

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

SPOILAGE ORGANISMS

***Clostridium novyi* type B as a causative agent of bovine meat spoilage**

Belgian researchers found and described a series of bovine meat spoilage cases in which meat showed green discoloration. Investigation revealed numerous spore-forming rods in the discoloured areas of the meat. A combination of sequencing the 16S rDNA and flagellum *fliC* genes of bacterial DNA from spoiled meat samples revealed the presence of *C. novyi* type B. Although this bacterium has been implicated in clinical necrotic hepatitis in cattle, the cases described here may be the first implicating *C. novyi* type B as a cause of bovine meat spoilage.

<http://www.sciencedirect.com/science/article/pii/S1075996412000297>

Spoilage microbiota associated with the storage of raw meat in different conditions – a review

This Italian review focuses on the composition of raw meat spoilage microbiota and the influence of storage conditions such as temperature, packaging atmosphere and different preservatives on the microbial community dynamics in raw meat. In addition, the most recent tools used for the detection and identification of meat microbiota, such as molecular methods like Terminal Restriction Fragment Length Polymorphism (TRFLP) are also reviewed. The type of bacteria and the

load depends on the initial meat contamination and on the specific storage conditions that can influence the development of different spoilage-related microbial populations thus affecting the type and rate of the spoilage process, and hence the shelf-life of raw meat products. However, because the succession of microbial association is not always described, there is still uncertainty of how and when these bacterial species or strains are influenced by the specific storage conditions. As a consequence, further research is needed to understand how specific conditions influence the type and rate of spoilage.

<http://www.sciencedirect.com/science/article/pii/S0168160512002814>

MICROBIAL TRANSFER IN PROCESSING

Transfer of *Listeria monocytogenes*

USA researchers scanned the available scientific data to determine bacterial transfer between environmental surfaces and foods, including those during slicing of food, and of bacterial removal during sanitizing. Results revealed surface type had the most influence on transfer. Overall, bacterial transfer was low, even though cross-contamination could be efficient under certain conditions such as with protein residues. With respect to *L. monocytogenes*, sanitizing efficiently reduced contamination in the environment and

therefore limited cross-contamination between surfaces. The mathematical models derived here could be used to evaluate *L. monocytogenes* cross-contamination dynamics in environments where foods are handled, and to assess the potential impact of different intervention strategies.

<http://www.sciencedirect.com/science/article/pii/S016816051200267X>

Transfer, attachment and formation of *E. coli* O157:H7 biofilms

This USA study examined the effects of contact material types, inoculation substrate, presence of air at the liquid–solid interface and incubation substrate on the attachment/transfer and subsequent biofilm formation by *E. coli* O157:H7 on beef carcass fabrication surface materials. Surface materials studied were stainless steel, acetal, polypropylene and high-density polyethylene. Attachment/transfer of *E. coli* O157:H7 was surface material and substrate dependent, although beef fat appeared to negate differences among surface materials. Beef fat was the most effective inoculation substrate, followed by ground beef, tissue homogenate, and a bacteriological growth medium, tryptic soy broth (TSB). Incubation (15°C for 16 days) of inoculated materials resulted in *E. coli* O157:H7 maximal biofilm formation observed between 2 and 8 days. The results indicated that the process of fabricating beef carcasses may be conducive to the attachment of *E. coli* O157:H7 onto meat-contact surfaces and subsequent biofilm formation. Furthermore, the authors recommended that substrates found in beef fabrication settings, rather than laboratory culture media, be used in studies designed to investigate biofilm development in these environments.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2012.02695.x/abstract>

Translocation and cross-contamination of *E. coli* O157 in subprimal cuts

The aim of this USA study was to determine the incidence and depth of translocated surface-inoculated *E. coli* O157 in high-pressure needleless injection (HPNI)-processed eye-of-round subprimal cuts. It was found that HPNI translocated *E. coli* O157 from the surface to the interior of the eye-of-round subprimal cuts with an incidence of 40%, 25% and 25% for subprimals that had been surface-inoculated with a 4-strain mixture of *E. coli* O157 strains at 0.5, 1, and 2 log₁₀ CFU/cm², respectively. The run-off water collected from each experiment was found to be 2, 2, and 3 log₁₀ CFU/ml. The runoff was re-used from each experiment for HPNI of additional subprimals, and this resulted in a cross-contamination incidence of 83, 60, and 37% respectively. Incidence of translocation and cross-contamination was similar at six different depths below the inoculated surface. These results indicated that surface microbiota on beef could be carried to the interior of HPNI-processed beef by initial translocation from the surface with the injected fluid and by cross-contamination with recycled fluid.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2012.02693.x/abstract>

