



Australian Government
**Department of Agriculture,
Fisheries and Forestry**



Technical activities to facilitate the implementation of the pending publication of meat inspection and disposition judgement standard AS4696:2021 in export licensed abattoirs

**Final Report
APL Project 2021-0008**

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Executive Summary

A review of the Australian standard AS4696:2007 (the standard) has been conducted with a focus on post-mortem inspection and disposition judgement (PMID). In the 2007 edition, PMID (Schedules 2 and 3) were not reviewed. In 2005 the Codex Alimentarius Commission published the *Code of Meat Hygiene* that embodied risk assessment principles. This latest review subjects PMID to a risk-based review.

The review was initiated by industry to capitalise on improvements in animal health over the past 40 years and not by regulators in response to an unmanaged food safety or wholesomeness issue.

An essential element of a risk-based system, as it applies PMID procedures and criteria is targeting current meat-borne hazards that are the cause of detectable gross abnormalities in carcasses at abattoirs. This places a contemporary lens on procedures that can be deleted due to eradication of zoonoses such as tuberculosis. The risk-based process also assesses any counter-productive effects such as cross-contamination arising from the PMID activities.

The review also assessed procedures for detection and removal of gross abnormalities that affect wholesomeness. These represent the bulk of abnormalities occurring and arise from animal health conditions and diseases.

The aim of the project was to provide technical and training support for the acceptance and implementation of the amended standard.

Technical and training support provided over the establishment phases of the standard included:

- technical response to Pig Operating Plant Veterinarians Special Interest Group enquiries
- provision of training to senior DAFF veterinarians
- refinement of Fact Sheets to support extension and as a resource for trainers
- providing technical updates to PPRG
- providing technical support to Export Standards Branch in preparing WTO notification for export markets of the amended standard
- proofing documents prepared for Standards Australia gazettal process
- response to Public Consultation received by Standards Australia
- drafting a paper for peer-reviewed publication summarising the outputs and outcomes.

There are several PMID outcomes resulting from this project, including:

- Approval of routine visual only post-mortem inspection for all commercial pigs
- Approval for inspection of unenucleated pig kidneys when not for human consumption
- Amended disposition criteria for melanoma, and pneumonia/pleurisy and polyarthritis
- Acceptance by all export markets of Australian pork of amendments to SAS4696 as resulting from a WTO notification process conducted by Export Standards Branch
- A successful Public Consultation by Standards Australia that will result in gazettal of AS4696:2023 in early 2023.

The amended standard has facilitated a further refocussing of meat safety resources commensurate with consumer risk. Benefits include reduced processing cost, wastage and potential cross-contamination.

This project report completes the work associated with the development and acceptance of the amended meat standard.

It is anticipated that logistical issues with implementation of routine visual only inspection will be brought to the attention of PPRG members by Operating Plant Veterinarians Special Interest Group, especially in relation to presentation and visibility of organs for visual inspection. Guidance on practical measures is available from DK and ND processors accordingly.

APL is advised to retain a close working relationship with Australian Meat Regulators Group and Department of Agriculture, Fisheries and Forests over use and recognition associated with publication of the Fact Sheets. At present they are owned jointly by APL and MLA.

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I. Background to Research

In 2016 Australian meat producers and processors initiated a review of carcass inspection of the domestic meat safety code for Hygienic Production and Transportation of Meat and Meat Products for Human Consumption (the standard; Anon 2007).

The risk management Terms of Reference addressed, and the related research priorities identified included:

- removing post-mortem inspection procedures that are no longer necessary due to the improving animal health status of Australian animals;
- altering or removing procedures where new knowledge of animal or foodborne disease indicates current risk management procedures are not effective;
- assessing the effect of inspection on microbial contamination of edible product visual inspection of pigs;
- reviewing the criteria used to determine disposition judgements;
- 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.

APL Projects 2015/023 and 2017/2207 were commissioned and completed successfully.

The resulting alternative post-mortem inspection techniques and disposition judgement criteria reflect changes at the abattoir as part of a broader risk-based approach. Routine use of palpation and incision in AS4696:2007 has been replaced routine visual-only inspection approved for pigs.

