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Commercially Prepared Retail Cuts of Beef and Lamb with an Extended Shelf-Life

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The aim of this study was to extend the shelf-life of retail cuts of beef and lamb to six weeks using modified atmosphere packaging (MAP) combined with vacuum skin packaging (VSP).

METHODS

Scotch fillets and trim lamb butterfly steaks were prepared under commercial conditions. Freshly slaughtered carcases were boned and sliced on the packaging day. Separate cutting boards were used in the boning and slicing procedures and these were cleaned and sanitised regularly at 40 minute intervals. Gloves were worn when handling the sliced meat prior to packaging. Meat samples were vacuum skin packed using white permeable Intact trays (33F) and a permeable top web (100μ Intact film). Four VSP trays were placed into each modified atmosphere (MA) tray and flushed with 100% CO_2 using a thermoform rollstock packaging machine (Multivac R7000) and stored at -1°C. Barrier top and bottom webs were used (Cryovac R0171 and RZ306 respectively). On the day of packaging and after 1, 2, 3 and 6 weeks, seven beef and seven lamb MA packs were opened and microbial load determined on six VSP samples of each. The remaining VSP samples were stored in a glass door refrigerator at 4°C to simulate retail display. After one and three days at 4°C, a further six samples were tested on each day for microbial load. Total counts (30°C/3 days) and psychrotrophic counts (7°C/10 days) were done using plate count agar (PCA, Oxoid). The meat was sampled by the core excision method using a 35mm (diameter) corer to excise two sub-samples which were homogenised (Colworth Stomacher) in 240 mL of 0.1% peptone for one minute. Samples were diluted in peptone water and plated out onto PCA. The pH of the homogenate was also measured.

Least significant differences (lsd) were calculated and used to compare the two way means of the total counts (log_{10}) and psychrotrophic counts (log_{10}).

The oxygen, nitrogen and carbon dioxide composition in the MA packs was determined upon packaging the meat and subsequently after 1, 2 , 3 and 6 weeks using gas chromatography.

Sensory Evaluation and Supermarket Surveys

A consumer-type panel of 25 individuals evaluated the meat samples after the simulated 3 day display at 4°C on Week 6. The MAP samples were compared with meat that had been only VSP on Week 0 and frozen. The meat was cooked in a fan-forced electric oven (270-280°C) for 8 minutes. The outer edges of each cooked piece were trimmed and discarded. The remaining piece was cut into 2.5cm cubes and used for evaluation. A combination of yellow and white fluorescent lights were used to mask differences in the colour of the cooked meat. The raw meat used for evaluation of colour and general appearance was vacuum skin packed and displayed under white fluorescent lights. Graphic rating scales were used to rate each sample for various attributes. The results were statistically analysed using analysis of variance and all comparisons were at the 5% level.

Consumer surveys were conducted in three supermarkets located in high, medium and low socio-economic areas. VSP meat was displayed in each supermarket and meat consumers were interviewed and asked to complete a questionnaire. The meat displayed in the supermarkets located in the high and low socio-economic areas had been stored at -1°C for one week and allowed to rebloom for 3 hours after removal from MA. However, the samples displayed in the supermarket located in the medium socio-economic area had been stored at -1°C for 7 weeks and allowed to rebloom as above.

RESULTS and DISCUSSION

Microbiological and Gas Analyses

The total and psychrotrophic counts with and without presentation at 4°C were below the accepted spoilage level of 10^7 cfu/cm^2 over the 6 weeks (Figures 1-4). The pH of the beef (5.8 ± 0.2) and lamb (5.7 ± 0.1) did not change markedly over the 6 week storage period indicating little microbial activity. In the initial two weeks, the gas composition in the packs varied as the absorption/loss of CO_2 and evolution by microbial metabolism reached an equilibrium. After two weeks, the gas composition remained relatively constant at 98.0% CO_2, 0.2% O_2 and 1.8% N_2 for the beef and lamb.

