INFLUENCE OF MODIFIED ATMOSPHERE PACKAGING APPLIED ON THE MICROBIOLOGICAL QUALITY OF SLICED COOKED HAM

RAFAELA F. BEDENDI[1], EXPEDITO T. F. SILVEIRA[2], NELIANE F.A. SILVEIRA[3] and PEDRO E. FELICIO[4]

[1]Frigorífico ROSFRIOS, Piracicaba, São Paulo, Brazil; E-mail: rafaferrari@yahoo.com.br
[2]Meat Technology Center, ITAL, Campinas, São Paulo, Brazil; E-mail: tfacco@ital.org.br
[3]Microbiology Laboratory, ITAL, Campinas, São Paulo, Brazil; E-mail: nferraz@ital.org.br
[4]Faculty of Food Engineering, State University of Campinas; E-mail: felicio@fea.unicamp.br

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Background

The consumption of cooked ham in Brazil has increased markedly reaching an expressive market in the last decade - 39.779 tons in 1989 going up to 79.059 tons in 1997 and 86.870 tons in 1998 (DATE Mark, 1998). The growing demand for convenience foods like sliced cooked meat products is driving the Brazilian market to chilled processed meats. Thus, meat manufacturing industries seek compliance with market demands through application of different technologies and modified atmosphere packaging has demonstrated great potential.

Vacuum packaging is applied to market sliced cooked ham in Brazil. One economical method of delivering case-ready sliced cooked ham is to prepackage the product in conventional polystyrene foam trays with heat sealed low density polyethylene film overwrap into barrier pouches large enough to hold six or more trays. The pouches are evacuated and immediately back-flushed with mixtures of carbon dioxide and nitrogen to retard microbial deterioration under refrigeration distribution. At the retail, opening the master pouch and exposures the individual packages to air. In this work the research effort concentrated on evaluation the effect of gas mixtures combinations on the keeping quality of pre-packed sliced cooked ham.

Objective

The aim of this work was to investigate the microbiological stability of sliced cooked ham packed with vacuum and modified atmosphere. The atmosphere used combine oxygen, carbon dioxide and nitrogen to maintain the quality of the product from microbiological point of view.

Methods

Packaging and Storage. Two hundred grams of sliced cooked ham were arranged in a heat sealed low density polyethylene primary pack. Six of these 200g primary packs were overwraped into secondary masterpack barrier co-extruded nylon/low density polyethylene pouch. The pouches were evacuated and immediately back-flushed with mixtures contained high CO_2 concentration (100%); 60%CO_2 /40% N_2 and 25% CO_2 /75% N_2 and heat sealed with a hand-operated vacuum machine. The treatments were stored in a cold room operating at 4°C without illumination and samples were analyzed at 2, 8, 15, 22, 29, 36, 43 and 50 days of storage time.

Packaging Headspace Gas Analyze. Masterpack headspace evaluation during storage time was carried out in a gas analyzer PBI - DANSENSOR A/S model COMBI CHECK 9800-1. The overall composition of the gaseous environment in the pouches was expressed as percentage volume of O_2, CO_2 and N_2.

Microbial Analysis. Variation of bacterial populations during storage time were monitored by means of total pseudomonas, total lactic acid bacteria, total aerobic psychrotrophic and total enterobacteriaceae. The methods for microbiological evaluation are recommended and described by VANDERZANT & SPLITTSTOESSER (1994).

Results and discussion

Based on the criteria that population counts of 6 log CFU/g indicates a spoiled sample the shelf life of sliced cooked ham packed in the vacuum and the gas mixture system varied from 20 days and 29 days, respectively.

Growth of **Pseudomonas sp** (Figure 1) was totally inhibited in the product as far as the high CO_2 concentration (100%) is concerned. Reduction of CO_2 gas mixture (60%CO_2 /40% N_2 and 25% CO_2 /75% N_2) was associated with markedly growth (at 43rd and 36th storage time, respectively) reaching population level near to 5 log CFU/g at the 50th day. Vacuum treatment provided very low levels (<10^2 CFU/g) of this bacteria (VANDERZANT & SPLITTSTOESSER, 1994) but its population increased strongly from 29th day on showing counts of 10^6 CFU/g at the 43rd day and keeping this level until the end of the storage time.

The increase in **lactic acid bacteria** (Figure 2) and **Psychrotrophic bacteria** (Figure 3) counts could be a result of the selective inhibition of spoilage bacterial produced by modified atmosphere packaging (**MAP**) as various authors have reported for different meat products (JEREMIAH *et al.*, 1995; NISSEN *et al.*, 1996; SANTOS *et al.*, 2000). In general **MAP** system ensured lower counts (25% CO_2 /75% N_2 was very effective for **LAB** whereas 60%CO_2 /40% N_2 for **Psychrotrophic**) than vacuum for both bacterias as it is shown during most of the storage time studied.

