

## 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

### LACTIC ACID WASH

#### Survival of *E. coli* O157:H7 on beef treated with 2% or 5% lactic acid

The aim of this American study was to investigate the effects of lactic acid sprays on acid-tolerant *E. coli* O157:H7 and *E. coli* on beef surfaces, slices of beef with cut muscle, fat and membrane surfaces. The surfaces were inoculated with a five strain cocktail of acid-adapted *E. coli* O157:H7, or with a non-acid-adapted strain of *E. coli*, at 5 and 1 log CFU/cm<sup>2</sup>. Inoculated slices were sprayed with water, 2% or 5% lactic acid at 0.5 ml/cm<sup>2</sup>, and compared to non-sprayed slices. Each acid treatment gave similar reductions in the number of *E. coli* or *E. coli* O157:H7. However, reductions were somewhat greater with 5% than with 2% lactic acid. The findings indicated that the *E. coli* or *E. coli* O157:H7 that survived acid treatments of meat surfaces were protected from exposure to injurious concentrations of undissociated acid. Consequently, both types of strains of *E. coli* would be inactivated similarly by solutions of lactic acid applied to beef surfaces.

<http://www.sciencedirect.com/science/article/pii/S095671351300159X>

### PROCESS AND PACKING TREATMENTS

#### Effect of MAP gas headspace/meat ratio on shelf-life

Irish researchers tested whether varying the gas headspace-to-meat ratio affected the quality and shelf-life of beef steaks packaged in high oxygen-modified atmosphere packs (MAP). Beef steaks were stored in MAP (80% O<sub>2</sub>:20% CO<sub>2</sub>) with gas headspace/meat ratios of 2:1, 1:1 and 0.5:1 for 14 days at 4°C. The pH, surface colour, texture and microbiology of beef steaks were not different with different gas ratios. Lipid oxidation (TBARS) positively correlated with days 10 and 14 of storage. Chemical and sensory detection of lipid oxidation in beef steaks were similar after day-14 of storage. The sensory quality and acceptability of beef steaks was similar in gas headspace to meat ratios of 2:1 or 1:1 and unacceptable in 0.5:1. Hence, results indicate that pack size and gas volume can be reduced to a point without negatively affecting fresh beef quality and shelf-

life. <http://www.sciencedirect.com/science/article/pii/S0309174013001101>

### **Effect of additives and packaging on *Clostridium perfringens* spores**

American researchers tested the effect of nitrite and erythorbate on *Clostridium perfringens* spore germination and outgrowth in ham during abusive cooling (15 hours). NaNO<sub>2</sub> (0, 50, 100, 150 or 200 ppm) and sodium erythorbate (0 or 547 ppm) were added to ground pork samples. Ten grams of meat (stored at 5 °C for 3 or 24 hours after preparation) were transferred to a vacuum bag and inoculated with a three-strain *C. perfringens* spore cocktail to obtain an inoculum of approximately 2.5 log spores/g. The bags were vacuum-sealed or aerobically stored, and the meat was heat-treated (control) (75 °C, 20 min) or abusively cooled within 15 h from 54 to 7 °C. The control ham samples stored for 3 and 24 hours resulted in *C. perfringens* population increases of 1.46 and 4.20 log CFU/g, respectively. All nitrite samples inhibited *C. perfringens*. For the 3 h samples that contained low NaNO<sub>2</sub> concentrations (50 ppm), the addition of sodium erythorbate reversed inhibition of *C. perfringens*, as populations of 5.2 and 2.8 log CFU/g were observed with or without sodium erythorbate, respectively. Anaerobic packaging increased *C. perfringens* growth in both 3 and 24 hour stored samples. The results indicate that for meat processing additives and their concentrations, storage time subsequent to preparation of meat (oxygen content) can negatively and positively affect *C. perfringens* spore germination and outgrowth during abusive cooling of ham. <http://www.sciencedirect.com/science/article/pii/S0740002013000312>

### **Use of pulsed light on ready-to-eat cured meat products**

Spanish researchers tested pulsed light (PL) for its efficacy to reduce *Listeria monocytogenes* and *Salmonella enterica* Typhimurium on the surface of two ready-to-eat (RTE) dry cured meat products (salchichón and loin). Maximum log reductions between 1.5 and 1.8 CFU/cm<sup>2</sup> were obtained for both microorganisms when a flux of 11.9 Joules/cm<sup>2</sup> was applied. Slight differences in the colour parameters were observed in both products. In salchichón, no changes in the sensory analysis were detected either immediately after treatment or during 30 days of storage. Sensory panellists perceived some changes in the quality of loin immediately after treatment, but these differences disappeared over the storage period. The results indicate PL could be considered as a useful alternative to other non-thermal techniques for increasing the safety of RTE dry cured meat products. <http://www.sciencedirect.com/science/article/pii/S0956713513000376>

