PE4.74 Comparison of South American and French Vacuum-packed Muscle Behavior 261.00

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Abstract - Ten vacuum-packed tenderloins (psoas major) from France and from South America were stored during four periods at -1.5°C: 45 days, 75 days, 90 days and 120 days. After each period, pH and drip losses were measured on muscles. Spoilage bacteria were counted. After storage at -1.5°C, muscles were sliced and steaks were vacuum-packed or packed in trays with modified atmosphere (50% N2+ 50%CO2). Trays were stored 14 days at +4°C. Geographical origin of muscles seems to have little effect on vacuum-packed muscle evolution compared to those of packed steaks during storage. A 90-day or 120-day storage period of muscles at -1.5°C is, in both cases, too long to produce cuts with shelf lives up to 8 days.

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Index Terms — storage, vacuum-packed, meat, shelf life.

I. INTRODUCTION

French companies have more and more difficulties to buy beef muscles on national market especially when they are issued from hind quarters. Therefore, they tend to buy muscles under vacuum from South America with long shelf lives (4 months usually). Chilled storage at -1.5°C increases shelf life of vacuum-packed muscles [1, 2, 3]. In these conditions and without decontamination technologies, French strip loins achieves 75-day shelf lives provided that: the maximum delay between slaughtering and storage is 3 days, storage temperature is roughly -1.5°C, initial contamination on muscle surface is below 16 CFU/g for pseudomonas and below 10 CFU/g for enterobacteriaceae before storage [4]. More color sensitive muscles such as tenderloin (psoas major) were not been studied. In France, storage temperatures of vacuum-packed muscles usually oscillate between 0°C and +2°C, and shelf lives do not exceed 30 to 45 days. Furthermore, the aim of this study is to assess the evolution of vacuum-packed tenderloins and steaks issued from these muscles after a long storage period at -1.5°C. Muscles from two different geographical areas were compared: tenderloins imported from South America and tenderloins from French cattle slaughtered in France.

II. MATERIALS AND METHODS

A. Raw materials

Ten French tenderloins were used. They were issued from five Frisonne Pie Noire cull cows ranging from 5 to 8 years old. Muscles were vacuum-packed 3 days after slaughtering in bags with very low oxygen permeability (20cm3/m2/day). Ten vacuum-packed tenderloins, with 120-day shelf lives, were imported from Brazil. They arrived in France 45 days after being packed. During this period, they were transported by ship at a storage temperature of -1.5°C.

B. Meat processing

French muscles were stored for 45 days, 75 days and 90 days at -1.5°C after being vacuum-packed; South American muscles for 75 days, 90 days or 120 days. After each storage period, 3 muscles were sliced in cuts, immediately after removing the vacuum bag. Cuts were either vacuum-packed in bags (oxygen permeability: 50cm3/m2/day) or packed in trays with modified atmosphere without oxygen (50% N2/50% CO2). Slices packed with both technologies were stored 14 days at +4°C.

C. Analyses

French tenderloins were analyzed on the packing day (Day 0) after storage periods of 45 days, 75 days and 90 days. South American tenderloins were analyzed on delivery day (Day 45) and after storage periods of 75 days, 90 days and 120 days. pH in the center of the muscles and drip loss were measured after each storage period at -1.5°C and after the packing day for French muscles(Day 0) and the delivery day (Day 45) for South American muscles. On the same dates, microbial analyses were carried out on 25cm² surface excisions from each muscle. Lactic flora, enterobacteriaceae and pseudomonas were counted and the results expressed in CFU/g. Steaks in trays or in vacuum bags were stored

for 14 days at +4°C. Drip loss and visual aspect were assessed 4 days, 8 days and 14 days after packing. On each date,5 different packages were evaluated. Visual acceptance was evaluated by 5 trained visual-color panelists. Aspect was described according to a scale of 1 = homogeneous discoloration on whole surface, 2 = partial discoloration on surface or on sides of steaks, 3 = grey color with slight discoloration, 4 = homogeneous dark color, 5 = homogeneous red color.

III. RESULTS AND DISCUSSION

A. Muscle evolution

pH tends to decrease during storage at -1.5°C but this trend was not significant from day 45 to day 90. Drip loss in vacuum bags and pH of South American tenderloins can be compared to those of French tenderloins except on day 90. On this date, South American tenderloins had lower pH than French ones (Table1). Contamination levels of French muscles before vacuum packaging and storage at -1.5°C were very low. Pseudomonas and enterobacteriaceae populations were inferior to 10 CFU/g. During the entire storage period, the microbial quality of French and South American muscles remained acceptable. A minimum 90-day microbial shelf life can be expected. The geographical origin effect of the muscle is very low. Pseudomonas and enterobacteriaceae populations of French tenderloins are lower than those of South American ones. This can be explained by the excellent microbial quality of French tenderloins used in this experiment without the use of decontamination technologies (Graph 1).

