

# Quality assurance and meat inspection in Australia

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## Summary

The aim of meat inspection in Australia is to contribute to the production of safe and wholesome food, comply with the requirements of importing countries, and support national animal health objectives. An analysis of the role of quality assurance (QA) in the meat inspection systems at federally inspected establishments shows that the position of Australia as a leading meat exporter is aided by a co-regulatory, QA-based approach to meat inspection, which is equally applicable to all species at slaughter. Technical developments in meat inspection at the national and international level during the 1990s led to significant enhancements in QA systems. Quality assurance is implemented through nationally uniform documented systems, which are designed to achieve consistent standards of meat safety. These systems are complemented by hazard analysis critical control point-based QA programmes which meet the quality standards of the International Organization for Standardization.

Quality assurance programmes aim for a 'whole of chain' approach, so that the system is implemented 'from the paddock to the plate', or from pre-harvest through to post-harvest, i.e., from on-farm practices to the refrigeration, storage and transportation stages. The QA elements of meat inspection employed in production systems in Australia have significantly contributed to the consistent achievement of meat safety objectives that are appropriate to contemporary risks.

## Keywords

Australia – Food safety – Meat inspection – Quality assurance – Veterinary Service.

## Introduction

The Australian meat inspection system has a clear veterinary public health focus on producing safe and wholesome food, meeting the demands of customers (national and international) and supporting animal health programmes. Historically, meat inspection standards were determined by a council of the elected Ministers responsible for agriculture from the Commonwealth (Federal) Government and the State and Territory Governments. In 2001, a decision was taken that all new meat standards would be developed under the policy framework of the Australia New Zealand Food Standards Ministerial Council.

The primary focus of meat inspection has historically been on the slaughter or 'harvest' stage of production at the abattoir. Risk assessments on emerging meat safety risks during the 1990s extended this focus to include the pre-harvest and post-harvest stages of production. In this paper, meat inspection is

defined as all the actions required to produce a safe product. Inspection is not limited to ante-mortem inspection or the traditional on-line post-mortem inspection of carcasses for visible defects, such as pathological lesions and contamination, although these remain important components of the system.

The majority of meat inspection resources are still dedicated to the harvest stage. The prominence of the harvest stage in national and international meat inspection standards is reflected in this paper, albeit as part of the broader 'whole of chain' quality assurance (QA) approach. A 'whole of chain' approach means that at each stage of production, through animal rearing, livestock feed formulation, agricultural and veterinary chemical usage, transport, slaughter, further processing and distribution, etc., animals and animal products are 'fit for their purpose' and, ideally, certified as such. Although this paper focuses on the harvest stage, a brief analysis of QA approaches at the pre-harvest and post-harvest stages is also provided. Details of scientific risk assessment processes, which

underpin the risk management elements of meat inspection systems, are beyond the scope of this paper.

The authors provide an analysis of the QA elements of meat inspection within the largest segment of the Australian meat industry – federally inspected establishments processing cattle, sheep, goats, pigs and horses. The concepts and principles presented in this paper should be equally applicable to meat inspection for these and other species around the world. In Australia, QA is applied to the regulatory activities of the meat inspection programme and also directly to controls on industry processes through programmes based on hazard analysis and critical control points (HACCP). Both of these QA aspects are interdependent.

Meat inspection at federally inspected establishments is conducted by the Australian Quarantine and Inspection Service (AQIS), one of nine business groups within the Commonwealth Department of Agriculture, Fisheries and Forestry – Australia. Inspection and certification are provided by AQIS for a range of animal and plant products exported from Australia, as well as quarantine inspection for the arrival of international passengers, cargo, mail, animals and plants or their products into Australia. These AQIS services are designed and delivered in consultation with the industry, through both formal consultative and advisory procedures with principal groups in the industry and liaison with individual clients. Meat inspection services at non-federally inspected meat establishments are the responsibility of the relevant State or Territory Government.

## The history of the Australian meat industry

Traditional slaughter species were not present in Australia before the arrival of the First Fleet from England in 1788. The first European settlers brought with them a small number of cows, bulls, sheep, goats, pigs, rabbits and poultry to establish livestock industries (24). The arrival of further ships over the ensuing years with more livestock, together with exploration and the opening up of more suitable grazing land, led to a flourishing beef and sheep industry by the early 1800s. As an example, New South Wales had a human population of approximately 190,000 in 1843, and a cattle herd of more than one million (15). New refrigeration technology enabled the first shipment of frozen meat from Australia to arrive in London in 1879, with chilled shipments commencing in 1934 (18).

The United Kingdom (UK) remained the major export meat market for Australia for 75 years until the expiry of a 15-year 'war contract' in 1955. The United States of America (USA) then replaced the UK as the major market, with a focus on cheaper manufacturing meat, until the mid-1990s, when

exports of higher quality beef to North and South-East Asian markets expanded (12).

