

EFFECT OF THE FREEZING PROCESS ON RAW MATERIAL DURING THE MANUFACTURE PROCESS OF "CECINA DE LEÓN"

C. Molinero*, B. Martínez, B. Rubio and M.D. García-Cachán

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

Keywords: freezing, dry cured beef, microbiology, sensorial, texture

Introduction

Dry-cured beef "Cecina de León" is a traditional intermediate meat product, manufactured in the province of León (Northwest of Spain). The processing is similar to that followed in the production of dry-cured ham. During the ripening of this meat product, proteins undergo various modifications, particularly proteolysis. As a consequence of these changes peptides, free amino acids and other small nitrogenized compounds are generated. Nowadays, due to the continuous increase in "Cecina de León" consumption it is necessary alternatives for increasing "Cecina de León" production without affecting its quality. Frozen raw material is an appropriate preservation technique to enable production independently of season. However, it must be taken into account that, some biochemical mechanisms, like proteolysis, can be affected. The aim of this work was to evaluate the microbiological and the sensorial evolution in "Cecina de León" manufactured with both frozen and refrigerated raw material, looking for possible differences between them.

Materials and Methods

Twenty knuckles (composed by *M. rectus femoris* and *vastus lateralis*, *vastus medialis* and *vastus intermedius*), weighing 5 ± 1 kg were procured from a slaughterhouse. The raw pieces were divided in two batches: (batch 1) the raw material was refrigerated ($2-3^{\circ}\text{C}$) and (batch 2) the raw material was frozen (7 days, -20°C) and thawed (4 days, 4°C). The manufacture process was according to the specifications of Protected Geographical Indication "Cecina de León" (BOCYL, 1994). Microbiological analysis (mesophilic aerobic bacteria, lactic acid bacteria and *Micrococaceae*) and instrumental texture profile analysis (TPA) were carried out at the pre-salting stage (day 0), at the middle of the post-salting stage (day 37), at the end of the smoking stage (day 55), during the drying phase (days 90, 145 and 180) and at the end of the process (day 210). In order to detected sensory differences between batches, a triangular test was performed at 210 days with an experienced 8-members panel. Besides, the panellists carried out a descriptive test using a 5-point hedonic scale for to evaluate the main sensory attributes of "Cecina de León". Statistical analysis of data was carried out by one-way analysis of variance, and means were separated by Tukey Honest Significant Difference test using at 5% level (Statistica software package).

Results and Discussion

Results obtained for microbiological analysis are shown in table 1. Mesophilic aerobic bacteria counts increased from day 0 to day 37 day and then, these counts remained constant until 187 days. At the end of manufacture process (210 days) a decrease was observed for mesophilic aerobic bacteria numbers and the values obtained at this point were similar to those found at day 0. *Micrococaceae* counts increased until day 55 for batch 1 and these count remained constant until day 187 to decrease at the end of the process. On the other hand, the counts in batch 2 increased until 90 day and a decrease was observed at the end of the process. Regarding lactic acid bacteria counts did not shown a clear trend along manufactured process. In general, *Micrococaceae* and lactic acid bacteria constituted the predominant flora of "Cecina de León". This fact could be explained because coccus and lactic acid bacteria are salt tolerant and are not inhibited by osmotic pressure or partial desiccation (Cornejo *et al.*, 1992; Carrascosa and Cornejo, 1991). No significant differences ($P>0.05$) were found with either mesophilic aerobic bacteria or *Micrococaceae* between batches. These results agree with data reported by other authors for "Cecina de León" (García *et al.*, 1995) and for dry-cured Iberian ham (Rodríguez *et al.*, 1995). However, significant differences ($P<0.05$) between batches were found in lactic acid bacteria but these differences did not allow establishing clear differences using refrigerated raw and frozen/thawed raw material. Table 2 shows the changes in the instrumental parameters of texture during the manufacture process of "Cecina León". There were evident textural changes, particularly regarding hardness, which increased significantly ($p<0.05$). Besides, cohesiveness and springiness decreased during the manufacture process ($p<0.05$). Changes in these texture parameters could be attributed to both loss water content and protein changes (Serra *et al.*, 2005). The chewiness, as expected, showed an analogous tendency that hardness. On the other hand, no difference ($p>0.05$) were found between batches respect to the parameters of instrumental texture. Regarding results obtained with the sensorial panel, the triangular test showed differences between batch 1 and batch 2 ($P<0.05$). Besides, the sensory scores obtained in descriptive test (table 3) showed significant differences ($P<0.05$) in colour intensity, marbling and chewiness between batches, probably due to the rupture of tissue membranes during freezing.

Table 1: Evolution of aerobic mesophilic bacteria, lactic acid bacteria and *Micrococaceae* (mean values) (log cfu/g) along manufacture process of "Cecina de León" made using refrigerated raw material (batch 1) and frozen/thawed raw material (batch 2).

