

Ability to produce long shelf life meats with French beef muscles

L. Picgirard¹, E. Lemoine¹ & M. Renerre²

¹Adiv – 10 rue Jacqueline Auriol – 63039 Clermont-Ferrand cedex 2, E-mail : laurent.picgirard@adiv.fr.

²Inra, Unité QuaPA – 63122 St Genès Champanelle, E-mail: michel.renerre@clermont.inra.fr.

Abstract

The study allowed to measure maximum shelf life of French beef striploins (*longissimus dorsi*) packaged under vacuum at low temperature. Visual shelf lives of sliced meats produced from these muscles have been evaluated. Moreover several technological parameters applied to muscles (vacuum level, storage temperature, ageing method) and to sliced products (packaging method, packaging removal/slicing time) have been measured in order to analyze their impact on shelf life. Results show that 75 days of shelf life seems possible to be achieved for French striploins provided that : muscles are cooled early and quickly, the maximal delay between slaughtering and storage is 3 days, storage temperature is around -1,5°C, initial contamination of surface muscles is below 16 CFU/g of *pseudomonas* and below than 10 CFU/g *enterobacteriaceae*. On the visual and sensory properties, the modified atmosphere packaging with 50% of nitrogen and 50% of CO₂ is the most appropriate packaging method for sliced products from muscles stored for a long period compared to vacuum packaging.

Introduction

French companies have more and more difficulties to buy beef muscles on national market and especially when they are issued from hind quarter. So, they tend to buy muscles under vacuum from South America with long shelf lives (4 months usually).

But using muscles under vacuum with long shelf lives can induce microbiological problems on muscles or spoils the color of the packaged slices issued from this muscles.

The study had 2 aims: i) to evaluate the ability to produce long shelf lives muscles under vacuum with french meats without decontaminating systems, ii) to define technical prescriptions to process this muscles in sliced packaged meats with best color stability. To optimize preservation of muscles, works of Gill (1), Penney (2) or Jeremiah (3) have been used. However no studies are available to evaluate the behavior of sliced meat issued from this muscle when they are packaged under vacuum or under modified atmosphere.

Material and methods

Several technological factors have been studied, i) the ageing method of muscles before long storage under vacuum : 10 days on carcass at 0/ +1°C or 10 days under vacuum at - 1,5°C, ii) the storage period under vacuum: 20 days, 40 days or 90 days; the storage temperature was - 1,5°C, iii) the delay between removing of vacuum bag and slicing: 1 hour or 24 hours, ii) the packaging method of sliced meats (under vacuum, modified atmosphere packaging (MAP) with 70% O₂ and 30% CO₂ or MAP with 50% N₂ and 50% CO₂).

All muscles are issued from cows of 5 years old from dairy cattle (Montbeliard). *Longissimus Dorsi* (thoracic vertebrae zone ie “rib”) only has been used for the experiments. Microbiological evolution on muscles surface (total aerobic count, *enterobacteriaceae*, *pseudomonas*, lactic flora, *brochotrix thermosphacta*), exudation of muscles under vacuum, pH have been measured on muscles.

Drip Losses, color (L*, a*, b*), and lipid peroxydation thanks to the TBARS indicator (Gatelier et Al. (4)) have been measured on sliced meats during their storage period at + 4°C.

Results and discussion

It seems possible to produce muscles under vacuum with 75 days shelf lifes, from non decontaminated French meats if i) muscles are chilled early and quickly at -1,5°C after debonning; ii) the delay between slaughtering and vacuum packaging is 3 days maximum; iii) microbiological contamination on muscles is below 16 CFU/g for *pseudomonas* and 10 CFU/g for *enterobacteriaceae* at the beginning of the storage period.

In these conditions, drip losses reach 3% after 90 days of storage at -1,5°C. Shelf lives of 90 days should be reached providing that development of *enterobacteriaceae* could be slowed or initial population on muscle could be lowered. From this point of view, carcass ageing allows development of *pseudomonas* and *brochotrix thermosphacta* whereas vacuum ageing induces growing of *enterobacteriaceae* (cf. figure 1a, 1b, 1c, 1d). So, a quick deboning after slaughtering has to be preferred to a deboning after a storage during 10 days on carcass state.

