

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

CONTROLS

A step closer to phage-based microbial control?

The USA-based biotechnology company, Intralytix Inc., has announced that it has received a 2009 Army Commercialisation Pilot Program grant to begin phase 3 trials of its ECP 100 product. ECP 100 is a bacteriophage cocktail that is effective at controlling greater than 100 strains of *Escherichia coli* O157:H7. The trial will involve planning and investment strategies for incorporation of ECP 100 into the commercial marketplace. The product is designed to be sprayed directly onto fresh fruit, vegetables and red meats as a control measure targeted at *E. coli*. The company has already successfully developed and commercially launched a similar product, LMP 102, targeted at *Listeria monocytogenes* that works in a similar fashion.

http://7thspace.com/headlines/299150/intralytix_wins_phase_iii_army_grant_for_e_coli_tech_nology.html

Novel application of nanotechnology to food safety

The United States Department of Agriculture is developing nanotechnologies that have food safety applications. Research is underway to develop nanoparticles that bind specifically to foodborne pathogens such as *Escherichia coli* and are capable of fluorescing at given light wave lengths. When applied to food samples, those products contaminated with the target organisms can be quickly and easily detected by applying light at the fluorescent wave length of that nanoparticle. Although the technology is unlikely to be available for some time, this research provides insight into some

of the food safety technologies that may be available in the future.

<http://www.examiner.com/x-1242-Omaha-Science-Examiner~y2008m12d31-Nanotechnology-to-be-applied-to-food-safety>

Influence of acid type on acid-mediated microbial control on fresh meat carcasses

Diluted solutions of organic acids are routinely sprayed onto fresh meat carcasses in the USA and Europe to control microbial growth. This treatment has been demonstrated to result in an immediate 1 – 3 log reduction in microbial numbers, and an end pH of between 3.3 and 5.8 depending on the type of acid used. These pH are within the physiologically acceptable limits of many microbes, including some foodborne pathogens. As such, depending on the acid used, an acid tolerance response (ATR) may be induced in certain bacterial species. This response is characterised by increased resistance to environmental stresses with subsequent risk of increased abilities to persist within the food processing environment. Researchers in Spain have investigated which acids were most effective at inducing the ATR in the foodborne pathogen *Salmonella* Typhimurium. They found that in all experiments, the order of acids (from high to low) best able to induce the ATR were citric > acetic > lactic > malic > hydrochloric > ascorbic. Furthermore, it was observed that the presence of a food source alone afforded a level of acid protection for the challenged microbes. The results of this work indicate that due to the complex nature of the ATR and high risk meat processing environment, caution must be used when selecting an organic acid to treat a carcass.

Alvarez-Ordóñez, A., Fernández, A., Bernardo, A. and López, M. (2009). Comparison of acids on the induction of an acid tolerance response in *Salmonella Typhimurium*, consequences for food safety. *Meat Science* 81 (1): 65 - 70
<http://dx.doi.org/10.1016/j.meatsci.2008.06.019>

Survival and persistence of *Escherichia coli* O157:H7 under model slaughterhouse conditions

Persistent *E. coli* contamination within meat processing facilities presents considerable risk for pathogen transmission and subsequent outbreaks. In a recent study conducted in the USA, factors that contribute to environmental persistence of *E. coli* O157:H7 were examined under model slaughterhouse conditions. These included the ability to form biofilms and the development of acid tolerance. Scenarios commonly found within slaughterhouses were tested, including sanitation and overnight drying during consecutive operational shifts. Under these conditions, *E. coli* O157:H7 strains were acid-challenged and allowed to form biofilms and the recovery was measured. Increased surface attachment and high acid resistance were observed when cells were pre-dried on surfaces. Additionally, significant recovery with restored acid tolerance was noted following exposure to washings. Based on this study, the researchers suggest that incomplete removal of biofilms can lead to the development of acid resistance within the slaughterhouse environment, particularly in regions where liquid meat waste may be present for extended periods.