	Batch	Days						
		0	37	55	90	145	187	210
Mesophilic aerobic bacteria	1	^A 5.52 _a	^A 6.50 _{cb}	^A 6.59 _c	^A 6.69 _c	^A 6.3 _{cb}	^A 6.12 _{cb}	^A 5.16 _a
	2	^A 5.18 _a	^A 6.54 _{cb}	^A 6.60 _{cb}	^A 6.84 _c	^A 6.15 _b	^A 5.47 _a	^A 5.50 _a
<i>Micrococaceae</i>	1	^A 3.13 _a	^A 4.74 _b	^B 6.38 _c	^A 6.18 _c	^A 6.11 _c	^A 6.06 _c	^A 5.06 _a
	2	^A 3.15 _a	^A 4.73 _b	^A 5.15 _{dc}	^B 6.90 _e	^A 6.06 _{cd}	^A 5.69 _{dc}	^A 5.00 _a
Lactic acid bacteria	1	^B 5.35 _{bc}	^A 4.33 _a	^A 4.47 _a	^B 6.07 _d	^B 6.39 _d	^B 5.93 _{cd}	^A 4.95 _b
	2	^A 4.23 _a	^B 5.12 _b	^A 4.39 _a	^A 5.74 _c	^A 5.39 _c	^A 4.30 _a	^A 5.30 _a

^{a,b,c,d,e} Means with different letters in the same row indicate significant differences during the processing (p<0.05).
^{A,B} Means with different letters in the same column indicate significant differences (p<0.05) between batches.

Table 2: Evolution of instrumental texture parameters (mean values) along manufacture process of "Cecina de León" made using refrigerated raw material (batch 1) and frozen/thawed raw material (batch 2).

	Batch	Days				
		55	90	145	187	210
Hardness (g)	1	^A 5133.0 _a	^A 9253.5 _{ab}	^A 12452.0 _b	^A 12039.1 _b	^A 9364.9 _{ab}
	2	^A 3486.0 _a	^A 6885.5 _a	^A 12101.0 _b	^A 14330.8 _b	^B 11963.1 _b
Cohesiveness	1	^A 0.49 _b	^A 0.48 _b	^A 0.49 _b	^A 0.33 _a	^B 0.39 _a
	2	^A 0.45 _b	^A 0.43 _b	^A 0.48 _b	^A 0.34 _a	^A 0.34 _a
Springiness	1	^B 0.76 _b	^A 0.62 _b	^A 0.60 _a	^A 0.50 _a	^A 0.51 _a
	2	^A 0.60 _b	^A 0.60 _b	^A 0.58 _{ba}	^A 0.50 _a	^A 0.51 _a
Chewiness (g)	1	^A 1683.6 _a	^A 2690.8 _{ab}	^A 3821.8 _b	^A 2002.6 _a	^A 1939.3 _a
	2	^A 933.7 _a	^A 1948.4 _{ab}	^A 3470.9 _c	^A 2358.5 _{bc}	^A 2107.1 _a

^{a,b,c} Means with different letters in the same row indicate significant differences during the processing (p<0.05).
^{A,B} Means with different letters in the same column indicate significant differences (p<0.05) between batches.

Table 3: Results of sensorial parameters (mean ± S.D.) evaluated on dry-cured "Cecina de León" made using refrigerated raw material (batch 1) and frozen/thawed raw material (batch 2).

	Batch 1	Batch 2
Colour homogeneity	^A 3.50±1.06	^A 3.92±0.53
Colour intensity	^A 4.29±0.49	^B 3.69±0.63
Marbling	^A 1.50±0.64	^B 2.61±0.98
Yellowness	^A 1.75±0.84	^A 1.80±0.90
Intermuscular fat	^A 1.33±0.61	^A 1.77±0.81
Odour intensity	^A 2.70±0.96	^A 2.77±1.07
Chewiness	^A 2.77±1.07	^B 3.20±0.78
Juiciness	^A 2.21±1.25	^A 2.11±1.29
Pastiness	^A 1.21±0.39	^A 1.23±0.38
Flavour intensity	^A 3.00±1.18	^A 2.88±1.32

^{A,B} Means with different letters indicate significant differences between batches (p<0.05).
 Values rates on a 5 point scale (1=lowest values, 5=highest values).

Conclusions

The freezing of the raw material had hardly any influence on the microbial and texture parameters evolution along manufacture process of "Cecina de León". However, the freezing of the raw material had an effect on sensorial characteristics of dry-cured "Cecina de León" according to panellists.

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Acknowledgments The authors thank the PGI "Cecina de León for providing the samples used in this work. This research was supported by the "Instituto Tecnológico Agrario de Castilla y León" project (2003/01001) and Fondos Feder.