

## 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 O-SEROGROUPS IDENTIFICATION METHODS**

#### **Application of a PCR-based system for monitoring of O-serogroup Shiga toxin-producing *E. coli* in cattle**

Swiss researchers collected faecal samples from 573 slaughtered cattle, aged three and 24 months, in seven abattoirs. Samples were screened by real-time PCR first for *stx* (Shiga toxin gene) and if positive, tested for the top-five Shiga toxin-producing *E. coli* (STEC) serogroups using PCR assays targeting genes specific for serogroups O26, O103, O111, O145 and O157. The results showed 74.1% isolates tested positive for *stx* genes. The serogroups O145, O103, O26, O157 and O111 were detected in 41.9%, 25.9%, 23.9%, 7.8% and 0.8%, respectively. The researchers concluded shiga toxin genes and the top-five STEC serogroups were frequently found in young Swiss cattle at slaughter, but that successful strain isolation rates were low, and that only a few strains showed the virulence pattern of human pathogenic STEC. <http://onlinelibrary.wiley.com/doi/10.1111/j.1863-2378.2012.01468.x/abstract>

#### **Rapid detection of *E. coli* O-serogroups in ground beef and beef trim**

In this USA study, O serogroup-specific genes (*wzx* or *wzy*) were used to design loop-mediated isothermal amplification (LAMP) assays for the rapid and specific detection of leading STEC serogroups (O26, O45, O103,

O111, O121, O145, and O157). LAMP is a simple, cost effective and rapid DNA amplification technique. Reactions only need to be heated to one temperature to amplify the DNA, unlike conventional PCR that requires many cycles at different temperatures. The assays were evaluated in pure culture and spiked food samples (ground beef, beef trim, lettuce, and spinach). 120 bacterial strains were used to evaluate assay specificity. The limits of detection for these STEC strains were approximately 1 to 20 CFU/reaction in pure culture and approximately 104 CFU/g in spiked food samples. The calculated standard curves indicated good linear relationships between STEC cell numbers and LAMP turbidity. In beef and produce samples spiked with low levels (1 to 2 and 10 to 20 CFU/25 g) of respective STEC strains, the LAMP assays consistently achieved accurate detection after 6-8 hours of enrichment. <http://aem.asm.org/content/early/2012/02/07/AEM.07975-11.short?rss=1>

### **MEAT TECHNOLOGIES**

#### **Research shows that LED lights may extend meat shelf-life**

USA researchers compared the use of LED and fluorescent lights in meat refrigeration units, examining five different meat products: pork loin chops, beef loin steaks, ground beef, ground turkey and beef inside round steaks. Discolouration and rancidity of these meat products and operating efficiency of the refrigeration units were monitored. The researchers found that LED lights scored

positively in nearly all areas, reducing operating costs and prolonging the shelf-life of most meat products. These products had colder internal product temperature that helped extend shelf-life. With respect to operational costs, LED lights had fewer cycles per running hour, meaning greater efficiency than fluorescent lights.

[http://www.eurekalert.org/pub\\_releases/2012-01/ksu-as011712.php](http://www.eurekalert.org/pub_releases/2012-01/ksu-as011712.php)

### **Efficacy of low-voltage AC for inactivating surface-adherent *E. coli* O157:H7**

Researchers in the USA conducted experiments using low-voltage alternating current (AC) to inactivate surface-adherent *E. coli* O157:H7 on beef samples. Meat samples (25cm<sup>3</sup>) were inoculated with *E. coli* and placed in NaCl solution that served as an electrolyte. Electrical current was applied to the samples at frequencies of 1, 10, and 100 kHz and current intensities of 300 mA (15 mA/cm<sup>2</sup>), 600 mA (30 mA/cm<sup>2</sup>) and 900 mA (45 mA/cm<sup>2</sup>) at treatment durations of 2, 8, and 16 min. The greatest pathogen reduction (2.15 log) was achieved using a 16 min treatment time with 900 mA (45 mA/cm<sup>2</sup>) current intensity and 1 kHz frequency. [http://www.inderscience.com/search/index.php?action=record&rec\\_id=44624&prevQuery=&ps=10&m=or](http://www.inderscience.com/search/index.php?action=record&rec_id=44624&prevQuery=&ps=10&m=or)

### **Thermal inactivation of *E. coli* O157:H7 at different depths of non-intact blade-tenderized beef steaks**

This USA study evaluated thermal inactivation of *E. coli* O157:H7 inoculated at different depths in simulated blade-tenderized non-intact steaks. Steaks were blade-tenderized and then inoculated with an 8 strain mixture of rifampicin-resistant *E. coli* O157:H7 on the surface or between slices, vacuum-packaged, and stored at 4 or –20°C for 5 days before cooking. In steaks inoculated on external surfaces and cooked by pan-broiling, greater pathogen survivors recovered from thinner (1.2 cm) than thicker (2.4 cm) steaks. Cooking steaks from a frozen state or after thawing did

not affect pathogen inactivation. Survivors after pan-broiling of 2.4 cm thick steaks increased with depth, from 0.3 to 1.3 log CFU/cm<sup>2</sup> for surface-inoculated steaks to 2.5 to 3.2 log CFU/cm<sup>2</sup> for samples inoculated at the centre. In comparison, overall thermal destruction of pathogens in steaks cooked by roasting was less, and survivor counts were generally not different at each depth of inoculation. <http://onlinelibrary.wiley.com/doi/10.1111/j.17503841.2011.02552.x/abstract>

