THE MICROBIOLOGY OF HOT AND CONVENTIONALLY DEBONED VACUUM-PACKED BEEF

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Background

One method of accelerating the production of vacuum-packed meat cuts after slaughter is deboning the carcasses pre-rigor, or "hot-boning" as the process is widely known. This process has several advantages (PISULA & TYBURCY, 1996). One is the removal of excess fat and bone before chilling, which results in savings on refrigeration input and in a reduction of cooler space. Another is the reduction of weight loss during chilling as well as drip loss of vacuum-packed cuts. However, there are suggestions in the literature (SHERIDAN & SHERINGTON, 1982) that additional hygienic precautions are required to process hot boned beef. Despite the technological and economic benefits, the microbiological quality of these processes must be evaluated

Objectives

The purpose of this study was to determine the effects of hot boning, electrical stimulation and conditioning temperature on the microbiological quality of vacuum-packed beef cuts using conventionally chilled meat as a comparison.

Methods

Four experiments were conducted involving a total of 24 Nelore (*Bos indicus*) steers, aged from 30 to 36 months and approximately 450 kg in weight. They were slaughtered over a period of three months at the Meat Technology Centre of Institute of Food Technology in Campinas. Immediately after exsanguination, the right sides of the carcasses were electrically stimulated with a potential difference of 21 V (rms), 0.25 A, at a frequency of 60 Hz, 5 s on, 1 s off, for 90 s using a JARVIS (BV 80, Argentine) stimulator. The *L. dorsi* was the muscle studied. The hot boned muscles were excised from the electrically stimulated carcasses, cut into five equally sized portions, vacuum-packed in Cryovac barrier shrinkable bags and stored for 10 h at 15°C (EQ15) or 25°C (EQ25). Temperature conditioning was performed in temperature-controlled rooms at 7°C and 3°C after temperature in the center of the muscles reached 10°C and 5°C, respectively. In the final stage the cuts were left in a storage room at 0 ± 2°C for aging until 35 days post mortem. The microbial counts were carried out at 7, 14, 21, 28 and 35-day intervals and the initial (0-time) sampling was done before vacuum packing. Microbiological sampling consisted of swabbing three areas of 10 cm^2 on each muscle using a sterile steel template and dry cotton swabs according to ABNT (1988). Total psychrotrophic aerobic counts were estimated in poured plates of Plate Count Agar (Oxoid CM 325); lactic acid bacteria were enumerated in poured plates of de Man Rogosa Sharp Agar (Oxoid CM 361); Lauryl Sulfate Tryptose 4-Methylumbilliferyl-β-D-Glucoronide Broth (LST-MUG; Merck 1.12588) and Brilliant Green Bile Broth (Oxoid CM 31) were used for coliforms enumeration by the most probable number (MPN) technique; *Escherichia coli* was enumerated in LST-MUG. The analyses were performed according to the standard procedures of VANDERZANT & SPLITTSTOESSER (1992). Bacterial numbers were converted to logarithms prior to data analysis and expressed as log CFU/cm^2 (total psychrotrophic aerobic counts and lactic acid bacteria) or log MPN/cm^2 (coliforms and *E. coli*). Data were statistically analyzed using the general linear model of Statistical Analysis System, version 5.0. Analysis of variance was performed to determine the significance of differences between treatments.

Results and Discussion

The total psychrotrophic population (**Figure A**) and lactic acid bacteria counts (**Figure B**) found in hot-boned samples were not significantly different ($p>0.05$) compared with those of conventionally-boned cuts during the first 14 days. However, hot processing had a significant effect on these bacteria growth from the 21st day onwards. After that, the hot processing of meat showed significant effect ($p<0.05$) for the 35 days of aging. SHERIDAN & SHERINGTON (1982) studied the effect on microorganisms of vacuum-packed hot bone cuts of beef, conditioned at 10°C for 16 h followed by storage at 0°C for 35 days. As in this study, the authors verified that the mean numbers of aerobic psychrotrophic bacteria were similar from hot or cold deboned beef. Furthermore, there were significantly higher numbers of lactobacilli on hot boned cuts. Despite increased numbers of lactic acid bacteria on hot bone, lactic spoilage, as evidenced by the production of acid or sour odors on opening the packs, was not present.

