

Meat Safety News Digests

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

E. COLI

Source of *E. coli* O157:H7 contamination during “high event period”

Researchers from the USA hypothesized that the high event period (HEP) meat contamination may be due to in-plant colonized *E. coli* O157:H7 strains rather than strains that come with live animals and that those strains may be able to survive better sanitization through biofilm formation. To test this, a total of 45 strains isolated from HEP beef contamination incidents and a panel of 47 strains from environmental samples were compared for biofilm formation and sanitizer resistance. Biofilm formation was tested for up to 6 days. The survival of biofilm cells after sanitization was compared using common sanitizers, including quaternary ammonium chloride, chlorine, and sodium chlorite. It was evident that there was no difference in “early stage” biofilms between HEP strains and strains from environmental samples after incubation at 22 to 25°C for 1 or 2 days. However, the HEP strains showed higher potency of “mature” biofilm formation after incubation for 4 to 6 days. Biofilms of the HEP strains also appeared to be more resistant to all sanitizers. These results suggest that biofilm formation and sanitization resistance could have a role in HEP beef contamination by *E. coli* O157:H7, highlighting the importance of

proper sanitization of food contact surfaces and food processing equipment in commercial meat plants.

<http://www.ingentaconnect.com/content/iafp/jfp/2014/00000077/00000011/art00019?token=00551a7940c10a46e139412f415d767834447b494a5f247a514d253048296a7c2849266d656ca923c0c5e>

PATHOGEN DETECTION

CoSYPS system for viable *Salmonella* and *Listeria* detection in carcass swab samples

This study validated the complete CoSYPS Path Food workflow (Combinatory SYBR®Green qPCR Screening system for pathogen detection in food samples) for detection of *Salmonella* spp. and *Listeria* spp. in carcass swabs. All steps from swab sample enrichment, DNA extraction, *Salmonella* spp. and *Listeria* spp. qPCR detection, isolation and confirmation of the detected strains were compared with the standard reference methods. The results showed that both reference and CoSYPS methods were equally efficient in detecting low levels of *Salmonella* spp. and *Listeria* spp. in beef carcass swab samples with limit of detection between 2 – 16 CFU/swab. The relative accuracy, specificity and sensitivity of complete CoSYPS workflow were 100% compared to reference methods besides providing presumptive negative or positive results

in half the time required for reference methods (2 days instead of 4-5 days). Whereas, the time required for confirmed positive results by both methods was same (6 days). Further, as a multi-genus system, CoSYPS is able to detect both *Salmonella* and *Listeria* in a single test from a single sample and provide information about detected species/subspecies at the same time. Thus complete CoSYPS workflow can be a valuable alternative to the standard methods for beef carcass control before distribution.

<http://www.sciencedirect.com/science/article/pii/S0168160514004814>

INTERVENTIONS

Use of high hydrostatic pressure in combination with chemical preservatives on beef products

The use of high hydrostatic pressure (HHP) on fresh beef often has a deleterious effect on red colour. To this end, researchers from Argentina aimed to develop the procedure for applying HHP to the beef products that still exhibit acceptable colour and microbiological stability. The proposed procedure was carried out by first immersing the beef samples in a preservative solution containing ascorbic acid, sodium nitrite, and sodium chloride. The composition of this preservative solution was optimised to maintain colour attributes. The treated samples were packed in low gas permeability film before HHP treatment (300 or 600 MPa). The stability of the treated samples during storage at 4°C was then determined by microbial counts, colour, texture, and exudate. The results revealed that the combination of treatments provided acceptable colour and microbiological stability during four

and six weeks of storage after the beef samples had been subjected to 300 and 600 MPa, respectively.

<http://www.sciencedirect.com/science/article/pii/S0309174014004653>

High pressure–low temperature inactivation of internalized *E. coli* in beef

The current US research elucidated the effect of high pressure-low temperature (HPLT) processing on *Escherichia coli* O157:H7 inactivation in non-intact whole muscle beef, its quality and cooking traits. Vacuum-packed semitendinosus beef samples were internally inoculated with a cocktail of four strains of *E. coli* O157:H7 and subjected to freezing (F; -25°C), high pressure low temperature treatment (HPLT; <-30°C/551 MPa/ 4 min) or high pressure processing (HPP; 3 °C/551 MPa/4 min). The HPLT treatment resulted in 1.7 and 1.4 log CFU/g reduction of *E. coli* on selective and non-selective media respectively, as compared to frozen untreated control beef without affecting its colour. Freezing did not change meat pH; nor did HPLT treatment; however HPP increased pH and lightness while decreasing cook yield, tenderness and protein solubility. Apart from a 4% loss in cook yield, HPLT had no detrimental effect on studied beef quality traits. The results of this study showed the potential of HPLT processing in improving food safety of frozen non-intact whole muscle red meat.

<http://www.sciencedirect.com/science/article/pii/S1466856414001337>

Use of short and repeated high-pressure processing to reduce non-O157 STEC in ground beef patties

To date, several studies have demonstrated the efficacy of high-pressure processing (HPP) in reducing *E. coli* O157:H7 in meat products. However, a concern has been raised whether HPP could also be used to reduce non-O157 STEC in ground beef. The aim of this American study was to investigate the efficacy of short and repeated HPP treatments to reduce non-O157 STEC in ground beef. Irradiated ground beef patties (80:20, 90:10 [lean:fat]) previously inoculated with non-O157 STECs were vacuum-packaged and high-pressure processed (four, 60 s cycles, 400 MPa, 17 °C). Surviving *E. coli* populations were then enumerated. It was found that HPP treatments caused at least 2.0 log₁₀ CFU/g reductions of non-O157 STECs. These reductions ranged from 2.4–3.9 and 2.3–4.3 log₁₀ CFU/g in 80:20 and 90:10 samples, respectively. The results of this study indicate that HPP could also be an effective, post-processing intervention to reduce the risk of non-O157 STEC contamination in ground beef.

