

Meat Safety News Digest

A collection of recent news relevant to the safety of red meat prepared by the Food Safety Program of Meat & Livestock Australia, for SAFEMEAT Stakeholders

INTERVENTION TECHNOLOGIES

Efficacy of tenderizing enzymes in reducing pathogens on beef

Researchers from the USA evaluated the potentials for using tenderizing enzymes as an antibacterial agent in reducing *L. monocytogenes* and three mixed strains of *E. coli* O157:H7 populations on beef. In this study, various concentrations of two tenderizing enzymes (actinidin at 175, 350 and 700 mg/ml, and papain at 5, 8, 10 mg/ml) were tested at 5, 25 and 35°C. It was found that the overall reduction of *E. coli* O157:H7 (1.08-1.94 log CFU/ml) was greater than that of *L. monocytogenes* (0.34-1.49 log CFU/ml). Higher concentrations of either enzyme also yielded greater reduction in bacterial populations. These findings suggest that, in addition to improving the sensory attributes of beef, tenderizing enzymes can enhance meat safety when stored at suitable temperatures.

<http://www.sciencedirect.com/science/article/pii/S0309174013006566>

Efficacy of electrolyzed oxidizing waters in reducing pathogens on beef hides

The objective of this American study was to evaluate the efficacy of electrolyzed oxidising (EO) waters as a hide intervention. Various EO water treatments were tested for their efficacy in reducing aerobic plate counts and

Enterobacteriaceae from uninoculated cattle hides and *E. coli* O157:H7 and *S. Typhimurium* from inoculated hides. Other treatments such as lactic acid were also included for comparison. The results revealed that 5% lactic acid (pH 2.04 at room temperature) was the most effective treatment in reducing all test organisms (at least 2.7 log CFU/cm²). However, all EO water treatments exhibited similar efficacy in reducing *Salmonella*, but not *E. coli* O157:H7. Hot alkaline pH EO water at 43°C (pH 11.60), and alkaline pH EO water spray followed by 150 mg/L available chlorine containing near neutral pH EO water spray (at room temperature) were found to cause the highest reduction of *E. coli* O157:H7 (approximately 1 log CFU/cm²) compared to other EO treatments. The results of this study highlight the potential for using EO water treatments as viable options to reduce pathogens on hide during slaughter, although LA treatment appeared to be more effective.

<http://www.sciencedirect.com/science/article/pii/S0956713513006713>

Effect of dehiding techniques on microbial contamination of beef carcasses

Skinning is a critical step in determining the overall hygienic status of beef carcasses. Researchers in UK compared two beef skinning methods: upward hide pulling (UPH) and downward

hide pulling (DHP) with regard to their effect on microbial contamination of carcasses. Eight carcass sites (ham, chuck, rump, bung, flank, brisket, shin and neck) were sampled following each hide pulling method in a single processing plant. Total viable counts (TVCs) and Enterobacteriaceae counts for each site were determined. Results revealed no significant differences in total carcass contamination (all 8 sampling sites pooled) with regard to dehiding methods. However, differences in TVCs were significant at the flank, shin, brisket and neck regions; reflecting possible implementation deficiencies of HACCP pre-requisite programmes here rather than implication of dehiding method.

<http://www.sciencedirect.com/science/article/pii/S0309174014000722>

Effect of lactic acid, levulinic acid and sodium dodecyl sulfate on STECs and *Salmonella* Typhimurium

Bactericidal activities of lactic acid, levulinic acid, levulinic acid and sodium dodecyl sulfate applied individually and in combination on STECs and *Salmonella* Typhimurium in pure cultures (21°C) and on beef trim pieces (spraying or immersion with or without hand massage) at different temperatures were examined in this USA study. Application of 0.5 % levulinic acid plus 0.05 % SDS for <1 min to pure cultures reduced the populations of all STEC strains (*E. coli* O26:H11, O45:H2, O111:H8, O103:H2, O121:H2, O145:NM and O157:H7) to undetectable levels (>6 log CFU/ml reduction). Whereas, reduction of these STECs was less pronounced with 3% lactic acid for 2 min (0.3 – 2.1 log CFU/ml).

