

**Title** Spoilage of value-added, high-oxygen modified-atmosphere packaged raw beef steaks by *Leuconostoc gasicomitatum* and *Leuconostoc gelidum*

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**Citation** International Journal of Food Microbiology, Volume 119, Issue 3, 1 November 2007, Pages 340-345

**Keywords** LAB; *Leuconostoc*; Spoilage; Moisture-enhanced beef; Marinated beef; Discolouration

### Abstract

Moisture-enhancing and marinating of meats are commonly used by the meat industry to add value to raw, retail products. Recently in Finland, certain value-added beef steak products have proven to be unusually susceptible to microbial spoilage leading to untoward quality deteriorations during producer-defined shelf-life. This study was conducted to evaluate the role of lactic acid bacteria (LAB) in the premature spoilage of value-added beef packaged under high-oxygen modified atmospheres. Spoilage was characterised by green discolouration and a buttery off-odour. The predominant LAB in eight packages of spoiled, marinated or moisture-enhanced beef steaks were identified by reference to a 16 and 23S rRNA gene restriction fragment length polymorphism pattern (ribotype) database. *Leuconostoc gasicomitatum*, *Leuconostoc gelidum*, *Lactobacillus algidus*, *Lactobacillus sakei* and *Carnobacterium divergens* were found to predominate in the LAB populations at numbers above  $10^8$  CFU/g. Inoculation of moisture-enhanced steaks with LAB strains and strain mixtures originating from the spoiled products demonstrated the spoilage potential of *L. gasicomitatum* and *L. gelidum* isolates. These two species produced green surface discolouration and buttery off-odours similar to these found in the spoiled, commercial products.