

## 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

### INTERVENTIONS

#### Use of mild irradiation doses to control pathogens on meat trimmings

Researchers from Uruguay evaluated the efficacy of moderate doses of gamma irradiation in reducing pathogens without altering the quality attributes of bovine trimmings for production of patties. In this study, meat trimmings were inoculated with or without *L. monocytogenes* and *E. coli* O157:H7 before subjecting to 2, 2.5 or 5 kGy irradiation. Bacterial numbers, physicochemical indicators (pH, colour and tiobarbituric acid) and sensory changes were then determined periodically throughout storage. It was evident that numbers of *L.*

*monocytogenes* and *E. coli* O157:H7 were reduced by 2 and 5 log<sub>10</sub> CFU/g at doses less than 2.5 kGy, respectively. Irradiation doses of <5 kGy also appeared not to affect the quality of beef patties. These results highlight the potential use of mild irradiation doses to improve the safety of meat trimmings for production of patties.

<http://www.sciencedirect.com/science/article/pii/S0309174014002058>

#### Use of lactic acid and electron beam irradiation to control pathogens on beef

In this Canadian study, researchers determined whether pre-treatment of lactic acid could enhance

the antimicrobial action of e-beam irradiation of beef. Beef meats were inoculated with *Salmonella* or STEC cocktails. The inoculated samples were treated with 5% lactic acid at 55°C, and packaged aerobically or vacuum-packed. All samples were then subjected to 1 kGy e-beam energy and kept at 4 or -20°C for ≤5 days.

The results revealed that lactic acid enhanced the efficacy of 1 kGy e-beam treatment against *Salmonella* but not *E. coli* on refrigerated meat. *Salmonella* numbers were reduced by 2 and 3 log<sub>10</sub> CFU/g in the irradiated and lactic acid plus irradiated samples, respectively. Approximately 4.5 log<sub>10</sub> CFU/g reduction of STEC was observed in all cases. By contrast, lactic acid treatment appeared to improve e-beam efficacy against both STEC and *Salmonella* on frozen meat. The combination of lactic acid with irradiation caused 2.5 log<sub>10</sub> CFU/g of *Salmonella*, whereas only 1 log<sub>10</sub> CFU/g reduction of *Salmonella* was evident when treated with irradiation alone. Similarly, an average 2 log<sub>10</sub> CFU/g reduction of STEC was observed in the irradiated samples, and at least 3 log<sub>10</sub> CFU/g reductions of *E. coli* were noted in the samples treated with lactic acid and irradiation. These results indicate that although pre-treatment of lactic acid was of limited value with 1 kGy treatment for improving control of STEC on fresh beef, it has the potentials to be used effectively

for controlling both STEC and *Salmonella* on frozen meat.

<http://www.sciencedirect.com/science/article/pii/S0740002014001555>

### **Effectiveness of steam vacuum pasteurisation in reducing microbial contamination of carcasses**

Researchers from Norway assessed the effectiveness of steam vacuum pasteurisation in reducing microbial contamination of lamb carcasses. Steam vacuum pasteurisation was applied at a temperature of  $>82^{\circ}\text{C}$  for 10 second on lamb carcasses ( $n = 120$ ). Samples were taken immediately: i) after trimming just before the use of steam vacuum and ii) after use of steam vacuum. Microbiological analysis was then performed to determine *E. coli* numbers and total plate count. The results showed that *E. coli* numbers and total plate count were significantly reduced by 1.1 and 0.65 log units, respectively. These indicate that application of steam vacuum pasteurisation was effective in reducing *E. coli* numbers and the total viable count on carcasses when implemented after slaughtering and dressing.

<http://www.sciencedirect.com/science/article/pii/S0309174014002721>

### **Antimicrobial edible films and coatings for meat and meat products preservation**

This review discusses the effectiveness of antimicrobial edible films and coatings (EFC) and their potential application to enhance safety and quality of meat products. Composition and properties of different types of EFC (lipids, proteins and polysaccharides based) are described. The characteristics and mode of action of antimicrobial compounds (organic acids,

essential oils, plant extracts, bacteriocins, proteins, chitosan and lauric arginate), most commonly used in meat industry are detailed. Further, the advantage of incorporating these antimicrobial compounds into EFC as an alternative to their direct application to meat is discussed. The slow release of incorporated antimicrobial compounds might lead to reduction in their usages as well as reduced sensory changes. Authors further emphasized that though EFC are a worthy alternative to improve the quality and safety of diverse meat and meat products, the challenges remain such as the need to improve and standardize a single coating procedure according to industry requirements, thereby reducing costs and increase shelf life to meet customer demands without modifying sensory characteristics of meat products.