## **BACTERIA LTRANSFER**

### **Transfer of *E. coli* O157, O26, O111, O103 and O145 from fleece to carcass**

The purpose of this Irish study was to investigate the transfer of *E. coli* (VTEC) O157, O26, O111, O103 and O145 from fleece to dressed carcasses of 500 sheep. Individual sheep were sampled throughout the slaughter process. Samples were tested for the presence of verotoxin (vt1 and vt2)

genes using PCR and positive samples were further screened for the presence of the five serogroups O157, O26, O111, O103 and O145. Isolates were screened for virulence genes (vt1, vt2, eaeA and hlyA) by PCR and isolates carrying vt genes were examined further. VTEC O26 was recovered from 5/500 (1.0%) fleece and 2/500 (0.4%) carcass samples. VTEC O157 was isolated from 4/500 (0.8%) fleece samples and 3/500 (0.6%) carcass samples. *E. coli* O103 was recovered from 84/500 (16.8%) fleece and 68/500 (13.6%) carcasses, but only one *E. coli* O103 isolate (0.2%) carried vt genes. *E. coli* O145 was recovered from one fleece sample, but did not carry vt genes. *E. coli* O111 was not detected in any samples. For the four serogroups recovered, the direct transfer from fleece to carcass was not observed, indicating that VTEC O26 isolates from a matched fleece/carcass "pair" were not identical. This study shows that while VTEC O157 were being carried by sheep presented for slaughter, other potentially significant verotoxin producing strains emerged.

<http://www.sciencedirect.com/science/article/pii/S0740002012002584>

### ***E. coli* O157:H7 in primals treated under commercial conditions**

American researchers evaluated the effect of commercial times and temperatures for searing, cooking, and holding on the destruction of *E. coli* O157:H7 within mechanically tenderized prime rib. Primals were inoculated with approximately 5.7 log CFU/g of a 5-strain cocktail and then passed once through a mechanical tenderizer. The primal was then seared (260°C for 15 min) in a conventional oven and cooked in a commercial convection oven at 121°C to a range of internal temperatures (38, 49,

60, and 71°C) before being held at 60°C for up to 8 hours. After searing, pathogen levels decreased by 1 log CFU/g.

Following cooking to internal temperatures of 38 to 71°C, pathogen levels decreased by an additional 2.7 to 4.0 log CFU/g. After cooking to 38, 49, or 60°C and then holding at 60°C for 2 hours, pathogen levels increased by 0.2 to 0.7 log CFU/g. However, for primals cooked to 38°C, pathogen levels remained relatively unchanged over the next 6 hours of holding, whereas for those cooked to 49 or 60°C, pathogen levels decreased by 0.3 to 0.7 log CFU/g over the next 6 hours of holding. In contrast, after cooking primals to 71°C and holding for up to 8 hours at 60°C, levels decreased by an additional 0.5 log CFU/g. The results demonstrated that to achieve a 5.0-log reduction of *E. coli* O157:H7 in blade tenderized prime rib, it would have to be seared at 260°C for 15 min, cooked to internal temperatures of 49, 60, or 71°C, and then held at 60°C for at least 8

hours. <http://www.ingentaconnect.com/content/iafp/jfp/2013/00000076/00000003/art00004>

## **TRACING PATHOGENS**

### **Strains of *Listeria monocytogenes* that cause ruminant encephalitis and their relatedness to human strains**

This study investigated the role of ruminants in the epidemiology of listeriosis in northern Italy and the possible association of animal-adapted strains of *Listeria monocytogenes* with strains associated with human disease. Twenty ruminant encephalitis isolates previously confirmed as *L. monocytogenes* were characterised by

serotyping, multi-virulence-locus sequence typing (MVLST), and multiplex single nucleotide polymorphisms (mSNP) for the detection of epidemic clones. Subtyping results were subsequently compared with those obtained from human, food and environmental isolates of *L. monocytogenes*, including 311 isolates from the University of Turin and 165 isolates representing major human listeriosis outbreaks worldwide. Both typing methods showed that 60% of the isolates analysed belonged to epidemic clone I (ECI), which has been linked to several human outbreaks of listeriosis, in particular, the 1981 Canada outbreak traced to manure and the 1985 California outbreak traced to raw milk. The results support the hypothesis that ruminants represent possible natural reservoirs of *L. monocytogenes* strains capable of causing epidemics of listeriosis in humans. <http://aem.asm.org/content/79/9/3059.abstract?etoc>

