AN EVALUATION OF SELECTED METHODS FOR THE DECONTAMINATION OF CATTLE HIDES PRIOR TO SKINNING

Small A., Buncic S.

University of Bristol, Dept. of Clinical Veterinary Science, Division of Farm Animal Science, Langford, Bristol BS40 5DU, UK

Background

The coats of slaughtered ruminants are the most significant source of contamination for the resultant carcass and the slaughterhall environment, both with foodborne pathogens and with spoilage organisms (2, 3, 4). Minimising the transfer of microbial hazards from animal coats onto meat is a critical control point in any HACCP-based system in abattoirs. Currently, in the EU, this is achieved mainly through two control measures, namely the assessment of the visual cleanliness of animals prior to slaughter and good hygiene practices during the skinning of the slaughtered animals. However, the two measures cannot eliminate the risks of carcass contamination. In some countries, additional interventions are based on carcass (meat) decontamination at the end of slaughter-line, which is not widely accepted in the EU. Alternatively, as a more proactive/preventative approach, the reduction of microbial loads on hides, post-slaughter but pre-skinning, via decontamination treatments can be considered (1, 5, 8).

Objectives

In the present study, the potential of various pre-skinning decontamination treatments in reducing microbial loads on hide of slaughtered cattle was assessed.

Methods

The hides used in each of the experiments were sourced from one large processing plant in the South West of England, processing 350 cattle per day, and all were categorised as category 2 clean livestock, based on the Meat Hygiene Service Clean Livestock Policy (UK) scoring system. This category is defined as dry or damp, with light contamination of dirt or faeces, and small amounts of loosely adherent straw or bedding. The hides were microbiologically sampled (100 cm^2 per sample) using a sponge swabs as described previously (7). For each hide decontaminating treatment, 30 samples were taken before and 30 samples after the treatment, to determine average reduction of Total Viable Count of bacteria (TVC; Petrifilm™ Aerobic Plate Count, incubated for 48 hours at 30°C) expressed as $\log_{10}$ cfu/cm^2. "Before treatment" samples were taken from the site immediately adjacent to treated site on hide, and "after treatment" samples were taken exactly from the treated site. Following ten hide treatments were evaluated:

1. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C;
2. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C followed by a 10 minute drying in air;
3. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C containing a 5% solution of Formula 963B (Gibson Chemicals; a food-safe detergent containing sodium hydroxide, anionic surfactant and amphoteric surfactant);
4. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C containing a 5% solution of Formula 963B (Gibson Chemicals; a food-safe detergent containing sodium hydroxide, anionic surfactant and amphoteric surfactant) followed by a 10 minute drying in air;
5. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C containing an approved hydrogen peroxide/ peracetic acid-based disinfectant (Henkel Ecolab; 3% solution of P3-topactive DES);
6. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C containing an approved hydrogen peroxide/ peracetic acid-based disinfectant (Henkel Ecolab; 3% solution of P3-topactive DES) followed by a 10 minute drying in air;
7. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C containing a quaternary ammonium sanitizer for the food industry (Henkel Ecolab; 10% solution of Betane Plus);
8. Washing for ten seconds using a wet-and dry vacuum cleaner supplied with water at 50°C containing a quaternary ammonium sanitizer for the food industry (Henkel Ecolab; 10% solution of Betane Plus) followed by a 10 minute drying in air;
9. Clipping of hair using a rotary cattle clipper;
10. Clipping of hair followed by a ten-second singe of the same site using a hand-held blow-torch.

The results were entered into MINITAB software and analysed using one-way unstacked Analysis of Variance (ANOVA).

Results and Discussion

The results are summarised in Table 1.

Some treatments did not result in a significant change in TVC on hide, i.e. washing with warm water alone or warm water containing a 5% solution of formula 963B detergent, although subsequent 10-min drying yielded certain microbial reduction (<0.5 $\log_{10}$ cfu/cm^2). Clipping even caused a slight increase in TVC, probably due to releasing of dust from the hair that contaminated the clipped site on hide. On the other hand, the treatments that significantly reduced microbial levels on hide were washing with warm water containing a disinfectant/sanitizer i.e. 3% solution of P3-topactive DES (around 1 $\log_{10}$ cfu/cm^2), or 10% solution of Betane Plus (just under 2 $\log_{10}$ cfu/cm^2), as well as the singeing of clipped cattle hides (just above 2 $\log_{10}$ cfu/cm^2). Obviously, the singeing treatment produced the greatest decrease in hide TVC found in this study. If a true correlation between the microbial load of hides and the microbial load of the resultant carcass exists (6), a reduction in hide load of around 2 $\log_{10}$ cfu/cm^2 could result in a similar reduction in the carcass load.

