Australian National Pig Carcass and Meat Microbiology Survey

Kaye Coates*, Mark Groves◊, David Hamilton◊, Vivien Kolega#, Mary Barton#, Stacey Barlow*, Phillip Widders*, Andrew Pointon†
* Victorian Institute of Animal Science, Attwood, Vic, # VetLabs, Glenside, SA, † South Australian Research and Development Institute, SA, ◊ Australian Quarantine Inspection Services

Introduction

The project forms part of the Pig Meat Hygiene Program, funded by the Australian Pig Research and Development Corporation, and is a survey of the microbiological status of carcasses and meat across the Australian pig industry. A total of 680 carcasses from 18 abattoirs and 120 samples of meat from the 6 major capital cities were tested to establish the levels of pathogens and of hygiene indicators. The survey targets *Escherichia coli* (as an indicator of faecal contamination) and Total Viable Counts (TVC 25°C and TVC 4°C) as indicators of general hygiene and shelf-life and levels of *Pseudomonas* spp. on meat to indicate prospective shelf-life.

Materials and Methods

Sample collection

Fresh meat samples (2 per pack) were purchased from retail display and shipped to the testing laboratories at 4°C. Carcass samples were collected by swabbing (Kitchel *et al* 1975) from randomly selected carcasses pre-chiller in the abattoirs and shipped similarly. These were composite samples of three 20 cm^2 samples from the butt, flank and jowl in 30ml peptone water.

Culture

On receipt at the laboratory meat samples were swabbed and prepared by stomaching. Carcass swabs were prepared similarly. Cultures were performed by Australian standard or similar methods. *E. coli* counts were performed on Petrifilms.

Results

Fresh Meat

A total of 240 pieces of meat was sampled for the trial. The mean total viable counts and *Pseudomonas* counts are shown in table 1.

Table 1. Summary of TVC and *Pseudomonas* data for fresh meat.

	Minimum city mean log count/cm^2 Supermarket, Butcher	**Maximum city mean** log count/cm^2 Supermarket, Butcher	**Overall store mean** log count/cm^2 Supermarket, Butcher
TVC 4°C	3.13, 3.47	3.90, 4.15	3.62, 3.95
TVC 25°C	3.51, 3.67	4.55, 4.70	4.06, 4.27
Pseudmonas **(Estimated shelf-life (days))**	2.48, 2.52 (5.06, 5.03)	4.08, 4.16 (3.85, 3.79)	3.19, 3.51 (4.53, 4.28)

Twenty nine of the 120 samples (10 from supermarkets) yielded *E. coli* (range of counts 0.75 to 1200/cm^2) with 24 of those samples <10/cm^2.

Carcasses

A total of 680 carcasses was sampled for the trial. Data from samples arriving at the laboratory above 12°C were rejected, leaving 580 samples. The mean total plate count data for TVC 4°C and TVC 25°C are shown in table 2.

Table 2. Summary of TVC data for carcasses.

	Minimum mean log count/cm^2	**Maximum mean** log count/cm^2	**Overall works mean** log count/cm^2
TVC 4°C	0.200	2.324	1.250
TVC 25°C	0.491	3.802	2.373

The *E. coli* data for carcasses is presented as a frequency distribution in figures 1 (all samples) and 2 (works by works). The data is presented this way to allow comparison with the Megaregs 3-class sampling plan where n=13, m=10, M=10^4 and c=3. Under this sampling regime no more than 3 samples in 13 are permitted to be between the lower limit of 10 and the upper limit of 10^4 and no samples are permitted to exceed the upper limit. No works had a count above M or more than 3 counts in 13 above m.

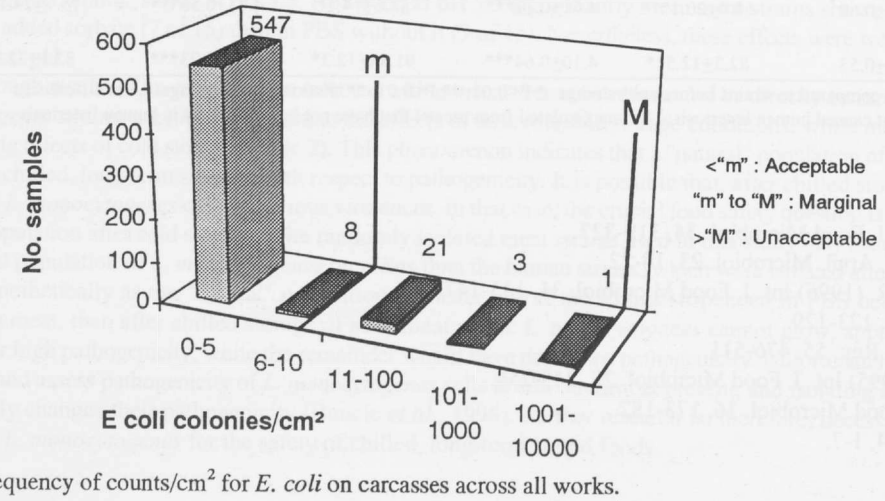
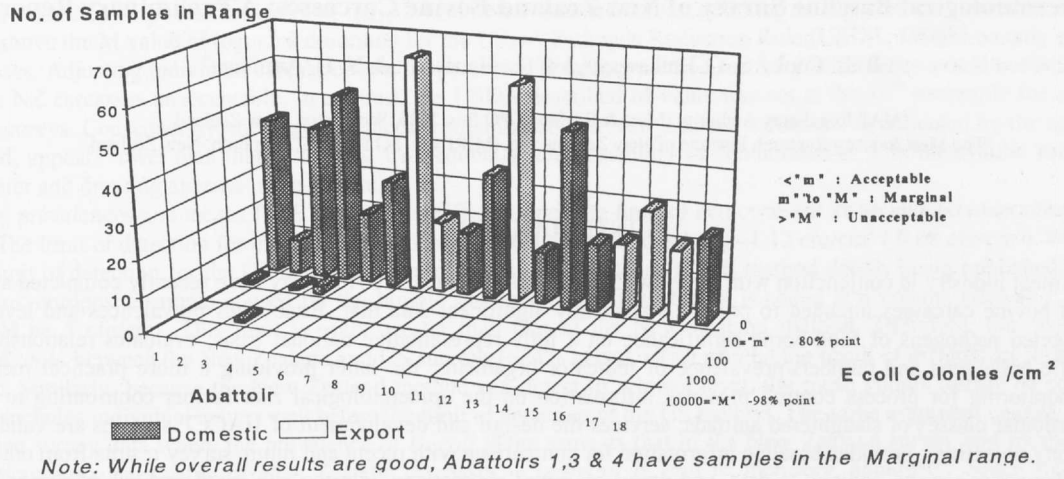