### **Investigation of chemical rinses suitable for small meat plants**

USA researchers tested the bactericidal effectiveness eight antimicrobial compounds (acetic acid, citric acid, lactic acid, peroxyacetic acid, acidified sodium chlorite, chlorine dioxide, sodium hypochlorite, and aqueous ozone) at various concentrations with small, hand-held spraying equipment. Beef pieces were inoculated with a faecal slurry containing *E. coli* O157:H7, *Salmonella* Typhimurium, *Campylobacter coli* and *Campylobacter jejuni*, and natural bacterial populations. The results showed that relative antimicrobial effectiveness was, from greatest to least: organic acids, peroxyacetic acid, chlorinated compounds, and aqueous ozone. For example, a 2% lactic acid rinse provided 3.5- to 6.4-log CFU/cm<sup>2</sup> reductions across all bacterial populations studied. Conversely, aqueous ozone yielded 0.02- to 2.9-log CFU/cm<sup>2</sup> reductions in pathogens. <http://www.ingentaconnect.com/content/iafp/jfp/2012/00000075/00000001/art00004>

## **SPOILAGE POTENTIAL OF LACTIC ACID BACTERIA**

### **Spoilage potential of *Lactococcus piscium* from modified atmosphere packaged meat**

Finnish researcher's isolated 222 psychrotrophic lactococci from modified atmosphere packaged (MAP) meat. The majority of the isolates (n = 215) were identified as *Lactococcus piscium*, while seven isolates

belonged to *Lactococcus raffinolactis*. *Lactococcus piscium* adapted to growing in a variety of MAP meat products including broiler, turkey, pork, and minced meat from beef and pork and were the dominant flora at the end of product shelf-life. The spoilage potential of *L. piscium* was evaluated by inoculating MAP pork with a sub-population of the 222 isolates and storing product at 6°C for 22 days. The sensory shelf-life of pork inoculated with *L. piscium* was shortened compared to the uninoculated control. *Leuconostoc* spp. counts, present as initial contaminants in the samples, also increased. These results indicated that *L. piscium* was not inhibited by other lactic acid bacteria or conversely have any inhibition effects themselves.

<http://www.sciencedirect.com/science/article/pii/S0168160512001195>

## EFFECT OF FEED ON FAECAL BACTERIAL COMMUNITY

### Influence of wet distillers grains diets on beef cattle faecal bacterial community

Researchers from the USA tested five diets consisting of a traditional diet fed to finishing beef cattle; CON (steam-flaked corn control with 0% distillers grains (DG)), and four concentrations of DG in the dietary dry matter; 10C (10% corn-based DG), 5S (5% sorghum-based DG), 10S (10% sorghum DG), and 15S (15% sorghum DG) were fed to the steers. Diets were essentially isonitrogenous with a formulated crude protein value of 13.5%. A next generation DNA sequencing method was used on faecal samples to generate over 100,000 bacterial sequences. A total of 24 phyla were observed, distributed amongst all beef cattle on all diets, revealing considerable animal to animal variation, however only six phyla were observed in all animals regardless of dietary treatment. The results indicated feeding DG-based diets to cattle resulted in significant shifts in the faecal microbial community structure compared with the traditional diet.

<http://www.biomedcentral.com/1471-2180/12/25/abstract>

## GENE EXPRESSION ANALYSIS

### Stress-induced genes regulation in persistent and non-persistent *Listeria monocytogenes* strains

USA researchers selected six persistent and six non-persistent *Listeria monocytogenes* strains from fish processing plants and one persistent strain from a meat plant to determine if expression of genes in two regulons (group of genes regulated by the same regulatory response) under salt stress conditions is associated with the ability of *L. monocytogenes* to persist in food processing environments. Quantitative reverse transcriptase–polymerase chain reaction was used to measure expression levels for four genes, before and after (10 mins) salt shock treatment. Exposure to salt stress induced higher expression levels relative to levels under non-stress conditions for all four genes across all strains tested. Statistical analysis revealed that levels for one gene were induced at significantly higher levels in non-persistent strains compared to persistent strains. However, no clear overall association between stress gene expression levels and persistence was detected. These data support an emerging model that proposes that establishment of *L. monocytogenes* persistence in a processing environment occurs as a random event, rather than as a consequence of specific bacterial strain characteristics.