As a first step in implementation, these alternative carcass inspection procedures and disposition judgements have been given effect in domestic establishments from 1st March 2020 by means of the AMRG Guideline 2020:1 (Anon 2020).

Risk communication of these alternatives is supported by scientific publications and Fact Sheets explaining the rationale, quantitative approach and data on which equivalence was assessed. These are available via <https://www.mintrac.com.au/page.asp?p=175>. OPV training has been conducted nationally across the Department of Agriculture Fisheries and Forests in late 2019.

With the pending gazettal of the amended AS4696:2023 the need for further training, response to implementation queries and support to market notification process by DAFF was anticipated.

Consequently, the project was commissioned to provide technical and training support for over the establishment phases of the standard. This included:

- technical response to Pig OPV Special Interest Group enquiries
- provision of training to senior DAFF veterinarians
- providing technical updates to PPRG
- providing technical support to Export Standards Branch in preparing WTO notification for export markets of the amended standard
- proofing documents prepared for Standards Australia gazettal process, and
- response to Public Consultation received by Standards Australia.

Countries importing beef, sheep meat, goat meat and pork from Australia have been notified according to World Trade Organisation (WTO) protocols and accepted the amendments without query.

An amended AS4696:2023 containing amended post-mortem inspection (PMI) techniques (Schedule 2) and disposition criteria (Schedule 3) is pending gazettal (Anon 2023) for use in domestic and export-licenced abattoirs (Anon 2023).

2. Objectives of the Research Project

Provide technical support and training

3. Introductory Technical Information

An initial qualitative risk assessment defined priorities for a risk-based review of post-mortem inspection activities and disposition judgment for cattle, sheep, goats and pigs in Australia (Pointon et., 2018). Priority projects identified for risk-based assessment were 1) routine visual only inspection of all pigs 2) inspection of unenucleated kidneys 3) detection and removal of pleurisy 4) condemnation of melanoma and 5) evaluation of disposition judgement criteria for pneumonia pleurisy complex and polyarthritis.

The outcome envisaged from those assessments is a standard where allocation of post-mortem inspection resources is commensurate with mitigating contemporary risk.

Validated alternative post-mortem inspection techniques

Amended equivalent PMI techniques, is now pending gazettal as AS4696:2023 Schedule 2 (Anon 2023) and includes:

- routine visual-only inspection of commercially reared pigs including cull breeding stock, irrespective of whether they are reared in intensive and extensive production systems (Pointon et al., 2000; Hamilton et al., 2002; Pointon et al., 2019a);
- observing unenucleated pig kidneys when not kept for human consumption and observation of enucleated kidneys when kept for human consumption (Pointon et al., 2019b).

Overall, these validation studies of alternative techniques based on national data demonstrated negligible:

- differences in non-detection rates between observation and palpation;
- occurrence of gross abnormalities of foodborne significance;
- adverse effect on information available for carcass disposition judgement; and
- adverse effect on animal health and welfare surveillance.

While routine incision and palpation is removed for pigs, provision is added for use of palpation and incision “where appropriate” for all conditions detected or suspected (Table 4, Schedule 2 AS4696:2023; Anon 2023). For example, in moving to routine visual-only inspection of pigs, such circumstances considered “appropriate” would be suspect carcasses identified through visual detection of relevant abnormalities or herd health history (i.e., particularly recent PMI data).

Use of palpation and incision is retained “where appropriate” to assist determination of acute systemic infection to judge carcass wholesomeness for all species (Table 4, Schedule 2 AS4696:2023; Anon 2023). In keeping with the evidence-based approach, when palpation and incision are used, these additional techniques must be followed by effective decontamination of hands and associated equipment to minimise subsequent contamination of edible tissue (Anon 2023).

Net effect of post-mortem inspection

Application of the CAC risk assessment guidelines (CAC 2005) also brings into scope an examination of the likely negative effect of traditional inspection where the net effect may be a poorer food safety outcome. Net effect is where the detection and removal of foodborne hazard: gross abnormality combinations is proportionally outweighed by contamination of edible tissue with hazards resulting from the actual inspection techniques utilised (EFSA 2013). Using previous Australian data to model net effect, Pointon et al., (2017) predict visual-only inspection of lymph nodes of pigs’ heads outweighs incision by around 214 to 1 - i.e., for each Salmonella contaminated head lymph node abscess detected, 214 carcasses (subsequent sites) handled are contaminated.

