

## 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

### STRATEGIES TO INCREASE PATHOGEN SENSITIVITY TO INTERVENTIONS

#### **Environmental stresses and subsequent responses of *E. coli* O157:H7 to resuscitative and inactivation challenges**

Meat preservation methods or 'interventions' do not always kill bacteria but instead exert 'stress' and retard their ability to survive. By understanding the cellular processes that cause bacterial stress, as well as resistance to stress, it may be possible to improve the effectiveness of meat food safety and quality interventions. This study determined the effect of combinations of different environmental stresses on the ability of *E. coli* O157:H7 to recover from injury that has failed to kill or completely inactivate cells. Environmental stresses included simultaneous exposures to pH (3.0-8.0), water activity (*A<sub>w</sub>*; 0.93-0.99) and temperature (3.0-62°C). The percentage of injured cells was assessed and found to be mostly affected by water activity and temperature, while the ability of the organism to recover after stress was influenced by pH, pH-temperature interaction and water activity-temperature interaction. Heat tolerance of the organism was adversely affected by pH and water activity stress. Injury and loss of cell viability did not induce adaptation to acid stress, however exposure to very low pH did lead to increased protection of *E. coli* O157:H7 against heat stress. These results show that the nature of injury from a particular environmental stress influences *E. coli* O157:H7's ability to survive, and may lead to 'smarter' strategies for carcase intervention.

[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6T7K-4YK2DXJ-2&\\_user=10&\\_coverDate=05%2F15%2F2010&\\_rdoc=1&\\_fmt=high&\\_orig=search&\\_sort=d&\\_docanchor=&view=c&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=83fb596f9c58825903ea0820a183a45d](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T7K-4YK2DXJ-2&_user=10&_coverDate=05%2F15%2F2010&_rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=83fb596f9c58825903ea0820a183a45d)

### BACTERIA IN THE BOVINE GUT

#### **Gastrointestinal tract distribution at necropsy of Shiga-toxigenic *E. coli* O157 in cattle naturally shedding the bacterium**

The distribution of shiga-toxigenic *E. coli* O157 (STEC O157) in the gastrointestinal tract (GIT) of 65 naturally exposed cattle was studied. *E. coli* O157 was distributed throughout the entire GIT, with variable distribution between animals. Results indicate that the dynamics of STEC O157 infections in the cattle GIT may involve more sites than just the rectoanal junction. Colonisation varied in that no single sample site accounted for all positive animals. Based on culture and isolation from sites along the entire GIT, faecal shedding appears to underestimate the true extent and occurrence (or prevalence) of STEC O157. It was concluded that no single sample type accurately predicts STEC O157 negative status of an individual animal.

<http://aem.asm.org/cgi/content/abstract/AEM.00400-10v1?etoc>

### ***E. coli* O157:H7 colonises the bovine rumen by “sensing” the presence of other bacteria**

The bovine gastrointestinal tract (GIT) contains a complex community of bacterial species which are involved in host nutrition, immunity and defence from disease. Before bacteria can become established in this environment, they must first colonise the GIT. Colonisation is not a random event but a series of specific processes that are triggered by chemical ‘sensing’ among bacteria. These chemicals, called “quorum factors”, are small compounds secreted by bacteria which allows them to ‘sense’ the presence of their species, as well as others.

*E. coli* O157:H7, a human pathogen, is also able to become established in the bovine GIT, particularly the rumen, using chemical sensing. A recent study shows that *E. coli* O157:H7 must first sense quorum factors produced by normal bovine GIT bacteria in order for it to colonise and become established in the bovine GIT. Importantly, quorum factors were shown to be produced in the rumen but absent in others areas of the GIT. This important finding could lead to novel strategies to block chemical signals and prevent *E. coli* O157:H7 colonising the bovine GIT, and becoming a potential food safety issue through transmission via faeces to other animals.

<http://www.pnas.org/content/early/2010/04/30/1002551107.short?rss=1>

## **INTERVENTIONS**

### **Determining carcase water washing conditions suitable for meat plants to reduce pathogens on beef surfaces**

The most effective combination of methods for removing potential pathogenic or ‘illness-causing’ bacteria from beef surfaces with a handheld hose was evaluated by testing various combinations of water temperature and washing method. Beef surfaces were inoculated with a slurry derived from cattle faeces containing the pathogens *E. coli* O157:H7, *Salmonella* Typhimurium, *Campylobacter coli* and *Campylobacter jejuni*. Surfaces were washed with cold and hot water, various water pressures and spray distances from the meat surface, and varying slurry application and drip times. The most effective combinations of washing conditions were then applied to beef brisket inoculated with bacteria in conjunction with hot (77°C), warm (54°C) and cold (15°C) water washes. High water temperature, increased application time, and shorter spray distances more effectively eliminated pathogenic bacteria from inoculated meat surfaces, providing new validation data for carcasses washing.

