# MEAT INSPECTION PROCEDURES: FULL MATCHING AND NEGATIVE MATCHING TRIAL DESIGNS TO DETERMINE PERFORMANCE CHARACTERISTICS

* HATHAWAY, S. C. and RICHARDS, M. S.

Current post mortem meat inspection procedures are largely based on traditional European procedures. In many countries, they may be inappropriate to the spectrum and prevalence of diseases present in a particular class of livestock. Determination of the performance characteristics of a range of inspection procedures can show that in some situations, less intense procedures can achieve equivalent results to more intensive traditional procedures.

## PERFORMANCE CHARACTERISTICS

Very few studies of post mortem meat inspection procedures have adequately assessed performance characteristics, even though these provide the only true means of quantitative comparison. All hazards of public health, animal health or aesthetic importance that could be present in the tissues of interest, and that could be detected by organoleptic meat inspection procedures have to be considered. Determination of the sensitivity and specificity of an inspection procedure and the prevalence of diseases in the slaughter population allows calculation of the non-detection rate in tissues passed for human consumption.

Field trials should include enough samples so as to give definite conclusions as to the consequences of changing the inspection procedures. The sample also has to be designed to give a reliable estimate of the prevalence of hazards. If the procedures under evaluation are applied to the same samples, this gives a more accurate estimate of differences than would be available from the same number of inspections on separate samples.

If possible, all tissues should be inspected by each of the procedures to be compared (full matching). Where processing line speeds are high, tissues found to be positive at the first inspection station often cannot be returned to the line for reinspection at the second station. This necessitates a negative matching design. Although foregoing some statistical power, this design is practical and reliable when different intensities of inspection (e.g. visual examination, compared with visual

* Hathaway, S. C. Ministry of Agriculture and Fisheries, Private Bag, Gisborne, New Zealand
Richards, M. S. Central Veterinary Laboratory, Ministry of Agriculture, Fisheries and Food, New Haw, Weybridge, Surrey, England.



Proceedings of the 6th International Symposium on Veterinary Epidemiology and Economics, 1991
Available at www.sciquest.org.nz

examination plus palpation) rather than alternative inspection procedures are being compared.

After inspection by the procedures under investigation, all tissues must be subjected to detailed inspection (usually by multiple incision). No inferences on non-detection rates can be made without determining the true status of all inspected tissues.

## STATISTICAL COMPARISONS

Acceptance of a proposed new procedure is based on a consideration of the worst case included in the confidence intervals for the difference between non-detection rates. Calculation of confidence intervals for trials incorporating full matching is shown in Table 1. (As the denominators in the fractions are different, the standard method for estimating the standard error of the difference in sensitivities cannot be used for non-detection rates).

Calculation of confidence intervals for trials incorporating negative matching requires a different approach (Table 2). The difference between the non-detection rate for the full procedure (Procedure 1 followed by Procedure 2) and the non-detection rate for Procedure 1 alone is used to estimate the increase in non-detection rate that is likely to be experienced if inspection is restricted to Procedure 1. Note that the standard errors and confidence intervals given in Tables 1 and 2 are approximate, and should be used with care when the number of samples rejected by either procedure is very small.

## CONCLUSION

Determination of the performance characteristics of different meat inspection procedures quantifies the precise non-detection rates that accompany their use for a particular class of slaughtered livestock, and provides the basis for the establishment of an acceptable defect level based on a scientific assessment of the likely public health, animal health and aesthetic risks.

Table 1. Analysis of data from a field trial incorporating a full matching design

| | Outcome of Procedure 1 | Outcome of Procedure 2 + | Outcome of Procedure 2 - |
|---|---|---|---|
| Normal tissue | + | a | b |
| Normal tissue | - | c | d |
| Abnormal tissue | + | e | f |
| Abnormal tissue | - | g | h |

Difference in non-detection rates: $$D = \frac{f+h}{b+d+f+h} - \frac{g+h}{c+d+g+h} \quad (1)$$

Approximate standard error:

$$S = \sqrt{\frac{(f+h)(b+d)}{(b+d+f+h)^3} + \frac{(g+h)(c+d)}{(c+d+g+h)^3} - 2\,\frac{h(b+d)(c+d) + d(f+h)(g+h)}{(b+d+f+h)^2(c+d+g+h)^2}} \quad (2)$$

Approximate 95% confidence interval: $$D \pm 2S \quad (3)$$

Table 2. Analysis of data from a field trial incorporating a negative matching design

| Outcome: Procedure1 | Outcome: Procedure 2 | Normal tissue | Abnormal tissue |
|---|---|---|---|
| + | +/- | a | b |
| - | + | c | d |
| - | - | e | f |

Decrease in non-detection rate: Procedure 2 following Procedure 1:

$$D = \frac{d+f}{c+d+e+f} - \frac{f}{e+f} \quad (4)$$

Approximate standard error: $$S = \sqrt{\frac{(c+e)(d+f)}{(c+d+e+f)^3} + \frac{ef(c+d-e-f)}{(c+d+e+f)(e+f)^3}} \quad (5)$$

Approximate 95% confidence interval = $D \pm 2S$ (6)