Additionally, a prevalence survey in two abattoirs found 14% of inspectors' hands were contaminated by *Salmonella* spp. during routine carcass inspection (Pointon *et al.*, 2018). However, it must be noted that PMI is only one of many processes involved in carcass processing that may contaminate edible tissues. Published reports indicate the increase in bacterial counts due to PMI is generally low, however, increases in prevalence of foodborne hazards may be substantial (Jordan *et al.*, 2012; Costa *et al.*, 2016). While the proportional contribution to overall contamination from PMI remains uncertain, European and USA jurisdictions have cited potential for counter-productive microbial contamination when advocating the modernisation of PMI (CR 2014; FSIS 2019).

Techniques transferable to companies' Quality Assurance systems

While official veterinary verification of PMI to ensure market access was not in question, one of the terms of reference asked by risk managers was to identify procedures that were principally related to product quality rather than food safety, that might be transferred to companies' Quality Assurance systems.

To examine this proposition a study was conducted to establish the Sensitivity (Se) of detection of pleurisy in pigs by routine slaughter-line personnel when removing thoracic organs. Pleurisy of pigs was chosen for this assessment as it is not attributed to foodborne hazards and is a leading reason for partial condemnation of pigs in Australia (Hudson and Hamilton 2016). This leads to processing inefficiency due to excessive numbers of carcasses detained for trimming.

The assessment, that included comparison on the same carcasses, found a high detection rate of pleuritic carcasses by experienced slaughter-line personnel when compared to official PMI (e.g., Se 0.9). This supports implementation of preliminary carcass trimming as part of routine carcass dressing (i.e., partial stripping of affected pleura before official PMI) to achieve carcass wholesomeness. This minimises carcasses having to be detained on the retail rail for final trimming. In addition, there is no loss of information to inform carcass disposition judgement as partially stripped pleura (i.e., dangling in situ) are obvious to official inspectors when subsequently conducting the final carcass disposition judgement (Pointon *et al.*, 2019c).

These findings offer feasible improvement in efficiency for both processing and official carcass inspection and can be incorporated practically without changes to the standard.

Amended disposition judgement criteria

In summary, the assessments of disposition criteria included pneumonia/pleurisy complex, and polyarthritis of pig carcasses found those with multiple chronic lesions often harboured primary infectious agents in the primary site, but not peripheral lymph nodes or edible tissues. *Salmonella* spp. was not recovered from any of these sites in the pig carcasses investigated (Pointon *et al.*, 2017; Pointon *et al.*, 2019d).

These findings reflect the view that chronic phase lesions are no more than a historical event which should not determine the wholesomeness of meat for human consumption (Murray 1986). Results of this Australian work are consistent with findings in market pigs and young bulls with prior septicaemia (pyaemia) in Denmark (Kruse *et al.*, 2015; Alban *et al.*, 2018; Petersen *et al.*, 2022) whereby carcasses with multiple gross abnormalities are trimmed rather than totally condemned due to a historic systemic infection.

Consequently, to minimise uncertainty in judging final carcass disposition use of acute or chronic classification is now consistently applied across these gross abnormalities. Amended equivalent disposition criteria now published as AS4696:2023 Schedule 2 (Anon 2023) for arthritis and pneumonia/pleurisy now includes:

- replacement of "Systemic effects" with specific descriptions and disposition judgements, notably;

- signs of acute disease manifest as septicaemia, indicated by petechial haemorrhages and/or polyserositis;
- multiple chronic abnormalities not being interpreted as “systemic effect” and thereby a reason for total carcase condemnation; and
- these carcasses may now be trimmed instead of being totally condemned, when not showing generalised signs of septicaemia and/or cachexia.

Where uncertainty inevitably remains, additional testing to determine safety and wholesomeness may be undertaken to minimise unnecessary wastage.

Disposition criteria for melanoma of pigs now only requires trimming of the affected part if there is no evidence of progression beyond the primary draining lymph node (Pointon *et al.*, 2017).

4. Research Methodology

The project provided technical and training support over the establishment phases of the standard.