<http://www.ingentaconnect.com/content/iafp/jfp/2010/00000073/00000005/art00013>

## **PATHOGENS IN ANIMALS**

### **Low occurrence of *Clostridium difficile* in faecal samples of healthy calves and pigs at slaughter and in minced meat in Switzerland**

*Clostridium difficile* is a human pathogen that is emerging as an increasingly significant organism. More ‘virulent’ strains and increases in the number and severity of human infections have been observed in recent years, particularly from ground or minced meat products. Livestock were therefore assessed as a possible vehicle for transmission of *C. difficile* to humans. This Swiss pilot study sampled the faeces of 204 calves (and some pigs) and examined 46 minced meat products to investigate the occurrence of *C. difficile* in livestock at slaughter and in retail ground meat products. All samples from calves were negative for the organism. The study concluded that in Switzerland there is currently a low occurrence of *C. difficile* in farm animals at slaughter and in minced retail meat.

<http://www.ingentaconnect.com/content/iafp/jfp/2010/00000073/00000005/art00022>

### **Relationship between virulence gene profiles of atypical enteropathogenic *Escherichia coli* and Shiga-toxingenic *E. coli* isolates from cattle and sheep in New Zealand**

In this study, the virulence gene profiles, (genes providing a bacterium with the capacity to cause illness), of two types of pathogenic *E. coli* from cattle, sheep and humans in New Zealand were examined to identify the relationships among the different strains or 'pathotypes'. Atypical enteropathogenic *E. coli* (aEPEC) and Shiga toxin-producing *E. coli* (STEC) were found to share common virulence factors (i.e. disease-causing molecules including intimin, EHEC-hemolysin, serine protease, type II secretion system) which indicates an evolutionary relationship between aEPEC and the Shiga toxin-producing STEC *E. coli* strain. In other words, EPEC and STEC were shown to have developed from a common ancestry, based on the current mechanisms by which they are both able to cause illness in humans.

<http://aem.asm.org/cgi/content/abstract/76/11/3744?etoc>

### **Animal- and truckload-level associations between *E. coli* O157:H7 in faeces and on hides at harvest and contamination of pre-evisceration beef carcasses**

The food safety of beef carcasses prior to evisceration can be adversely affected by the presence of *E. coli* O157:H7 derived from faecal contamination of cattle and hides. This study investigated pre-evisceration occurrence or 'prevalence' of *E. coli* O157:H7 and examined factors influencing the contamination of carcasses. Samples of hide, faeces and sections of pre-evisceration carcass were collected from up to 32 animals on each of 45 trucks arriving at a USA abattoir. Selective and enrichment cultures (that selectively support growth of certain bacteria) were used to determine presence of *E. coli* O157:H7 on hides, carcasses and in faeces, with direct agar plating employed to identify individual animals shedding high *E. coli* O157:H7 numbers in faeces. Proportion of cattle shedding faecal *E. coli* O157:H7 was 13.8%, with 3.3% being determined as shedding high numbers of the organism. 10.5% of carcasses and 38.5% of hides tested positive for *E. coli* O157:H7. These results indicate that implementation of pre-slaughter treatments or 'interventions' for decreasing *E. coli* O157:H7 presence on livestock carcasses should concentrate on hide treatment and truckload-level decontamination.

<http://www.ingentaconnect.com/content/iafp/jfp/2010/00000073/00000006/art00003>

### **Prevalence and antibiotic resistance of *Campylobacter jejuni* and *Campylobacter coli* isolated from cattle between 2002 and 2006 in France**

This 5-year French study evaluated the occurrence of *Campylobacter jejuni* and *Campylobacter coli* in cattle across various regions of France, and assessed antibiotic resistance. Faeces samples from 2,255 cattle of various ages were collected at abattoirs. *Campylobacter* was recovered from 16.5% of samples; (*C. jejuni* from 12.8% and *C. coli* from 3.7%), with the majority of positive samples coming from calves. Resistance to six antibiotics was tested. Most bacterial isolates were resistant to the antibiotic tetracycline, however low resistance was found to the antibiotics ampicillin and erythromycin; multiple resistance was frequently detected for *C. jejuni* and *C. coli*. Also, 0.8% of *Campylobacter* isolated were resistant to five of the six antibiotics tested. The study indicates a significant increase in the resistance of *C. jejuni* to fluoroquinolones, which has significant food safety implications as there have been recurrent reports of links between human illness involving *Campylobacter* and livestock.