<http://www.ncbi.nlm.nih.gov/pubmed/25050387>

### **Pathogens reduction in sheep meat by zinc oxide nanoparticles and acetic acid**

The focus of this Iranian study was to determine the effect of different concentrations (0, 1, 2, 4, 6 and 8mM) of zinc oxide nanoparticles (ZnO NPs) and acetic acid (0.5, 1 and 2%) on the survival of *Listeria monocytogenes*, *Escherichia coli*, *Staphylococcus aureus* and *Bacillus cereus* inoculated onto culture media and raw sheep meat (stored at  $4^{\circ}\text{C}$  for 12 days). Significant reduction in pathogen growth was observed with 2% acetic acid as compared to control and 0.5 or 1%. Similar increase in growth inhibition with higher concentrations of ZnO NPs was also observed. Further, application of different concentrations of ZnO NPs suspensions containing 1% acetic acid

showed a significant inhibitory effect on the growth of *L. monocytogenes*, *E. coli* and *S. aureus* but no effect on *B. cereus* in broth culture. Among six concentrations of ZnO, 8mM was the most effective against *L.*

*monocytogenes*, *E. coli* and *S. aureus*, almost completely inhibiting their growth during 12h of incubation. Similarly, when sheep forequarters inoculated with *L. monocytogenes*, *E. coli* and *S. aureus* (7 log cfu/g) were treated with ZnO NPs (6 and 8mM) plus 1% acetic acid suspensions, higher concentration of ZnO NPs significantly decreased the population of *L. monocytogenes* (4.09 – 4.72 log cfu/g), *E. coli* (0.84 – 1.24 log cfu/g) and *S. aureus* (2.12 – 2.75 log cfu/g). This is the first report demonstrating the potential of these nanoparticles as antibacterial agents in meat industry.

<http://www.ingentaconnect.com/content/afp/jfp/2014/00000077/00000009/art00020>

### Occurrence of antilisterial bacteriocin genes in meat lactic acid bacteria

The aim of this study was to analyse the occurrence of bacteriocin encoding genes in 115 lactic acid bacterial strains (*Lactobacillus sakei*, *Lactobacillus curvatus*, *Lactobacillus plantarum*, *Enterococcus faecium* and *Pediococcus acidilactici*) isolated from Argentinean raw meat and meat fermented products as well as its correlation with antilisterial activity against four *Listeria monocytogenes* and one *L. innocua* 7 strains. The presence of bacteriocin encoding genes was evaluated by PCR.

Among LABs, *L. sakei*, *L. curvatus* and *E. faecium* showed great inhibition of all *Listeria* strains evaluated in this study, while *P. acidilactici* and *L. plantarum*

demonstrated a limited or no antilisterial activity. *L. monocytogenes* UC8159 was the most susceptible strain followed by *L. innocua* 7. Further, PCR analysis showed that out of 71 *L. sakei* strains only 24 had one or more bacteriocin encoding genes. Although, antilisterial activity was detected among *P. acidilactici*, no *pedA* (a bacteriocin encoding gene) was amplified from these strains suggesting the production of a novel antimicrobial compound. The bacteriocins producing meat borne LABs analysed in this study showed a great potential to be used as bioprotective cultures, thereby providing an additional hurdle for the control of *L. monocytogenes* in meat products.