4.1 Technical response to Pig OPV Special Interest Group (SIG) enquiries

The SIG lodged a query regarding the effect of inspecting unenucleated kidneys (when not for human consumption) as the first point of contact for African Swine Fever. A short technical paper and participation in a SIG virtual meeting was provided.

The matter was further raised by the SIG as part of the Public Consultation of amended AS4696 to Standards Australia. A detailed report has been provided and the matter is being handled internally by DAFF.

4.2 Provision of training to senior DAFF veterinarians

The Principal Investigator attended a two-day Meat Leaders Conference (MLC), DAFF and presented 3 keynote papers on the process, evidence and amendments to AS4696.

The MLC was attended by senior veterinarians responsible for export certification including national Field Operations Managers, Area Technical Managers and representatives from the Export Standards Branch responsible for WTO notifications.

4.3 Revising Fact Sheets

Fact Sheets describing the risk-based process, evidence and amendments to AS4696 have been developed and updated to reflect recent gazettal processes.

These are written for inspectors seeking further understanding and as a resource for Registered Training Organisations.

These will be formally provided to Australian Meat Regulators Group and DAFF for proofing and likely lodgement on MINTRAC's website.

4.4 Providing training presentations to National Veterinary Technical Manager DAFF

Presentations prepared for the MLC have been provided on request to Dr Stew Lowden, National Veterinary Technical Manager for further training of On Plant Veterinarians.

4.5 Providing technical updates at PPRG meetings

The PI has attended PPRG meetings to provide updates on progress of the gazettal process of the new standard.

4.6 Presenting an invited paper to Aust NZ College of Veterinary Surgeons conference

The PI delivered a one hour invited paper at the Australian New Zealand College of Veterinary Surgeons in May 2022; attended by the national CVO outlining principles of risk-based reform.

4.7 Providing technical support to Export Standards Branch (ESB) in preparing WTO notifications for export markets of the amended standard

The PI has been requested by ESB to proof documentation for the WTO notification of export markets of the amended AS4696.

4.8 Proofing documents prepared for Standards Australia gazettal process

Similar proofing was conducted prior to the Standards Australia gazettal process.

5. Results

There are a series of detailed reports, slide presentations and Fact Sheets arising from the activities described in Research Methodology.

These are available on request.

There are several outcomes resulting from this project, including:

- Approval of routine visual only post-mortem inspection for all commercial pigs
- Amended disposition criteria for melanoma, and pneumonia/pleurisy and polyarthritis
- Acceptance by all export markets of Australian pork of amendments to SAS4696 as resulting from a WTO notification process conducted by ESB
- A successful Public Consultation by Standards Australia that will result in gazettal of AS4696:2023 in early 2023.

6. Discussion

The project has provided a broad range of technical activities to meat safety regulators responsible for the pending gazettal of AS4696:2023.

Assistance provided to Export Standards Branch, DAFF has underpinned acceptance of all amendments by all pork export markets, thereby retaining market access and confidence in the safety of Australian pork.

The project has also provided a broad range of extension and training resources for the ultimate implementation of the gazetted AS4696:2023.

The regulatory and market acceptance of the amended standard provides the opportunity for a further publication of the successful risk-based review of a standard, providing further credence to the competitive reputation of meat exported from Australia.

The project is a clear demonstration of the value of a sound evidence-base needed to drive regulatory reform. Benefits have been derived from participating in the international reform effort (Alban *et al.*, 2018).

Throughout the program there has been consistent commitment to publishing in peer-reviewed journals. It is common practice for food safety regulators to recognise publishing in this manner as meeting their threshold for accepting and acting on the technical outputs. Most publications may be found in the References section of this final report.

The adoption of routine visual only inspection by the European Commission (2014), in part, utilised earlier APL funded work. Additional data and clarification of the equivalence process by meat safety regulators has led to this substantial amendment of post-mortem inspection and disposition criteria.

The project has delivered the national reforms envisaged from a program of APL projects conducted in concert with similar projects for beef, sheep and goats. There has been substantial benefit in sharing approaches and joint investment in extension resulting from this collaboration.

7. Implications & Recommendations

This project report completes the work associated with the development and acceptance of the amended meat standard.