Skandamis, P., Stopforth, J., Ashton, L., Geornaras, I., Kendall, P. and Sofos, J. (2009). *Escherichia coli* O157:H7 survival, biofilm formation and acid tolerance under simulated slaughter plant moist and dry conditions. *Food Microbiology* 26 (1): 112 - 119
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6WFP-4TGHNB5-1&_user=1526876&_rdoc=1&_fmt=&_orig=se&_arch&_sort=d&_view=c&_acct=C000052220&_version=1&_urlVersion=0&_userid=1526876&_md5=b870ea2950cfe9273f80002f39799ab8

Cranberry as a supplementary hurdle to control *Escherichia coli* O157:H7 associated with minced beef

Researchers in the USA have applied cranberry juice (2.5, 5 and 7.5% w/w) to minced beef to test its antimicrobial effect on *E. coli* O157:H7, including the effect on selected cell wall gene regulation. A 0.4, 0.7 and 2.4 log reduction of *E. coli* O157:H7 was observed, respectively, for each concentration tested. A panel of 50 testers detected no difference in the flavour, taste or texture of the meat product following treatment. Quantitative real-time polymerase chain reaction highlighted bacterial cell wall stress following treatment with the cranberry concentrate, confirming growth inhibition. The study indicates that cranberry concentrate could be useful as a supplementary hurdle against *E. coli* O157:H7 in minced beef while not affecting the eating quality of the product.

Wu, V., Qiu, X., Des Los Reyes, B., Lin, C. and Pan, Y. (2009). Application of cranberry concentrate (*Vaccinium macrocarpon*) to control *Escherichia coli* O157:H7 in ground beef and its antimicrobial mechanism related to the down regulated *slp*, *hdeA* and *cfa*
<http://www.ncbi.nlm.nih.gov/pubmed/19028302>

Pre-slaughter Bovine Spongiform Encephalopathy testing

Canadian scientists have identified elevated protein levels in the urine of cattle infected with BSE. The findings may lead to a simple urine strip test, similar to a human pregnancy test, which changes colour if the cattle's urine is positive for the BSE protein marker. The exciting breakthrough means that animals could be tested for BSE without first being slaughtered, which is the current method. As such testing could be performed on cattle herds more often, leading to greater food safety.

<http://farminguk.com/news/Canada-New-fast-testing-for-BSE.9655.asp>

PATHOGENS

Measuring the prevalence *E. coli* in market mutton with molecular probes

Escherichia coli strains recovered from market mutton in India were tested to investigate the prevalence of infective strains. These strains were identified by detecting the virulence markers verotoxin 1 (VT1) and 2 (VT2), intimin (eae) and production of enterohaemolysin. Prevalence of verotoxin 2 and intimin was both non-existent and very low (0.00 and 3.22% respectively), while verotoxin 1 was detected in 38.70% of the samples. Similarly, 31.18% of the samples exhibited enterohaemolysin activity. The results of this study indicate a relatively high level of virulent *E. coli* present in the sampled market mutton. The high prevalence of verotoxin 1 may indicate a higher proportion of phage 933J (associated with the transfer of VT1) to 933W (associated with the transfer of VT2) as these phage transmit these verotoxin genes between *E. coli* strains. The study presents interesting insight into the prevalence and distribution of *E. coli* virulence determinants throughout a market mutton sampling, and highlights the need for post harvest contamination controls.

Bhong, C., Brahmabhatt, M., Joshi, C. and Rank, D. (2008). Detection of virulence determinants by real time PCR in *E. coli* isolated from mutton. *Meat Science* 80 (4): 1129 – 1131

<http://dx.doi.org/10.1016/j.meatsci.2008.05.017>

Transportation stress and animal temperament reported to have no effect on faecal shedding of *Escherichia coli* O157:H7 in cattle

A study based in the USA compared the effects of stress from transportation and animal temperament on the level of *E. coli* O157:H7 that they shed. Stress levels and the temperament of the animals were assessed based on pre-determined disposition scores. Presence of *E. coli* O157:H7 was determined by rectal swab and colons collected postmortem. Both measures

were collected before and after transportation. The calm animals were observed to shed greater numbers of *E. coli* O157:H7 throughout the study. Findings from this study indicate that transportation stress does not increase faecal shedding of *E. coli* O157:H7.

