

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

PATHOGEN TRANSMISSION

Cross-contamination routes of *L. monocytogenes* in a meat processing facility

The aim of this Romanian study was to determine the putative routes of cross-contamination of *L. monocytogenes* in a meat processing facility and the factors that contribute to its prevalence and persistence. A total of 226 samples covering the entire food processing environment; area for processing raw materials, area for food processing, delivery of unheated meat products & portioning, packaging & distribution of ready to eat (RTE) meat products were collected on four occasions within a year. The sampling focussed on non-food contact surfaces (NFCS), food contact surfaces (FCS), raw materials and RTE meat products.

Authors observed the highest prevalence of *L. monocytogenes* positive samples for raw materials (45%) followed by FCS (32.9%), RTE meat products (20%), and NFCS (19.7%). Significant differences were observed in prevalence between the FCS and NFCS samples and between the raw material and RTE food samples. Pulsed-field gel electrophoresis profiles identified 11 distinct pulsotypes of *L. monocytogenes* possessing diverse capacities for adhesion and biofilm formation, two of which were frequently isolated and considered persistent. Further,

cross-contamination hotspots and factors promoting these were identified by mapping the persistent and other isolates. The present study provides essential information regarding the need to understand cross-contamination routes of *L. monocytogenes*, to improve hygiene measures in production facilities and prevention of contamination of RTE meat products.

<http://www.ingentaconnect.com/content/iaf/p/jfp/2015/00000078/00000009/art00006>

Supershedders and the transmission of *E. coli* O157:H7 among feedlot cattle

This UK study investigated a formal relationship between *E. coli* O157:H7 shedding and transmission, role of supershedders in the maintenance of infection in a cattle population and an appropriate definition of 'supershedding'. A total of 20 pens of eight steers were sampled twice weekly over a 13 week grain feeding period in small non-adjacent research pens located on a working commercial feedlot with over 10 000 animals on the premises. Sampling consisted of recto-anal mucosal swab (RAMS) and samples of freshly passed manure. The key findings of this study were that (i) supershedding individuals appeared to pose around double the risk of transmission resulting in colonization, as compared to low shedding individuals; (ii) a data-driven estimate for the definition of

a supershedding threshold was 3 log₁₀ cfu/g faeces; and (iii) there was no evidence of environmental transmission occurring over timescales longer than 2 days. Study also emphasised the importance of reducing animal density to reduce within-pen transmission of *E. coli* O157:H7 in feedlot settings.

<http://rsif.royalsocietypublishing.org/content/t/12/110/20150446>

SALMONELLA

***Salmonella* prevalence in the peripheral lymph nodes of different cattle breeds**

Previous research has reported a significant variation in the prevalence of *Salmonella* in peripheral lymph nodes (LNs) of feedlot cattle and cull cows, with greater prevalence in feedlot cattle. To this end, a group of USA researcher investigated whether these differences in *Salmonella* prevalence in peripheral LNs are due to, or influenced by, breed. Peripheral LNs were collected from Holstein (i.e., dairy cows; n=467) and beef (n=462) cattle originating from the same feedlot and harvested on the same day. Of these cattle, 62.1% of Holstein and 59.7% of beef cattle samples contained *Salmonella*, with 51.2 and 48.9% of samples containing quantifiable concentrations, respectively. The concentration of *Salmonella* within the LNs appeared to decrease over the collection period (5 months). These results indicated that the differences in *Salmonella* prevalence observed are not due to breed, but are likely a function of age, immune function, or other factors yet to be identified. Understanding which cattle are more likely to harbor *Salmonella* within their LNs will aid in developing both pre- and postharvest intervention strategies

that could be used to minimise the public-health risks associated with *Salmonella*.

<http://www.ingentaconnect.com/content/iafp/jfp/2015/00000078/00000011/art00020?token=004612526e5c5f3b3b47465276663b6f7049795942404f582a2f4876753375686f4903>

INTERVENTION

Effects of antimicrobial interventions on pathogens on beef products

A group of USA researchers evaluated the efficacy of chemical antimicrobials for controlling *E. coli* O157:H7 and *Salmonella* during production of marinated non-intact beef products. In this study, boneless beef strip loins were inoculated with either approximately 5.8 or 1.9 log CFU/cm² (i.e., high and low inoculation levels, respectively) of *E. coli* and *Salmonella*. Inoculated samples were chilled at 2°C for 24 h, vacuum packaged, and aged for 7 to 24 days at 2°C. After aging, all samples were subjected to no treatment (control) or one of five antimicrobial spray treatments: 2.5% L-lactic acid (pH 2.6, applied at 53°C), 5.0% L-lactic acid (pH 2.4, at 53°C), 1,050 ppm of acidified sodium chlorite (pH 2.8, at 18°C), 205 ppm of peroxyacetic acid (pH 5.2, at 20°C), or tap water (pH 8.6, at 26°C). Treated and control samples were then vacuum tumbled in a commercial marinade and collected throughout the experiment to monitor changes in bacterial numbers. For high-inoculation strip loins, it was evident that the 5.0% L-lactic acid treatment was the most effective for reducing bacterial numbers on meat surfaces before marination, giving a 2.6-log mean reduction. Peroxyacetic acid treatment produced the greatest reduction of

surface-located bacteria in marinated product. Water treatment resulted in greater internalization of bacteria compared with the control. These results indicated that validated antimicrobial processes should be used to maximize microbial reduction and minimize internalization of surface bacteria into the finished product.