CARCASS PROCESSING INTERVENTIONS

Clean animals and good hygiene at slaughter reduce *E. coli*

The aim of this Norwegian project was to collect data that would help to improve the hygienic quality of meat from cattle and sheep by means of cleaner animals and efficient ways of slaughtering high-risk animals (e.g. dirty or unshorn). Clean animals and good hygiene during slaughtering are essential preconditions for food safety. Meat from lambs was hosed with water at 82°C for 8 seconds in an enclosed "shower" (hot water pasteurization) before being cooled. This treatment was found to reduce the amount of *E. coli* on high-risk carcasses by 99.5%. After 5 days of cooling, no further *E. coli* was found on the meat and it could be processed together with clean carcasses, negating the need for separate processing lines. The researchers studied the effect of the measures implemented on both farms and in slaughterhouses. They also developed an enzymatic method for detecting *E. coli* that was as reliable as the traditional method for detecting and monitoring *E. coli* in abattoirs. <http://www.sciencedaily.com/releases/2012/05/120504110031.htm>

Efficacy of hypobromous acid as a hide-on carcass antimicrobial intervention

In this USA study, the antimicrobial properties of hypobromous acid (HOBr) were tested by spraying cattle hides at two concentrations, 220 or 500 ppm. Treatment with 220 ppm of HOBr reduced the prevalence of *E. coli* O157:H7 on hides from 25.3 to 10.1% and reduced the prevalence of *Salmonella* from 28.3 to 7.1%. Treatment with 500 ppm of HOBr reduced the prevalence of *E. coli* O157:H7 on hides from 21.2 to 10.1% and the prevalence of *Salmonella* from 33.3 to 8.1%. The application of 220 ppm of HOBr reduced aerobic plate counts, total coliform counts, and *E. coli* counts on hides by 2.2 log CFU/ 100

cm². The use of 500 ppm HOBr resulted in reduction of aerobic plate counts, total coliform counts, and *E. coli* counts by 3.3, 3.7, and 3.8 log CFU/100 cm², respectively, demonstrating that the use of higher concentrations of HOBr on hides resulted in additional antimicrobial activity. <http://www.ingentaconnect.com/content/iafp/jfp/2012/00000075/00000005/art00020>

The efficacy of interventions applied during primary processing - a review

The objective of this Canadian review was to identify, critically evaluate and synthesize published intervention research about treatment efficacy at the abattoir on *E. coli* contamination of beef carcasses using systematic analysis of data from scientific literature to determine knowledge gaps. Although 44 interventions were identified at nine stages of processing, analysis was precluded for most due to small study numbers, high risk of bias and heterogeneity. Reduced odds of generic *E. coli* carcass contamination demonstrated by the analysis was final carcass washing, pasteurization and 24 hour dry chilling. Combining effects of potable water carcass wash, steam or hot water pasteurization and a 24 hour dry chill, assuming no additional contamination and all variables constant, resulted in a reduced prevalence of 1.22%. The predicted risk difference in carcass contamination was 14, 42 and 35 per 100 carcasses upon application of final wash, carcass pasteurization and 24 hour dry chill, respectively. <http://www.sciencedirect.com/science/article/pii/S0956713512001478>

Efficacy of octenidine hydrochloride for reducing *E. coli* O157:H7, *Salmonella* spp. and *L. monocytogenes*

Researchers from the USA tested the efficacy of octenidine hydrochloride at different concentrations (OH, 0.025, 0.15 and 0.25%) for inactivating *E. coli* O157:H7, *Salmonella* spp. and *L. monocytogenes* on cattle hide at 23°C in the presence and absence of bovine

faeces. Octenidine hydrochloride is a positively charged bispyridinamine that exerts its antimicrobial activity by binding to the negatively charged bacterial cell envelope, and thereby disrupting vital functions of the cell membrane and killing bacteria. They found OH was effective in killing planktonic cells and biofilms of *Listeria monocytogenes* on different abiotic surfaces at 37, 21, 8 and 4°C in the presence and absence of organic matter. On cattle hide, all tested concentrations of OH were effective in decreasing more than 5.0 log CFU/cm² in 5 minutes. Results suggest that OH could potentially be used to decontaminate cattle hide. However further studies under commercial settings are necessary to validate these results. <http://aem.asm.org/content/early/2012/03/25/AEM.00259-12.short?rss=1>

PREDICTIVE MICROBIOLOGY

Modelling the growth of non-O157 *E. coli* in raw ground beef

The objective of this USA study was to investigate the growth of Shiga toxin-producing *Escherichia coli* (STEC, including serogroups O45, O103, O111, O121, and O145) in raw ground beef and to develop mathematical models to describe the bacterial growth under different temperature conditions (10 to 35 °C at 5°C increments). Three primary growth models were evaluated, including the Baranyi model, the Huang 2008 model, and a growth model based on the cell signalling during bacterial growth. Minimum relative growth (<1 log₁₀ cfu/g) was observed at 10°C, whereas at other temperatures, all 3 phases of growth were observed. Analytical results showed that all 3 models were equally suitable for describing the bacterial growth under constant temperatures. The maximum cell density of STEC in raw ground beef increased exponentially with temperature, but reached a maximum of 8.53 log₁₀ cfu/g of ground beef. The specific growth

rates estimated by the 3 primary models were practically identical.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2012.02647.x/abstract>

