WHAT'S NEW

Summaries of recent publications

Meat technology-What's new

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Targeted interventions to control *E. coli*

There are quite good data on the prevalence of *E. coli* O157:H7 on beef carcases, but little on the individual sites on the carcase that are most frequently contaminated. If the most commonly contaminated sites can be located, an intervention that targets those areas during processing, could bring about further reductions in prevalence of *E. coli* O157:H7. A US study collected samples from specific locations on carcases during dressing, to determine if targeted interventions reduced contamination.

Firstly, samples were collected from carcases at a slaughtering plant over five separate days using the existing procedures, in order to establish a baseline. Samples were collected over 5 days from 500 cm^2 areas of the foreshank, hindshank, topside, midline and neck by sponge swabbing. The areas with the highest pathogen prevalence were the foreshank, hindshank and topside at 21.7%, 24.2% and 37.5% respectively. Two interventions were then implemented for these areas: hot water at 82 °C for the fore and hind shanks immediately after hide removal; and steam vacuum for the topside after final hide removal. Further sets of samples were then taken after implementation of the targeted interventions.

The prevalence of *E. coli* O157:H7 pre-evisceration was 21.7% on the foreshanks in the baseline study and was reduced to 3.1% by the intervention. When carcases were sampled at the end of dressing after being subjected to the standard plant interventions of 5% lactic acid and hot water, the prevalence on foreshanks was reduced from 4.2% in the baseline study to 0%. The prevalence on the hindshanks at the end of dressing was reduced from 24.2% to 11.5% and on the topside from 37.3% to 16.7%

Prior to establishing the targeted interventions, 6.2% of samples taken from the fabrication (boning room) environment tested positive for *E. coli* O157:H7 and this was reduced to 0.7%, indicating that the potential to contaminate pathogen-free meat has been reduced by implementing the targeted interventions.

Alternative cooling procedures for large meat products

As is the case in Australia, the USDA has regulations for cooling cooked whole muscle products—such as leg hams and beef topsides—that can be difficult for processors to meet. The regulated cooling times are designed to limit the growth of *Clostridium perfringens* to 1 log which will ensure that there is no growth of *Clostridium botulinum*. The USDA requires cured products to be cooled from 54.4°C to 26.7°C in 5 h and then to 7.2°C in a further 10 h. Uncured products must be cooled from 54.4°C to 26.7°C in 1.5 h and to 4.4°C in a further 5 h. Scientists from the Texas A&M University conducted a study to determine if alternative, slower cooling programs could comply with the performance standard for *C. perfringens*.

Large (9 to 12 kg) bone-in cured hams and large (8 to 13 kg) uncured topsides were inoculated at the centre with a cocktail of *Cl. perfringens* spores and cooked to an internal temperature of 64.4°C for a minimum of 107 seconds and assigned to 11 different cooling regimes for hams and 10 for topsides. The cooling regimes included a control treatment for the hams which conformed to the regulations, a worst case scenario where the products were allowed to cool at room temperature and further combinations of times to reduce the internal temperature from 54.4°C to 26.7°C and then to 7.2°C (or 4.4°C in the case of topsides). Due to the size of the product the regulation for the uncured beef could not be met.

In the case of the cured hams, all cooling treatments, including the 'worst case' of cooling at room temperature resulted in less than 1 log growth of *Cl. perfringens*. Therefore the cure had an inhibitory effect on the growth of *Cl. perfringens*. The 'worst case' for beef resulted in >1 log growth, but all other treatments met the criteria; however, the treatments that took the longest time of 3.5 h to reduce the temperature from 54.4°C to 26.7°C resulted in 0.9 log growth and were not recommended.

The results of the study demonstrated that industry could use slower cooling times than prescribed in the USDA regulations and still meet the performance standards for whole muscle products.

Little difference in contamination between grass-fed and grain-fed beef

Grass-fed and organic beef hold only about 2% of the US market, but this is increasing by 10% per annum due partly to marketing claims that they are safer than the grain-fed alternative. Grass-fed is marketed as being safer based on the high-fibre diet and the beneficial effect of forage on gut microbes.

This safety claim was tested in a preliminary study by purchasing 50 grass-fed and 50 grain-fed beef samples from retail outlets and analysing for a range of bacteria and antimicrobial resistance of *E. coli* and *Enterococcus* isolates.

They found no significant differences in total coliform, *E. coli*, or *Enterococcus* levels between grass-fed and grain-fed samples. No *E. coli* O157:H7 or *Salmonella* were isolated from any of the samples. There were no differences in the percentages of antimicrobial resistant *E. coli* isolated from each group with *E. coli* most commonly resistant to sulfisoxazole and tetracycline. There was a higher level of antimicrobial resistance found in *Enterococcus* isolates with near 100% of isolates from both groups resistant to chloramphenicol and flavomycin. *Enterococcus* isolates from grain-fed beef were more frequently resistant to daptomycin and linezolid than isolates from grass-fed beef samples.

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In the United States, grass-fed beef is generally processed in small or very small plants, therefore it is likely that the processing hygiene would play as great a role as diet in the overall safety of the products. It was concluded that, based on the preliminary trial, grass-fed beef products do not have clear advantages in terms of food safety.

