Poster exhibition parallel session 7: Meat and gastronomy

PE7.01 Effect of frozen storage time on consumer acceptability of lamb meat 26.00

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Abstract— The effect of frozen storage time (FST) (1, 3, or 6 months) on the sensory quality of lamb meat aged for 72 h was evaluated, and compared with fresh meat. A sensory test with consumers was performed on loin chops (Longissimus dorsi muscle). FST affected significantly sensory quality, and 6 month FST showed the lowest acceptabilities. However, consumers did not discriminate between fresh and thawed meat. Cluster analysis for overall acceptability divided the population in four classes for each FST with different preference patterns. Considering FST, only 36% population distinguished between fresh and thawed meat. Fresh meat did not always have the best acceptability.

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Index Terms— length of frozen storage, lamb, consumer, cluster

I.INTRODUCTION

Among food preservation methods, the use of low temperatures is largely applied, especially in a perishable product, such as meat. Either refrigeration or freezing procedures keep meat organoleptic characteristics, as well as reduce or inhibit microorganism growth and most of enzymatic reactions. Meat can be stored frozen for a long time keeping intact its freshness characteristics and with few modifications compared to fresh meat [1], unlike other preservation methods, as heat treatment. However, in general, consumers consider that frozen meat has less quality than fresh meat at purchase point, although this does not happen with other foods. In Spain, this fact plays an important role at purchase intention in lamb meat, since lamb is associated with traditional production and consumption [2]. However, consumers have the habit of freezing meat at home (64% of New Zealand consumers and 67% of Australian ones, for example) [3], and they do it with conventional systems, which do not have the same capacities than industrial ones. Freezing meat could affect some of its properties, such as texture, colour, juiciness, or flavour. This fact depends on freezing, frozen storage, and thawing procedures. Frozen storage conditions (time, temperature, light and/or air exposition, etc) play a main role in thawed meat quality. As sensory quality is a main criterion for consumer purchase of lamb meat [4], any effect that could reduce it will be critical for its acceptability. The objective of this study was to determine the influence of the length of frozen storage in the acceptability of commercial lamb meat considering sensory characteristics.

II. MATERIALS AND METHODS

Ninety out of 100 lamb carcasses of the Rasa Aragonesa breed (local meat purpose breed reared intensively), with cold carcass weight of 11-13 kg, were divided into three batches of 30 carcasses, one lot for each of three frozen storage times (FST): 1, 3 or 6 months. The remaining 10 carcasses were not frozen (control group). Animals were slaughtered in an EU-licensed abattoir in different batches according to frozen storage time before the performance of the sensory test, and following standard protocols. Carcasses were randomly selected for the study. Within 15 min of dressing, they were transported and kept under refrigerated conditions to the facilities of Pastores Group. At 18 h post-slaughter, the lumbar segment of each left carcass side was obtained and kept refrigerated (0-4 ºC) for 30 h more before being cut into 12 mm-thick chops. Keeping the record by animal and anatomical location, chops were grouped and

covered with a retractile oxygen-permeable plastic film. Chop groups were then frozen (following commercial procedures) and stored at -20º C in cardboard boxes for the correspondent FST. The samples of fresh meat (control group, 10 carcasses) were aged in a refrigerator (0-4 ºC) for 72 h before analysis. Consumer sessions were performed in five consecutive weeks (1 session per week) and under controlled conditions in the Veterinary Faculty. Each session was composed of twenty consumers (total n = 100), Zaragoza citizens, which evaluated Overall acceptability, Tenderness acceptability, and Flavour acceptability, with an 8-point structured scale from 1 (dislike extremely) to 8 (like extremely).

The day before each session, samples, inside the plastic wrap, were thawed for 24 h in a refrigerator (0-4 ºC). Chops containing Longissimus dorsi muscle (1st-5th lumbar segment) from a same animal were wrapped together in aluminium foil and placed as a cylinder. The cooking was at 200 ºC on a pre-heated double-grill hotplate until the internal muscle temperature of the muscle reached 70 ºC. The cooked chops were cut into 2 portions each one (free of visible fat and connective tissue), wrapped individually in aluminium foil, and assigned a single random three-digit code. Samples were kept warm at 50 ºC until served (<20 min after being cooked). In each session, each consumer was presented plates containing one sample each, tasted in random order among consumers. To assess the statistical significance of FST on the sensory quality of lamb meat, a General Linear Model (GLM) was used. FST was treated as fixed effect. Descriptive statistics and correlation values were calculated for each variable. To detect significant differences among means, the Duncan's Multiple Range Test was used (level for statistical significance: p≤0.05). These analyses were executed using SPSS 14.0 (2007) for Windows XP. A Cluster analysis was used using XLSTAT (2007) for Windows XP, evaluating the effect of FST inside each cluster. Clusters were described in gender and age using frequencies analysis. To describe the relationship between meat quality traits, a Principal Component Analysis (PCA) was performed using SAS 8.02 (2008) program for Windows XP.