### **Faeces-associated microbial source tracking**

This Australian study evaluated the host specificity and host sensitivity of two bovine faeces-associated bacterial (BacCow-UCD and cowM3) and one viral [bovine adenovirus (B-AVs)] microbial source tracking (MST) markers by screening 130 faecal and wastewater samples from 10 target and non-target hosts. In addition, 36 water samples were collected from a reservoir and tested for the occurrence of all three bovine faeces-associated markers along with faecal indicator bacteria, *Campylobacter* spp., *E. coli* O157, and *Salmonella* spp. The overall host specificity values of the BacCow-UCD, cowM3, and B-AVs markers to differentiate between bovine and other non-target host groups were 0.66, 0.88, and 1.00, respectively (closer to 1.00 =

greater specificity). The overall host sensitivity values of these markers, in composite bovine wastewater and individual bovine faecal DNA samples were 0.93, 0.90, and 0.60, respectively. Among the 36 water samples tested, 56%, 22%, and 6% samples were positive for the BacCow-UCD, cowM3, and B-AVs markers, respectively. Among the 36 samples tested, 50% and 14% samples were positive for *Campylobacter* spp. and *E. coli* O157, respectively. The results imply that multiple bovine faeces-associated markers could be used to track bovine faecal pollution. The presence of the multiple bovine faeces-associated markers along with the presence of potential zoonotic pathogens indicates bovine faecal pollution in the reservoir water samples. <http://aem.asm.org/content/79/8/2682.abstract?etoc>

## **PATHOGEN ATTACHMENT TO CARCASSES**

### **Cultured cell lines as a model for assessment of bacterial attachment**

The mechanisms of bacterial attachment to meat tissues need to be understood to enhance meat safety interventions. In this Australian study, attachment of six *E. coli* and two *Salmonella* strains to primary bovine muscle cells and a cultured muscle cell line, was measured. The effect of temperature was also tested. At 37 °C, all but one strain (*E. coli*) attached to cultured cells, whereas only five of eight strains attached to primary cells. At 10 °C, two strains attached to cultured cells, compared to four strains of primary cells. Comparing all strains at both temperatures, one *E. coli* strain displayed the highest attachment to cultured cells

(4.6 CFU/muscle cell at 37 °C), whereas greater numbers a *Salmonella* strain attached per primary cells (51 CFU/muscle cell at 37 °C). This study indicated that primary bovine muscle cells may provide a more relevant model system to study bacterial attachment to beef carcasses compared to cell lines at relevant storage temperatures. <http://www.sciencedirect.com/science/article/pii/S0309174013000417>

## ANTIBIOTIC RESISTANCE

### Prevalence of antibiotics resistant-*E. coli* on dairy and beef farms

This study assessed the prevalence of extended-spectrum  $\beta$ -lactamase (ESBL)-producing *E. coli* in dairy cows and beef cattle in the southern part of Bavaria, Germany. Faecal samples, boot swabs and dust samples were taken from 30 mixed dairy and beef cattle farms and 15 beef cattle farms. Polymerase chain reaction (PCR) was performed to screen for two groups (CTX-M and ampC) of resistance genes. A total of 598 samples yielded 196 (32.8%) that contained ESBL-producing *E. coli*, originating from 39 (86.7%) of 45 farms. Mixed farms were more likely to have ESBL-producing *E. coli* positive than samples from beef only farms. A total of 183 isolates (93.4%) of 196 ESBL-producing *E. coli*-positive strains had CTX-M genes, CTX-M group 1 being

the most frequently found group. Forty-six isolates contained ampC genes. The study shows that ESBL-producing *E. coli* strains are commonly found on Bavarian dairy and beef cattle farms.

<http://aem.asm.org/content/79/9/3027.abstract?etoc>

## pH AND MEAT FREEZING POINT

### The initial freezing point temperature of beef increases with pH

This New Zealand study tested the hypothesis that the initial freezing point temperature of meat may be affected by pH. Sixty four *M. longissimus dorsi* were classified into two pH groups: low (< 5.8) and high pH (> 6.2) and their cooling and freezing point temperatures measured at each pH group. The initial freezing temperatures ranged from -0.9 to -1.5 °C with the higher and lower temperatures correlating with high and low pH, respectively. Therefore, high pH meat may be associated with freezing (ice formation) in a container load of valuable chilled product that may be downgraded to a lower value frozen product. <http://www.sciencedirect.com/science/article/pii/S0309174013000089>



## DIET EFFECTS ON MICROBIAL DIVERSITY

### Changes in rumen bacterial diversity as affected by diet

Little is known about the dynamics of bacterial species on the rumen surface (epimural) in cattle fed different diets. Using DNA techniques, Canadian researchers studied the epimural bacterial communities of 8 cattle during transition from forage to a high grain diet, during acidosis and after recovery. Bacterial community composition was found to differ by diet. During acidosis, several genera of bacteria increased, such as, *Atopobium*, *Desulfocurvus*, *Fervidicola*, while others, *Lactobacillus*, *Olsenella* and *Succinivibrio* reverted to levels similar to the high grain diet. The relative abundance of bacterial populations changed during diet transition except for *Streptococcus* spp. Bacterial community structure of epimural populations differed with changes being most prominent between mixed forage versus grain, acidotic challenge and recovery diets. Determining the metabolic roles of these key genera in the rumen of cattle fed high grain diets could help define a clinical microbial profile associated with ruminal acidosis.

<http://aem.asm.org/content/early/2013/04/08/AEM.03983-12.abstract?etoc>

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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](mailto:ijenson@mla.com.au)



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