COMPARISON OF THE EXCISION AND THE SWABBING TECHNIQUES FOR MICROBIOLOGICAL SAMPLING OF CARCASSES AT ABATTOIRS

Reid C.-A.[1], Hutchison M.[2], Small A.[1], Comrie F.[1], Wilson D.[2] and Buncic S.[1]
[1] University of Bristol, Department of Clinical Veterinary Science, Division of Animal Sciences, Langford, Bristol BS40 5DU, UK
[2] ADAS Laboratories, Woodthorne, Wergs Road, Wolverhampton WV6 BTQ, UK

Background

The recent EU Commission Decision (2001/471/EC) requires that fresh red meat operators must have validated HACCP-based systems in place and conduct regular checks on general hygiene. These checks include microbiological examination of: a) carcasses, and b) utensils, fittings and machinery. The two carcass sampling techniques described in the EU Decision are: a) excision, and b) wet-dry swabbing. The appropriateness of any sampling technique for routine use in commercial abattoirs has to be considered from a range of aspects, with two of them being particularly important: a) bacterial recovery efficacy, and b) robustness and practicality in routine use.

Objective

The main objective of the present, ongoing, study was to compare performances of swabbing and excision techniques under a range of conditions at UK red meat commercial abattoirs, as well as under experimental conditions.

Methods

Immediately after slaughter and dressing, 492 pooled samples (each from 4 standard carcass sites, EU Decision 2001/471/EC) were taken from bovine, ovine and porcine carcasses at 10, 10 and 9 commercial abattoirs, respectively (i.e. non-inoculated carcasses). Also, at a single abattoir, 108 samples were collected from randomly selected sites on carcasses inoculated by submersion in a three-strain bacterial suspension (*Escherichia coli* K12 plus two other bacterial species previously isolated from carcasses) and 5-min draining. Half of the samples in each of non-inoculated and inoculated group of the carcasses were taken by excision and the other half by swabbing techniques. The excision sampling method was based on cutting 5 cm^2 slices from the carcass surface using a disinfected borer. The wet-dry swabbing sampling method was based on using cotton swabs to sample 100 cm^2 (bovines) or 50 cm^2 (ovines and porcines) areas of the carcasses. In the case of non-inoculated carcasses, four slices or swabs from each carcass (standard carcass sites, EU Decision 2001/471/EC) were pooled into a single sample, while in the case of inoculated carcasses slices or swabs were not pooled. In each sample, total viable count of bacteria (TVC) and *Enterobacteriaceae* count (EC) were determined by standard methods (ISO 6887:1999, ISO 2293:1998, ISO 5552:1997, ISO 7218:1996, ISO 7402:1993, ISO 4833:1991). The counts were used to calculate: a) swab bacterial recovery as percent of related excision recovery (excision = 100%), rounded to the nearest whole percentage, and b) mean log CFU/cm^2 values.

Results and discussion

Overall, when all species are taken together, on average 21% of TVC population was recovered by swabbing method, compared with excision, from both non-inoculated and inoculated carcasses (Table 1). However, mean TVC recoveries varied significantly between animal species, between abattoirs, and between non-inoculated and inoculated carcasses. When all species were taken together, 5% and 25% of EC population was recovered by swabbing from non-inoculated and inoculated carcasses, respectively. In the case of non-inoculated carcasses, mean EC recoveries from different species were very similar, but not in the case of inoculated carcasses. This relatively high variability of bacterial recoveries by swabbing method are probably due to the influences of numerous, inherently variable factors that may have significantly larger overall influence on performance of the swabbing method, compared with excision, as indicated in Table 2. Generally, numerous older studies agree that swabbing recovers only a portion (1-89%) of carcass microflora recoverable by excision; hence the swabbing counts are significantly lower as compared with the excision counts. However, there are some disagreements between more recent published studies as to whether bacterial recoveries achieved by swabbing and excision methods are significantly different. In a recent study involving four beef and two pig abattoirs (3), TVC recoveries by cotton swabbing, compared with excision recoveries, were: a) not significantly different at three beef abattoirs, b) significantly lower at fourth beef abattoir, and c) significantly lower at both pig abattoirs. Other studies showed that sponge swabbing also recovers significantly lower TVC than excision (1, 2). On the other hand, it seems clear that the existence or not of significant differences between bacterial recoveries by the two methods is also dependant, among other factors, on whether the surface is fat or lean (4), skin (pork) or meat (beef) (3), or examined immediately or after sample storage (5).

