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Assessment of the post-mortem inspection of beef, sheep, goats and pigs in Australia: Approach and qualitative risk-based results

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ABSTRACT

A risk-based assessment of post-mortem inspection activities and disposition judgment criteria was undertaken for cattle, sheep, goats and pigs in Australia against the current Australian Standard (AS 4696). The assessment utilized Codex Alimentarius Commission principles and guidelines for the conduct of microbiological risk assessment and the *Code of Hygienic Practice for Meat*. The assessment aimed to identify priorities for evaluating alternative procedures that deliver equivalent or better food safety outcomes to the current standard. An initial qualitative risk assessment used contemporary public health and industry data for differentiating gross abnormalities as meat safety or wholesomeness issues and to assess the likely effect of current inspection procedures on overall food safety outcomes. This article details the approach taken and reports the results of the qualitative risk assessment. The priorities identified for further validation of alternative post-mortem inspection procedures, matched against the risk managers' primary concerns include: (1) bovine tuberculosis, *Cysticercus bovis* and Caseous Lymphadenitis of sheep and goats - removing post-mortem inspection procedures that are no longer necessary due to the improving animal health status of Australian animals; (2) inspection of spleens and unenucleated kidneys of sheep and goats - altering or removing procedures where new knowledge of animal or foodborne disease indicates current risk management procedures are not effective; (3) routine visual inspection of pigs, visual inspection of offal of sheep and goats - assessing the effect of inspection on microbial contamination of edible product; (4) melanoma of pigs, peri-acute pneumonia of cattle and pigs, polyarthritis of cattle and pigs - reviewing the criteria used to determine disposition judgments; and (5) pleurisy of pigs - identifying procedures that are principally related to detecting gross abnormalities that affect product wholesomeness (AS4696) rather than food safety and might, therefore, be managed within quality assurance arrangements. The outcome sought from this work will be a standard where post-mortem inspection is commensurate with risk.

1. Introduction

As a leading producer and exporter of beef, sheep and goat meat and a moderate producer of pork, the Australian meat industry maintains advanced food safety and product integrity systems from "paddock-to-plate" to protect public health and maximize export opportunities (APIQ 2017; NVD 2017; PigPass 2017; LSA 2017). Continual improvement of these systems warrants periodic major reviews, in this case of post-mortem inspection procedures (Schedule 2) and disposition criteria (Schedule 3) of the Australian Standard 4696 (Anon., 2007).

Traditional organoleptic post-mortem inspection was developed in the late 19th and early 20th century to control important zoonotic diseases such as tuberculosis, taeniasis and trichinosis in Europe and North America when these diseases were relatively prevalent (Federal Meat Inspection Act of 1906; Von Ostertag, 1892). In the last 50 years there has been considerable improvement in animal health status in many countries whereby the gross abnormalities found at slaughter are mostly not associated with identified foodborne hazards (Edwards, Johnston, & Mead, 1997; EFSA, 2011, 2013a,b; Hill et al., 2014). This improvement is evident in Australia where significant zoonoses (e.g. bovine tuberculosis and *Cysticercus bovis*) have either been eradicated or are rarely seen

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(Gee, 1986; Meat and Livestock Australia, 2003a, b; Pearse, Langbridge, Cobbold, & Glanville, 2009; Pearse, Traub, Davis, Cobbold, & Vanderlinde, 2010; Sergeant, Happold, & Langstaff, 2017). Improvements in animal health status have also been accompanied by the recognition that incision and palpation inspection procedures can have a negative effect on meat safety by contaminating edible tissue (EFSA, 2011, 2013a,b; Alban et al., 2008; Hamilton et al., 2002; Nesbakken, Eckner, Høidal, & Røtterud, 2003; Pointon, Hamilton, Kolega, & Hathaway, 2000; Walker et al., 2000). The resulting negative net effect (i.e. gross abnormalities with human health consequences removed versus contamination increased) was used along with other evidence to justify adoption of routine visual inspection for pigs in European Commission Regulation No 219 (CR, 2014). For the purposes of this report, the term cross-contamination, is the process by which bacteria or other microorganisms are unintentionally transferred from one substance or object to another (i.e. edible tissue), with harmful effect (i.e. increased risk of consumer exposure). More recently, risk modelling has supported the recognition of the substantial redistribution of *Salmonella* contamination within and between pig carcases resulting from traditional post-mortem inspection (Costa, Corbellini, Silva, & Nauta, 2016). Efforts to achieve similar reform of post-mortem inspection of cattle, sheep and goats based on the risk-based principle of the net effect of removing gross abnormalities with human health consequences and increased risk due to microbial contamination continues in the European Union (Blagojevic, Antic, Ducic, & Buncic, 2011; Dupuy, Hendrikx, Hardstaff, & Lindberg, 2012; EFSA, 2013a,b; Hardstaff et al., 2012; Hill et al., 2013, 2014). In the United States these same principles have led to the HACCP-Based Inspection Models Project (HIMP) for market hogs approach (FSIS, 2014) in which “establishment employees sort out unacceptable carcasses and parts”.

