EFFICACY OF SIMPLE METHODS OF CLEANING FOR RED MEAT ABATTOIR LAIRAGES

A. Small*[1,3], C. James[2], G. Purnell[2], P. Losito[1], S. James[2] and S. Buncic[1]

[1] Division of Farm Animal Science, University of Bristol, Langford House, Bristol BS40 5DU, UK. [2] Food Refrigeration and Process Engineering Research Centre (FRPERC), University of Bristol, Churchill Building, Langford House, Bristol BS40 5DU, UK. [3] Current address: Food Science Australia, PO Box 3312, Tingalpa DC, QLD 4173, Australia. Email:alison.small@csiro.au

Keywords: abattoir, lairage, cleaning, washing

Introduction

In the abattoir lairage, many animals from numerous sources are gathered in close proximity (Jarvis *et al.*, 1996), potentially carrying foodborne pathogens on their coats and in their intestines (Paiba and Gibbens, 2000; Reid *et al.*, 2002). Such organisms may be shed into the environment during the lairaging period, and can remain on the surfaces within the lairage for a number of days, particularly in the presence of faecal material (Gibson, 1961; Small *et al.*, 2003), and these organisms may contaminate the animals passing through the facility (Collis *et al.*, 2004). Abattoir operators are recommended to keep lairages clean, but routine cleaning procedures are often insufficient to remove significant pathogens from the environment (Swanenburg *et al.*, 2001, Schmidt *et al.*, 2004). This study was carried out to evaluate some simple methods of lairage cleansing found to be in use at commercial abattoirs in the UK (Small *et al.*, submitted for publication).

Materials and Methods

A mechanical rig was designed to effect consistent repeatable application of cleaning treatments, and this was used to clean concrete slabs designated as visually dirty (painted with bovine faeces inoculated with field strains of *E. coli* and *Salmonella* Kedougou) or visually clean (painted with a broth culture of the two organisms). Each of 30 visually clean and 30 visually dirty concrete slabs were cleaned using the following methods: *(i)* Plain hose (mains pressure); *(ii)* Pressure washer *(iii)* Pressure washer with Janitol branded sanitiser (DEB Limited); *(iv)* Steam under pressure. From the results gained, a further 30 visually dirty slabs of concrete were cleaned with each of a combination of *(v)* plain hose followed by steam or *(vi)* pressure wash followed by steam.

Samples were taken from each concrete slab immediately prior to the onset of cleaning, immediately after cleaning and after a one-hour drying period, using a wet/dry swab technique over a templated area of 100cm^2. Samples were taken into a peptone salt solution in all cases except for those samples taken after the use of Janitol sanitiser, in which case the samples were taken using a proprietary neutralising medium. Samples were processed using standard methods for the enumeration of *Enterobacteriaceae* and the results were analysed by ANOVA using MINITAB software.

Results and Discussion

There was no significant difference in overall reduction in *Enterobacteriaceae* count between plain hose and pressure washer on visually clean surfaces, although pressure washing gave a greater reduction in *Enterobacteriaceae* count immediately after cleaning, and neither was there a significant difference in overall reduction in *Enterobacteriaceae* count between Janitol sanitiser or steam under pressure on visually clean surfaces. There was no significant difference between the overall reductions in *Enterobacteriaceae* achieved by plain hose and pressure wash on dirty concrete when compared with clean concrete, nor between the immediate reductions obtained using pressure wash. However, plain hose gave a greater immediate reduction in *Enterobacteriaceae* count on dirty concrete (2.1 log) than on clean concrete (1.7 log)($P<0.01$), while Janitol sanitiser gave a greater immediate reduction on clean (5.2 log) than on dirty (4.4 log), but less overall (5.2 log versus 5.7 log)($P<0.01$). The use of steam under pressure gave good reductions in *Enterobacteriaceae* count (3.7 log immediate, 5.5 log overall) on a clean surface, this overall reductions being statistically similar to that achieved using Janitol sanitiser. However, in the presence of faecal material, steam under pressure gave the poorest reduction in *Enterobacteriaceae* count (0.9 log immediate, 1.8 log overall). Of the single treatments, Janitol sanitiser gave the greatest immediate reduction in *Enterobacteriaceae* (5.2 log on clean and 4.4 log on dirty surfaces) as a result of the cleaning process, but there was little further effect of drying.

Using a combination of pressure wash followed by steam on a visually dirty surface gave overall reductions in *Enterobacteriaceae* (5.8 log) comparable with those achieved using sanitiser (5.7 log)($P<0.01$), but there was a greater component of drying where the combination cleanse was used. This combination also gave reductions comparable with those seen using steam alone on a visually clean surface (5.5 log), but a combination of plain hose and steam was less effective in cleansing a visually dirty surface. This combination gave results comparable with those achieved using a pressure wash alone (4.1 log and 3.9 log)($P>0.01$). It is possible that allowing a drying phase between the two phases of the pressure and steam combination may give greater reductions in *Enterobacteriaceae*.

