

# SHELF LIFE OF PORK IN A MODIFIED ATMOSPHERE PACKAGING WITH HUMIDITY ADSORBER SYSTEM

O. Almeida, M.J. Fraqueza and A. Barreto\*

Faculty of Veterinary Medicine CIISA, Technical University of Lisbon, Av. Universidade Técnica, Pólo Universitário, Alto da Ajuda, 1300-477 Lisbon, Portugal (Email: mjoaofraqueza@fmv.utl.pt)

**Keywords:** sliced pork, MAP, shelf life, active package

## Introduction

Modified atmosphere packaging (MAP) involves the removal of air from the food pack and its replacement with a single gas or a mixture of gases using one of two different techniques: gas flushing or compensated vacuum. In the first case the efficiency of the system is limited, since replacement of the air is accomplished by dilution (Blakistone, 1999). It is known that several factors affect MAP meat products' shelf life: temperature control, hygiene control, raw material quality, time prior to packaging, gas-to-product ratio, gas composition, and residual gas composition (dependent on the MAP technique used), gas purity, package film permeability; pack design, adsorption of gases to product surfaces, CO<sub>2</sub>/O<sub>2</sub>/N<sub>2</sub> permeability ratio. Presently, commercial systems with desiccant capacity are available in adsorbent sheets. These materials are basically a super-absorbent polymer placed between two polyolefin layers (López-Rubio *et al.*, 2004). Use in meat packaging avoids the accumulation of water surrounding the meat, thus reducing the micro flora growth rate. The aim of this work was to establish the shelf life of sliced meat pork, packaged in a MAP (O<sub>2</sub>/CO<sub>2</sub>), with a humidity adsorber system, in accordance with the normal work conditions of a flow pack machine industrial slaughter processing room.

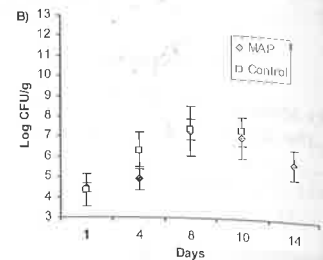
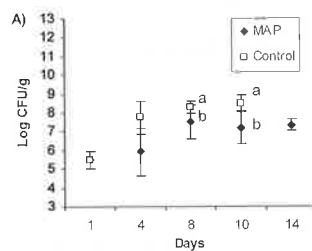
## Materials and Methods

The samples were collected in an industrial slaughter processing room in accordance with real work conditions. Sliced samples of approximately 200 g were taken from a pork leg. They were packaged on a MAP flow pack machine, (Speed up to 40m/min, gas mixture: 70%O<sub>2</sub> / 30% CO<sub>2</sub> - ULMA-Alaska HRX-300, Spain) on a polystyrene tray with a humidity adsorber (Linpac, Terplus, England) using a polyolefin, coextruded, multilayer shrink film (Cryovac BDF 3050, France) with a permeability of -18 cm<sup>3</sup>/m<sup>2</sup> for O<sub>2</sub> and 52 cm<sup>3</sup>/m<sup>2</sup> for CO<sub>2</sub>. Control pork meat samples were also packaged under aerobic conditions using the same polystyrene tray with the humidity adsorber and an extensible PVC film (NOVUM, Spain) with a permeability of -25000cm<sup>3</sup>/m<sup>2</sup> for O<sub>2</sub> and 130000cm<sup>3</sup>/m<sup>2</sup> CO<sub>2</sub>. All the samples were stored at 2±1 °C in the dark. Microbial and chemical analyses were performed at days 1, 4, 8, 10 and 14. Measurements of O<sub>2</sub>% and CO<sub>2</sub>% on MAP Packaging Headspace were performed. Five trials in the conditions previously referred to, were made.

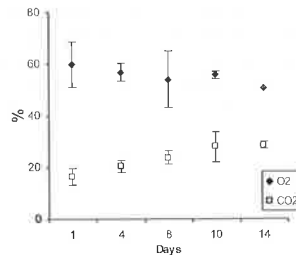
The following analyses were carried out, **Microbial analysis:** Mesophylic aerobic total counts in Plate count agar (Sharlau, Spain) at 30 °C for 2 days; *Enterobacteriaceae* counts in violet red bile agar (Merck Germany) at 37 °C for 2 days; *Escherichia coli* counts in Tergitol-BCIG (Biokar Diagnostics, Spain) at 44.5 °C for 24 hours; Detection of *Listeria monocytogenes* according to ISO/DIS 11290-1, 1995; Detection of *Salmonella* spp. according to ISO/DIS 6579, 2002; Detection of *Staphylococcus aureus* (NP-4400-2, 2002). **Chemical analysis:** TVBN (total volatile basic nitrogen) (NP-1848, 1987). **Packaging Headspace Gas Analyze:** pack headspace evaluation was carried out in a gas analyzer PBI-Dasensor A/S model CheckMate 9900. **Statistical Analysis:** the mean values were compared using the paired samples t Student test for time factor and independent samples for package conditions, according to SPSS 11.5 for Windows.

