# Validation Of A Generic HACCP Plan For Ovine Slaughter And Inverted Dressing Systems

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## INTRODUCTION

There are increasing numbers of generic HACCP plans available for raw food commodities but many appear to be based on a systematic application of traditional parameters of good manufacturing practice (GMP) and existing national regulatory requirements rather than an assessment of food-borne risks to the consumer. Validation is a key issue often neglected in the development of HACCP plans.

In attempting to address some of the problems associated with the design of risk-based HACCP systems for raw food commodities, the NZ MAF Regulatory Authority has developed a generic template for fresh meat (Anon, 1997). Application of this template to slaughter and inverted dressing of sheep involved several key tasks (Anon, 1997), including establishment of prerequisite programmes, food safety objectives (FSOs), hazard identification of raw material components and their interaction, and the use of a customised decision tree (Anon, 1997). Validation of the model using existing ovine slaughter and inverted dressing systems was essential to determine whether the FSOs could be achieved.

A HACCP plan was developed with the following microbiological food safety objective: ATo minimise transfer and redistribution of microbiological hazards from the gastrointestinal tract and the pelt to the carcass, (including control of grossly detectable contaminants) by application of a HACCP plan that achieves specified microbiological process descriptions. Application of the customised decision tree resulted in four critical control points (CCPs); receiving of livestock, flaying during forequarter work up, pelting and retain rail trimming.

This paper reports the results of validation trials to confirm whether HACCP as applied to ovine slaughter and inverted dressing using the generic model as a base, delivered a Asignificantly@ better microbiological outcome for *Escherichia coli* as an indicator of faecal contamination (and by association, enteric food pathogens) than that obtained by GMP.

## VALIDATION TRIALS

Three premises were selected at which to carry out the validation trials. Initially, the premises had to demonstrate ongoing compliance with GMP, regulatory and market access requirements. This was achieved by identifying prerequisite activities and documenting them. These prerequisite programmes had to be verified as complete and effective, prior to the HACCP plan being introduced to the trial.

Staff at each premises required an introduction to HACCP and a clear indication of the role and responsibilities they would have in the trial. This involved a wide range of staff, including yards, slaughter floor, and laboratory personnel. The generic HACCP model for ovine slaughter and inverted dressing was customised for each premises, while endeavouring to maintain as close a fit as possible with the generic layout.

A food safety objective for each premises was established, and stated: ATo "significantly" decrease the prevalence of *E. coli* and reduce levels of *E. coli* at all sampling sites by application of a HACCP plan to an ovine slaughter and inverted dressing system.@ The pre-HACCP microbiological profiles were those achieved given current processing technology and GMP. The HACCP plan was applied and the post-HACCP microbiological profile determined.

Twenty five carcasses were randomly selected for pre- and post-HACCP groups from mobs of lambs presenting with short (3-5cm) clean dry wool. Swab samples were collected from five sites per carcass; outside hind leg, flap, brisket, shoulder and forequarter opening cut area. All samples were collected transported and analysed for *E. coli* according to the procedures described in the technical specification to the National Microbiological Database (Anon., 1997b).

The effect of application of HACCP on the level of *E. coli* contamination was analysed using the paired t-Test assuming equal variance. The effect on prevalence of *E. coli* contamination was analysed using Pearson=s chi-square test.

## RESULTS & DISCUSSION

Pre- and post-HACCP results are presented in Table 1.

Previous studies (Biss & Hathaway, 1995, Biss & Hathaway, 1996) have confirmed that the pelting operation transfers the bulk of the microbial contamination onto the carcass during the slaughter and dressing process. The degree of contamination can be positively influenced by appropriate livestock presentation as defined by the critical limits in the generic model relating to wool length, cleanliness and the dryness of lambs but often at the expense of an increase in visible contamination on the carcass.

The validation trials generally reflected the expected microbial decrease, after HACCP implementation, in the form of a reduction in prevalence and levels of *E. coli* at all premises, with the exception of the levels of *E. coli* at the outside hind leg sites at premises A and C. At premises B, a decrease in *E. coli* levels was observed at all sites and similarly, the prevalence decreased at all sites.

At premises A and C, while a statistically significant decrease in the level of *E. coli* was not observed at any of the sampled sites, a statistically significant reduction in the prevalence of *E. coli* was observed at all sites except the outside hind leg site for premises A. At premises B, the decrease in *E. coli* levels was only statistically significant at the brisket and flap sites and there also was a statistically significant decrease in prevalence at the outside leg, open Y cut and brisket sites.

