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Novel methods to extend the shelf life of raw minced beef (#611)

Joan Tollerton, Linda Farmer, David Farrell

Agrifood and Biosciences Institute, Food Research, Belfast, UK

Introduction

Shelf life extension has long been a major goal of the meat industry. Currently, producers use combinations of packaging solutions, storage conditions and food additives to minimize microbial spoilage. High pressure processing (HPP) has been shown to extend the shelf life of a variety of food stuffs (1) and there is growing interest in the antimicrobial properties of essential oils (2). The aim of the present study was to identify the potential synergistic effects of HPP and antimicrobial oil-based active packaging on the shelf life of raw minced beef.

Methods

Essential oils (n=25) were selected and screened for antimicrobial activity by means of a disk diffusion assay followed by minimum inhibitory concentration (MIC) to give the lowest concentration capable of inhibiting growth of the spoilage microorganisms (3). Each oil was assessed against a broad range of 12 spoilage organisms including Gram-negative and Gram-positive bacteria. The three best performing essential oils were then selected for further investigation: lemongrass, cinnamon bark and clove bud oil. Ethanolic solutions of the oils were used to prepare active films for packaging. Results from the MIC assay indicated that cinnamon and clove oil should be applied to active packaging at 1.2% w/v and lemongrass oil at 2% w/v.

Retail packs of raw minced beef were purchased from a range of supermarkets and transferred to storage at 4°C. Portions (10g) of minced beef were aseptically weighed, applied to the active packaging and manipulated to adhere to the surface area of the active packaging. Three HPP treatments were selected: control (0MPa), 400MPa and 500MPa for a hold-time of 60 seconds. All prepared samples were stored at 4°C until pressure was applied then returned to 4°C until needed for further analysis.

Results were compared at the point where counts reached 10^7 colony forming units per gram (CFU/g) of sample. This is commonly used as an arbitrary measure of spoilage (4). Aerobic total viable count (TVC), anaerobic total viable count (TVCan) and lactic acid bacteria (LAB) were measured over a period of up to 70 days as an indicator of shelf life.

Fisher's LSD test was used to assign pairwise differences within pressure treatments, between oils tested for each of the bacterial counts. All significant differences were recorded at the 5% level.

Results

Figure 1 shows the observed TVC counts for all treatments. The results show that each active packaging treatment alone, effected a significant ($P<0.05$) 2 log reduction in TVC (after 7 days) when compared to a control treatment, though there was no significant difference after 14 days. Lemongrass oil active packaging on its own was shown to extend shelf life by 2 days over the control samples. Observed shelf life extensions using the HPP treatments were consistent with previous findings (1). Synergistic effects were observed when samples in active packaging were HPP treated. Here, the lemongrass oil active packaging treatment performed best with shelf life being extended by 14 days (400MPa) and 48 days (500MPa) over the control samples. Application of high pressure alone showed an increase of 5 days (400MPa) and 28 days (500MPa) compared to untreated samples to reach 10^7 CFU/g TVC. Pressure in combination with lemongrass-enhanced active packaging showed an impressive synergistic effect increasing time to reach 10^7 CFU/g TVC by 14 (400MPa) and 48 days (500MPa). Similar results were observed for TVCan and LAB counts.

Conclusion

Lemongrass, clove and cinnamon oils were identified as "best performers" to inhibit the growth of spoilage microorganisms during the screening process, with lemongrass being the best of the three. Positive synergistic effects between active packaging and HPP have been observed. The work has shown the potential for HPP in combination with active packaging to increase the shelf life of raw minced beef on the basis of inhibition of spoilage microorganisms, especially where lemongrass oil has been used as the antimicrobial agent. Further work is required to determine a level of treatment which will maintain this synergism in providing extra shelf life and also give an end product which is acceptable to consumers. It will also be important to ensure that with extra shelf life, the growth of pathogenic organisms is controlled.

References

1.
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