Schuehle-Pfeiffer, C., King, D., Lucia, L., Cabrera-Diaz, E., Acuff, G., Randel, R., Welsh, T., Oliphint, R., Curley, K., Vann, R. and Savell, J. (2009). Influence of transportation stress and animal temperament on faecal shedding of *Escherichia coli* O157:H7 in feedlot cattle. *Meat Science* 81 (2): 300 – 306

<http://dx.doi.org/10.1016/j.meatsci.2008.08.005>

Prions detected in fat tissue

Researchers have identified for the first time the ability of prions to infect fat tissue. Prions are a group of infectious agents that cause transmissible spongiform encephalopathy's, including bovine spongiform encephalopathy (BSE). Exposure of humans to prion diseases is a major economic and public health concern. Transmission of prion diseases is believed to result from consumption of infected tissue. Previous studies identified nervous tissue as the primary source of prion transmission, confounding epidemiological investigations in which nervous tissue was not consumed. In a recent collaborative study, prions were observed to infect fat tissue (both white and brown) in a mouse model. Prion presence within these tissues was determined using an animal model system and biochemical experimentation. These findings present a possible means of prion transmission independent of nervous tissue. Knowledge of prion transmission and extent of tissue deposition is essential for effective prevention and control within food industries.

Race, B., Meade-White, K., Oldstone, M., Race, R. and Chesebro, B. (2008). Detection of prion infectivity in fat tissues of Scrapie infected mice. *PLoS Pathogens* 4 (12): e1000232. doi:10.1371/journal.ppat.1000232

<http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1000232>

The diversity of free living protozoa in meat cutting plants

A study based in Belgium surveyed 5 meat processing plants for the diversity of free living protozoa. Protozoa are ubiquitous eukaryotic microorganisms that often have an association with bacteria. In recent studies protozoa have been observed internalising the known human foodborne pathogens *Campylobacter jejuni*, *Escherichia coli* O157:H7 and *Listeria monocytogenes* and it has been suggested that these pathogens may have a protozoan component to their life-cycle. Such a life-cycle may have implications in terms of environmental persistence and resistance to cleaning and sanitisation. The survey utilised microscopy and molecular biology techniques for identification. The survey identified high protozoan species richness within each of the sampled plants. Microscopy identified 61 independent categories of protozoa with molecular characterisation defining 49 among these. Importantly, the study showed that a number of protozoa are capable of hosting foodborne pathogens. The study indicates an interesting and possibly under-recognised reservoir for foodborne pathogens, however the authors state that the ecological significance of free-living protozoa within food processing areas remains unclear.

Vaerewijck, M., Sabbe, K., Barre, J. and Houf, K. (2008). Microscopic and molecular study on the diversity of free – living Protozoa in meat cutting plants. *Applied and Environmental Microbiology*

<http://aem.asm.org/cgi/reprint/AEM.00980-08v1>

Wild animals identified as potential *Salmonella* spp. reservoirs for meat production animals

Researchers in Denmark have demonstrated that meat production animals such as cattle can pass *Salmonella* spp. to wild animals. A total of 3622 samples were collected over

two Summers from cattle, pigs and wild animals. *Salmonella* was detected in the wild animal samples only during the periods when *Salmonella* was detected in the meat production animals. The researchers believe that lateral transmission of *Salmonella* is bidirectional and as such, may represent a source for the introduction of *Salmonella* species (and possibly other foodborne pathogens) to meat production animals. The study indicates that wild animal control should form part of the meat animal production process in order to control a potential reservoir for foodborne pathogens.

Skov, N., Madsen, J., Rahbek, C., Lodal, J., Jespersen, J., Jorgenson, J., Dietz, H., Chriel, M. and Baggsen, D. (2008).

<http://www3.interscience.wiley.com/cgi-bin/fulltext/121452796/PDFSTART?CRETRY=1&SRETRY=0>

ADDITIVES AND CONTAMINANTS

Cinnamon compound used to reduce *Escherichia coli* O157:H7 in cattle drinking water

Researchers in the USA have found that cinnamic aldehyde, a major component of cinnamon, is effective at reducing *E. coli* O157:H7 in cattle drinking water troughs. Cattle drinking water troughs are a known reservoir of this food borne pathogen. The study investigated the effects of low concentrations of cinnamic aldehyde in water troughs containing 1% w/v bovine faeces, 1% w/v cattle feed and clean water. All concentrations of the compound were found to be effective at reducing *E. coli* O157:H7 numbers; however the efficacy was reduced with bovine feed and faeces contamination. Palatability studies are yet to be performed so, although effective at *E. coli* O157:H7 reduction, cattle response to the additive remains to be determined.