The coliforms were recovered only after 21 days of storage on the hot boned samples (**Figure C**). The growth of coliforms was not detected during the whole aging period for the conventionally boned cuts. It was possible to notice the significant effect ($p<0.05$) of the hot processing of meat over the counts of coliforms. Different results were found by KOTULA & EMSWILER-ROSE (1981) and TAYLOR *et al.* (1980-81), where coliforms were not influenced by hot-boning before or after storage. It was noted that the difference between the means at 25°C was greater than at 15°C after 21 days for total psychrotrophic and coliforms bacteria and 28 days for lactic acid bacteria.. *E. coli* was not detected in all treatments for the 35 days of aging.

According to our findings, from a microbiological standpoint, hot boning presents little problems provided strict measures for Good Manufacturing Practices are adopted by the meat industry. Some authors (FUNG *et al.*, 1980) agreed that when hygiene is not more stringent than that used in conventionally-processed beef, a serious reduction in shelf-life and pathogenic organisms proliferation may happen on the meat prior to packaging.

Conclusion

The microbiological quality of the processes evaluated was considered adequate. Up to 14 days at 0°C, hot boned beef had the same microbiological pattern than conventionally boned beef. By the 21th day, bacteria counts tended to be larger in hot boned beef but counts were still within recommended levels.

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Acknowledgements

The authors thank FAPESP for the financial support (Process 2001/05552-4).

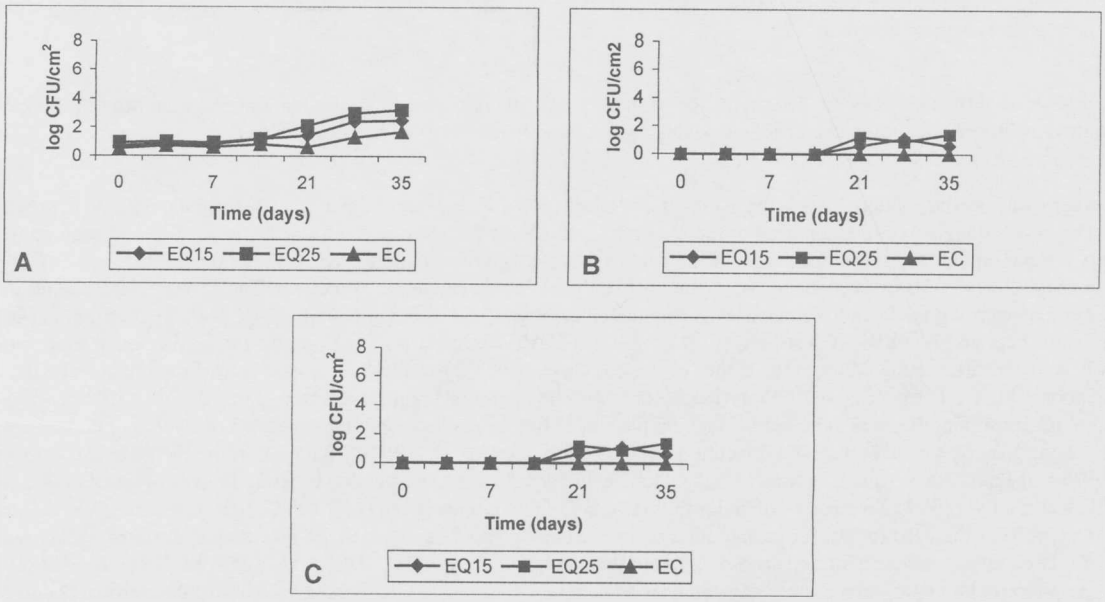

Figure . Effects of processing treatment and storage time at 0 ± 2°C on the growth of psychrotrophic bacteria (A), lactic acid bacteria (B), and coliforms (C) on vacuum-packed beef.