<http://www.liebertonline.com/doi/abs/10.1089/fpd.2011.1000>

### High temperature and UV irradiation enhances transfer of shiga toxin genes in *E. coli*

USA researchers hypothesized that strong UV radiation in combination with high temperature accelerates shiga toxin genes (*stx*) transfer into non-pathogenic *E. coli* in feedlots. An *E. coli* O157:H7 strain was subjected to different UV irradiation (0 or 0.5 kJ/m<sup>2</sup>)

combination with different temperature (22, 28, 30, 32, and 37°C) treatments and the induction of *stx2* prophages (viral DNA that gets incorporated into the bacterial genome) was assayed by quantitative real-time PCR. Results showed that prophages in *E. coli* O157:H7, including those carrying *stx2*, were activated under UV radiation and enhanced by elevated temperature. Colony screening indicated that these activated *stx2* prophages were capable of converting a laboratory strain of *E. coli* K12 into new shiga toxigenic *E. coli*. Cattle feedlot sludge can have high numbers of *E. coli* O157:H7 and non-pathogenic *E. coli*, and is frequently exposed to UV radiation via sunlight, which may contribute to the rapid spread of these genes to non-pathogenic *E. coli* and diversity of shiga toxin producing *E. coli*.

[http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0031308?utm\\_source=feedburner&utm\\_medium=feed&utm\\_campaign=Feed%3A+plosone%2FMicrobiology+%28PLoS+ONE+Alerts%3A+Microbiology%29](http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0031308?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+plosone%2FMicrobiology+%28PLoS+ONE+Alerts%3A+Microbiology%29)

## PROCESSING AND TECHNOLOGY REVIEWS

### A death-time study on processed meat products

This research tested ready-to-eat (RTE) meat products, consumed directly or after warming, as a source for the transmission of *Listeria monocytogenes*. The appropriate application of heat treatments is an essential issue for RTE food processors. However, quantitative data on thermal inactivation of pathogenic and spoilage microorganisms is difficult in these meat products because of the particularities of the formulations, the variability of heat resistance among bacterial strains and heating procedures. Therefore, the heat resistance parameters (D and z values) of *L. monocytogenes*, *Lactobacillus delbrueckii* and accompanying microflora in meat slurry were

established in order to provide more accurate F values (number of minutes required to kill a known population of microorganisms) and improve operation conditions. Results showed *L. delbrueckii* had the largest z value (temperature raised 9.3°C the processing time is cut by 1 log cycle) and adjusted F values of 2.4 and 3.8 min could reduce bacterial counts in hot dogs and cured coarse sausages to a safe level.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1745-4549.2011.00627.x/abstract>

### Application of modified atmosphere packaging and active technologies to red meat and poultry: a review

This paper reviews the current advances in modified atmosphere packaging (MAP) of red meat and poultry products. MAP packaging results in shelf-life prolongation by inhibiting microbial growth and promoting oxidative stability, compared to foods packaged aerobically. The authors discuss the various combinations of O<sub>2</sub> or CO<sub>2</sub> and their limitations and benefits. The use of CO also gives promising results due to its positive effects on colour and microorganism growth inhibitions which result in shelf-life prolongation during wider distribution of case-ready products. Also, the authors consider the area of active and intelligent/smart packaging. These relatively new technologies have shown positive results regarding product safety and shelf-life prolongation as well as communicating information on several quality characteristics of packaged food during transportation and storage. <http://www.springerlink.com/content/x67372420p103164/>

### Intervention technologies for ensuring microbiological safety of meat: a review

Some promising non-thermal and thermal technologies, such as chemical and biological interventions, high hydrostatic pressure (HHP), irradiation, active packaging, natural antimicrobials and microwave, radiofrequency and steam pasteurization are reviewed. The authors illustrate that these alternative



technologies are designed to be mild, energy-conserving and environmentally friendly, while maintaining the natural appearance and flavour of food, and eliminating pathogens and spoilage microorganisms. Combinations of these technologies, as in hurdle theory, may improve their effectiveness for decontamination meats and meat products.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1541-4337.2011.00177.x/full>

## REGULATORY NEWS

### **FSIS notice: Collecting supplier information**

This USA FSIS notice revises previous directions in order to clarify the type of information to collect from source product, to change from the term “supplier” to “grinder” in the instructions and to clarify information to be collected from the containers of meat product purchased from a broker or distributor. This notice also instructs Inspection Program Personnel (IPP) to record information about source materials and about the suppliers at the time they sample ground beef or bench trim for *E. coli* O157:H7. These instructions are part of FSIS’s goal of responding to presumptive positive results by identifying all affected

product and potential suppliers as quickly as possible to protect public health.

<http://www.fsis.usda.gov/OPPDE/rdad/FSISNotices/80-11.pdf>

### **FSA to publish UK meat plants audit reports**

The Food Standards Agency in the UK has started the regular publication of audit reports of approved meat plants in England, Scotland and Wales. This is the beginning of routine publication of these reports, and will be issued at the end of each month (about 200 each month). FSA approval is required before a meat plant can operate (such as slaughterhouses, cutting plants and game handling establishments). The FSA is currently reviewing audit arrangements with the aim of making them easier to understand, both for the food business operator and for people not involved in the meat industry. Once this review is complete, the FSA will publish audits for all approved meat plants across the UK, including Northern

Ireland. <http://www.foodingredientsfirst.com/news/FSA-Publishes-Meat-Plants-Audit-Reports.html>

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