In Australia efforts to reform post-mortem inspection have been active, dating from the 1980s, to align post-mortem inspection procedures with food safety risk. In revising procedures thirty years ago, Murray (1986) promoted the following principles:

- Differentiation of active and chronic phase of infectious disease whereby chronic lesions are no more than a historical event and should not determine the suitability of meat for human consumption;
- Incision of lymph nodes can lead to contamination of edible parts;
- Procedures should be reviewed and revised periodically to reflect improvements in animal health status both regionally and nationally resulting from disease eradication, new control tools and practices, and
- Recognition and or removal of lesions of limited or no public health significance should be regarded as a commercial concern for processing companies.

Alternative post-mortem inspection procedures proposed by Murray (1986) were quantitatively validated by McMahon et al. (1987). These centered around evaluating the effect of changing from incision of lymph nodes to palpation and from palpation to observation for some conditions. In summary, there were no significant differences found between existing and alternative procedures in relation to residual pathology (McMahon et al., 1987). Despite reforms from this early work, Webber, Dobrenov, Lloyd, and Jordan (2012) cited continued concerns that post-mortem inspection practices were still embedded in a system that was slow to respond to scientific developments that were increasingly providing alternatives with potential to increase consumer protection. To this effect, these authors note that the core of meat inspection in Australia continues to be largely based on techniques developed in the late 19th and early 20th centuries. In particular, Webber et al. (2012) highlight the continuation of outdated procedures and practices such as: (1) failure to fully capture the benefits of eradication of bovine tuberculosis (Gee, 1986; Pearse et al., 2009; Sergeant et al., 2017) and (2) the continued treatment of CLA in sheep and goats as a food safety issue instead of a product blemish.

For future development, Webber et al. (2012) note that the SPS agreement (WTO 2017) requires regulation only of characteristics relevant to human or animal health, and specifies risk assessment as the basis for determining equivalence. Aspects that are of concern for consumer/aesthetic reasons are not identified as being subject to country-country agreements. Reflecting Murray (1986), these authors note risk assessment outputs could then form the basis of allocating inspection resources by identifying procedures that should be conducted by certifying authorities and those that should be fully devolved to the meat company. Continued reform is required to fully capitalize on gains in animal health and those now facilitated by adopting risk assessment principles (CAC, 1999; 2005).

The purpose of this paper is to report on continued risk-based assessment of post-mortem inspection, with particular emphasis on Schedule 2 (Procedures for Post-Mortem Inspection) and Schedule 3 (Ante-mortem and Post-Mortem Dispositions) of the Australian domestic meat inspection standard, AS4696 (Anon., 2007). The underlying principle of the assessment is to provide equivalent or better food safety outcomes for consumers while maintaining wholesomeness (Anon., 2007). Details the approach taken, results of an initial qualitative risk assessment used to identify potential alternative procedures and approaches to validate equivalence with the Australian Standard are reported.

2. Terms of reference

Reflecting the opportunity for reform enabled by the risk assessment approach, industry consultation with state and federal meat safety risk managers established a willingness to consider equivalence assessments of alternative procedures to Schedules 2 and 3 of the Australian Standard 4696 for Hygienic Production and Transportation of Meat and Meat Products for Human Consumption (Anon., 2007). The terms of reference for the assessment are the risk managers’ primary concerns for the risk assessors to address. These included:

1) Removing procedures that are no longer necessary due to the improved animal health status of the Australian herd.
2) Altering or removing procedures where new knowledge of animal or foodborne disease indicates current risk management procedures are not effective.
3) Assessing the effect of cross-contamination arising from current inspection procedures
4) Reviewing disposition judgment criteria for total carcase condemnation where appropriate.
5) Using alternate risk management procedures either at the processor or elsewhere in the supply chain.
6) Identifying procedures that are principally related to product quality rather than food safety that might be transferred to companies' QA systems.

It is important to note that in proposing revisions to meat regulation AS4696 in Australia (Anon., 2007), the Australian Meat Regulators Group require validation of an alternative technique (inspection) procedure by demonstrating equivalence with the Standards (Meat Research Corporation, 1997). For this assessment, this equivalence principle is applied to both food safety and