

Meat technology-What's new

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Effect of surface drying on survival of *Salmonella* on beef during heating

Heat treatment is often used to decontaminate product to ensure microbiological safety, and it is known that dry heat is less effective than moist heat. Irish investigators studied the effect of the surface water activity (a_w) on the survival of *Salmonella* Typhimurium on beef surfaces during heating.

Discs of beef were inoculated with *Salmonella* and dried in air to achieve surface a_w of 0.95, 0.85 and 0.70. The samples were then vacuum packed and heat treated in a water bath at 60°C. Curves showing the survival of *Salmonella* during heating at 60°C for different surface a_w values, were developed. The a_w influenced the shape of the curves and the time required to achieve a 1-log reduction. At high water activities there was a rapid decline in numbers of *Salmonella*, with a 1-log reduction being achieved in 0.5 min at a_w of 0.99 and 1.55 min at 0.95. When dried samples were heated, there was an initial decline in numbers of cells followed by a much slower rate of inactivation. A 1-log reduction was achieved in 11.25 min at a_w 0.85 and 17.79 min at 0.70.

These results would indicate that caution needs to be exhibited using hot, dry air to decontaminate meat surfaces as this may rapidly dry the surface resulting in enhanced survival of the pathogens.

Meat quality of Brahman and Brahman cross cattle

Brahman is the predominant cattle breed in northern Australia due to its suitability to the harsher production environment, and now over 50% of the national herd is estimated to have some Brahman genes. It is well documented that as the proportion of *Bos indicus* content increases, the eating quality of the meat decreases due to decreased tenderness and marbling. The Beef CRC has reported on trials to quantify the effect of *Bos indicus* content on meat palatability and to examine the effects of the application of tenderstretching for improving meat quality of meat from these cattle.

Muscles from the striploin and eye round from pure-bred Brahmans had the highest shear force (toughest) and failed to meet the MSA grading standard. Cattle with up to 75% Brahman content successfully met minimum objective and sensory meat quality consumer thresholds for tenderness.

When Brahman and Brahman-cross cattle were finished in a feedlot for the domestic, Korean and Japanese markets, they

reached market weight by 24 months of age, whereas those finished on sub-tropical pasture were up to 36 months old due to their seasonally interrupted growth. Pasture finishing adversely affected meat quality with Korean and Japanese market animals being unacceptably tough.

Tenderstretching during carcass chilling improved the tenderness of the loin muscle by reducing the mean shear force by 1.04 kg. It also reduced the degree of variation in shear force in both the Brahman and other tropical cross-breeds.

Changes in *Listeria* populations on frankfurters

Time/temperature control is one of the most important factors in controlling the risk of food-borne pathogens. *Listeria monocytogenes* is the main organism of concern with refrigerated ready-to-eat meat products because of its ability to grow at refrigeration temperatures. Most of the published studies on growth of *L. monocytogenes* have been conducted under constant conditions, whereas in practice there are temperature fluctuations between manufacture and consumption. A study was undertaken in America to evaluate the fate of *L. monocytogenes* inoculated onto frankfurters, formulated with and without antimicrobials lactate/diacetate, and stored under the variable conditions that may be experienced.

Frankfurters were manufactured with and without 1.5% potassium lactate and 0.1% sodium diacetate and inoculated on the surface with 10 strains of *L. monocytogenes*. Storage and distribution conditions were selected to simulate a potential temperature abuse scenario. The samples were held at 4°C for 24 h to simulate in-plant storage, then 7 h at 7°C followed by 7 h at 12°C to simulate temperature abuse during transport to retail. They were then stored at 4°C for up to 60 days to simulate retail storage. At set intervals, packages were exposed to 3 h at 23°C and then opened or held sealed at 4 or 7°C to simulate storage at home or a food service establishment.

L. monocytogenes counts remained relatively constant on frankfurters with potassium lactate/sodium diacetate added regardless of product age and storage conditions; however, they increased on product without antimicrobials. During home storage in sealed and opened vacuum packs, the pathogen grew faster on older product than on product that had zero time of storage prior to purchase. The results confirmed USDA recommendations that frankfurters can be safely stored at 4.4°C in opened packages for no more than one week and in vacuum packs for no more than 2 weeks; however, if product without antimicrobials was contaminated at packaging, held at 4°C for 2 weeks and then stored unopened for 7 days by the consumer, pathogen numbers may increase by more than one log cycle.