B. Steaks evolution

As remarked in previous experiments [4], modified atmosphere packaging (MAP) induces less drip loss than vacuum packaging (VP): -1.17% +/- 1.02 vs. -3.66% +/- 1.57. Geographical muscle origin has a strong influence on steaks' drip loss. Average drip losses during storage of South American tenderloins were -3.61% +/- 1.97 while those of French muscles only reach -3.05%+/- 1.69, during the same period Visual acceptance of steaks from South American and French tenderloins was equivalent: 2.05 +/- 1.31 and 2.42 +/- 1.67 respectively (Graphs 2 and 3). The storage period induced a significant decrease of visual acceptance scores from day 8 to day 14 ($p<0.1\%$). MAP generated a more stable color to steaks than VP, 3.16 +/- 1.5 vs. 2.68 +/- 1.9 respectively ($p<5\%$) which confirms results obtained in previous studies on strip loins [4]. Unfortunately, for tenderloin cuts, O2 scavenger has to be added to trays with modified atmosphere without oxygen to delay greying of steaks. During storage, defects on vacuum-packed products were different from those observed on steaks packed with modified atmosphere. In vacuum bags, discoloration appeared on the sides of the steaks. In trays, there was a homogeneous greying of the upper surface area (the lower one remained red), and O2 scavenger delayed outbreak of the defect. Despite the presence of O2 scavenger, there is an optimum period for using vacuum-packed muscles stored at low temperature and processing them in steaks packed with modified atmosphere (Graphs 2 and 3). For tenderloins, whatever their geographical origins, the storage period of muscles at -1.5°C is limited to 45 days in order to obtain steaks in trays with an 8-day visual acceptability at +4°C. Beyond this storage period at -1.5°C, visual acceptance of steaks will not exceed 4 days at +4°C. These results confirm the lower color stability of sirloins compared to strip loins. Steaks from strip loins in modified atmosphere packaging without oxygen can achieve 8-day shelf lives if vacuum-packed muscles are stored 75 days at -1.5°C [4].

IV. CONCLUSION

South American or French origin has littl effects on the evolution of vacuum-packed tenderloins stored at -1.5°C. The results have to be moderated by the excellent microbial quality of French muscles used in this experiment. Packaging technology has a strong influence on the drip loss evolution of steaks stored at +4°C. MAP without oxygen induces less exudate than VC. MAP provides the best visual acceptance scores for packed steaks compared to VC. Unfortunately, steaks in trays will have a maximum 8-day shelf life providing that the raw materials are stored for a maximum of 45 days at -1.5°C. Tenderloins have lower color stability than strip loins. O2 scavenger has to be added to tenderloin cuts packed with modified atmosphere without oxygen whereas they are not necessary for strip loins. Muscle origin (France vs. South America) has little effect on the evolution of packed steaks.

ACKNOWLEDGEMENTS

This study was carried out thanks to the financial support of Interbev and Office de l'Elevage