PATHOGEN IDENTIFICATION AND PREVALENCE

Comparing bovine and human strains of enterohaemorrhagic *E. coli*

The aim of this Belgian research was to study the genomic differences between two enterohaemorrhagic *E. coli* (EHEC) strains of serogroup O26 isolated from a young calf and a human, in an effort to identify specific sequences of the bovine strain that could be implicated in initial adherence or host specificity. Most EHEC strains can be found in the gut of healthy ruminants, but some of the strains, belonging to O26, O111, O118 serogroups, for example, are also responsible for digestive disorders in calves. However, no DNA sequence similarity implicated in host specificity was found during this study. Several genetic factors not usually present in EHEC strains of serogroup O26 were identified in the bovine strain. One of them, the PAI ICL3 locus, initially used as a pathogenicity genetic marker for locus of enterocyte effacement (LEE)-negative verotoxin-producing *E. coli* (VTEC) strains, was found in 11.3% of enteropathogenic *E. coli* (EPEC) and EHEC strains. <http://onlinelibrary.wiley.com/doi/10.1111/j.1574-6968.2012.02542.x/abstract;jsessionid=9A4F2352CF4D761CEE5B31D877E99841.d03t01>

Prevalence and serotypes of *Listeria monocytogenes*

A study examined the occurrence of total *Listeria* species, especially *Listeria monocytogenes*, and identified serotypes present in beef processing plants in China. A total of 439 samples were obtained from carcasses, hides and faeces at three processing plants. A standard protocol (ISO 11290-1) was followed to detect total *Listeria* species and *L. monocytogenes*. Also a polymerase chain reaction (PCR) was used to identify the various *L. monocytogenes* serotypes. The overall prevalence of *Listeria* spp. and *L. monocytogenes* was 65.6 and 26.4%, respectively, and contamination was found to be highest for hide samples. The *L. monocytogenes* serotypes were 1/2c and 1/2a. The results of this study indicated that *Listeria* species contamination can be high in beef processing plants in China, and that specific measures should be taken to prevent and/or treat *L. monocytogenes* contamination of faeces and hides in beef slaughter plants.
<http://online.liebertpub.com/doi/abs/10.1089/fpd.2011.1088>

individuals making up one ground beef batch at 300 to 500. In the packing plant, a probability can be calculated as the likelihood of an individual animal being detected in a batch of ground beef. Hence, the researchers took 10 samples from each ground beef batch and by cross-referencing the DNA collected earlier; they determined how many muscle fibres came from different individuals. Using these numbers, researchers accurately estimated the number of individuals in six batches. As a result, specific contaminated batches could be recalled instead of all batches from a packing day. This technology could also be used for traceability of meat sources.

<http://www.thecattlesite.com/news/38068/improving-food-safety-recalls>

RECALL IMPROVEMENT

Improving food safety recalls

Canadian researchers looked at improving food safety recalls. They developed a statistical method for estimating the number of cattle that contribute to a single production run of ground beef by using a technique (mark-recapture) for counting wild animals. A proportion of animals are marked and released back into the population. A second proportion of animals are then captured and the previously marked animals are counted. Since the number of marked individuals within the second sample should be proportional to the number of marked individuals in the whole population, an estimate of the total population size can be obtained. Using this method, previous research put the number of

REGULATORY NEWS

FSANZ approves use of dibromo-dimethylhydantoin (DBDMH)

Food Standards Australia New Zealand (FSANZ) received an application to amend Standard 1.3.3 – Processing Aids, of the *Australia New Zealand Food Standards Code* to permit the use of dibromo-dimethylhydantoin (DBDMH) as a processing aid. The applicant proposed that DBDMH be used as an antimicrobial washing agent to treat all foods, although primarily use would include treating meat and poultry carcasses, parts, trim, organs, hides and heads. When added to water, DBDMH hydrolyses to form hypobromous acid, which is the active compound that possesses antimicrobial activity. It has been found to be effective against *E. coli* 0157:H7 and *Salmonella* species. The Code also contains permission for a similar antimicrobial washing agent, halohydantoin bromo-chloro-dimethylhydantoin (BCDMH) to treat all foods. The applicant requested the entry for BCDMH be replaced with a joint entry for DBDMH and BCDMH. <http://www.foodstandards.gov.au/srcfiles/A1054%20DBDMH%20as%20a%20PA%20AppR%20FINAL.pdf>

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