Impact of process design on greenhouse gas generation by wastewater treatment plants

Wastewater treatment plants (WWTPs) are recognised as a significant source of greenhouse gas (GHG) emissions such as CO₂, CH₄ and N₂O. The estimation of these emissions has traditionally been based on the on-site emissions only, but there are also off-site emissions associated with the plant operation. These off-site emissions arise from production of electricity for the plant, production and transport of fuel and chemicals for on-site usage, degradation of the remaining constituents in the effluent and transportation and disposal of solids, and are traditionally allocated to the energy sector and not the WWTP.

Most studies relating to GHG emissions from WWTPs have concentrated on municipal treatment plants. A Canadian study has examined the higher-strength wastes from the food industry and developed a model to estimate both on-site and off-site emissions. Three types of biological treatment processes were examined: an aerobic system, an anaerobic system and a hybrid anaerobic/aerobic process. All systems employed an on-site anaerobic digestion system to process waste sludge.

Based on an influent BOD of 2,000 g/m³ and a flow rate of 1,000 m³/day, the model calculated the CO₂-e emissions for each type of treatment system. Contrary to previous reports in the literature, it was found that the aerobic system had the lowest GHG emissions when the off-site emissions were included. The overall on-site emissions were 1952, 1992 and 2435 kg CO₂-e/day for aerobic, anaerobic and hybrid systems respectively. The off-site emissions were 1313, 4631 and 5205 kg CO₂-e/day.

Recovery of the biogas for use as a fuel would cover the total energy needs of each of the three types of operations. This would reduce GHG emissions by 512, 673 and 988 kg/CO₂-e/day for the aerobic, anaerobic and hybrid systems respectively.

Cattle welfare and beef quality

A paper at the American Reciprocal Meat Conference 2009, reviewed the pre-slaughter factors that affect meat quality, and discussed the effect of heat stress, transport, pre-slaughter holding and stunning on the quality of beef.

Acute heat stress before slaughter can lead to dark cutting meat when there is glycogen depletion. A study in the US

found that the incidence of dark cutters was highest during the second half of summer and that the provision of shade in the feedlot reduced the incidence. If there is no shade, sprinkling the cattle with water to relieve heat stress is good practice.

Bruising can occur during transport, particularly if animals fall. Hard cornering was provided as the main reason for falls, but bruising and falls could be reduced by dividing the cattle into small pens within the vehicle.

The holding time at the abattoir and the treatment immediately prior to slaughter can have some small effects on meat quality. A longer holding period allows the animals to rest and rehydrate, but there is a greater risk of high or intermediate pH meat if they are held for too long, and there is a greater opportunity for bruising if there is mounting behaviour. The intermediate pH range associated with increased toughness is usually between 5.8 and 6.2. Situations that can lead to a higher prevalence of intermediate pH beef include sourcing cattle from saleyards, excessive exercise before slaughter and slaughtering cattle following transport without providing a rest period.

The *L. dorsi* pH is not always representative of other muscles in the carcass when exercise stress is involved. Running has very little effect on the *L. dorsi* (loin), but it depletes glycogen in the *semimembranosus* and the *semitendinosus* (leg movement muscles) leading to higher meat pH. Feedlot cattle can get tired feet and those that sat down in the abattoir holding yard overnight were more likely to have brighter-red meat than those that did not sit down.

Cattle that were excited and stressed during the 15 minutes before slaughter by repeated prods with an electric goad had meat that had poorer tenderness, juiciness and flavour and released more drip during storage.

Our new image

CSIRO established the Division of Food and Nutritional Sciences on 1 July in new collaborative arrangements with the Victorian Government. The new Division maintains the full food and nutrition research capability and research portfolio that was operated by Food Science Australia (FSA), a joint venture of CSIRO and the Victorian Government, and CSIRO Human Nutrition. While the look of Meat Industry Services publications has changed to reflect us being part of CSIRO, our role has not changed and we are still supported by AMPC, MLA and CSIRO.

The information contained herein is an outline only and should not be relied upon in place of professional advice on any specific matter.

Contact us for additional information

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

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