Sensory Evaluation

After six weeks at -1°C, the MAP beef was significantly preferred to the control with respect to colour and general appearance of the raw meat. Panellists also found the cooked MAP beef significantly more tender and more juicy than the control. There were no significant differences perceived by panellists in flavour, odour or overall quality and palatability between the MAP and control beef samples. In contrast, the colour and general appearance of the raw control lamb was significantly preferred to the MAP lamb. However, there were no significant differences in tenderness and juiciness between the cooked MAP and control lamb samples. There was a significantly stronger "off" meat odour and "off" flavour in the MAP lamb at Week 6. However the panellists did not perceive a significant difference in overall quality and palatability between the cooked MAP and control lamb samples.

Supermarket Surveys

The results of the consumer surveys in the three supermarkets are presented in Figures 5-8. The colour of the beef and lamb in the VSP trays was found to be acceptable by over 60% of consumers even after 7 weeks of storage at -1°C (refer to results of the medium socio-economic location of supermarket in Figs. 5 and 6). The new packaging format was accepted by over 50% of consumers at each location (Fig. 7) even though more than 50% of consumers at the high socio-economic location preferred red meat not to be prepackaged (Fig. 8).

CONCLUSIONS

The use of MAP with 100% CO_2 combined with VSP and a storage temperature of -1°C extended the shelf-life of scotch fillet and trim lamb butterfly steaks to 6 weeks. VSP successfully contained the product drip and the use of permeable packaging material for VSP allowed the meat to rebloom after removal from the MA.

To maximise the shelf-life of meat packaged in this manner it is important to use high quality fresh meat that has been boned and handled under clean conditions. If minor modifications to the vacuum skin packs (e.g. clear trays, different pack sizes) were made, this system could be commercially viable.

ACKNOWLEDGEMENTS

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Fig.1 Total Counts - Scotch Fillet