It is anticipated that logistical issues with implementation of routine visual only inspection will be brought to the attention of PPRG members by OPV SIG, especially in relation to presentation and visibility of organs for visual inspection. Guidance on practical measures is available from DK and ND processors accordingly.

APL is advised to retain a close working relationship with AMRG and DAFF over use and recognition associated with publication of the Fact Sheets. At present they are owned jointly by APL and MLA.

8. Intellectual Property

AS4696:2023 is now owned Standards Australia.

9. Technical Summary

A risk-based review of post-mortem inspection and disposition criteria (PMID) has demonstrated the equivalence of alternative techniques with previous techniques, without any adverse effects on food safety, wholesomeness, and surveillance of animal health (including zoonoses) and welfare.

The process applied reflects the principles agreed internationally for evidence-based reform of meat regulation in the Codex Alimentarius Commission Code of Meat Hygiene (CAC 2005). The amended standard underpins public health and acts as the default for exported meat products. The review was initiated by industry to capitalise on improvements in animal health over the past 40 years and not by regulators in response to an unmanaged food safety or wholesomeness issue.

An essential element of a risk-based system, as it applies PMID procedures and criteria, is it targets current meat-borne hazards that are the cause of detectable gross abnormalities in carcasses at abattoirs. This places a contemporary lens on procedures that can be deleted due to eradication of zoonoses such as tuberculosis. The risk-based process also assesses any counter-productive effects such as cross-contamination arising from the PMID activities.

The transition to routine visual only inspection reflects both the mitigation of meat-borne zoonoses that are detectable as gross abnormalities at slaughter and the adoption of protocols that mitigate the transfer of “hidden” contamination between carcasses and cuts. In short, the research process provides a transparent and objective means of allocating food safety resources commensurate with consumer risk.

PMID regulatory change is now evidence-driven reflecting the Code of Meat Hygiene (CAC 2005). The research outputs advocated internationally in this final project have all been accepted by our export market access regulators without query. This is essential for eventual implementation of amended PMID in export-licensed establishments once AS4696:2023 is gazetted.

The resulting changes for PMID of pig carcasses include:

- routine visual-only inspection of commercially reared pigs including cull breeding stock, irrespective of whether they are reared in intensive and extensive production-systems;
- observing unenucleated pig kidneys when not kept for human consumption and observation of enucleated kidneys when kept for human consumption;
- disposition criteria for melanoma of pigs now only requires trimming of the affected part if there is no evidence of progression beyond the primary draining lymph node;
- equivalent disposition criteria for arthritis and pneumonia/pleurisy now includes replacement of “systemic effects” with specific descriptions and disposition judgements, notably;
 - signs of acute disease manifest as septicaemia, indicated by petechial haemorrhages and/or polyserositis;
 - multiple chronic abnormalities not being interpreted as “systemic effect” and thereby a reason for total carcass condemnation; and
 - these carcasses may now be trimmed instead of being totally condemned, when not showing generalised signs of septicaemia and/or cachexia.

While routine incision and palpation is removed for pigs, provision is added for use of palpation and incision “where appropriate” for all conditions detected or suspected (Table 4, Schedule 2 AS4696:2023). For example, in moving to routine visual-only inspection of pigs, such circumstances considered “appropriate” would be suspect carcasses identified through visual detection of relevant abnormalities or herd health history (i.e., particularly recent PMI data).

Use of palpation and incision is retained “where appropriate” to assist determination of acute systemic infection to judge carcass wholesomeness for all species (Table 4, Schedule 2 AS4696:2023).

In keeping with the evidence-based approach, when palpation and incision are used, these additional techniques must be followed by effective decontamination of hands and associated equipment to minimise subsequent contamination of edible tissue (Anon 2023).

The amended standard has facilitated a further refocussing of meat safety resources commensurate with consumer risk. Benefits include reduced processing cost, reduced wastage and reduced potential for cross-contamination of product.