Figure 1a : Evolution of lactic flora on surface of longissimus dorsi

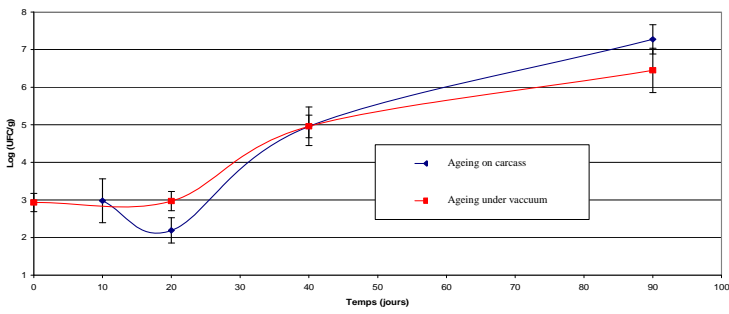


Figure 1b : Evolution of *enterobacteriaceae* on surface of longissimus dorsi

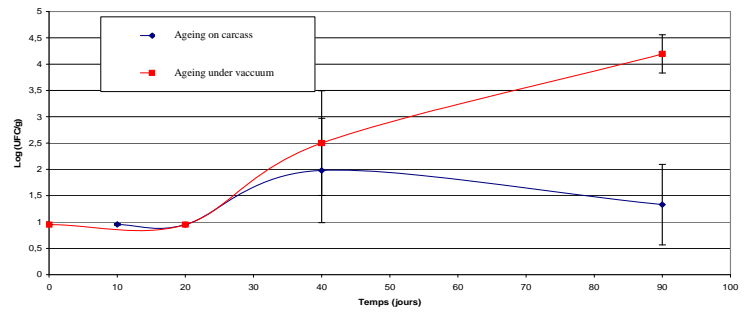


Figure 1c : Evolution of *pseudomonas* on surface of longissimus dorsi

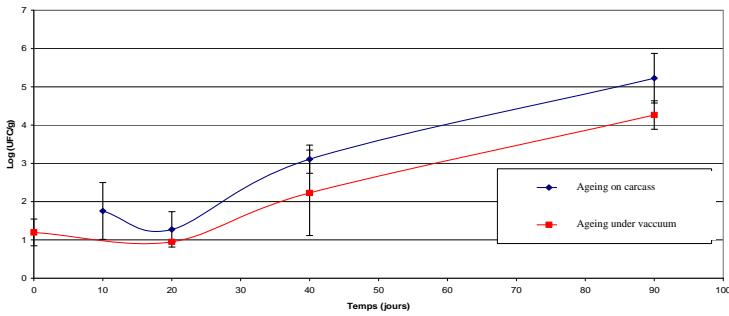
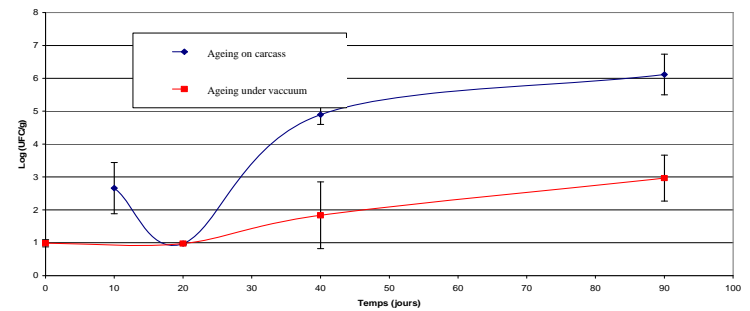
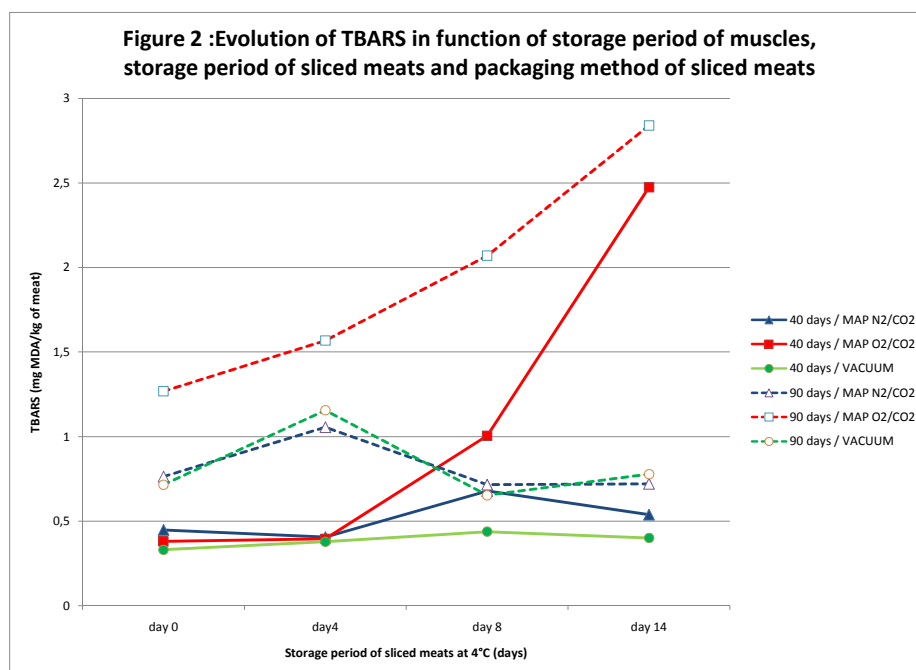