Present methods of carcass decontamination give a reduction usually ranging between 2 and 3 $\log_{10}$ cfu/cm^2, suggesting that hide decontamination offers at least comparable performance with carcass decontamination. However, potentially, if the two are used simultaneously, and the effects are additive, the reduction on the carcass microbial load could be as much as 4-5 $\log_{10}$ cfu/cm^2. This level of reduction is at present unachievable using carcass decontamination alone. In addition, hide decontamination, has a potential to reduce the overall microbial loads introduced into slaughter line on slaughtered animals – i.e. from the point of skinning and further. Other benefits include potential improvement of the microbiological status of the air, environmental surfaces, staff, equipment and tools at least at the beginning of slaughter line. Further advantages of hide decontamination approach include the fact that, for carcass decontamination, available chemicals (or their

concentrations) are limited by the chemical meat safety- and/or meat sensory qualities-related implications, whereas with hide decontamination this is not a problem as the hide is an inedible by-product.

In this study, no attempt was made to assess the effects of the treatments on the hide itself. It is possible that the application of harsh chemical or heat treatments to the surface of the hide may denature the collagen of the dermis, and thus devalue the hide for the leather industry. However, if the treatments were applied solely along the major incision lines of the skinning process, any hide damage would be limited to the edges of the hide, areas that are often removed and discarded during the tanning process. If such, then even harsher treatments than used in this study (e.g. stronger chemicals/higher concentrations, or much higher temperatures) could be used for hide, which could result in further and larger bacterial reductions.

Table 1 – Effect of various decontamination treatments on the bacterial load of cattle hide

Treatment	Average change in total viable counts of bacteria (TVC; $\log_{10}$ cfu/cm^2±SD)	Statistical significance
1. Warm water wash	-0.13 ± 0.56	No (P>0.05)
2. Warm water wash followed by drying	-0.45 ± 0.72	Yes (P<0.05)
3. Warm detergent wash	-0.27 ± 0.56	No (P>0.05)
4. Warm detergent wash followed by drying	-0.23 ± 0.50	No (P>0.05)
5. Warm disinfectant wash	-0.97 ± 0.79	Yes (P<0.001)
6. Warm disinfectant wash followed by drying	-1.18 ± 0.72	Yes (P<0.001)
7. Warm sanitizer wash	-1.80 ± 0.50	Yes (P<0.001)
8. Warm sanitizer wash followed by drying	-1.98 ± 0.53	Yes (P<0.001)
9. Clipping	+0.20 ± 0.19	Yes (P<0.001)
10. Clipping followed by singeing	-2.11 ± 0.25	Yes (P<0.001)

Concluding remarks

Overall, the results of the present study indicated that a hide decontamination approach has a significant potential to improve the microbiological status of carcasses and, inherently, meat safety. This improvement can be achieved either by the hide decontamination alone, or by hide decontamination-carcass decontamination combination. However, for further increasing of microbial reductions achievable on hide, as well as for development of related engineering solutions under commercial conditions, further research is necessary.

Pertinent Literature

1. Castillo, A., Dickson, J.S., Clayton, R.P., Lucia, L.M. and Acuff, G.R. (1998) Chemical dehairing of bovine skin to reduce pathogenic bacteria and bacteria of fecal origin. Journal of Food Protection **61**:623-625

2. Elder, R.O., Keen, J.E., Siragusa, G.R., Barkocy-Gallagher, G.A., Koohmaraie, M. and Laegried, W.W. (2000).Correlation of enterohemorrhagic *Escherichia coli* O157 prevalence in feces, hides and carcasses of beef cattle during processing. Proceedings of the National Academy of Science **97**:2999-3003

3. Hadley, P.J., Holder, J.S. and Hinton, M.H. (1997) Effects of fleece soiling and skinning method on the microbiology of sheep carcases. The Veterinary Record **140**:570-574

4. Hudson, W.R., Mead, G.C. and Hinton, M. (1998) Assessing abattoir hygiene with a marker organism. The Veterinary Record **142**:542-547

5. McEvoy, J.M., Doherty, A.M., Sheridan, J.J., Blair, I.S. and McDowell, D.A. (2001) Use of steam condensing at subatmospheric pressures to reduce *Escherichia coli* O157:H7 numbers on bovine hide. Journal of Food Protection **64**: 1655-1660

6. Newton, K.G., Harrison, J.C.L. and Wauters, A.M. (1978) Sources of psychrotrophic bacteria on meat at the abattoir. Journal of Applied Bacteriology **45**: 75-82

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

8. Schnell, T.D., Sofos, J.N., Littlefield, V.G., Morgan, J.B., Gorman, B.M., Clayton, R.P. and Smith, G.C. (1995) Effects of postexsanguination dehairing on the microbial load and visual cleanliness of beef carcasses. Journal of Food Protection **58**:1297-1302

Acknowledgements

Thanks are due to Mr W.N.H. Cobden and the staff at Southern Counties (Microbiological Services), UK, for their assistance.