Beef surface temperature was found to affect the bactericidal activity of treatment with 3 % levulinic acid plus 2 % SDS (LV-SDS). Application of LV-SDS

spray at 21, 62, or 81°C on cold beef trim (4°C) for 30 s reduced *E. coli* O157:H7 by 1.0, 1.1 and 1.4 log CFU/cm², respectively. Whereas treating beef trim at 8°C with LV-SDS at 12°C for 0.1, 1, 3 or 5 min reduced *E. coli* O157:H7 by 1.4, 2.4, 2.5 and 3.3 log CFU/cm², respectively. Treatment of beef trim at 4°C with 5 % lactic acid resulted in 1.3 log CFU/cm² reduction of *E. coli* O157:H7. Comparatively greater reductions in *S. Typhimurium*, 2.1, 2.6 and >5.0 log CFU/cm² were observed when beef trims at 8°C were treated with LV-SDS for 1, 2 or 3 min, respectively. Hand massaging the treated beef trim with LV-SDS resulted in substantial reduction of both pathogens (<5 CFU/cm²).

<http://www.ingentaconnect.com/content/iaf/p/jfp/2014/00000077/00000004/art00001>

MEAT SHELF LIFE

Potential of multispectral imaging technology for microbial quality determination of beef

Researcher in this study evaluated the potential of multispectral imaging to monitor spoilage of aerobically packaged beef fillets stored at different temperatures (0, 4, 8, 12, and 16 °C). Fresh beef fillets were cut into small portions (50 g) and packaged aerobically for storage at different temperatures. Microbiological data: total viable, *Pseudomonas* spp. and *Brochothrix thermosphacta* counts were recorded. Based on total viable counts (TVC) meat samples were divided into different groups: Class 1 (TVC < 5.5 log¹⁰ CFU/g), Class 2 (5.5 log¹⁰ CFU/g < TVC < 7.0 log¹⁰ CFU/g) and Class 3 (TVC > 7.0 log¹⁰ CFU/g). Relationships among spectral data (in visible and short wave near infrared area) obtained from meat surface and meat quality classes were established. Models were also built and validated for the prediction of total viable counts, *Pseudomonas* spp. and *B.*

thermosphacta, using the spectral information as model input variables and the counts of each individual microbial group as output. Results revealed good performance of models in classifying meat samples, with overall correct classification rate for the three quality classes ranging from 91.8% to 80.0% for model calibration and validation, respectively. Similar, good correlations were observed between spectral data and microbial counts. Study showed that multispectral image technology has the potential to provide a rapid and non-invasive meat quality analysis without any pre sample preparation step, which could be an interesting alternative to laborious and time consuming microbiological analysis.
<http://www.sciencedirect.com/science/article/pii/S016816051300603X>

Use of dietary rosemary extract to extend shelf life of lamb meat

Spanish researchers investigated the potential use of dietary rosemary extract (DRE) as a nutritional strategy to extend shelf life of lamb meat. In this study, lambs were fed a diet supplemented with 0, 200 or 400 mg DRE (containing carnosic acid and carnosol at 1:1 ratio) per kg feed during the fattening stage. Meat fillets derived from these lambs were then vacuum-packed and stored under retail conditions for up to 14 days. The effects of diet on meat quality were periodically evaluated based on different physical-chemical (color, pH, protein oxidation and volatiles from lipid oxidation etc.), microbial (total viable and psychrophilic bacteria, Enterobacteriaceae, molds and yeasts) and sensory (appearance and odor) characteristics. It was found showed that DRE at both doses delayed lean and fat discoloration, lipid oxidation, odor deterioration and microbial spoilage. Both DRE doses also provided similar shelf-life

extension (from around 9 to 13 days). These results indicated that DRE could be used to extend the shelf life of lamb meat.
<http://www.sciencedirect.com/science/article/pii/S0309174013006396>

Effect of irradiation on shelf-life of vacuum-packed refrigerated lamb

This Brazilian study evaluated the effect of gamma radiation (at 1.5 kGy and 3.0 kGy) on the shelf-life of vacuum-packed lamb loins stored at 1 ± 1 °C for 56 days. Samples were analysed for sensory, microbiological and physicochemical characteristics at day 0 and thereafter every fortnight. Results showed that irradiation (3.0 kGy) significantly reduced the microbial counts without having any negative affect on the physicochemical and sensory quality of lamb loins.