## Results and Discussion

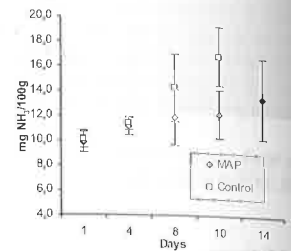
Initial samples of sliced pork meat samples show values of approximately 5 log<sub>10</sub> CFU/g for mesophylic aerobic total counts and 4 log<sub>10</sub> CFU/g for *Enterobacteriaceae* counts (Figure 1). Low *E. coli* counts showed that all samples were packaged according to good hygienic practice. Meat samples packaged under work conditions of a flow pack machine presented approximately 20% of atmospheric air in the gas mixture due to a dilution factor (Figure 2). The high O<sub>2</sub>% and approximately 25% of CO<sub>2</sub> in the MAP sliced pork did not inhibit the growth of *Enterobacteriaceae* (Figure 1B). However, an inhibition occurred regarding the mesophylic aerobic total counts promoted by this gas mixture in packaged pork samples. After 8 storage days there is a significant difference ((p<0.05, 1 to 2 log<sub>10</sub> CFU/g) between total flora in MAP sliced pork and samples control. This can be explained by the CO<sub>2</sub> effect on main spoilage meat flora such as *Pseudomonas* (Gill, 1986; Erkmen, 2000). TVBN evolution (Figure 3) agrees with that as observed for mesophylic aerobic total counts, revealing an increase on meat spoilage promoted by the microbial flora utilization of amino acids, apart the enzymatic action. The increase of TVBN values over than 14 mg NH<sub>3</sub>/100g and a total bacterial count higher than 7 log<sub>10</sub> CFU/g would not allow us to extend the shelf life of pork meat under MAP with a humidity adsorber stored at 2 °C, more than 10 days. Concerning the pathogenic micro flora (Table 1) *Listeria monocytogenes* and *Salmonella* spp were not detected in pork under MAP storage conditions. *Staphylococcus aureus* was present in few samples but no increased prevalence was observed either in control or MAP meat.



**Figure 1:** Mesophylic aerobic total (A) and *Enterobacteriaceae* (B) counts evolution on sliced pork packaged under MAP (CO<sub>2</sub>/O<sub>2</sub>) and Control conditions, stored at 2° C.



**Figure 2:** Packaging Headspace O<sub>2</sub>/CO<sub>2</sub> (%) evolution in MAP studied conditions.



**Figure 3:** Total volatile basic nitrogen evolution on sliced pork packaged under MAP (CO<sub>2</sub>/O<sub>2</sub>) and Control conditions, stored at 2° C.

**Table 1-** Frequency (%) of *Listeria monocytogenes*, *Staphylococcus aureus* and *Salmonella* spp detection on sliced pork packaged under MAP (CO<sub>2</sub>/O<sub>2</sub>) and Control conditions, on different days of storage at 2° C (n=5).

Day	1		4		8		10		14	
	MAP	Control	MAP	Control	MAP	Control	MAP	Control	MAP	Control
<i>Listeria monocytogenes</i>	0	0	0	0	0	20	0	20	0	-
<i>Staphylococcus aureus</i>	0	40	40	0	20	0	40	20	0	-
<i>Salmonella</i> spp.	0	0	0	0	0	0	0	0	0	-

### Conclusions

The increase of TVBN values greater than 14 mg NH<sub>3</sub>/100g and a total bacterial count higher than 7 log CFU/g does not allowed the extension of the shelf life of pork meat greater than 10 days with the use of the MAP technique with humidity adsorber, stored at 2° C, no more than 10 days.

### References

- Blakistone, B.A.(1999). Principles and Applications of modified atmosphere packaging of foods. Maryland, Aspen Publishers, Inc. 2nd edition.
- Erkmen, O.(2000). Antimicrobial effects of pressurized carbon dioxide on *Brochothrix thermofacta* in broth and foods. Journal of the Science of Food and Agriculture, 80, 1365-1370.
- Gill, C.O.(1986). The control of microbial spoilage in fresh meat. In: Advances in Meat Science. Vol 2 Meat and poultry microbiology. Eds. A.M. Pearson & T.R. Dutson, AVI publishing Co. Inc. Westport, Connecticut. Pp. 49-88.
- López-Rubio, A.(2004). Overview of Active Polymer-Based Packaging Technologies for Food Applications. Food Reviews International, Vol. 20, No. 4, pp. 367.