Concerning to the **Enterobacteriaceae** (Figure 4) the product under **MAP** system presented counts close to 4 logarithmic cycles lower than the vacuum at the 43rd storage time. The significantly growth demonstrated by this group of microorganisms under vacuum system is based on the fact that they are anaerobic facultative (VANDERZANT & SPLITTSTOESSER, 1994).

Conclusions

Considering microbiological quality of the sliced cooked ham produced by the carbon dioxide masterpack investigated (100% CO_2 ; 60% CO_2 /40% N_2 and 25% CO_2 /75% N_2) it can be concluded that the system provides greater stability increasing the shelf life of the product from 20 days (vacuum system) to 29 days (**MAP** system). Although products packed with high CO_2 **MAP** inhibit the potential hazardous bacterias efficiently the gas mixtures contained less CO_2 can also be used with the advantages of keeping flexible package from collapsing (Figure 5).

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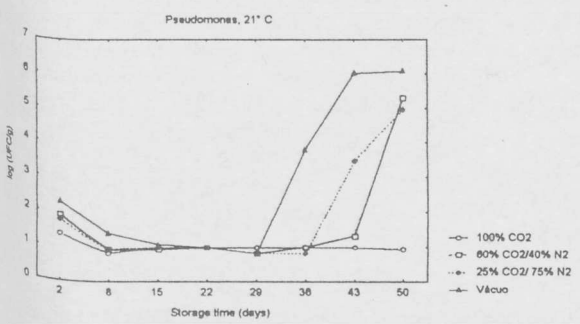

FIGURE 1. Evolution of Pseudomonas in sliced ham stored in modified atmospheres at 4^0C.

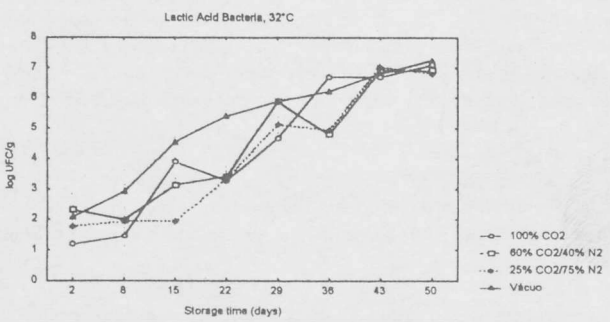

FIGURE 2. Evolution of lactic acid bacteria in sliced ham stored in modified atmospheres at 4^0C.

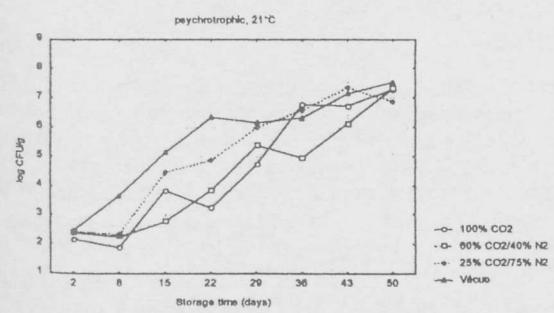

FIGURE 3. Evolution of Psychrotrophic in sliced ham stored in modified atmospheres at 4^0C.

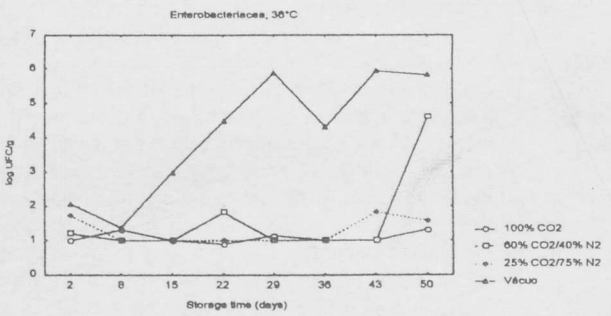

FIGURE 4. Evolution of Enterobacteriaceae in sliced ham stored in modified atmospheres at 4^0C.

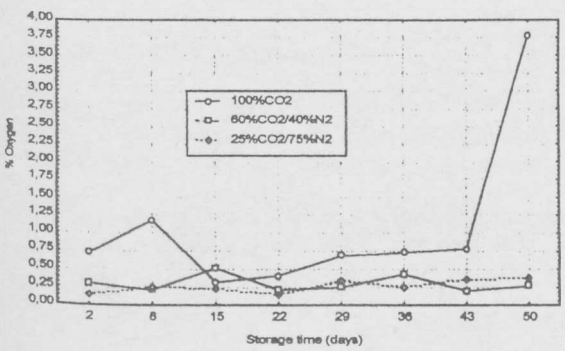

FIGURA 5. Oxygen levels in masterpack headspace during storage time.