<http://www.ingentaconnect.com/search/article?option1=tka&value1=Effects+of+antimicrobial+interventions+on+E.+coli+O157%3aH7+and+Salmonella+on+beef+products&pageSize=10&index=1>

STEC

Inactivation of STEC within beef steaks following cooking

The aim of this USA study was to determine the minimum length of cooking that could achieve at least a 5.0-log reduction in STEC numbers within knitted/cubed beef steaks. Both sides of each beef cutlet (approximately 64 g; 8.5 cm length by 10.5 cm width by 0.75 cm height) were surface inoculated (approximately 6.6 log CFU/g) with a cocktail consisting of single strains from each of eight target serogroups of STEC: O26:H11, O45:H2, O103:H2, O104:H4, O111:H2, O121:H19, O145:NM, and O157:H7. Inoculated steaks were either passed once through a mechanical tenderizer and then passed one additional time through the tenderizer perpendicular to the orientation of the first pass (single cubed steak; SCS; approximately 0.6 cm thick), or passed once through a mechanical tenderizer, and then two tenderized cutlets were knitted together by passage concomitantly through the tenderizer two additional times perpendicular to the orientation of the

previous pass (double cubed steak; DCS; approximately 1.3 cm thick). Both SCS and DCS were then cooked for up to 3.5 min per side in 30 ml of extra virgin olive oil heated to 191.5°C on a hard-anodized aluminum non-stick griddle using a flat-surface electric ceramic hot plate. Changes in STEC numbers were determined before and after cooking. The results revealed that cooking SCS and DCS on a griddle set at 191.5°C for 0.5 to 2.5 min and 1.0 to 3.5 min per side, respectively, resulted in total reductions in pathogen levels of 1.0 to 6.8 log CFU/g. A 5.0-log reduction of STEC could be achieved by cooking SCS or DCS on a griddle heated at 191.5°C for at least 1.25 and 3.0 min per side, respectively. These results validate that cooking knitted or cubed steaks on a griddle for a certain period of time is effective for eliminating STEC that may be present at naturally low levels on the surface of raw beef and that may be distributed throughout the meat due to cubing.

<http://www.ingentaconnect.com/content/iafp/jfp/2015/00000078/00000005/art00021?token=00491502f52e86e5865462431426f576b5f4c7a3f6c25505e4e26634a492f25303329768b>

Use of genetically marked strains of STEC as tools for detection and modelling

The aim of this USA study was to construct positive control (PC) strains for the detection of STEC O157 and the six USDA-regulated non-O157 STEC (i.e., serogroups O26, O45, O103, O111, O121, and O145). The PC strains were constructed by integrating a unique DNA target sequence and a gene for antibiotic (i.e., spectinomycin) resistance into the chromosomes of the seven STEC strains.

End-point and real-time PCR assays were then developed for the specific detection of the PC strains and were tested against 93 strains of *E. coli* (38 STEC O157:H7, at least 6 strains of each of the USDA-regulated non-O157 STEC, and 2 commensal *E. coli*) and 51 strains of other bacteria (30 species from 20 genera). The results revealed that the PCR assay could be used to specifically detect the integrated target sequence of PC strains on multiple runs, indicating high specificity and stability of the target sequence. Furthermore, the PC strains were evaluated for their potential use in modelling the growth of STEC. It was found that plating the PC strains mixed with ground beef flora on modified rainbow agar containing antibiotic eliminated the growth of the background flora that grew on modified rainbow agar without Sp. Therefore, these PC strains have the potential for using as tools for detection and modelling the growth of STEC in the presence of foodborne background flora.

<http://www.ingentaconnect.com/content/iafp/jfp/2015/00000078/00000005/art00004?token=004511326275c277b42573a46217674252570512b45592f653b2a2d3a7c4e724770dd>

SHELF-LIFE MODELS

Shelf-life models based on dissolved CO₂ concentration in purge and microbial counts of VP pork

The objectives of this US study were to determine the dissolved CO₂ and O₂ concentrations in the purge of VP pork chops over a 60 day storage period at 4°C and to model the relationship of these dissolved gases to the product microbial populations and shelf-life. Results showed an overall increase in microbial population

with time; dominated with lactic acid bacteria, followed by *Enterobacteriaceae* and *Brochothrix thermosphacta*, causing changes in gaseous composition of the purge. An increase in dissolved CO₂ and decrease in O₂ concentration during storage was observed. Mathematical models were developed to estimate the microbial populations based on dissolved CO₂ concentration of the purge. These models provide a 'real-time' measurement of VP pork shelf-life. Study showed that rapid instrument measurements, such as dissolved CO₂ can be used to estimate microbial populations and thus product shelf-life.

<http://www.sciencedirect.com/science/article/pii/S0309174015300309>

LAB ENUMERATION

Adequacy of Petrifilm aerobic count plates for enumeration of lactic acid bacteria in VP salami

Researchers in this study compared alternative protocols for the enumeration of lactic acid bacteria (LAB) in salami. Fourteen pure cultures, two mixed starter cultures of LAB and natural LAB microbiota of VP salami samples were tested using six protocols: 1) Petrifilm™ aerobic count (AC) with MRS broth and chlorophenol red (CR), incubated under aerobiosis or 2) under anaerobiosis, 3) MRS agar with CR, 4) MRS agar with bromocresol purple, 5) MRS agar at pH 5.7, and 6) all-purpose Tween agar.

Further, selectivity of the protocols was assessed by molecular methods. No significant differences were observed among the tested protocols, independent of the period and incubation conditions ($P > 0.05$). Colonies from different media were confirmed as LAB by molecular

means. These results demonstrate the possibility of using Petrifilm aerobic count plates under aerobic conditions for shorter incubation period (24 h) for proper enumeration of LAB in VP salami.

<http://www.sciencedirect.com/science/article/pii/S0309174015300590>

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