<http://www.ingentaconnect.com/content/iafp/jfp/2010/00000073/00000005/art00003>

### **Prevalence, characterization, and genotypic analysis of *E. coli* O157:H7/NM from selected beef exporting abattoirs of Argentina**

The predominant strain of *E. coli* in Argentina associated with human foodborne disease haemolytic uremic syndrome (HUS) is *E. coli* O157:H7/NM (or STEC O157). The disease is common to or endemic in that country, with greater than 400 cases being identified each year. To determine the

numbers and characteristics of STEC 0157 in beef cattle at the time of slaughter, 1,622 faecal and carcass samples were taken in nine beef exporting abattoirs from 2006 to 2008. Fifty-four (54) samples tested positive for STEC 0157, with a positive occurrence of 4.1% in faeces and 2.6% on carcasses. Prevalence in faeces of calves (10.5%) and heifers (8.5%) was higher. STEC 0157 strains isolated from 5 of 21 cattle carcasses were found to be identical by using pulsed-field gel electrophoresis (a DNA fingerprinting technique) to strains identified in the faecal samples of the same or nearby cattle lot.

<http://www.ingentaconnect.com/content/iafp/jfp/2010/00000073/00000004/art00005>

## SHELF-LIFE EXTENSION

### **Application of chitosan-incorporated LDPE film to sliced fresh red meats for shelf-life extension**

Active packaging (i.e. plastic food packaging impregnated with anti-bacterial agents), have the potential to control microbial growth in packaged meats, as well as extend quality sensory attributes. In this study, the effectiveness of a low density polyethylene film treated with different concentrations of the substance chitosan lactate was evaluated against three food-borne bacterial pathogens: *Listeria monocytogenes*, *E. coli*, and *Salmonella enteritis*. In addition, its effect was studied on meat colour shelf-life. Chitosan lactate was able to prevent the growth or 'inhibit' all three pathogens when they were suspended in liquid media and placed in direct contact with the film, however this same effect was not observed when the impregnated film was in contact with red meat surfaces inoculated with the pathogens. Water vapour permeability of the film increased with the addition of chitosan, but did not reduce oxygen permeability, resulting in significant colour shelf-life extension with sliced red meats.

[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6T9G-4YGHGXH-2&\\_user=10&\\_coverDate=07%2F31%2F2010&\\_rdoc=1&\\_fmt=high&\\_orig=search&\\_sort=d&\\_docanchor=&view=c&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=eef03aa53d16c218d4230103f6d15d90](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T9G-4YGHGXH-2&_user=10&_coverDate=07%2F31%2F2010&_rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=eef03aa53d16c218d4230103f6d15d90)

### **Protective action of *Lactobacillus curvatus* CRL705 on vacuum-packaged raw beef: effect on sensory and structural characteristics**

This study evaluated the protective effect of *Lactobacillus curvatus* CRL705 in the prevention of spoilage of vacuum-packed fresh beef stored for 60 days at 2°C. The protective culture was applied (inoculated) onto the meat surface and became the dominant bacterium present throughout the storage period, controlling the growth of spoilage bacteria naturally present on the meat surface. The meat developed an acidic off-flavour (determined by sensory testing) after 60 days of storage but no off-odours were detected. It was concluded that use of this *Lactobacillus* strain would provide an additional measure of safety, or 'hurdle' technology to prevent the spoilage of packaged raw beef during refrigerated storage.

[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6T9G-4YC80XN-1&\\_user=10&\\_coverDate=07%2F31%2F2010&\\_rdoc=1&\\_fmt=high&\\_orig=search&\\_sort=d&\\_docanchor=&view=c&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=e423af923649e619648a905d83ce38f2](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T9G-4YC80XN-1&_user=10&_coverDate=07%2F31%2F2010&_rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=e423af923649e619648a905d83ce38f2)

## CARCASS SAMPLING

### **The relationship between abattoir staff sampling experience and numbers of bacteria recovered from carcasses by swabbing with sponges**

Carcasses of cattle and other animals (pigs, bison) were swabbed by both experienced and inexperienced sampling staff, using randomly chosen sites on dressed carcasses swabbed with moistened synthetic sponges. The numbers of aerobic (oxygen-tolerant) bacteria obtained by each person was assessed. The majority of levels differed by less than 0.5 log unit, indicating that numbers of bacteria recovered from carcasses using sponge swabs is unlikely to differ substantially, despite the experience of the sampler, if the same procedure is used.

### **The effectiveness of sponge sampling for removing carcase bacteria**

Sampling carcase surfaces with a sponge is a common, non-destructive method that measures carcase hygiene by physically removing bacteria. However, little is known about the quantity of bacteria that are actually removed using standard protocols, compared to bacteria that are more tightly associated with the carcase surface. This study compared removed carcase bacteria by sequentially sponging single sites, versus the number of residual bacteria obtained by excising and stomaching (mechanically digesting) the same sponged site. Results showed wide variation (11.1 to 97.4%) in the amount of bacteria that were removed with a sponge compared to the number of residual cells measured by excision. In general, larger proportions were recovered with the first sponge. The authors also showed high variation of recovery among different operators (2.3 - 93.1%). These findings demonstrated that sponge sampling, while convenient, is a highly variable method of removing bacteria from carcase surfaces.

(Seager et al., 2010. Food Protection Trends. Vol. 30:336-339)

<http://www.foodprotection.org/publications/food-protection-trends/index.php>

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