The use of a chemical cleaning agent has been reported to be an important step in reducing microbial numbers on stainless steel for the dairy industry (Dunsmore, 1981), but the efficacy of chemical disinfectants or sanitisers is often much reduced in the presence of organic material (Sprenger, 1997), or by usage with water at temperatures below 25°C

(Gelinas *et al.*, 1984). The current study found that where a concrete surface is visually clean, the use of a proprietary sanitiser at maximum recommended concentration, or the application of steam under pressure gave the greatest reductions in microbial contamination. Plain hose or pressure washing gave similar results to one another, findings similar to those reported in the 1970s comparing hot water at low pressure to cold water at high pressure (Dempster, 1977), and were only slightly less effective than steam or sanitiser. Where the concrete surface was visually contaminated with the faecal material, the use of a pressure wash followed by immediate steam application gave reductions in microbial contamination comparable with the use of a proprietary sanitiser at maximum recommended concentration. The use of a pressure wash alone, or plain hose followed by immediate steam application would rank second in effectiveness, both giving similar reductions in microbial contamination, and the use of plain hose alone would rank third. The reduced effect observed in the presence of faecal contamination could be accounted for by the organic material forming a protective layer containing the organisms, and becoming firmly adherent to the concrete surface during the post-deposition period. The use of steam alone on a visually dirty surface was not an effective means of reducing microbial contamination, and was not even sufficient to remove visual faecal contamination.

Conclusions

When cleaning a faecally soiled area such as a holding pen floor, pressure washing immediately followed by steam under pressure gives comparable microbiological cleaning to use of a proprietary sanitiser at maximum recommended concentration. Pressure washing is not as good, but better than plain hose with steam, which in turn is better than plain hose alone. Drying of the surface following cleaning is important to maximize reductions in microbial load. Further work is required to explore the effects of parameters such as water temperature or pressure and angle of application.

References

Collis, V.J., C.-A. Reid, M. L. Hutchison, M. H. Davies, K. P. Wheeler, A. Small A. and S. Buncic (2004). Spread of marker bacteria from the hides of cattle in a simulated livestock market and at an abattoir. Journal of Food Protection, 67, 11, 2397-2402.

Dempster, J. F. (1977). Cold water, ultra-high pressure cleaning of abattoirs. Journal of Hygiene, Cambridge, 78, 11-16.

Dunsmore, D. G. (1981). Bacteriological control of food equipment surfaces by cleaning systems. I. Detergent effects. Journal of Food Protection, 44, 1, 15-20.

Gelinas, P., Goulet, J., Tastayre, G. M. and Picard, G. A. (1984). Effect of temperature and contact time on the activity of eight disinfectants - a classification. Journal of Food Protection 47, 11, 841-847.

Gibson, E. A. (1961). Salmonellosis in calves. The Veterinary Record, 73, 1284.

Jarvis, A. M., Harrington, D. W. J. and Cockram, M. S. (1996). Effect of source and lairage on some behavioural and biochemical measurements of feed restriction and dehydration in cattle at a slaughterhouse. Applied Animal Behaviour Science, 50: 83-94.

Paiba, G.A. and Gibbens, J.C. (2000). Prevalence of faecal carriage of VTEC O157 and other foodborne pathogens by cattle and sheep at slaughter in Great Britain, VLA/MHS Collaborative Project.

Reid, C.-A., Small, A., Avery, S. M. and Buncic S. (2002). Presence of foodborne pathogens on cattle hides. Food Control, 13, 411-415.

Schmidt, P. L., O'Connor, A. M., McKean J. D. and Hurd H. S. (2004). The association between cleaning and disinfection of lairage pens and the prevalence of *Salmonella enterica* in swine at harvest. Journal of Food Protection 67, 7, 1384-1388.

Small, A., Reid, C.-A. and Buncic, S. (2003). Conditions in lairages at abattoir for ruminants in Southwest England and *in vitro* survival of *Escherichia coli* O157, *Salmonella* kedougou and *Campylobacter jejuni* on lairage-related substrates. Journal of Food Protection, 66, 9, 1570-1575.

Sprenger, R. A. (1997). Hygiene for Management. London, Highfield Publications.

Swanenburg, M., Urlings, H. A. P., Keuzenkamp, D. A. and Snijders, J. M. A. (2001). *Salmonella* in the lairage of pig slaughterhouses. Journal of Food Protection, 64, 1, 12-16.

Acknowledgements

This project was funded by the Food Standards Agency, UK.