Meat technology-What's new

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WHAT'S NEW
Summaries of recent publications

Heat-resistant *E. coli* from a beef processing facility

Interventions are commonly used in beef processing to reduce the numbers of pathogenic bacteria on the carcase. These often utilise heat via hot water washes, steam pasteurisation or steam vacuuming. Acid washes, typically with 2–4% lactic acid are also used for beef decontamination.

Despite the widespread use of these interventions, particularly in North America, enterohaemorrhagic *Escherichia coli* (EHEC) remain a major concern and represent a potential public health risk. Generic *E. coli* is an indicator that pathogenic strains could be present on beef carcases and it has been demonstrated that some of these strains survive interventions during slaughter and persist on slaughtering equipment. A study in Canada compared the heat resistance of slaughter-plant isolates of generic *E. coli* with strains isolated from live cattle and a laboratory collection.

Twenty strains of *E. coli* were isolated from a commercial beef slaughter-plant environment, seven from live dairy cattle, one from a slaughter plant prior to decontamination and two from a laboratory reference collection. Cocktails of five strains were inoculated on to meat surfaces which were treated with steam followed by lactic acid.

The 20 slaughter-plant strains were more resistant to heat and lactic acid than the reference strains or strains from live cattle. The time for live cattle strains to be reduced by 90% at 60°C (D_{60}) ranged from 0.1 to 0.5 minutes, whereas the D_{60} values for the slaughter-plant strains were between 15 and 71 minutes. One particular strain of *E. coli* (AW 1.7) was found to be extremely heat resistant and was capable of surviving in ground beef when cooked to the recommended internal temperature of 71°C.

Although heat-resistant strains of *E. coli* represent only a very small proportion of organisms present, the use of interventions may select for heat-resistant strains in the abattoir environment.

Effects of dry and spray chilling on *E. coli* and *Salmonella*

Small beef slaughter establishments do not install intervention processes such as hot water, steam and acid spray cabinets mainly due to the high capital and operating cost. Instead, many small plants in the United States hold carcases in a dry chiller at less than 5°C for a minimum of 6 days. This process results in high evaporative losses compared with larger processors who often use spray chilling to reduce chilling weight loss.

In a recent study spray chilling, followed by ageing beef in vacuum packs, was compared with dry chilling, followed by dry ageing. The influence of each treatment on numbers of *E. coli* O157:H7 and *Salmonella* on beef fat and lean surfaces was determined.

Samples of fat and lean tissue were excised from carcases prior to chilling and inoculated with cocktails of three strains of *E. coli* O157:H7 and two strains of *Salmonella* Typhimurium. Samples were then either spray chilled then aged in vacuum packs (wet-aged) or dry chilled and then dry aged in air without packaging at 3°C and 80% RH for up to 28 days.

For both *E. coli* and *Salmonella* lean tissue had higher counts than fat at most sampling periods. After 24 hours chilling, numbers of *E. coli* and *Salmonella* were lower on the spray-chilled than on the dry-chilled samples, indicating a possible wash-off effect of spray chilling. There were no differences in *E. coli* numbers at 48 hours, but from days 7 through to 28, numbers recovered from dry-aged samples were lower than from wet-aged samples. Numbers were reduced from 4.7 to 1 $\log_{10}$ CFU/cm^2 on dry-aged samples compared with a reduction of 4 to 3.7 $\log_{10}$ CFU/cm^2 on the vacuum-aged meat. There were similar reductions in *Salmonella* numbers on dry-aged samples after extended storage.

The results confirmed that 'chilling and ageing' is a potential intervention for small and very small beef processing plants.

Dead stock disposal methods

Death of animals during the raising and transport of livestock is an inevitable consequence of farming systems. The carcases need to be disposed of safely, practically and economically. In some countries, particularly the EU, there are limited legal avenues available due to concerns regarding the spread of transmissible spongiform encephalopathy (TSE) and pollution. A review discussed the current and possible future methods for disposing of livestock mortalities.

Burial

This is a traditional method of disposing of dead stock, but is banned in the EU and concerns have been raised in other countries that it could lead to contamination of ground and surface water. However, no studies have linked burial of animal carcases with serious environmental impact or detrimental effects on human or animal health. The application of lime during operation of a burial pit may be a simple method of improving biosecurity.

Burning

Mass burning has been used in disease outbreaks such as the British foot-and-mouth disease outbreak of 2001. Despite the potential for pollution, soil contamination was negligible and air emissions only had an effect in the immediate vicinity. Despite minimal environmental impact, there was considerable social concern regarding odour and unsightliness.

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Incineration

Incineration is the process of burning at high temperature (≥850°C) and is expected to destroy all infective agents. Incineration has a high energy demand and would normally be done at a central facility requiring transport of animal carcases leading to possible spread of disease.

Rendering

Rendering is a well established method of disposal of livestock mortalities with the main environmental concerns being odour emissions from the raw material, the process and effluent. The EU requires high-risk material to be processed at 133°C for 20 min at 300 kPa to inactivate TSEs.

Composting

Composting is a simple technique that can be undertaken using windrows or a bin in which the animal carcase is layered between carbon-rich material such as straw, sawdust or rice hulls. Composting should be undertaken on an impervious base to minimise the risk of pollution due to leaching and runoff. The temperatures of up to 70°C generated during composting reduce numbers of bacteria and viruses, but there is little information on the fate of TSE prions or spore-forming bacteria.

Anaerobic digestion

Anaerobic digestion involves the degradation of organic material under anaerobic conditions to produce biogas and liquid and solid fertiliser. Although widely used for other wastes, there is little information on its use for digestion of carcases. Anaerobic digestion can eliminate a range of pathogenic organisms, but TSEs are not destroyed.

Alkaline hydrolysis

Alkaline hydrolysis is a relatively new technology and uses sodium hydroxide or potassium hydroxide to catalyse the hydrolysis of biological material into a sterile aqueous solution consisting of peptides, amino acids, sugars and soaps. The process is effective in eliminating both pathogens and prions due to the combination of high pH and elevated temperature and pressure.

An alternative to immediate treatment of mortalities is to freeze the carcase for storage until collected by a processor.

The effect of roofing material on the quality of harvested rainwater

The collection of rainwater for potable and non-potable uses is undergoing a surge in popularity in many parts of the world in order to conserve traditional high-quality water supplies. Harvested rainwater can include contaminants including heavy metals, pesticides and a range of microorganisms. A study was undertaken in the US to examine the effects of roofing material on the quality of harvested rainwater.

Five pilot-scale roofs were constructed in Austin, Texas. Three were of material commonly used in the United States (asphalt fibreglass shingle, Galvalume® (aluminium-zinc coated steel) and concrete tile). Another two were alternative roof materials: an unfertilized green roof and a 'cool roof' constructed of acrylic-surfaced, 2-ply polypropylene bituminous membrane. The roofs were equipped with a sampling system consisting of a first-flush bottle and collection tanks. The contents and an ambient sampler were analysed for a range of pollutants.

The results showed that the rainwater harvested from any of the tested roofing materials would require treatment if the consumer wanted to meet the USEPA drinking water standards or non-potable reuse guidelines. At a minimum first-flush diversion, filtration and disinfection are recommended, based on the samples collected; but rainwater collected in other locations may be of different quality.

Metal roofs are commonly recommended for rainwater collection applications but this study did not show that the quality of the water was clearly superior to that collected from concrete tiles or the cool roof. The dissolved organic carbon concentrations in the water from the shingle and green roofs were very high and could lead to high concentrations of disinfection by-products after chlorination. Otherwise the water from these roofs was of comparable quality in most respects.

Contact us for additional information

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