Susan Charles, A., Ananda Baskaran, S., Murcott, C., Schreiber, D., Hoagland, T. and Venkitanarayanan, K. (2008). Reduction of *Escherichia coli* O157:H7 in cattle drinking water by *trans*-cinnamaldehyde. *Foodborne Pathogens and Disease* 5 (6): 763-771

<http://www.liebertonline.com/doi/abs/10.1089/fpd.2008.0126>

United States Food and Drug Administration (USFDA) revokes ban on use of cephalosporins

The USFDA's plan to ban the "extralabel use" (use other than that directed on the package labeling) of cephalosporin antimicrobials in food producing animals has been revoked. Cephalosporins are a group of antimicrobials important in human medicine. The ban on their use was driven by the risk of developing microbial resistance against the agents. The USFDA considered their use a public health risk in July of this year. The change in position was driven by appeals from agricultural groups and animal drug companies on the importance of these agents to agriculture, claiming cephalosporins prevented many infectious diseases in animals.

<http://www.foodproductiondaily.com/Quality-Safety/FDA-revokes-ban-on-antimicrobial>

Dioxin-tainted beef detected in Ireland

The chemical group dioxins have been detected in Irish beef up to 350 times the European Union's allowable level. However, the Food Safety Authority of Ireland (FSAI) has stated that the beef poses a far less risk than the recent pork contamination, and that no action is required by either retailers or consumers. Dioxins are a group of chemicals formed by the burning of chlorine-containing compounds. The contamination has been sourced to cattle feed that was exposed to fumes from a nearby power recycling plant. The Irish Department of Agriculture, Fisheries and Food (DAFF) has confirmed that 21 of the 120,000 cattle farms in Ireland have received the contaminated feed. As a precautionary measure, FSAI has recommended to DAFF that cattle from the 21 contaminated farms be slaughtered.

<http://www.foodqualitynews.com/Food-Alerts/Beef-analysis-results-show-high-dioxin-levels>

GENETIC MODIFICATION

Cloned meat to be sold in Japan 2009

The Japanese government is likely to approve the commercial sale of cloned beef and pork in Japan. The meats are derived from cloned eggs and body cells, and have been found to be safe by the Japanese Food Safety Commission. Final confirmation on approval is required; however it is believed that cloned beef and pork will be commercially available in Japan from 2009. The safety findings agree with those found by the United States Food and Drug Administration in 2007 that meat and meat products from cloned animals was deemed safe.

<http://english.donga.com/srv/service.php3?biid=2009010723778>

Genetically modified cotton seed accidentally added to animal feed

In the USA, approximately 250 kg of cotton seed engineered to produce a pesticide was accidentally combined with 60,000 kg of non-modified cotton seed growing nearby. Some of the contaminated seed was then used to prepare animal feed and fed to cattle in Mexican feed lots before officials became aware of the error. The pesticide protein produced by the modified seed is said to pose no threat to humans or animals. The company is working with the United States Department of Agriculture to rectify the problem. Opponents suggest that the incident highlights a need for tighter regulation of genetically modified crops to minimise food safety and economic risks.

<http://www.iht.com/articles/ap/2008/12/03/amERICA/Biotech-Cotton.php>

REVIEWS

Control of the risk of human Toxoplasmosis transmitted by meat

Toxoplasmosis is a disease caused by the protozoan parasite *Toxoplasma gondii*. Farm animals represent the primary reservoir, with transmission to humans predominantly associated with consumption of undercooked

meat. The economic and public health costs of toxoplasmosis are similar to other more widely recognised food pathogens such as *Salmonella* and *Campylobacter*. However, treatment and prevention options remain substandard to a large degree throughout the world, despite relatively straight-forward methods of post harvest decontamination being available to high risk facilities. In this review, Toxoplasmosis is discussed in detail. Meat animals as infection reservoirs, including meat products, are addressed.

Discussion then moves to farm risk management, outlining necessary preventative measures, post harvest prevention including surveillance and the role of the consumer. Finally, current and newly developed methods of controlling the parasite, including freezing, heating and irradiation are detailed. The review provides a concise explanation of Toxoplasmosis risk management in relation to meats.

Kijlstra, A. and Jongert, E. (2008). Control of the risk of human Toxoplasmosis transmitted by meat. *International Journal for Parasitology* 38 (12): 1359 – 1370

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T7F-4T2637D-1&_user=1526876&_rdoc=1&_fmt=&_orig=search&_sort=d&_view=c&_acct=C000052220&_version=1&_urlVersion=0&_userid=1526876&md5=5ae51c7c583fba6ac14d8dff2d21bba2

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