The SimPlate method for enumeration of *E. coli*

The occurrence of *Escherichia coli* on the surface of carcases is used as an indicator of faecal contamination and is monitored by meat processors; however, using the traditional pour-plate methods, it can take two days to obtain a result. The more rapid SimPlate method can achieve a result in 24–48 hours. SimPlate is a most probable number (MPN) method and has been compared with conventional methods for detecting *E. coli* on other food products, but not for swab samples from beef or sheep carcases.

In Norway, 588 swab samples were collected from beef and sheep carcases. Sterile saline peptone water was added to each stomacher bag containing the swab and, after stomaching, the dilution fluid was used for both methods.

E. coli was detected by at least one of the methods on 270 (46%) of the samples. Forty-five samples (8%) were positive only by the SimPlate method and 28 (5%) were positive only by the pour-plate method. Statistical analysis of the results showed a high level of agreement between the two methods. The SimPlate method is a rapid and simple method that can be used by relatively untrained staff with little equipment and was recommended as an alternative method for *E. coli* detection by the meat industry.

Lactobacillus to preserve vacuum-packed lamb

Lactic acid bacteria (LAB) normally become the dominant microbial flora in the anaerobic conditions of vacuum-packaged meat. Some strains of *Lactobacillus sakei* found on chilled meat have been shown to inhibit the growth of undesirable pathogens and spoilage organisms such as *Listeria monocytogenes, Campylobacter jejuni and Clostridium estertheticum*. Under normal processing, the numbers of these desirable, benign LAB strains is highly variable from pack to pack, so trials were done in New Zealand on seeding lamb cuts prior to vacuum packaging.

Lamb leg slices were inoculated with a combination of three strains of *L. sakei* at high and low levels, stored at –1°C for up to 14 weeks and sampled every two weeks from week 6.

In all the inoculated packs, *L. sakei* became the predominant flora and between 6 and 14 weeks comprised between 68% and 98% of the anaerobic population which reached 8 $\log_{10}$ cfu/cm^2 after 14 weeks. There was a high degree of uniformity of LAB populations between packs as compared with the variation observed in numbers usually seen in similar product packed conventionally.

The surface pH of the inoculated samples followed a similar trend to that of the uninoculated controls, but about 0.3 pH units lower, demonstrating that inoculation with *L. sakei* has the effect of reducing surface pH. Packs stored for up to 12 weeks appeared and smelled acceptable, but those opened at 14 weeks had strong spoilage odours and were not subjected to sensory evaluation. All packs were acceptable up to 12 weeks and the inoculated samples were no less acceptable to consumers than the controls. The results demonstrated that inhibitory *L. sakei* strains could be inoculated on to meat surfaces and develop into the dominant flora without reducing the acceptability of the cooked product.

Influence of high-oxygen MAP on beef quality

High-oxygen modified atmosphere packaging (MAP) enhances the colour stability of red meat and is used to extend the supermarket display life; however, the high oxygen level leads to increased lipid oxidation and it has also been shown that beef steaks are less tender, although the reasons for this are not clear. Vacuum packaging will provide a longer shelf life, but is not as acceptable for retail display. A trial was conducted replicating the storage times used in Sweden to compare the quality of beef aged in vacuum packs with beef aged in MAP and a combination of the two (vacuum packaging followed by MAP).

Steaks from the loins of young bulls were packaged in vacuum or high-O_2 MAP three days after slaughter. They were then stored for combinations of 0, 5 or 15 days in vacuum and 0, 5 or 10 days in MAP at 4°C, before samples were packed in oxygen-permeable film for up to 5 days for assessment of colour stability.

The steaks in MAP were less tender as measured by shear force and by a sensory panel. They were also scored lower for juiciness and flavour compared with steaks packaged only in vacuum. Steaks aged for the longest period of 15 days in vacuum or a combination of 5 days in vacuum and 10 days in MAP had the poorest colour stability when packaged in oxygen-permeable film.

Contact us for additional information

Meat Industry Services is supported by the Australian Meat Processor Corporation (AMPC) and Meat & Livestock Australia (MLA).

Brisbane:
CSIRO Food & Nutritional Sciences
PO Box 745
ARCHERFIELD QLD 4108

Neil McPhail
T +61 7 3214 2119
F +61 7 3214 2103
M 0414 336 907
Neil.McPhail@csiro.au

Armidale:
Alison Small
CSIRO Livestock Ind.
Locked Bag 1
ARMIDALE NSW 2350

T +61 2 6776 1435
F +61 2 6776 1333
M 0409 819 998
Alison.Small@csiro.au

Sydney:
Bill Spooncer
PO Box 181
KURMOND NSW 2757

T +61 2 4567 7952
F +61 2 4567 8952
M 0414 648 387
bill.s@bigpond.net.au

Melbourne:
Robyn Warner
Private Bag 16
WERRIBEE VIC 3030

T +61 3 9731 3268

M 0407 316 760
Robyn.Warner@csiro.au

Adelaide:
Chris Sentance
PO Box 344
LYNDOCH SA 5351

T +61 8 8524 4469

M 0419 944 022
chrisfss@ozemail.com.au