<http://www.sciencedirect.com/science/article/pii/S0956713514003508>

## STEC ATTACHMENT TO MEAT SURFACES

### Effects of chilling on the attachment of STEC to beef surfaces

The focus of this American study was to investigate the effects of chilling on STEC attachment to beef surfaces, and the effects of post-inoculation storage on STEC recovery. Paired briskets from the split carcasses were used. One brisket was kept non-chilled, while the other was chilled to a surface temperature of  $\leq 5^{\circ}\text{C}$ . Both non-chilled and chilled briskets were then inoculated with a cocktail of eight STEC and stored at 5 or  $25^{\circ}\text{C}$ . At 0, 30, 60, 90 and 120 min post-inoculation, 30 cm<sup>2</sup> of tissue was excised and processed for selective enumeration of attached STEC. The results revealed that chilled briskets had significantly greater STEC attachment (4.0 log<sub>10</sub> CFU/cm<sup>2</sup>) compared to non-

chilled briskets ( $3.6 \log_{10}$  CFU/cm<sup>2</sup>). However, no significant differences in STEC attachment were observed between non-chilled briskets stored at 5 or 25°C, or between chilled briskets stored at 5 or 25°C. Attachment of STEC to beef briskets also declined during over a period of 2 h post-inoculation. The results of this study indicate that beef chilling and post-inoculation storage conditions can influence STEC attachment to beef surfaces.

<http://www.sciencedirect.com/science/article/pii/S0740002014001531>

### **Colonization of meat proteins by O157 and non-O157 *E. coli***

This French study investigated the effect of research protocols especially mechanical treatments (i.e. shaking, centrifugation, pipetting and vortexing) and types of *E. coli* strains on colonization of the skeletal-muscle extracellular matrix proteins (collagen I, III and reconstituted proteins). Eight strains of higher risk enterohemorrhagic *E. coli* (O157: H7 EDL933, O26: H11 ED180, O45: H2 12047 (Fred5), O103: H2 CH087, O111:H2 ED191, O121: H19 32316, O145: H28 PH27 and O104: H4 CB13348) were studied. Results showed that mechanical treatments significantly bias the outcomes of *E. coli* adhesion assays. Growth conditions were also observed to greatly influence the specificity of *E. coli* adhesion to extracellular proteins. In addition, significant differences in adhesion and biofilm formation abilities were observed between O157 and non-O157 *E. coli* strains. This study revealed that differences in the colonization ability of *E. coli* strains should ultimately be taken into consideration while evaluating the risk of contamination of different types of food matrices.

<http://www.sciencedirect.com/science/article/pii/S0168160514003584>

## **SHELF-LIFE**

### **Shelf-life stability of lamb loin packed in different packaging systems**

The aim of this Brazilian study was to evaluate the effect of different packaging systems on the stability of lamb loins stored under refrigeration. Lamb meat was packed under vacuum, 75% O<sub>2</sub> + 25% CO<sub>2</sub> and 100% CO<sub>2</sub>, and stored at 1°C for 28 days. Microbiological (counts of aerobic and anaerobic psychrotrophic microorganisms, coliform at 45°C, coagulase-positive staphylococci and lactic acid bacteria and presence of *Salmonella*), physical and chemical (thiobarbituric acid reactive substances [TBARS], objective colour, pH, water loss from cooking [WLC] and shear force), sensory (acceptance testing using a 9-point hedonic scale) and gas composition analyses were performed periodically throughout the storage. It was evident in all packaging systems that lamb meat showed good microbiological, physical and chemical stability. Among all packaging systems, lamb meat stored in the packages containing 100% CO<sub>2</sub> had the greatest stability and longest shelf life. However, the 100% CO<sub>2</sub> treatment was the least preferred in terms of the appearance of the raw meat.

<http://www.sciencedirect.com/science/article/pii/S0309174013004890>

### **Beef freshness determination using electronic nose**

The prospect of this Chinese study was to investigate the potential of electronic nose (comprised of eight metal oxide semiconductor gas sensors) in determining the beef striploins freshness.

The beef samples were stored at 4°C for 10 days and electronic nose responses to these samples were measured every day. The total viable counts (TVCs) and total volatile basic nitrogen (TVB-N) were used as the freshness reference standard of stored beef for comparison. A steady increase in TVCs was observed after day three with final counts reaching  $1.12 \times 10^8$  cfu/g by the end of storage. Similar was the trend for TVB-N with corresponding decrease in meat freshness. The fresh group included day 0 and 1 samples, rest of the samples belonged to not fresh group. Principal component analysis only partially discriminated beef samples whereas, stochastic resonance (SR) signal-to-noise ratio (SNR) spectrum discriminated all beef samples successfully. Further, beef strip loins freshness discrimination model was developed using SR SNR maximums (SNRmax) linear fitting regression with 90% analytical precision. <http://link.springer.com/article/10.1007%2Fs12161-014-9796-8#page-1>

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