The use of organic acids as potential inhibitors of bacterial growth in minced beef.

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Background

Microbial contamination in meat occurs as a result of the processes involved in transforming live animals into meat. This contamination can be minimised by the use of good manufacturing practices during processing and retailing of meat, but the total elimination of bacteria is very difficult if not impossible to achieve. Organic acids are natural food grade additives, which have the ability to inactivate bacteria by reducing the pH within the cell. In the past, research has confirmed the antibacterial effect of organic acids in fresh beef (Anderson 1992; Dickson and Siragusa, 1994, Podolak *et al.*, 1996). However, the majority of these trials have been focused on spraying the acids onto the surface of meat, where the effectiveness of these acids is usually limited by contact time, application temperature and the concentration used (Dickson *et al.*, 1997). Little attention has been given to evaluate the effectiveness of these acids when mixed into ground beef. The present work demonstrates the effect of mixing organic acids into minced beef, on microbial growth and appearance of the mince during chilled storage.

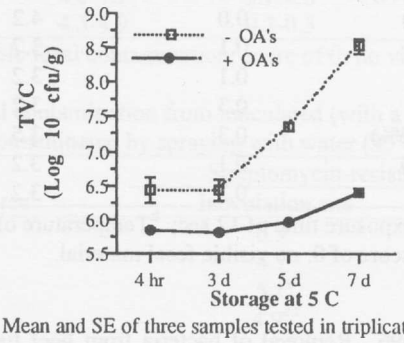
Material and methods

Forequarter muscles from three beef carcasses were removed 48h after slaughter. The meat from each carcass was cut into cubes and kept separate during storage for a further 24h at 2 °C. Half of the meat from each carcass was treated with a commercial preparation (BOMBAL, Van Hees; FISPAK Ltd.) containing the following organic acids; sodium acetate, sodium ascorbate, citric acid and ascorbic acid at a rate of 5g BOMBAL/kg of diced meat (OA's). The untreated meat was used as a control. The meat was then minced and packed in oxygen permeable packs, each containing 250g. Care was taken to avoid traces of treated meat being incorporated into the untreated control meat and the meat from the three carcasses was identifiable as such. The packs were stored at 5 °C for 7 days. Three packs of treated and untreated meat from each carcass were removed and assessed microbiologically after 4hrs, 3dys, 5dys and 7dys by monitoring Total Viable Counts (TVC) on plate count agar (37°C for 2 days) and coliform contamination on VRB agar (37°C for 24h). Microbial counts were recorded as $\log_{10}$ cfu (colony forming units) per gram of minced meat. Appearance was assessed by visual observation and recorded by photography.

Results

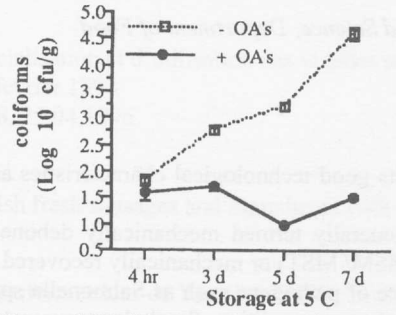
The results show that coliform contamination did not increase in the treated meats and TVCs only rose by 0.56 $\log_{10}$ units during the storage period. Meat treated with OA's maintained significantly lower levels of microbial contamination compared with controls, during the storage period. The difference in bacterial contamination between treated and untreated samples (Figure 1 and Figure 2) increased with storage time ($P<0.001$) for both Total Viable Counts (TVC) and coliforms, with a maximum difference after 7 days of storage of 2.12 and 3.08 $\log_{10}$ units respectively. Bacterial inhibition was evident as early as 4 hours after the addition of BOMBAL; treated mince had significantly ($P<0.05$) lower TVC levels compare with the controls (Figure 1; 6.67 vs 5.87 $\log_{10}$ cfu/g). Treated meat retained a fresh red colour while untreated meat developed brownish grey tones. These colour differences became evident after 3 days of storage and persisted throughout the 7 days storage.

Figure 1 Effect of organic acids (OA's) on TVC ($\log_{10}$ cfu/g) during storage at 5°C.



* Mean and SE of three samples tested in triplicate.

Figure 2 Effect of organic acids (OA's) on coliforms (Log10 cfu/g) during storage at 5°C



* Mean and SE of three samples tested in triplicate.

Conclusions

The combination of sodium acetate, sodium ascorbate, citric acid and ascorbic acid, was effective in controlling bacterial growth, including coliforms. It was also evident, that the antioxidant properties of citric and ascorbic acids, had an extra beneficial effect in extending colour shelf-life of the treated meat. Further research is required to study the possible effect of these compounds on food poisoning bacteria when present in mince beef.

Acknowledgements

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