Concluding remarks

Results from the present and other studies indicate that, due to inherent variability of each of sampling methods, numerical comparison of, and/or numerical correlation between, bacterial recoveries by swabbing and excision methods is only possible where other (also potentially variable) factors are as specified/standardized as possible. In practice, this means comparing excision and swabbing microbiological data obtained from comparable species/carcass types and comparable levels/composition of microflora (i.e. from comparable types of operations). A single, clear numerical correlation factor between excision and swabbing data is difficult to expect if/where a wide range of significantly different conditions is included. Nevertheless, if/where recoveries by swabbing methods are generally inferior but can be reasonably standardized, they can be used for longer-term trend analysis rather than for comparison of the counts between individual samples. In such case, the swabbing methods used for regular hygiene checks in abattoirs must be accompanied by related baselines and performance criteria. It seems clear that further research on sampling methods, particularly to improve the swabbing recoveries and, equally or even more important, to quantify and reduce the swabbing variabilities (indicated in Table 2), is needed.

Pertinent literature

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Table 1: Comparison of the excision and the swabbing methods for microbiological sampling of carcasses

Species		Recovery of total viable counts (TVC)				Recovery of *Enterobacteriaceae* counts			
		Non-inoculated carcasses at commercial abattoirs		Inoculated carcasses		Non-inoculated carcasses at commercial abattoirs		Inoculated carcasses	
		Bacterial recovery by excision	Bacterial recovery by swabbing	Bacterial recovery by excision	Bacterial recovery by swabbing	Bacterial recovery by excision	Bacterial recovery by swabbing	Bacterial recovery by excision	Bacterial recovery by swabbing
Bovine	N	84	84	18	18	84	84	18	18
	A	4.35	2.90	4.84	4.88	1.47	0.24	5.03	4.70
	B	100%	4%	100%	100%	100%	6%	100%	47%
Ovine	N	83	83	18	18	83	83	18	18
	A	4.71	4.18	5.07	4.43	1.61	0.27	3.89	2.87
	B	100%	30%	100%	23%	100%	5%	100%	9%
Porcine	N	79	79	12	12	79	79	18	18
	A	4.34	3.80	5.65	3.83	2.24	0.91	3.06	2.57
	B	100%	29%	100%	2%	100%	5%	100%	32%
Overall average (all species)	N	246	246	48	48	246	246	54	54
	A	4.56	3.60	5.13	4.45	1.77	0.5	3.99	3.38
	B	100%	21%	100%	21%	100%	5%	100%	25%

N = number of samples; A = mean log CFU/cm^2; B = percent of bacterial population recovered (if excision = 100%)

Table 2: Assessment of whether some factors influence the variability of the results obtained by the excision and the swabbing methods

Sampling technique	Time to sampling	Nature of the substrate	Between-sampling variations by the same staff	Between-sampling variations by different staff	Bacterial attachments/detachments
Excision	Yes/No*	Yes/No*	No	No	*Single*: meat-to-diluent
Wet-dry swabbing	Yes	Yes: a) carcass b) swab	Yes	Yes	*Multiple*: meat-to-wet swab-to-diluent; meat-to-dry swab-to-diluent; swabs-to-meat

* Bacterial attachment to carcasses can vary with time/substrate, but excision always recovers all "recoverable" microflora under given conditions