



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

E. COLI O157:H7 SHEDDING PATTERNS

Differences in *E. coli* O157:H7 strain colonization and shedding patterns in cattle

American researchers conducted oral challenge studies with three different genotypes of *E. coli* O157:H7 in cattle to determine the genotypic variability in shedding frequencies and concentrations and the extent of contamination of the environment. Four groups of Holstein steers each were orally challenged with 10^6 CFU of one of the three *E. coli* O157:H7 strains. Recto-anal mucosal swabs and environmental samples were taken on alternate days over 30 days. The numbers of *E. coli* O157:H7 and generic *E. coli* were determined by the presence and absence of 28 gene targets using real-time PCR. Over the study period, strains were found in varying frequencies (52%, 42%, and 2% of swabs, respectively). Environmental detection of the challenge strains was found mainly in samples of the hides and pen floors. Based on the analysis of 28 genes, genotypes of enterohaemorrhagic *E. coli* (EHEC) and generic *E. coli* were clustered into three sub-groups. The researchers concluded that the type and intensity of measures to control this pathogen at the pre-harvest level may need to be strain-specific.

<http://aem.asm.org/content/early/2012/09/04/AEM.02363-12.short?rss=1>

O157 AND NON-O157 SEROGROUP COMPARISONS

Evaluation of lactic acid as a sub-primal intervention measure

The objective of this USA study was to validate the initial use of lactic acid as a sub-primal intervention during beef fabrication followed by a secondary application to vacuum-packaged product. Chilled beef sub-primal sections (100 cm^2) were either left uninoculated or were inoculated with 6 log CFU/ cm^2 of a 5-strain mixture of *E. coli* O157:H7, a 12-strain mixture of non-O157 Shiga toxin-producing *E. coli* (STEC), or a 5-strain mixture of non-pathogenic *E. coli*. Uninoculated and inoculated sub-primal sections received an initial, or an initial and a second, application spray of lactic acid. The initial spray resulted in counts reduced from 6.0 log CFU/ cm^2 to 3.6, 4.4, and 4.4 log CFU/ cm^2 for the non-pathogenic *E. coli*, *E. coli* O157:H7, and non-O157 STEC inoculation groups, respectively. After the second spray, total counts were 2.6, 3.2, and 3.6 log CFU/ cm^2 for the inoculation groups as listed above.

These data may be useful to the meat industry as part of the HACCP validation process. <http://www.ingentaconnect.com/content/iafp/jfp/2012/00000075/00000009/art00020>

Comparison of antimicrobial treatments on trimmings against *E. coli* O157:H7 and six non-O157 STEC serogroups

Researchers from the USA evaluated the decontamination efficacy of six chemical treatments for beef trimmings against *E. coli* O157:H7 and six non-O157 Shiga toxin-producing *E. coli* (nSTEC) serogroups (O26, O45, O103, O111, O121, and O145). Four-strain mixtures of *E. coli* O157:H7 and nSTEC serogroups were separately inoculated (3 to 4 log CFU/cm²) onto trimmings from beef chuck rolls, and then immersed for 30 s in solutions of (acidified sodium chlorite (0.1%, pH 2.5), peroxyacetic acid (0.02%, pH 3.8), sodium metasilicate (4%, pH 12.5), Bromitize® Plus (0.0225% active bromine, pH 6.6), or AFTEC 3000 (pH 1.2)), or for 5 s in SYNTRx 3300 (pH 1.0). Results showed that all tested decontamination treatments were similarly effective against the 6 nSTEC serogroups as they were against *E. coli* O157:H7. Irrespective of pathogen inoculum, treatment of beef trimmings with acidified sodium chlorite, peroxyacetic acid, or sodium metasilicate reduced initial pathogen counts by 0.7 to 1.0, 0.6 to 1.0, and 1.3 to 1.5 log CFU/cm², respectively. Reductions of pathogen counts by Bromitize Plus, AFTEC 3000, and SYNTRx 3300 were 0.1 to 0.4 log CFU/cm², depending on treatment.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2012.02878.x/abstract>

Evaluation of antimicrobial interventions for fresh beef against non-O157 STEC serotypes