Figure 1d : Evolution of *brochothrix* on surface of longissimus dorsi



The most appropriate packaging method for sliced meat produced from long shelf lives ribs is modified atmosphere packaging with 50% N₂ and 50% CO₂. With this packaging method, lipid peroxydation is lower and drip losses after a storage of 14 days at + 4°C reach 1% only. When sliced meats are produced from muscles stored 90 days at – 1,5°C, their visual acceptability stays correct after 12 days at + 4°C and the best sensory properties are observed after 8 days of storage at + 4°C. For this method, carcass ageing has to be avoided and muscles have to be sliced quickly after removing the vacuum bag.

Modified atmosphere packaging with 70% O₂ and 30% CO₂ is not adapted for muscles stored under vacuum for 40 days or 90 days at -1,5°C direct to high oxydation (cf. figure 2).



Vacuum packaged of sliced meats gives results more comparable to MAP with 50% N₂ and 50% CO₂ but drip losses reach 3,3% after a storage during 14 days. Visual acceptability is lower than products packaged with modified atmosphere 50 %N₂ / 50% CO₂ (about 8 days at + 4°C) due to the oxydation of exsudate. A proteolytic flavor has been detected after 8 days at + 4°C. This phenomenon is probably due to the use of a vacuum bag with a too high gas permeability (50 cm³ /m² /day). Better results could be obtained with more gas barrier bags.

Conclusions

Visual acceptability of sliced meats stored 14 days at + 4°C, packaged under modified atmosphere with 50% N₂ and 50% CO₂ and produced from muscles stored 90 days under vacuum at -1,5°C can be acceptable if hygienic precautions are taken during deboning and slicing stages and if muscles are early deboned and quickly chilled at -1,5°C before a stable storage at this temperature. For the tests, *longissimus dorsi* which color is stable, has been used. Complementary experiments should be carried out to check if same results can be obtained with less stable muscles like *psaos major*.

Acknowledgements

The study has been carried out thanks to the financial support of Interbev and Office de l'Élevage.

References

- (1) Gill CO & Jones T. 1997. The display life of retail – packaged beef steaks after their storage in master packs under various atmospheres. *Meat Science* 38 (3). p 385-396.
- (2) Penney N. and al. 1997. Performance during retail display of hot and cold boned beef striploins after chilled storage under vacuum or carbon dioxide packaging. *Food Res. Int.* 31. p 521-527.
- (3) Jeremiah L.E. 2001. Packaging alternatives to deliver fresh meats using start or long term distribution. *Food Res. Int.* 34 (9). p 749-772.
- (4) Gatelier P., Mercier Y., Juin H. Renerre M. 2005. Effect of finishing mode (pasture or mixed diet) a lipid composition, colour stability and lipid oxydation in meat from charolais cattle. *Meat Science* 69 (1). p 175 – 186.