EFFECTS OF HIGH TEMPERATURE CONDITIONING AND AIR TRAPPING ON THE KEEPABILITY OF HOT AND COLD BONED, VACUUM-PACKAGED, BEEF LONGISSIMUS

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SUMMARY

The impact of air trapping on the bacteriological condition of hot and cold boned, vacuum-packaged beef was examined. The bacterial load of hot boned beef was higher than that of cold boned beef. In the present study we investigated whether conditioning, time of boning or air trapping was the cause of this difference. Our results indicate that neither conditioning nor air trapping adversely affects keepability. In all cases colony counts on hot boned meat were higher than those on cold boned meat. Probably this is the result of more favourable initial growing conditions on hot meat.

INTRODUCTION

Hot meat is more difficult to vacuum pack than cold meat. Higher meat temperature and the sticky surface of the hot meat tend to increase the risk of "air trapping" (Apple and Terlizzi 1983). The impact of such a deficient packaging technique on the bacteriological quality of meat is not known. In a previous study Van Laack et al. 1987) we compared the effect of air trapping on the quality of hot and cold boned beef. Bacterial counts of hot boned beef were higher than counts of cold boned beef. It remained unclear, however, whether these differences were the result of air trapping or other factors such as conditioning or time of boning. Purpose of this paper was to investigate the impact of air trapping and high temperature conditioning on the bacteriological condition hot and cold boned, vacuum packaged beef.

MATERIAL AND METHODS

The righthandside longissimus muscle of six Dutch Friesian cows was excised within 1 h post mortem. The lefthandside longissimus muscle was cold boned after 24 h chilling. Muscles were divided in 18 chops, 150-200 g each, which were immersed in a suspension of bacteria cultured from the scrapings of tables from a commercial beef cutting operation. After immersion chops were allowed to drain for 10 s and vacuum packaged. Air trapping was simulated in 12 chops by injection 8-10 ml of air through air-tight rubber discs which had previously been glued to the vacuum film. Half of these "air trapped" chops and all other vacuum packaged chops were conditioned for 5 h at 15°C before refrigeration at 0°C. The remaining air trapped chops were chilled immediately. Except for the conditioning, the cold boned lefthandside longissimus received a similar treatment. After 7, 14, 21 and 28 days of storage, 8 chops of each group were unpacked and sampled for bacteriological examination. The meat surface of all cuts was samples by means of a sterile cork borer. Two tissue discs of 4.5 cm^2 were punched out and subsequently macerated in 27 ml peptone-sale solution in a Stomacher. Numbers of colony forming units (CFU) of the following micro-organisms were assessed in the macerate, 1 ml of which corresponded with 0.33 cm^2 meat surface:

a. Aerobic mesophilic colony counts; in poured plates of Trypton Glucose Beef extract Agar; incubation 3d 30°C.

b. Aerobic psychrotrophic colony counts; on spread plates of Tryptone Glucose Beef extract Agar; incubation 14d 4°C.

c. *Enterobacteriaceae*; in poured plates of Violet Red Bile Glucose Agar with overlayer; incubation 1d at 30°C.

d. *Brochothrix thermosphacta*; on spread plates of STAA (Gardner 1966); incubation 2d at 24°C.

e. Lactic acid bacteria on spread plates of MRS (pH 6.2); anaerobic incubation 3d at 30°C.

f. *Lactobacillaceae*; on spread plates of Rogosa (pH 5.4), anaerobic incubation 3d at 30°C.

Significance of differences were assessed by Student t-test. To this end samples with less than 7 colonies on the first decimal dilution plate, and therefore inappropriate for colony assessment (Mossel and Drion 1954), were assigned counts corresponding with the limit of detection (log_{10} CFU/cm^2 = 1.3 for *Enterobacteriaceae* and 2.3 for *Lactobacillaceae*, lactic acid bacteria and *Brochothrix thermosphacta*).

Table 1 The microbiological condition (means in log N cm^{-2}) of hot boned (HB) and cold boned (CB) beef, after 3 weeks of vacuum storage at 1 ± 1°C, as affected by air trapping during vacuum packaging (AT), and 5 h conditioning at 15°C (C); NAT = no air trapping, NC = no conditioning.

	HB			CB	
	AT/C	AT/NC	NAT/C	NAT	AT
Enterobacteriaceae	2.31	2.23	2.54	1.38	1.86
	(75)*	(50)	(100)	(13)	(25)
Lactic acid bacteria	3.97^{a}**	3.47^{a}	3.51^{ab}	3.25^{b}	3.19^{b}
	(100)	(100)	(100)	(100)	(100)
Lactobacillaceae	3.13	2.75	2.72	3.29	3.11
	(75)	(50)	(75)	(25)	(63)
Brochothrix thermosphacta	4.54^{a}	4.50^{a}	4.29^{ab}	3.98^{b}	4.47^{a}
	(75)	(50)	(100)	(13)	(25)

