# EFFECT OF VACUUM PACKAGING ON MICROBIAL COUNT AND QUALITY TRAITS OF *m. Longissimus thoracis* FROM CHAROLAISE YOUNG BULLS

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## Background

The use of meat vacuum packaging (VP) with impermeable-to-gas plastic bags after a short period of chilled storing, represents a feasible and attractive strategy to increase the shelf-life of this food (Jayasingh, 2001). The VP has shown to maintain organoleptic quality of meat extending shelf-life due to a lower microbial spoilage (Warriss, 2000). In addition, VP allows to store meats for prolonged time without decreasing the potential capacity of myoglobin to bind oxygen after air exposure (Gill and McGinnis, 1995; Boakye and Mittal, 1996). However, in some case shelf-life of vacuum packaged chilled beef could be affected by problems due to prolonged storage, i.e. deterioration of colour and flavour upon opening the pack and increased weep loss (Hotchkiss, 1994).

## Objectives

The present study aimed at evaluating the effect of vacuum packaging 9 d *post mortem* on microbial count and chemical traits of *m. Longissimus thoracis* from Charolaise young bulls. Instrumental and sensory quality traits of the meat were also considered.

## Methods

Six young bulls of Charolaise breed were slaughtered at an industrial plant and carcasses (404±22 kg; SEUROP score = 4.0±0.3 on a 18-point scale; fatness score = 9.0±0.2 on a 15-point scale) stored at 0-2°C. Forty-eight hours *post mortem* after sectioning carcasses in quarters, from six hind-quarters (one from each animal in a randomised sampling) *m. Longissimus thoracis* was excised and immediately vacuum packaged (VP). The remaining hind-quarters (HQ) and the VP samples were stored at 0-2 °C for the next seven days. Packaging film (®CRYOVAC BB4L bag) was a multiply coextruded shrink bag, 59μ thick, based on polyolefins with a VDC copolymer gas barrier, 400 mm x 700 mm, with an oxygen transmission rate of 30 $ml \cdot m^{-2} \cdot d^{-1}$ (atmospheric pressure, 23°C and 0% relative humidity). A sample joint of *m. Longissimus thoracis* was dissected between 5th and 8th ribs from VP and control (HQ) treatments 9 d *post mortem* and meat was submitted to following microbiological, chemical, physical and sensory analysis. For microbial count a surface of 100 $cm^2$ was sampled utilising the swab technique (0,1% peptone, 0,85% NaCl). The samples were analysed for total viable count (TVC) on Plate Count Agar (Merck), 30°C for 48-72 h, *Micrococcus* spp. and *Staphylococcus* spp. on Baird-Parker Agar (Merck), 37°C for 48 h, *Lactobacillus* spp. on MRS Agar (Merck), 37°C on anaerobic environment for 48 h and *Pseudomonas* spp. and *Aeromonas* spp. on GSP Agar (Merck), 20°C for 72 h. Chemical analysis considered pH, moisture and intra-muscular fat (AOAC, 1990). After exposition for 1 h to air at 2°C, meat colour was measured by CR100 (Minolta, camera Co. Ltd, Japan) chromameter set on average daylight illumination (source '*C*') and data were expressed by Hunter-L*a*b* system (Mc Dougall, 1976). The L*a*b* values were used to calculate hue (H*) and saturation (S*). Cooking weight loss was determined on 2.5-cm thick steaks after the heating procedure suggested by Boccard et al. (1981). Warner-Bratzler (WB) shear force measurements were performed on cylindrical cores of cooked meat (Joseph, 1979). Meat sensory evaluation was carried out according to AMSA (1978) on 1.9-cm thick steaks cooked into an electric oven at 165°C until the meat core reached 70°C. Steaks were then cut into 1.3 $cm^2$ square pieces, which were immediately offered to the panellists. Determined sensory attributes were tenderness, juiciness and flavour using an hedonic scale from 1 to 5, where 1 was undesirable and 5 was extremely desirable. Data were submitted to one-way ANOVA within PROC GLM of SAS (1999) considering the effect of storage method.