<http://www.sciencedirect.com/science/article/pii/S0309174014000357>

Characteristics of spoilage bacteria on low and high pH lamb cuts in vacuum packs

In this New Zealand's study, researchers investigated the spoilage potential of *Brochothrix thermosphacta* and two Enterobacteriaceae species (*Serratia proteamaculans* and *Rahnella aquatilis*) in vacuum packaged lamb of high (5.9 to 6.4) and low (5.4 to 5.8) pH. Vacuum packaged fore-shank and striploins (n = 306) were selected and inoculated with each of bacterial species (100 CFU). All inoculated samples were then stored for twelve weeks at temperatures – 1.5, 0, 2 and 7°C. Changes in bacterial numbers and spoilage characteristics were determined periodically and analysed in comparison to un-inoculated control samples. The results showed that all three species grew on vacuum packaged lamb of both low and high pH values at all temperatures.

However, *B. thermosphacta* and *S. proteamaculans* caused spoilage to the meat under all test conditions, whereas *R. aquatilis* only spoiled high pH meat at 7°C. This study provided evidence that was inconsistent with beef models stipulating the inability of *Brochothrix* and *Enterobacteriaceae* species to grow on or to cause spoilage of low pH meat in the absence of oxygen.

<http://www.sciencedirect.com/science/article/pii/S0309174014000072>

PACKAGING

Effects of packaging system and temperature abuse on the quality of ground beef

The focus of this American study was to determine the effects of packaging systems and temperature abuse on the sensory and shelf-life characteristics of ground beef. Ground beef patties were packaged using different packaging systems. These were polyvinyl chloride overwrap (aerobic packaging), HI-OX modified atmosphere packaging (MAP; 80% O₂, 20% CO₂), LO-OX MAP (30% CO₂, 70% N₂), CO-MAP (0.4% CO, 30% CO₂, 69.6% N₂), or vacuum (anaerobic packaging). All samples were then subjected to color, odor, biochemical and microbial analyses over display. Comparison of data between MAPS indicated that CO-MAP showed the most desirable color and consumer acceptability throughout display. However, among all packaging systems, anaerobic packaging provided best sensory characteristics and longest shelf-life after display and temperature abuse.

<http://www.sciencedirect.com/science/article/pii/S0309174013006384>

Effect of packaging systems on storage stability of ground beef

The objective of this study was to compare modified atmosphere packaging

(MAP, 0.4% carbon monoxide [CO], 30% carbon dioxide, 69.6% nitrogen) to conventional vacuum (VP) and polyvinyl chloride (PVC) packaging systems in ground beef (three fat levels: 10, 20 and 30%) stored at 4 °C for 25 days. Results showed significant effect of packaging on ground beef storage stability regardless of fat content. Meat pH decreased for MAP and VP and increased for PVC with storage. Differences were observed among MAP and VP for TBARS (thiobarbituric acid reactive substances). For MAP stored meat the absorption of CO increased with time without any significant difference among different fat levels. Further, no effect of MAP on maintaining carboxymyoglobin “cherry red” fresh meat colour during storage were observed as compared to VP or PVC packaging.

<http://www.sciencedirect.com/science/article/pii/S030917401400059X>

New active natural antioxidant coated packaging films for greater oxidative stability of meat

The aims of this study were to develop active packaging films using natural antioxidants and assess their ability in enhancing oxidative stability of refrigerated stored beef. The antioxidant potential of PVPP-WS extract (polyvinylpyrrolidone – waste stream) - a natural extract obtained from brewery residual waste was compared with rosemary extract and two synthetic antioxidants (butylated hydroxytoluene and propyl gallate). Antioxidants were either applied directly to beef or as a coating on packaging films. Results revealed that films coated with PVPP-WS extract significantly reduced (up to 80%) beef lipid oxidation relative to control. Similar reductions in lipid oxidation were also observed when antioxidants were directly added to meat. Thus use of natural extract

coated packaging films could improve the oxidative stability of meat products and should therefore be of great interest to meat industry.