III.RESULTS AND DISCUSSION

The population that participate in the test was balanced for the percentage of sex (52% male, 48% female), and age (27% ≤ 30 years old; 43% from 31 to 50 years old; 30% ≥51 years old) categories. Neither sex nor age (or interaction between them and/or with FST) had a signifficant effect on any tested variable. FST had a significant effect on the three variables evaluated by consumers (Table 1).

Table 1: Effect of Frozen Storage Time (significance values) on consumer scores[1] (mean and standard error deviation)

Effect/ Variable	*Frozen storage time*				SED	p-Value
	6 m	*3 m*	*1 m*	*Fresh meat*		
Overall acceptability	5.00a	5.35b	5.22ab	5.23ab	1.25	*
Tenderness quality	4.88a	5.21ab	5.27b	5.09ab	1.40	**
Flavour qualiy	5.28ab	5.57b	5.24a	5.31ab	1.18	**

[1] Scale used from 1 (dislike extremely) to 8 (like extremely).
SED: Standard error deviation. ns: no significant differences;* p≤0.05; ** p≤0.01; *** p≤0.001.
a, b: different letters in the same row indicate significant differences (p≤0.05).

It is noticeable how fresh meat did not have the best acceptability value, as it could be expected, and it was no statistically different from 1 or 6 months FST. Related to tenderness liking, there were no statistical differences between fresh meat and 3 and 6 months FST, although tenderness acceptability was lower as FST increased (Table 1). In the literature, tenderness has been considered as the main factor on meat acceptability [4]. FST had a significant effect on flavour acceptability. 1 month FST had the lowest flavour liking but it only differed significantly from 3 months FST, which showed the best acceptability. Fresh meat had similar values than frozen meat. However, all the sensory scores were above the middle point (4 points) of the scale used in the test, and all the meats could be considered as 'pleasant' by consumers. Correlation values were highly significant among the three variables evaluated and in a positive way (Table 2).

Table 2: Correlation values and signification

	OA	TA	FA
OA		,839 (***)	,801 (***)
TA			,640 (***)
FA			

OA: Overall acceptability; TA: Tenderness acceptability; FA: Flavour acceptability; *** p≤0.001.

Both tenderness and flavour acceptabilities were highly correlated with overall acceptability, however tenderness was more correlated than flavour. Considering Overall acceptability, the population was divided in four Clusters (Table 3), which include consumers with similar preferences.

Table 3: Mean and Standard deviation scores[1] for Overall acceptability consumer Clusters for Frozen storage time effect

		Frozen storage time					
	% Population	*6 m*	*3 m*	*1 m*	*Fresh meat*	SED	p-Value
Cluster 1	34	5.24 a	5.81 b	5.91 b	5.79 b	0.13	**
Cluster 2	30	4.94 b	5.69 c	5.22 bc	3.97 a	0.15	***
Cluster 3	6	3.52 a	4.47 a	4.55 a	7.00 b	0.15	***
Cluster 4	30	5.12 bc	4.65 ab	4.56 a	5.50 c	0.14	**

[1] Scale used from 1 (dislike extremely) to 8 (like extremely). SED: Standard error deviation. ** p≤0.01; *** p≤0.001; a, b, c: different letters in the same row indicate significant differences (p≤0.05)

FST had a significant effect over all of them. When all the population is considered together, the results could be misunderstood [5] as population characteristics could be masked. In general, consumers did not differed among thawed meats (Table 3), although fresh meat was clearly separated from them, but it was not always the best valuated. Cluster 2 (30% population) followed an opposite tendency compared to the other cluster classes, as fresh meat was scored less acceptable than thawed meats, regardless of FST. Cluster 2 also differed from the others in the characteristics of its population, since it was composed for a majority percentage (73%) of men and a minority percentage (33%) of 30-50 years range, while the other 3 clusters were equilibrated in gender and age of their population, with the exception of Cluster 4, with majority percentage women (65%). The first two principal components explained 99% of the overall variation. PCA analysis (Figure 1) clearly separated fresh meat from frozen meat, regardless of FST, since the three FST had similar distance to the axis origin. Also, fresh meat showed the lowest variability, since it was closer to the axis origin. Six months FST was negatively related to tenderness and overall acceptability (both also strongly related in a positive way) and 3 months FST was highly related with flavour acceptability and in a positive way.

IV. CONCLUSION

Consumers did not differ among fresh and thawed meat, regardless of frozen storage time until 6 months. In fact, considering overall acceptability, only a minority cluster (6% of total population) was able to identify fresh meat, their preference for overall acceptability. This fact should reduce concerns that consumers might have about freezing meat or purchasing frozen meat.

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