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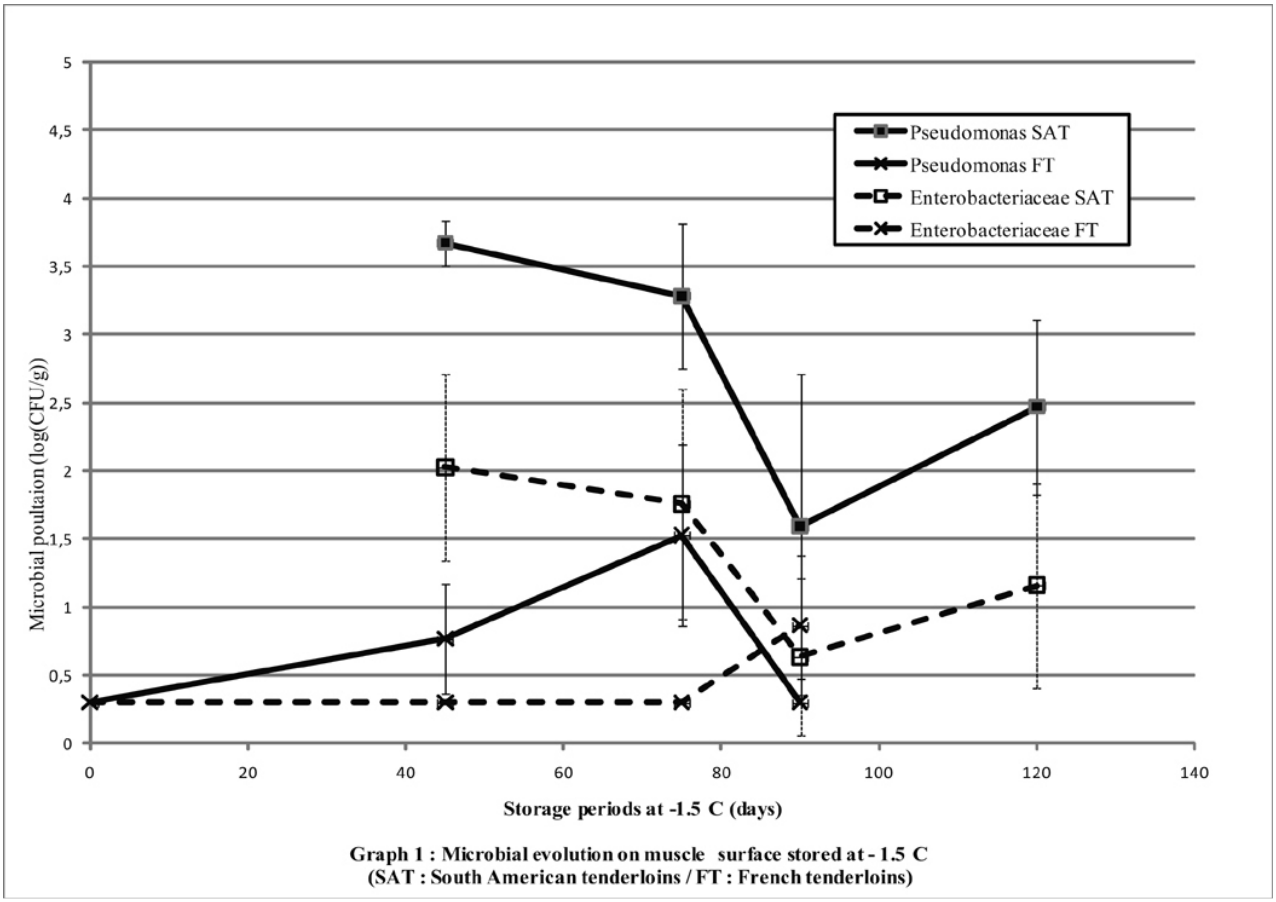
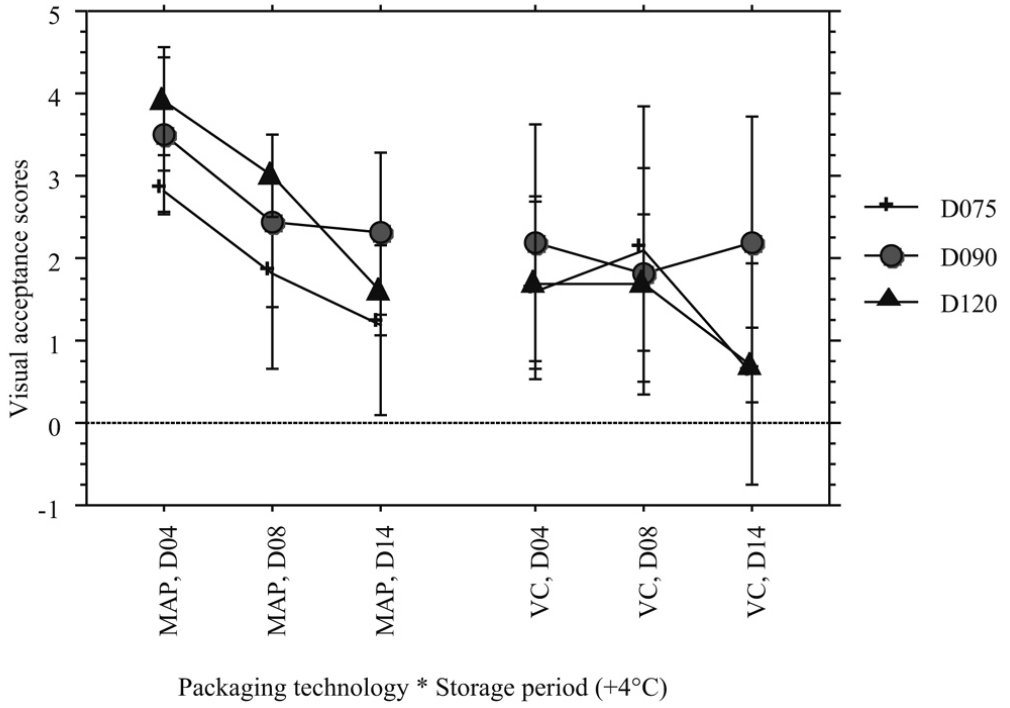
Storage period at – 1,5°C	pH			Drip loss (%)		
	South American tenderloins	French tenderloins	Origin effect	South American tenderloins	French tenderloins	Origin effect
D45	5,52 ± 0,04	5,57 ± 0,05	NS	3,43 ± 1,97	1,79 ± 0,24	NS
D75	5,51 ± 0,01	5,48 ± 0,03	NS	3,50 ± 1,24	3,01 ± 1,37	NS
D90	5,43 ± 0,05	5,59 ± 0,01	**	4,05 ± 2,83	2,75 ± 1,34	NS
D120	5,33 ± 0,17	/	/	4,58 ± 0,25	/	/