<http://www.sciencedirect.com/science/article/pii/S0309174014005002>

PACKAGING

Effects of polyethylene film wrap on the quality of beef carcasses

The objective of this Brazilian study was to evaluate the potential use of polyethylene film wrapping of beef half carcasses for preservation. The cooler shrink, cooling characteristics and microbial status of the wrapped carcasses were determined and compared to those of the unwrapped

carcasses. It was evident that film wrapping reduced cooler shrink by 55%, 43%, 36% and 30% after 24, 48, 72 and 96 h of cooling, respectively. However, the surface water activity (i.e., dryness) showed no differences among the time periods. The wrapped carcasses appeared to have a lower cooling rate and higher surface and internal temperatures. The higher numbers of the aerobic mesophiles, *Staphylococcus aureus* and *Enterobacteriaceae* were also observed in the half carcasses wrapped in film, except for *E. coli* numbers. In conclusion, the film was effective in reducing cooler shrink. However, it caused a delay in cooling, enabling potential increase microbial counts and impairing the hygienic and sanitary conditions of the carcasses. This may be an impediment to the practical application of this technology.

<http://www.sciencedirect.com/science/article/pii/S0309174014004665>

Effect of packaging and storage on the quality of fresh beef steaks

Researchers in this study investigated the effects of different packaging methods; air (control), vacuum, modified atmosphere packaging 1 (MAP1; 60:40/O₂:CO₂) and MAP2 (60:20:20/O₂:CO₂:N₂) on the shelf-life of beef steaks. Packed samples were stored at 4±1 °C for 35 days and evaluated for sensory (visual colour evaluation), physical (headspace gas analysis, weight loss, water holding capacity, Warner-Bratzler shear force and instrumental colour) and chemical (pH, thiobarbituric acid reactive substances (TBARS) and myoglobin content) characteristics at 5 days regular intervals. Results showed change in gas composition in control and MAP

packages during storage. The weight loss increased significantly with storage under all packaging methods. The lowest weight loss and the highest water holding were observed for vacuum-packed steaks. Vacuum packed steaks also scored highly for sensory colour evaluation and TBARS. High-oxygen (MAP1) packaging shortened the shelf-life by increasing lipid oxidation of meat. Significant interaction effects of packaging methods and storage days were observed for pH, shear force and L*, a*, b* values of the beef steaks.

<http://www.tandfonline.com/doi/pdf/10.1080/19476337.2014.919029>

PREDICTIVE MODEL

Identification of meat spoilage using infrared spectra

Researchers in this study developed a rapid and non-destructive decision support system for the classification/prediction of meat spoilage using fourier transform infrared (FTIR) spectroscopy. For this beef samples were stored aerobically at 0, 5, 10, 15 and 20°C until spoilage was noticeable. Data on total viable, *Pseudomonas* spp., *Brochothrix thermosphacta*, lactic acid bacteria and *Enterobacteriaceae* counts and sensory parameters (colour and odour) were recorded and compared with FTIR spectral measurements. A range of mathematical algorithms were used to develop a reliable framework for accurate evaluation of meat quality classes (fresh, semi-fresh and spoiled). The sensitivity of the new framework showed an excellent performance for fresh and spoiled samples; categorised accurately 13 out of 14 samples, except for *Enterobacteriaceae* where the correct classification was 85.7%. No fresh

samples were misclassified as spoiled or *vice versa*, the only misclassified sample belonged to semi-fresh group. Further, the proposed modelling scheme not only classified meat samples in the respective quality class but also predict their associated microbiological population directly from FTIR spectra.

<http://www.sciencedirect.com/science/article/pii/S0260877414002593>

Quality tracing in meat supply chain

The aims of this German study were to develop a temperature based predictive model for real time quality monitoring of vacuum-packed Irish lamb and implement this model as a decision support tool (DST) to best manage distribution, storage and quality in the overall supply chain. For model development, trials were conducted with vacuum-packed Irish lamb saddles. The characteristic sensory attributes (meat colour, meat juice colour and volume, gas formation, texture and overall appearance) and microbial counts (total viable counts, *Pseudomonas* spp., *Brochothrix thermosphacta*, *Enterobacteriaceae* and lactic acid bacteria) were analysed at different temperatures (2, 7, 15 and 20°C). The microbial results showed great variations in the growth characteristics and the amount of different spoilage organisms between samples. This hindered the development of a specific spoilage organism based model. Thereby, a sensory-based quality control model, including all sensory attributes (termed quality index, QI) was developed for this product.

Further, process analysis was conducted to define general technical requirements for the implementation of temperature-based model into a meat

supply chain. The essential hardware and software for continuous temperature monitoring and sharing were developed and tested to use the model under actual supply chain conditions. This allowed the prediction of freshness loss under dynamic supply chain conditions based on product temperature history. The traffic light signal type visualization of actual status of the meat product enhanced simple use even for untrained personnel. The decision support tool

founded on shelf –life modelling and real time temperature monitoring approaches as elaborated in this study are useful for the overall improvement of quality and storage management not only within the meat logistics network but other perishable supply chains as well.

<http://www.ncbi.nlm.nih.gov/pubmed/24797136>

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FOR FURTHER INFORMATION PLEASE CONTACT:

Manager, Market Access Science and Technology

Ian Jenson

PH: 02 9463 9264

ijenson@mla.com.au



MEAT AND LIVESTOCK AUSTRALIA, LOCKED BAG 991 NORTH SYDNEY NSW 2059