

final report

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Scientific underpinning of the beef and sheep processing tools, and how they can be used

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1 Scientific underpinning

1.1 Beef tool

In 2004, MLA commissioned Project PRMS.048b "Variables in beef processing and testing". In this project a team of scientists from Food Science Australia (FSA) and Department of Primary Industry Victoria (DPIV) visited 15 export beef establishments, tasked with gathering data on all aspects of operations from transport of livestock, through slaughter and dressing and including training & retention of personnel. The team used a questionnaire which included 77 questions as the basis for gathering information, which was done by interviewing key management staff at each plant, together with observation of slaughter and dressing operations.

The team then concluded: There are many factors which can affect the microbiological quality of beef carcases: the state of the animals at slaughter, the care with which they are processed and the speed with which they are chilled. Under each of these broad headings there are more factors that can influence the final outcome. To try and relate these factors to an average measure of the hygiene of carcases is difficult if not impossible. The data presented in this report confirms this and highlights the variability associated with practices essentially delivering the same outcome.

It may be that with more careful analysis trends can be identified and this should be attempted. Also it may be possible to group plants based on similarities in their practices. In this way other factors can be studied with less 'noise' from the common tasks. By grouping plants based on common practices it might be possible to determine if there are any underlying trends.

The data generated by the research team was analysed by statisticians at the South Australian Research and Development Institute (SARDI) who calculated a Problem Score for each plant which summarised the hygienic condition of livestock entering the plant. Then a Process Score was developed which summarised key operations at each plant. Finally, plants were grouped on their ability of their process to cope with the incoming livestock problem. The scientific team and statisticians published their findings in the International Journal of Food Microbiology (Kiermeier *et al.* 2006).

The final stage was to build a spreadsheet tool which can be used by QA and management staff to inform on their individual operation. The tool was validated by using data provided by three plants for the condition of their livestock to generate a Problem score and for their process to derive a Process Score. These data were compared with bacterial counts generated during the 3rd national baseline study (Phillips *et al.* 2006).

1.2 Sheep tool

The microbiological status of sheep (and lamb) carcases has been monitored on a number of occasions during the period 1996-2004 via MLA Project MSHE.006 *Contamination of carcases during slaughter and dressing* (1996-98) and via the second and third national baseline studies of 1998 and 2004 Phillips *et al.* 2001).

The former was an in-depth investigation where a range of factors including livestock type, hygienic condition, processing procedures were studied at four sheep processing establishments (coded as 1,2,5,6 in the MSHE.006 report). During this 18-month investigation each abattoir was visited on six occasions. For three of the four plants (Plant 2 ceased slaughtering sheep) data were also available from the second & third baseline studies.

A follow-up statistical analysis of the data collected during the 1996-98 study was performed in 2005 (MLA project PRMS.082). In 2006, three of the plants for which long-term microbiological

data were available were visited and observations made on their processes. The results of this investigation were published in Project PRMS.082 "Factors affecting the microbiological status of sheep carcases". A number of these operations were considered crucial for carcase hygiene, including:

- Preventing contamination from hides at several stages along the chain
- Preventing contamination from knives
- Preventing contamination from operators' hands and arms
- Removing contamination by steam vacuuming of cutting lines
- Minimising contamination from gut contents
- Preventing urine contamination
- Adjusting chain speed according to "hygiene risk".

Discussion of each of these aspects was linked with published work, especially that of Grau (1979) on the bacteriology of sheep carcases, of Bell and Hathaway (1996) who reported on knife contamination in a New Zealand abattoir and of Eustace *et al.* (2006) on knife cleaning in an Australian abattoir.

Finally, a spreadsheet tool was developed to inform QA and management staff on their individual operation. The tool was validated by using data provided by three plants for the condition of their livestock to generate a Problem score and for their process to derive a Process Score. These data were compared with bacterial counts generated during the 3rd national baseline study (Phillips *et al.* 2007).

2 How the tools can be used

2.1 Range of incoming contamination on livestock

The Australian meat industry is spread over a large latitudinal range with intense seasonal changes involving rainfall and temperature effects on incoming livestock. Breeds of *Bos taurus* and *B. indicus* are raised on both pasture and, increasingly, in feedlots. In some cases, livestock are transported huge distances to the abattoir.

Taken together, these factors account for a wide range of contamination on incoming livestock. Both tools attempt to capture this variability in a Problem score, which is unique for each establishment. The ability of each plant to cope with their unique, incoming problem is the assessed by the Process score for the plant. The beef and sheep tools remove any "one size fits all approach to assessing slaughter and dressing; every plant should be assessed on its ability to control carcase contamination through its management and operational procedures.

2.2 Using the tool in conjunction with ESAM results

One assessment can be made by examining the ESAM data generated by each plant. Recently MLA commissioned a study to better utilise the vast amount of data generated by industry over the past decade. One way of using the ESAM database is to generate performance charts for the whole industry in which each establishment's performance is illustrated against the industry as a whole.

An example is presented in the next chart, where the Total Viable Counts (TVCs) on beef carcases of each establishment are plotted over the previous six months. Clearly, there is a difference between establishments and, if yours is on the right hand side of the chart your first response might be to ask "Why are we so bad?"

The first response would be that none of the counts shown in the chart is bad, with most plants having the vast majority of their carcase counts less than log 2/cm² (<100/cm²). If you're the QA Manager at each of the plants in the chart you should take the time to gather data and input them to the tool. If you're one of the "better" plants (those on the left of the chart) and over the past six months your livestock have been mainly grass fed, transported over short distances and arrived with low levels of visible contamination (low Problem score) your processes are obviously coping, giving low carcase contamination. If your plant is on the right flank of the chart and you have a high Problem score then you've also done well to keep contamination to low levels.



2.3 Using the tool for process improvement

Suppose you have a low Problem score and you're on the far right of the chart you may wish to improve your process. The tool gives you options and you can see the effect of any changes to processing by making "what-if scenarios" – what if we install a hot water pasteurisation cabinet, or a 2-knife system or manage difficult mobs better.

3 How not to use the tool

Both tools give a final score which should be used as an indication only – not as a definitive assessment of your process. This is especially so for the sheep tool where there can be huge differences in scores because the tool multiplies the Problem by the Process score. You can see this in the examples given in the Sheep User Manual.

So no attempt should be made to "grade" plants using the final score. Neither should the score be used as the basis for imposing changes on a plant. That provision is already enshrined in the ESAM process where failing a window triggers a review of the plant's process.

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