Table 1: Effect of origin on pH and drip loss (%) evolution of muscles stored at -1.5°C

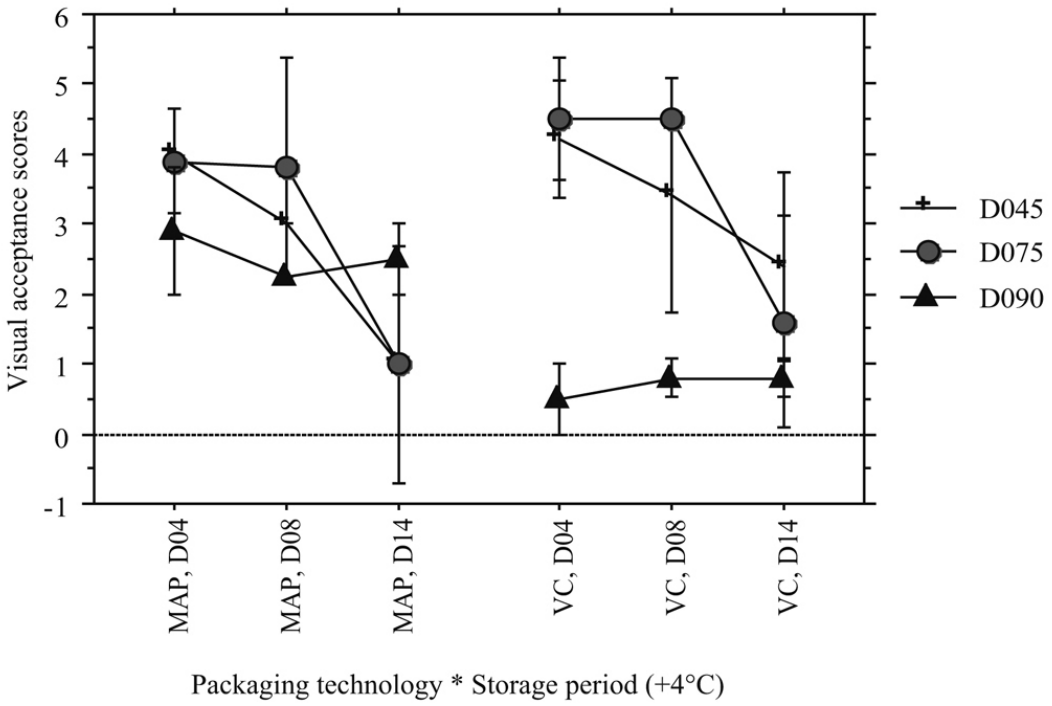
NS: not significantly different / **: significantly different p<1%



Graph 1 : Microbial evolution on muscle surface stored at - 1.5 C (SAT : South American tenderloins / FT : French tenderloins)



Graph 2 : South American tenderloins : Effect of muscle storage period (-1.5°C), meat cuts storage period (+4°C) and packaging technology on visual acceptance scores



Graph 3 : French tenderloins : Effect of muscle storage period (-1.5°C), meat cuts storage period (+4°C) and packaging technology on visual acceptance scores