## Results and discussion

Microbial counts observed at 9th d *post mortem* are presented in Table 1. The use of VP as storage method lead to a significant reduction in TVC (2.8 vs. 3.4 $Log_{10}$ CFU/$cm^2$; $P<0.05$) and to an increase in *Lactobacillus* spp. (1.2 vs. –0.3 $Log_{10}$ CFU/$cm^2$; $P<0.01$) and *Aeromonas* spp. (1.2 vs. –0.3; $P<0.05$). Among the undesirable microbial strains, *Pseudomonas* spp., were subjected to a significant growth inhibition (1.9 vs. 3.2 $Log_{10}$ CFU/$cm^2$; $P<0.01$). The increase of *Aeromonas* spp. in VP samples is justified by their capacity to grow also in anaerobic condition while *Pseudomonas* spp. did not. The proteolytic and lipolytic activity of Aeromonads make them a reliable marker to assess the growth of Gram negative rod shaped spoiling bacteria in VP meat (Hudson et al., 1994). These results confirm that VP favours the growth of lactic acid bacteria and the change from aerobic to anaerobic organisms is the main factor which extends the storage life of vacuum packaged meat (Lee and Yoon, 2001). Vacuum packaging did not significantly affect pH and chemical composition of *m. Longissimus thoracis* (Table 2). Colour measurements also resulted in no significant differences for lightness (L*), redness (a*), yellowness (b*), hue (H*) and saturation (S*). These data indicate that, under the short storage period considered in the present study, VP did not modify the capacity of myoglobin to bind oxygen after air exposure. In particular, it seems that meat VP did not interfere whit the activity of the oxygen-utilising enzymes, leading to the same blooming level after air exposure (bright red colour development) of HQ samples. Cooking loss was lower in VP than in HQ stored meat (28,2 vs. 30.6 %; $P<0.05$). Furthermore, VP meat showed lower values of Warner-Bratzler shear force (3.23 vs. 4.17 kg/$cm^2$, $P<0.05$). Devine et al. (1999) found that the amount of muscle shortening can be effectively reduced by tightly wrapping *m. Longissimus thoracis* in the pre-rigor state, resulting in a higher degree of tenderness 7 d *post mortem*. Lee and Yoon (2001) found a positive effect of VP on meat tenderness extending the storage time. Sensory traits evaluated by the taste panel did not differ between samples obtained by using a different storage technique (Table 2). In particular the sensory evaluation of meat tenderness did not confirm the instrumental result pointing out the lack of a linear correlation between the two evaluation systems. This agrees with the conclusion of Peachey *et al.* (2002) who reported a curvilinear relationships between objective and sensory assessments of tenderness which leads to underestimate samples with higher scores.

## Conclusions

The vacuum packaging of meat 48 h *post mortem* according to protocol adopted by many slaughter plants showed a significant microbial growth reduction and a progressive shift in favour of the anaerobic bacteria such as lactic acid ones. Compared to the traditional ageing method in hind-quarter, vacuum packaged meat stored for 7 d did not affect the main quality traits except for an increase of the instrumental tenderness.

**Pertinent literature**

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Table 1. Effect of vacuum packaging on microbial count of *m. Longissimus thoracis* of Charolaise young bulls 9 d *post mortem*.

| | | VACUUM PACKAGED | HIND QUARTER | Significance | SEM |
|---|---|---|---|---|---|
| Total Viable Count | $Log_{10}$ CFU/cm$^2$ | 2.8 | 3.4 | * | 0.4 |
| *Micrococcus* spp. | " | 1.4 | 1.6 | ns | 0.6 |
| *Lactobacillus* spp. | " | 1.2 | -0.3 | ** | 0.8 |
| *Pseudomonas* spp. | " | 1.9 | 3.2 | ** | 0.6 |
| *Aeromonas* spp. | " | 1.2 | -0.3 | ** | 0.6 |

*: P<0.05; **: P<0.01

Table 2. Effect of vacuum packaging on chemical traits, colour, cooking weight loss, WB shear force and sensory evaluation of *m. Longissimus thoracis* of Charolaise young bulls 9 d *post mortem*.

| | | VACUUM PACKAGED | HIND QUARTER | Significance | SEM |
|---|---|---|---|---|---|
| Chemical traits | | | | | |
| pH | | 5.54 | 5.52 | ns | 0.03 |
| Moisture | % | 74.1 | 74.3 | ns | 0.8 |
| Ether extract | % ww | 1.8 | 1.9 | ns | 0.6 |
| Colour | | | | | |
| L* | | 44.2 | 46.2 | ns | 2.4 |
| a* | | 18.5 | 19.9 | ns | 1.8 |
| b* | | 9.9 | 10.9 | ns | 1.2 |
| H* | | 0.49 | 0.50 | ns | 0.03 |
| S* | | 21.0 | 22.7 | ns | 2.1 |
| Cooking weight loss | % | 28.0 | 30.8 | * | 1.9 |
| WB shear force | kg/cm$^2$ | 3.28 | 4.12 | * | 0.35 |
| Sensory evaluation (scores)[1] | | | | | |
| Tenderness | | 3.4 | 3.5 | ns | 0.2 |
| Juiciness | | 2.5 | 2.7 | ns | 0.3 |
| Flavour | | 2.9 | 3.0 | ns | 0.2 |

*: P<0.05; [1]Five-point scale: from 1 = undesirable to 5 = extremely desirable.