10. Literature cited

- Alban, L., E., Ruttscheid, E., Valeria., C., de Sá, Buholzer, G. P., Viera-Pinto, M., Langkabel, N., Meeken, D., Pointon, A.M., Hamilton, D.H., and Abley, M. (2018). Modernization of meat inspection of pigs. The world is on the move towards a more evidence-based type of inspection. *Fleischwirtschaft International*, 2, 8-15.
- Anon (2007). Hygienic Production and Transportation of Meat and Meat Products for Human Consumption. Australian Food Regulation Standing Committee Technical Report Series 3. AS 4696:2007. Standards Australia.
- Anon (2020). Post-Mortem Meat Inspection – Australian Meat Regulators Group, Guideline 2020:1 for AS4696:2007. Department of Primary Industries, Sydney, New South Wales, Australia. https://www.foodauthority.nsw.gov.au/sites/default/files/2020-02/AMRG%20Guideline%202020_I_Alternative%20techniques%20guideline.pdf
- Anon (2023). Post-Mortem Meat Inspection – Code of Meat Hygiene, Standards Australia, (pending)
- CAC (2005). CAC Alimentarius Commission, Code of Hygienic Practice for Meat. CAC/RCP 58-2005.
- Costa, E. d. F., Corbellini, L. G., Silva, A. P. S. P. d., & Nauta, M. (2016). A Stochastic Model to Assess the Effect of Meat Inspection Practices on the Contamination of the Pig Carcasses. *Risk Analysis*. [doi:10.1111/risa.12753](https://doi.org/10.1111/risa.12753)
- CR (2014). Commission Regulation No 219/2014 of 7. Amending Annex I to Regulation (EC) No854/2004 of the European Parliament and of the Council as regards the specific requirements for post-mortem inspection of the Australian meat standard swine. Text with EEA Relevance, 2014; 2014:99–100.
- FSIS (2019). Modernization of Swine Slaughter Inspection. Document citation 84 FR 52300. Food Safety and Inspection Service, USDA. <https://www.federalregister.gov/documents/2019/10/01/2019-20245/modernization-of-swine-slaughter-inspection>
- Hamilton, D. R., Gallus, P., Lyall, L., Lester, S., McOrist, S., Hathaway, S. C., and Pointon, A. M. (2002). Risk-based evaluation of post-mortem inspection for pigs in Australia. *Veterinary Record*, 151(4), 110-116.
- Hudson, D. and Hamilton, D. (2016). Causes and cost of pig carcasses condemnation. APL Final Report 2015/2209. Australian Pork Ltd, Barton, ACT.
- Jordan, D., Sentance, C. B., Spooncer, W. F., Balan, J. A., and Morris, S. M. (2012). Inspection of lymph nodes for caseous lymphadenitis and its effect on the density of microbes on sheep carcasses. *Meat Science*, 92(4), 837-840.
- Kruse, A. B., Larsen, M. H., Skou, P. B., and Alban, L. (2015). Assessment of human health risk associated with pyaemia in Danish finisher pigs when conducting visual-only inspection of the lungs. *International Journal of Food Microbiology*, 196(0), 32-39.
- Murray, G. (1986). Ante-mortem and post-mortem meat inspection: an Australian Inspection Service perspective. *Australian Veterinary Journal*, 63(7), 211-215.
- Petersen, J.V., Abildgaard, K.S., Poulsen, M.K. and Alban, L (2022). Investigating ways of detecting and handling findings indicating prior septicaemia in bovines. *Food Control* Volume 137, July 2022, 108901 <https://doi.org/10.1016/j.foodcont.2022.108901>

- Pointon, A.M., Hamilton, D., Kolega, V. and Hathaway, S. (2000). Risk Assessment of Organoleptic Post-mortem Inspection of pigs in Australia. *Veterinary Record*. 146: 124-131.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2017a). Review of the Post-mortem Inspection and Disposition Schedules of the Australian Standard – Pork. Project 2015/023: Appendices 1-8. Australian Pork Ltd, Canberra, Australia.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2018). Assessment of the post-mortem inspection of beef, sheep, goats, and pigs in Australia: Approach and qualitative risk-based results. *Food Control* 90:222-232. <https://doi.org/10.1016/j.foodcont.2018.02.037>
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K (2019a). Validation of Routine Visual Only Post-Mortem Inspection of Pigs in Australia. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s47.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K (2019b). Risk-based Review of Post-mortem Inspection of Kidneys of Pigs in Australia. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s48.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K (2019c). Validation of alternative post-mortem inspection procedures with reference to pleurisy of pigs in Australia. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s75.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2019d). Risk-Based Assessment of Criteria used for Disposition Judgement for Polyarthritis of Pigs. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s74.