This result generally reflects a movement of the frequency distribution profile for *E. coli* to the left, indicating an overall improvement in dressing hygiene. Since the outside hind leg site is not routinely a high risk site for faecal contamination in an inverted dressing system, it is therefore understandable that procedural changes designed to lower the risk of faecal contamination may not always be reflected at the outside hind leg site. Of note is the observation that levels of *E. coli* showed statistically significant decreases only where the initial numbers were greater than $\log_{10}$ 1.30 cfu/cm$^2$. It is possible that most contamination events can result in residual bacterial numbers up to log 1.30, but only some dressing procedures, deemed problematic when presentation status is compromised, result in counts greater than this.

The positive effect of presentation status was also observed in a previous study using excision sampling (unpublished data) where the mean *E. coli* count on the leg site was $\log_{10}$ cfu/cm$^2$ 1.71 with implementation of a HACCP plan. The mean counts on a similar site in the these validation trials were $\log_{10}$ cfu/cm$^2$ 0.87, $\log_0$ cfu/cm$^2$ 1.11, and $\log_0$ cfu/cm$^2$ 0.75 respectively, using surface swabbing. Given the findings of a recently completed sampling method calibration study (unpublished data) which indicates that swab sampling detects marginally less *E. coli* than excision sampling, ($\log_{10}$ cfu/cm$^2$ 0.22) the findings of these trials compare favourably with previous work.

Anecdotal evidence from the trial premises suggests that the visual contamination with wool, seen in association with the reduction in prevalence/levels of *E. coli* is considerably higher than pre-HACCP. Inconsistencies are also noted in the premises results when comparing degree

of contamination at individual sites. This can be expected when implementing HACCP and has been noted by others (Biss and Hathaway 1996). It can usually be attributed to the many variables associated with the process such as livestock, processing conditions, workforce performance and the ability to institute change successfully. Further work is necessary to determine if increased visual contamination with wool compromises the gains made in reducing unseen contamination with *E. coli* by implementation of HACCP. Similarly, nationally-derived microbiological process descriptions will be developed so that all export slaughterhouses achieve acceptable process hygiene on an ongoing basis.

A difference in ability to implement a HACCP plan will be inevitable, given the range of industry experience available. The critical limits associated with presentation of lambs for slaughter, alone, require a significant change in direction for industry compared with current practices and this must be balanced against the observed changes to visible contamination on the carcass, in terms of the desired outcome for the end product. Variation in operators carrying out tasks at the pelting CCPs will influence microbial transfer at those sites, even though monitoring, under the requirements of the HACCP plan, should be stabilising and thus control this variable. In conclusion, while application of HACCP to ovine slaughter and inverted dressing resulted in marked improvements in dressing hygiene, the associated increase in visible contamination primarily with wool, requires industry to identify procedures that offer an acceptable and practical balance between decreasing the presence of potential enteric pathogens as indicated by the prevalence and levels of *E. coli* , while limiting rates of visible contamination to levels acceptable to industry, their clients and the regulators.

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**TABLE 1**

Prevalence and count of *Escherichia coli* prior to and after implementation of HACCP in an ovine slaughter and inverted dressing system

| | Premises A | | | Premises B | | | Premises C | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample site | n | n detected | $Log_{10}$ cfu/cm$^2$ % change | n | n detected | $Log_{10}$ cfu/cm$^2$ % change | n | n detected | $Log_{10}$ cfu/cm$^2$ % change |
| Outside hind-leg | | | | | | | | | |
| Pre-HACCP | 24 | 16 | +66 | 25 | 12* | -47 | 25 | 10* | +15 |
| Post-HACCP | 25 | 7 | | 24 | 2* | | 25 | 3* | |
| *Opening Y cut* | | | | | | | | | |
| Pre-HACCP | 25 | 20* | -76 | 25 | 10* | -73 | 25 | 14* | -54 |
| Post-HACCP | 25 | 3* | | 24 | 3* | | 25 | 3* | |
| *Brisket* | | | | | | | | | |
| Pre-HACCP | 25 | 16* | -65 | 25 | 15* | -86* | 25 | 14* | -54 |
| Post-HACCP | 25 | 1* | | 24 | 3* | | 25 | 2* | |
| *Flap* | | | | | | | | | |
| Pre-HACCP | 24 | 21* | -51 | 25 | 17 | -89* | 25 | 17* | -53 |
| Post-HACCP | 25 | 13* | | 24 | 10 | | 25 | 6* | |
| *Shoulder* | | | | | | | | | |
| Pre-HACCP | 25 | 6* | -59 | 25 | 7 | -76 | 25 | 9* | -57 |
| Post-HACCP | 25 | 1* | | 24 | 5 | | 25 | 2* | |

* t-Test or Chi-square test: Significant at $p<0.05$