999). Rubio, B and Molinero, C gratefully acknowledges of a grant from Junta de Castilla y Leon-Spain.

References

Arnau, J., Hugas, M. and Monfort, J.M. 1988. El envasado del jamón curado in Jamón curado: Aspectos técnicos. 88-90.

Breene, W.M. 1975. Applications of texture profile analysis to instrumental food texture evaluation. J. Texture Study. 6:53-82.

García-Esteban, M., Ansorena, D. and Astiasarán, I. 2004. Comparison of modified atmosphere packaging and vacuum packaging for long period storage of dry-cured ham: effects on colour, texture and microbiological quality. Meat Science. 67:57-63.

Ruiz, J., García, C., Muriel, E., Andrés, A. I. and Ventanas, J. 2002. Influence of sensory characteristics on the acceptability of dry-cured ham. Meat Science. 61:347-354.