II. Publications Arising

Fact Sheets

- AS4696:2023 Amended Post-Mortem Inspection & Disposition – Review Overview
- Australian Standard Risk-based for Review of Schedule 2 - Post-mortem Inspection Principles
- Australian Standard Risk-based Amendment – Visual Only of Post-mortem Inspection
- Australian Standard Risk-based Amended Post-mortem Inspection of Kidneys of Pigs
- Rationale for the Risk-Based Disposition Judgement Criteria in Schedule 3 of the Australian Meat Standard
- Australian Standard Amended Risk-based Disposition Judgement Criteria for Melanoma in Pigs
- Australian Standard Amended Risk-based Disposition Judgement Criteria for Pneumonia and Pleurisy of Pigs
- Australian Standard Amended Risk-Based Disposition Judgement Criteria for (poly)Arthritis in Pigs

Project Publications

- Pointon, A.M., Hamilton, D., Kolega, V. & Hathaway, S. (2000). Risk Assessment of Organoleptic Post-Mortem Inspection of pigs in Australia. *Veterinary Record*. 146: 124-131.
- Hamilton, D. R., Gallas, P., Lyall, L., Lester, S., McOrist, S., Hathaway, S. C., & Pointon, A. M. (2002). Risk-based evaluation of post-mortem inspection for pigs in Australia. *Veterinary Record*, 151(4), 110-116.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2018). Assessment of the post-mortem inspection of beef, sheep, goats and pigs in Australia: Approach and qualitative risk-based results. *Food Control*, 90,222-232. <https://doi.org/10.1016/j.foodcont.2018.02.037>
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2019b). Review of Pig Post-mortem Inspection and Disposition Schedules of Australian Standard 4696. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s39.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2019c). Validation of Routine Visual Only Post-Mortem Inspection of Pigs in Australia. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s47.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2019d). Risk-based Review of Post-mortem Inspection of Kidneys of Pigs in Australia. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s48.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2019e). Risk-Based Assessment of Criteria used for Disposition Judgement for Polyarthritits of Pigs. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s74.
- Pointon, A.M., Hamilton, D.H. and Kiermeier, A.K. (2019f). Validation of alternative post-mortem inspection procedures with reference to pleurisy of pigs in Australia. Manipulating Pig Production XVII, *Advances in Animal Biosciences*, Cambridge University Press. 10:S1:s75.

Pending Peer-reviewed publication

The following draft publication has been prepared for the Journal of Food Protection for submission after the gazettal of AS4696:2023 in early 2023.

Risk-based modernisation of post-mortem inspection and disposition judgement of cattle, sheep, goat, and pig carcasses in Australia

Andrew Pointon, Samantha Allan, Andreas Kiermeier, David Hamilton, David Cusack, Ian Jenson, Daryl Stevens and John Langbridge

ABSTRACT

*This article reports risk-based assessment processes and outputs for modernisation of organoleptic post-mortem inspection and criteria for disposition judgement of cattle, sheep, and goat carcasses in Australia. Initial studies determined the performance of current inspection, that in turn facilitated comparing performance of alternative carcass inspection techniques. Gross abnormalities affecting wholesomeness alone were afforded similar stringency as those of food safety significance. A full quantitative risk assessment for *Cysticercus bovis* was used to predict the effect of different post-mortem inspection options on consumer risk. The equivalence of alternative techniques was based on any adverse effects on food safety, wholesomeness, and surveillance of animal health (including zoonoses) and welfare. Alternative carcass inspection techniques and disposition criteria were assessed as equivalent with the previous Australian standard by domestic meat safety jurisdictions. These amendments have subsequently been accepted by all importing countries ensuring ongoing export market access. An amended standard has been gazetted as AS4696:2023 featuring outputs of a risk-based review of Schedules 2 and 3, accordingly. Opportunities for amendments have arisen from improvements in animal health over the past 40 years, including eradication of tuberculosis. The amended standard has facilitated a further refocussing of meat safety resources commensurate with consumer risk.*