American researchers evaluated if antimicrobial interventions currently used have a similar effect in reducing non-O157 STEC serogroups (O26, O45, O103, O111, O121, and O145) compared with *E. coli* O157:H7. Pre-rigor beef flank surfaces (160) were inoculated with a high (10⁴ CFU/cm²) or a low (10¹ CFU/cm²) count of two strain mixtures. Mixture 1 was composed of O26, O103, O111, O145, and O157, while mixture 2 was

composed of O45, O121, and O157. The inoculated fresh beef cuts were subjected to spray treatments by either: acidified sodium chlorite, peroxyacetic acid, lactic acid, and hot water. High-level inoculation samples were directly compared with the untreated controls, while low-level inoculation samples were chilled for 48 h at 4°C before enrichment and isolation. Spray treatments with hot water were the most effective, resulting in mean pathogen reductions of 3.2 to 4.2 log CFU/cm², followed by lactic acid (1.9 -2.7 log CFU/cm²). Hot water and lactic acid also were the most effective interventions with low-level inoculation on surfaces of fresh beef after chilling (mean reduction 3.6 and 3.1 log CFU/cm² respectively). Peroxyacetic acid had an intermediate effect (decreasing counts by 0.9 – 2.6 log CFU/cm²), while acidified sodium chlorite was the least effective in reducing STEC levels immediately after treatment (0.6 – 1.9 log

CFU/cm²). <http://www.ingentaconnect.com/content/iafp/jfp/2012/00000075/00000007/art00003>

Survival of O157:H7 and non-O157 *E. coli* in bovine rumen fluid and bile salts

The focus of this USA study was to determine whether variations exist in the ability of different serotypes of STEC to survive within bovine rumen fluid medium and bile salts. Since recent changes in testing for non-O157 by the U.S. Department of Agriculture Food Safety and Inspection Service (USDA-FSIS), there is a need to understand the biological activity of non-O157 serogroups. The researchers found that the five serotypes tested (O157:H7, O111:H8, O103:K:H8, O145:H28, and O26:H11) were capable of growing in rumen fluid medium. However, these data suggest that non-O157 serogroups of *E. coli* respond differently to the environment of the bovine gastrointestinal tract. For example, the concentrations of the serotypes O103:K:H8 and O26:H11 after 24 h were significantly less than that observed for the other serotypes tested. There was only a

significant decrease in the survival of O103:K:H8 in 50 mg/mL of bovine bile salts in comparison to the other STEC strains tested..

<http://online.liebertpub.com/doi/abs/10.1089/fpd.2012.1208>

Serotypes and virulotypes of non-O157 shiga-toxin producing *E. coli* (STEC) on bovine hides and carcasses

Irish researchers screened four hundred and fifty beef animal hides and carcasses for STEC in 3 beef abattoirs over a 12-month period using PCR and culture-based methods. 67% (301/450) of hides and 27% (122/450) of carcasses were STEC PCR positive. Forty isolates representing 12 STEC serotypes (O5:H-, O13:H2, O26:H11, O33:H11, O55:H11, O113:H4, O128:H8, O136:H12, O138:H48, O150:H2, O168:H8 and ONT:H11) and 15 serotype–virulotype combinations were identified. This study provided non-O157 STEC surveillance data and also evidence of bovines as a source of clinically significant STEC as well as identifying 3 emerging serotypes (by the virulence indicator gene *eae* variants) O5:H- (*eae*-β1), O13:H2 (*eae*-ζ), and O150:H2 (*eae*-ζ) that may be considered when developing beef testing procedures for non-O157 STEC in the future.

<http://www.sciencedirect.com/science/article/pii/S0740002012001268>

SPOILAGE BACTERIA AND SHELF-LIFE

Influence of different conditions on *Clostridium* to cause blown pack spoilage in chilled vacuum-packed beef

Brazilian researchers determined the ability of psychrotrophic *Clostridium* strains isolated from vacuum-packed beef cuts and abattoir environments to cause 'blown-pack' spoilage of vacuum-packed beef stored at 2 and 15°C. The influence of package shrinking temperature (83, 84 and 87°C) and vacuum pressure (6 and 9 mbar) on the occurrence of

such spoilage as well as the effects of simulated transportation (500 km) on the integrity of packages was determined. At 15°C and 2°C, twelve and six strains caused 'blown-pack' spoilage, respectively. The combination of vacuum pressure (9 mbar) combined with shrinking temperature (87°C) retarded the occurrence of spoilage. The simulated transportation under the experimental conditions did not affect the integrity of packages.