<http://www.sciencedirect.com/science/article/pii/S0309174014000424>

PATHOGEN PREVALENCE

Incidence of pathogenic bacteria in abattoir air

This Irish study determined the incidence of air-borne *Salmonella* and *L. monocytogenes* in commercial beef, sheep and pig plants. Air samples from lairage, hide/fleece pulling or dehairing/scraping, evisceration and chilling areas were collected and analysed. The results revealed that both pathogens were detected in all plants, with a very low level. However, *Salmonella* was detected more often than *L. monocytogenes* in all areas. *S. Typhimurium* appeared to be a common serotype in the beef/sheep plants, whereas the common serotypes of *L. monocytogenes* included 1/2a–3a and 1/2b–3b–7. Despite these, it was concluded that air is unlikely to be a significant source of carcase or plant surface contamination.

<http://www.sciencedirect.com/science/article/pii/S0309174014000345>

MEAT SAFETY

Contribution of meat inspection on animal health and welfare surveillance

Meat inspection (MI) is a surveillance system used to identify meat of animals that is not fit for human consumption. In Europe, MI protocols are regulated at the European level, which include visual inspection, palpation and incisions before and after stunning (*ante-* and *post-mortem* inspection). These protocols are currently being revised because of its low sensitivity for important

public health hazards. A change from current protocols to visual-only *post-mortem* inspection has been proposed. In this European study, a group of researchers aimed to investigate the strengths and weaknesses of both current and new MI protocols with primary focus on their use as a means for detection of animal disease and welfare cases. During an initial study, a number of literatures were reviewed to determine the performance of MI for detecting diseases and welfare conditions in several species including bovines. It was found that there was a substantial lack of data on the frequency of occurrence of many diseases and conditions affecting food animals. To overcome these limited data, additional data were obtained from expert opinion. All data were then analysed by a quantitative stochastic model (known as ‘scenario tree modelling’) to quantify the probability of case detection. The model indicated that current MI protocols were effective in detecting clinical and/or pathological signs in affected animals. Among these protocols, *ante-mortem* inspection appeared to be essential for detecting animal welfare conditions. This was despite that the impact of a proposed change to visual-only *post-mortem* inspection was only negligible for most diseases and conditions with a few exceptions, such as detectable cases of tuberculosis. Furthermore, MI was found to play an important role as “back-up” surveillance in a situation where other means of detection fail, or where there is basically no other means of detection for certain infections (e.g. liver fluke or cestodes). MI information could also be used to assess the effectiveness of other disease control measures such as vaccination.

<http://www.sciencedirect.com/science/article/pii/S0956713513005835>

The challenge of defining risk based metrics to improve food safety

<http://www.sciencedirect.com/science/article/pii/S0168160514000415>

Food safety is a highly prioritised issue of public health worldwide that warns implementation of a successful safety management system. In this paper, authors reviewed the current status of food safety system. Disparities among EC Regulation 178/2002 of European Parliament and the Council and Commission Regulation 2073/2005 with regard to food safety criteria have been highlighted. Whereas, regulation 178/2002 emphasised that food laws should adopt risk analysis approach, the Commission regulation 2073/2005 recommended microbiological and process hygiene criteria (which are not based on risk analysis) as a basis for food safety. The importance of risk based metrics: appropriate level of protection (ALOP), food safety objective (FSO) and performance objective (PO) as described by Codex Alimentarius Commission (CAC) are discussed. The lack of guidance to establish and implement these risk based metrics linked to each other in the past has been highlighted. The risk assessment model based approach to link ALOP, FSO and PO is suggested. The opportunities to include PO/FSO in future European food safety regulations has been explored in the light of availability of results of the EU funded BASELINE study and software tools developed using these results.

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