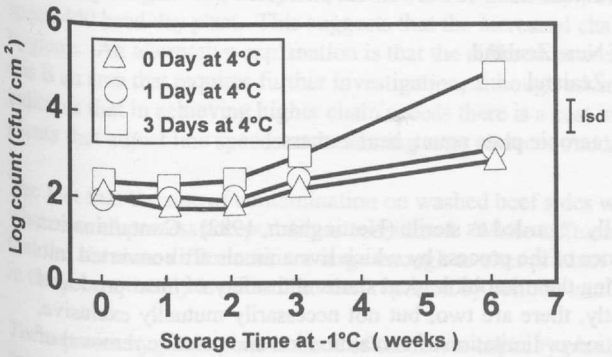

Fig. 2 Psychrotrophic Counts - Scotch Fillet

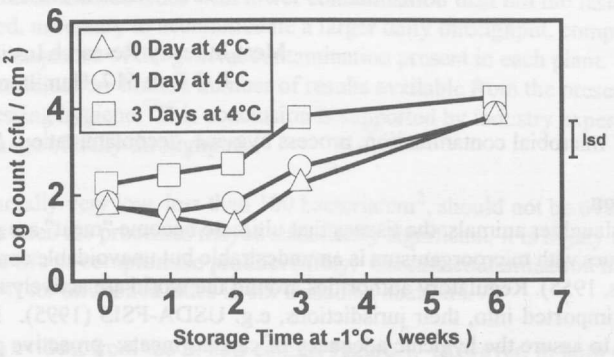

Fig.3 Total Counts - Trim Lamb Butterfly Steaks

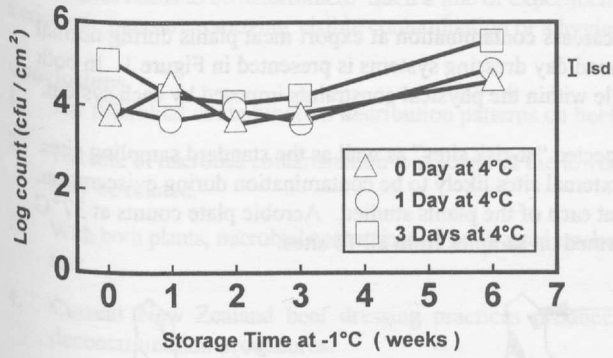

Fig.4 Psychrotrophic Counts - Trim Lamb Butterfly Steaks

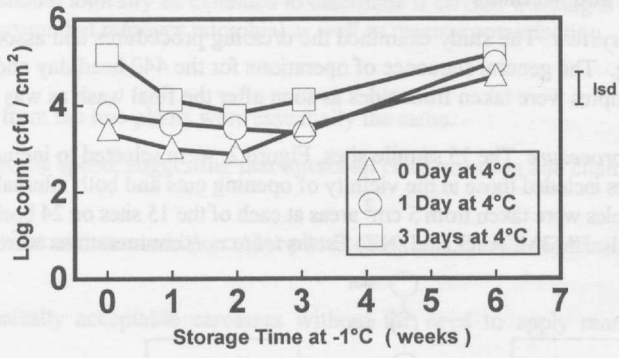

Fig. 5 Colour Acceptability of Beef after Reblooming

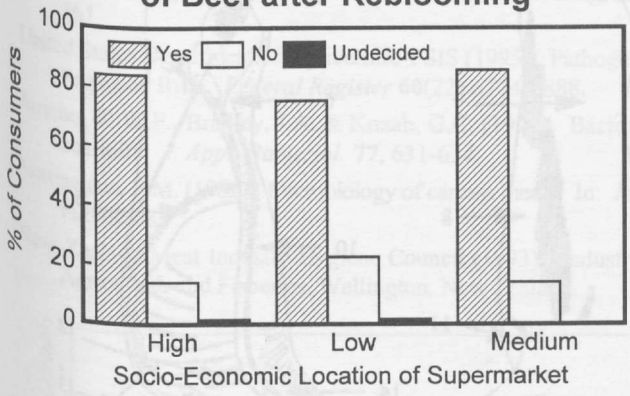

Fig. 6 Colour Acceptability of Lamb after Reblooming

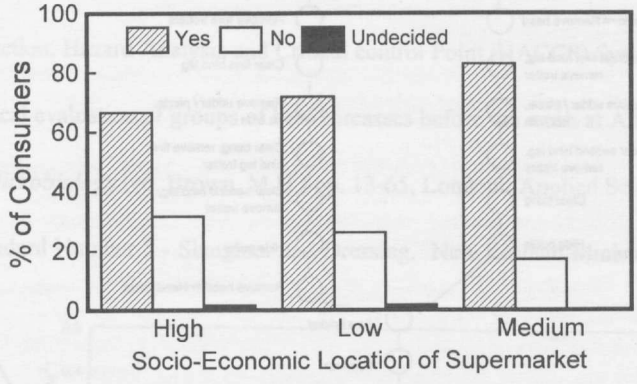

Fig.7 Acceptability of New Packaging Format

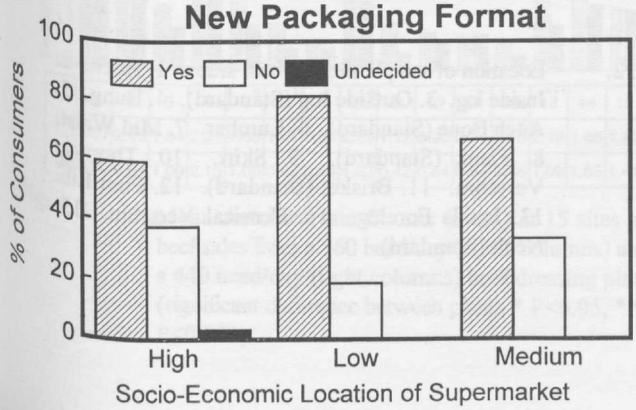

Fig.8 Preference for Prepackaged Red Meat