<http://www.sciencedirect.com/science/article/pii/S0309174012001817>

Gas-producing and spoilage potential of Enterobacteriaceae and lactic acid bacteria

This Brazilian study firstly aimed to enumerate and identify lactic acid bacteria and Enterobacteriaceae from spoiled and non-spoiled chilled vacuum-packaged beef, and secondly, determine their potential to cause blown pack spoilage of vacuum-packaged beef stored at chilled temperature (4°C) and abuse temperature (15°C). Populations of lactic acid bacteria in exudate of spoiled and non-spoiled samples were not significantly different, whereas the number of lactic acid bacteria on the surface was significantly higher in spoiled samples as compared to non-spoiled samples. The population of Enterobacteriaceae species in exudate and on the surface of samples were significantly higher in spoiled packs in comparison with non-spoiled packs. Using *Hafnia alvei* as the inoculum, results of the deterioration potential showed that 'blown pack' spoilage was noticeable after 7 days at 15°C and after 6 weeks at 4°C.

<http://www.ingentaconnect.com/content/bsc/ijfst/2012/00000047/00000008/art00024>

Influence of cold chain interruptions on shelf-life

In this study German researchers evaluated the influence of fluctuations of the cold chain on the growth of *Pseudomonas* spp. on fresh pork and poultry and hence shelf-life. In four trials, shelf-life at the control (4°C,

constant) was compared with shelf-life at two temperature shift scenarios (4 to 7 and to 15°C, respectively). Overall, fresh pork and fresh poultry showed similar spoilage patterns at shifting temperature conditions, with reductions in shelf-life when short temperature upshifts occurred at the beginning of the storage. Reductions were up to 2 days, although the storage time with an abusive temperature was <5% of the total storage time. Trial scenarios with shifts to 15°C led to higher shelf-life reductions than scenarios with shifts to 7°C for both meat

types. <http://www.ingentaconnect.com/content/bsc/ijfst/2012/00000047/00000008/art00010>

PACKAGING TECHNOLOGY

Antimicrobial and antioxidative strategies to reduce pathogens and extend shelf-life – a review

This review discusses spoilage potential of predominant bacteria and factors influencing their impact on meat quality. These organisms include *Pseudomonas*, *Acinetobacter/Moraxella* (*Psychrobacter*), *Shewanella putrefaciens*, lactic acid bacteria, *Enterobacteriaceae*, and *Brochothrix thermosphacta*. Modifying the atmosphere of the packaging is commonly used but vacuum remains the major packaging method for meat distribution. Other methods include a two-step master packaging (outer anoxic-20% CO₂+ 80% N₂/inner gas-permeable film) can be used for centralized MAP distribution, but carbon monoxide (CO) use (0.4%) in low O₂ packaging systems is limited by consumer uncertainty. Active packaging where the film contributes more than a gas/physical barrier is an important technology and has been studied widely. Furthermore, both organic acids and antioxidants have been evaluated for their effects on microorganism growth, in concert with the prevention of lipid oxidation; hence work in this area is also examined.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1541-4337.2012.00188.x/abstract>

A combination of MAP and antimicrobial packaging to extend the shelf-life of beefsteaks stored at chill temperature

Italian researchers developed an antimicrobial film by coating a nisin-based antimicrobial solution onto polyethylene (PE) sheets. These sheets were used for the packaging of beefsteaks to be stored in air or modified atmosphere packaging (MAP, 60% O₂–40% CO₂). Microbial populations, species diversity, headspace volatile organic compounds, colour and sensory properties were monitored after 0, 1, 7 and 12 days of storage at 4°C. The viable counts showed that there was an effect of MAP and antimicrobial film on the development of all the spoilage associated microbial populations.

Carnobacterium spp., *Brochothrix thermosphacta*, *Pseudomonas fragi* and *Rhanella aquatilis* were found in most of the samples. *C. maltaromaticum* was identified in samples stored in air as well as MAP.