* (n) means: n% of samples above limit of detection

** Figures with superscripts not containing a common letter differ ($p < .05$)

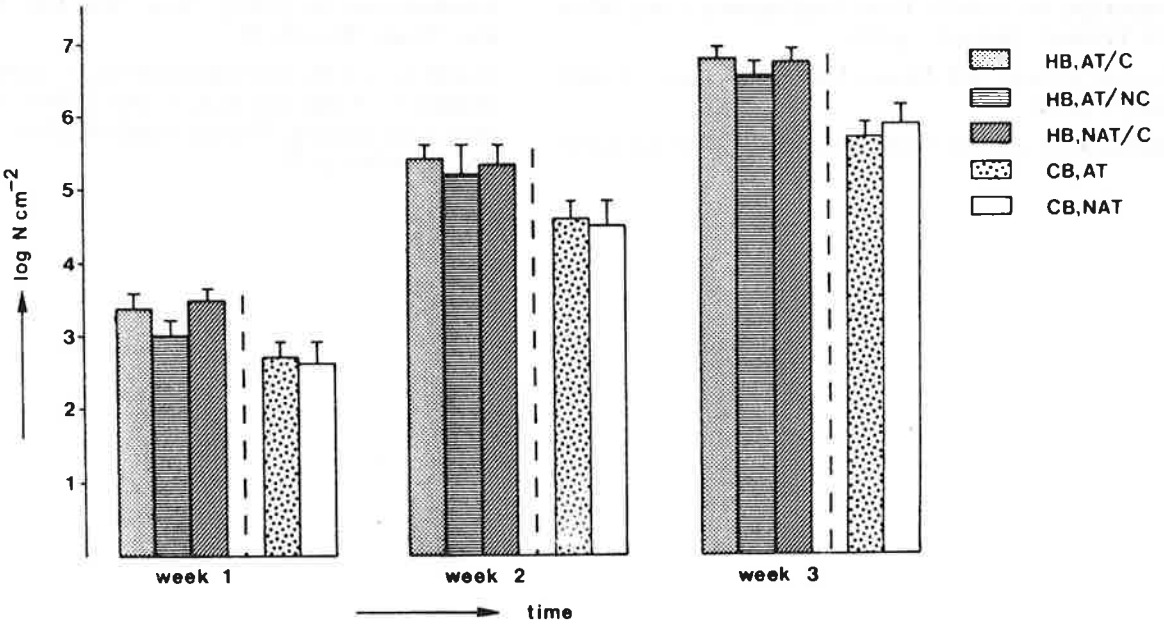

Figure 1. Total aerobic mesophilic colony (means ± SD in $\log_{10}$ .cm^{-2} of hot boned (HB) and cold boned (CB) beef, during 3 weeks of storage at 1 ± 1°C, as affected by air trapping during vacuum packaging (AT) and 5 h conditioning at 15°C (C); NAT = no air trapping, NC = no conditioning

RESULTS AND DISCUSSION

Figure 1 includes the aerobic mesophilic colony count at different times of storage. In addition, *Enterobacteriaceae*, lactic acid bacteria, *Lactobacillaceae* and *Brochothrix thermosphacta* colony counts after 3 weeks of storage are listed in Table 1. Whereas initially colony counts of hot and cold boned beef were similar, the microbial load of HB cuts were higher after 1, 2 and 3 weeks storage. Neither conditioning nor air trapping affected the bacteriological condition significantly.

In hot boned meat packs the residual O_2 is metabolised faster than in cold boned meat packs, resulting in higher CO_2 levels (Van Laack et al. 1987). Yet after 3 weeks of storage the bacterial load of hot boned cuts was significantly higher than that of cold boned cuts. Conditioning of hot boned meat is necessary to avoid shortening and tenderness problems (Chrystall 1982; Smulders et al. 1984). Smulders et al. (1984) also reported that conditioning had a negative effect on the storage life of beef. However, in the present experiment high temperature conditioning did not affect colony counts. Perhaps the more favourable initial growing-conditions on hot boned meat (warmer, non-desiccated surfaces at higher initial pH) mask the adverse effects of both a short high temperature conditioning period and air trapping.

Some workers are of the opinion that the higher temperature of the meat at the time of boning will always give rise to increased bacterial numbers on hot as compared with cold boned meat (Fung et al. 1980). However, others report these effects are variable (Sheridan and Sherington 1982).

Our results indicate that, with regard to keepability of hot boned meat, it is essential to reduce the initial contamination. Special procedures as boning on the rail (Smulders and Eikelenboom 1987) and intensive desinfection of boning utensils may be prerequisites to safeguard the microbiological quality of hot boned beef.

CONCLUSIONS

Air trapping during vacuum packaging does not give rise to higher bacterial counts, neither on hot nor cold boned beef. With similar levels of initial contamination the keepability of hot boned meat is shorter than these of cold boned beef, irrespective of high temperature conditioning.

Higher bacterial counts on hot boned meat are probably due to the more favourable initial growing conditions, which reduce the lag-phase of the meat spoilage bacteria.

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