Figure 1. Frequency of counts/cm^2 for *E. coli* on carcasses across all works.



Note: While overall results are good, Abattoirs 1,3 & 4 have samples in the Marginal range.

Figure 2. Frequency of counts/cm^2 for *E. coli* on carcasses works by works.

Discussion

Sample collection was via the wet-dry swab method of Kitchel *et al* (1975). This contrasts with similar assays undertaken in red meats where excision of samples was used. In the Australian pig industry, carcasses are marketed with the skin intact, so in the design of the survey it was decided to use a swabbing method so that future sampling by the works could be correlated to results from this nationwide survey. In similar comparative studies recovery of organisms by swabbing was less than by excision, approximately 20-50%. (Ojala, 1964).

Total viable counts at 25°C are an indicator of general hygiene of the carcasses. The across all works mean of log 2.373 indicate that carcasses are generally clean. In the fresh meat survey TVC 25°C were 4.063 log/cm^2 for pork at supermarkets and 4.268 log/cm^2 for pork at butchers, an increase of approximately 1.9 log from pre-chiller abattoir to retail display. Chilling may reduce the counts in TVC 25°C as mesophiles are unable to grow and may decline in number. In a red meat survey undertaken in Australia in 1995 the log TVC 25°C/g for sheep carcasses was 4.15 (domestic) and 3.83 (export), while for beef carcasses it was 3.76 (domestic) and 3.13 (export). These data indicate similar levels of processing hygiene for each species processing line, with pig carcasses at the lower end of the range. If an allowance of 0.3 log is made for the difference in recovery from swabbing to excision then the differences in counts are from 0.4 to 1.5 log. Studies in South Africa, Spain and Canada have reported levels of 2 to 3log/cm^2 TVC for pig meat immediately after boning (CAST, 1994).

Total Viable Counts at 4°C are an indicator of the possible shelf-life of carcasses. Average counts were 1.2log/cm^2. These data are consistent with other studies where the counts of spoilage organisms are low at the end of abattoir processing lines and increase over time of transport and storage pre-boning (Coates *et al* 1995). In the fresh meat survey TVC 4°C were 3.623 and 3.945 for supermarkets and for butchers respectively. This indicates an increase of up to 2.8 log in the time between pre-chiller at abattoir and retail display. This is consistent with an increase in psychotrophic organisms during transport and storage at refrigeration temperatures. In comparison with similar data from the Australian red meat survey, log TVC 5°C/g for sheep carcasses were 3.6 (domestic) and 3.3 (export) and for beef 3.03 (domestic) and 2.20 (export). Allowing for a 0.3 log difference for swabbing versus excision, pig carcasses have counts of 0.7 to 2.3 log less than red meat carcasses. This difference is most likely as a result of the different time of collection of samples. The red meat samples were collected from carcasses in the chiller. An increase in low temperature organisms would be likely in refrigerated storage.

Recovery of *E. coli* and coliforms are indicative of faecal contamination and general poor hygiene. *E. coli* counts were performed on 580 carcass samples. The resulting data were expressed as frequency data to align with the Megaregs testing criteria. There were no instances where a works would fail those criteria, indicating that Australian pig carcasses were of good hygiene compared to USA standards. As a percent of carcasses positive for *E. coli* isolation, 29.3% had detectable counts. Of the fresh pig meat samples tested 24.2% were positive for *E. coli*, which is a similar level. In the red meat survey 22.3% of beef and 75% of sheep carcasses were positive for *E. coli*. (Vanderlinde and Murray 1995). The higher levels in sheep carcasses may relate to the difference in pre-slaughter hygiene in sheep compared to the other two species.

Conclusion

Based on the data from this study the likely incidence of faecal pathogens (as indicated by presence of *E. coli*) in Australian pig carcasses and meat is lower than, or similar to, levels in red meat in Australia and those reported in pork in other countries. The expected shelf-life of pig carcasses is also better than that in red meats in Australia.

This study is an important start to benchmarking the hygiene of pig meat in Australia but is not a comprehensive survey. There are no severe problems indicated, but the data reported is not a full assessment of the potential for problems to develop.

References

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