Quantitative analysis of the headspace showed that during storage the production of volatile organic compounds (VOCs) was affected by the use of the treated film and the MAP storage. The results indicated, the antimicrobial PE sheet in combination with MAP storage at 4°C were effective for storage of beefsteaks. Evidenced by inhibiting the growth of spoilage bacteria, lower concentrations of VOCs and acceptable levels of colour and other sensory parameters for more than 10 days.

<http://www.sciencedirect.com/science/article/pii/S0168160512003716>

SALMONELLA IN BEEF

Tracking the sources of *Salmonella* in ground beef

The objective of this USA study was to determine the source(s) of *Salmonella* contamination in ground beef.. Ninety six percent of the hide samples, 47% of the carcasses before antimicrobial intervention, 18% of the lymph nodes, 7.14% of the trim, and 1.67% of the ground beef samples were positive for *Salmonella*. None of the samples obtained from the carcasses after the full complement of interventions and none of the air samples were positive for *Salmonella*. Genetic analysis indicated the strain isolated from ground beef were the same as the strains isolated from hides and from carcasses immediately after hide removal. The *Salmonella* isolates from trim samples and lymph nodes also had the same genetic pattern. These results indicated that hide and lymph nodes are the most likely sources of *Salmonella* in ground beef. Dressing practices that effectively reduce or eliminate the transfer of bacteria from hide to carcass and elimination of lymph nodes as a component of raw ground beef should be considered as measures to reduce *Salmonella* contamination of ground beef. <http://www.ingentaconnect.com/content/iafp/jfp/2012/00000075/00000008/art00013>

SURFACE DISINFECTION

Impact of cleaning and disinfection on bacterial loads of food-contact surfaces

French researchers assessed the impact of industrial cleaning and disinfection on three cell measurements: CFUs, viable (culturable and viable but non-culturable) cells and on total cells (viable and dead cells). Bacterial loads on polyvinyl chloride (PVC) and stainless steel (SS) surfaces in a cutting room at a beef processing plant were determined before and after cleaning by real-time PCR and total viable counts(TVC) to quantify cells from successive

swabs from surfaces. Agar contact plates were also applied after cleaning for comparison. Before cleaning, total cells (viable and dead) reached 5.4 and 4.7 log cells/cm², viable cells 4.0 and 4.4 log cells/cm² and CFUs 3.1 and 2.9 log CFU/cm² on PVC and SS surfaces, respectively. Cleaning and disinfection was found to leave surfaces visually clean, it did not lead to a reduction in total cells. Reductions were only observed on PVC for CFUs (0.8 log) and on SS surfaces for viable cells and CFUs (0.8 and 1.5 log, respectively). The results indicate that CFUs were both more easily detached and killed on SS surfaces than on PVC surfaces. Other conclusions the researchers found were: a single swabbing detached only between 2 and 27% of the bacterial load; after cleaning and disinfection, the difference between the culturable population and the one assessed by agar contact plates was 1.9 and 2.7 log CFU/cm² on PVC and SS, respectively.

<http://www.sciencedirect.com/science/article/pii/S0168160512003777>

REGULATORY NEWS

Specifications for epidemiological indicators to be covered by meat inspection in Europe

In this European Food Safety Authority (EFSA) report, harmonised epidemiological indicators are proposed for food-borne biological hazards to public health that are related to poultry and meat and that can be addressed within meat inspection. These hazards include *Salmonella*, *Campylobacter* and extended-spectrum/AmpC beta-lactamase (ESBL) producing *E. coli* as well as generic *E. coli* as an indicator for process hygiene. It was expected that the indicators will be used in the integrated food safety assurance system for poultry meat, particularly to help categorise farms/flock and slaughterhouses according to the risk related to the hazards and process

hygiene as well as setting appropriate targets. The proposed indicators should be regularly reviewed in light of new information and the data generated by their implementation.

http://www.efsa.europa.eu/en/efsajournal/pub/2764.htm?WT.mc_id=RSS&emt=1

© Meat & Livestock Australia ABN: 39 081 678 364

Care is taken to ensure the accuracy of information in the publication. However, MLA cannot accept responsibility for the accuracy and completeness of the information or opinions contained in the publication. Readers should rely on their own enquiries in making decisions concerning their interests.

Reproduction in whole or in part of this publication is prohibited without the prior written consent of MLA.

Produced by the [Food Safety Centre](#) for Meat & Livestock Australia

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