## The structure of the Australian meat industry

Australia has well-developed, mature sectors within its meat industry which focus on export markets, domestic markets or both. The value of the industry was approximately AUS\$9 billion from 2000 to 2001 (2). Meat exports to approximately 132 markets worldwide for the same period were estimated to be worth over AUS\$5.5 billion (17). Australia is the largest beef exporter in the world, and the second-largest exporter of sheepmeats. Selected slaughter and meat production statistics are provided in Table I. This table also demonstrates the reliance of Australia on export markets. For example, approximately 50% of beef production and 35% of sheepmeat production is exported. Australia also produces meat from deer, goats, camels, kangaroos, emus, ostriches, wild boar, possums and crocodiles, but in smaller quantities. In addition, Australia exports significant quantities of the by-products of slaughter, such as hides, rendered meals, animal food and raw materials for the pharmaceutical industry.

Providing a modern meat inspection programme, which meets the requirements of a large number of importing countries, requires a significant investment in human resources and training. The AQIS meat inspection programme employs approximately 100 veterinarians, the majority of whom are engaged in the on-site auditing and supervision of slaughtering establishments, and assisting with ante-mortem and post-mortem inspection. In addition, AQIS also employs approximately 450 meat inspectors (more specifically, the equivalent of 450 full-time positions), who principally perform on-line post-mortem inspections, have received specific training in veterinary public health competencies and work

**Table I**  
**Australian slaughter and meat production statistics from 2000 to 2001**

Type of meat	Total production (kt)	Exports (kt)	Slaughterings ('000s)
Beef and veal	2,054	1,025	8,695
Sheep meat	723	256	35,028
Pork	365	46	5,016
Poultry	655	21	–

kt: kilotonnes

Source: Australian Meat and Livestock Industry, 2002 (5); Meat and Livestock Australia, 2001 (17)

under the direct supervision of AQIS veterinarians. The annual cost of the AQIS meat inspection programme is approximately AUS\$55 million. Meat inspection services are provided to approximately 90 integrated export abattoirs, 40 independent boning rooms, 80 meat-processing establishments and 80 independent cold stores.

## Evolution of a modern meat safety system

Traditional methods of meat inspection conducted during abattoir processing cannot absolutely guarantee meat safety. The risks posed by meat safety hazards demand a co-operative approach by farmers, meat processors, consumers and government authorities. This is because the action or inaction of any party in the chain of meat inspection, meat processing, distribution and meal preparation, from the farm to consumption, can lead to an increased level of risk to human health.

Before the 1990s, the traditional meat inspection system in Australia was similar to other such systems around the world. The system did not take into account industry QA programmes and focused on the removal of macroscopic defects at the end of the commercial meat production chain, as well as supporting national animal health objectives, such as the eradication of bovine tuberculosis and brucellosis (16, 21). Abattoirs used elements of QA, such as good manufacturing practice at workstations along the slaughter line, but these practices were not systematically implemented. In the traditional system, the meat inspection service condemned individual carcasses or their parts, based largely on macroscopic findings of pathology or contamination. This system was very prescriptive and was not principally focused on prevention, with limited meat safety controls over raw materials, the production process and distribution. The focus was on enforcement and prosecution, and not on a co-regulatory QA approach to either the inspection service or industry processes (7). It is clear that a traditional inspection system alone would address few of the important hazards in the meat supply of today, such as pathogenic micro-organisms and contamination of stockfeed by chemical residues.

In addition, since this traditional meat inspection system was not consistent with HACCP-based QA programmes, which have now been incorporated into national and international standards, failure to modernise the system would have placed the Australian meat industry at a disadvantage in the global marketplace. The industry would have been unable to meet the requirement of many importing countries for an 'equivalent' meat inspection system, and so would have had a reduced capacity to compete effectively against meat imports into Australia.

A modern, integrated QA approach to meat inspection in Australia has catered for these complexities within the production chain and has addressed contemporary meat safety issues, while continuing to support national animal health objectives. The Australian system places a greater emphasis on achieving meat safety results or 'outcomes' through QA arrangements which incorporate an HACCP-based approach. Quality assurance systems based on HACCP principles, supported by effective on-farm and transport controls and combined with consumer education, offer the best way to consistently achieve a safe meat supply.

Quality assurance programmes based on HACCP principles have redefined the respective responsibilities of industry and regulatory authorities in Australia. Through a co-regulatory, partnership arrangement, AQIS is responsible for the broad design of the inspection system and its audits and sanctions, while the industry is responsible for further developing, implementing and maintaining the system. This arrangement reflects the belief in Australia that the main responsibility for the production of safe meat should rest, to a significant degree, with livestock producers and meat processors. However, it is equally important that AQIS applies a QA approach to its own functions, with a view to systematically and objectively monitoring meat inspection and encouraging continuous improvement to the system through performance feedback.

A true government/industry partnership operates in Australia to design, implement and update the meat inspection programme (22). Pooling resources and knowledge from different government and industry bodies has demonstrated benefits. The emphasis is on a flexible and adaptable approach, which can react to the latest national and international developments through periodic updating of standards, regulations and industry practices, as appropriate. This collegiate, multidisciplinary approach engenders trust, improves lines of communication and has the greatest chance of producing optimal meat safety outcomes. In addition, a partnership approach promotes industry ownership of the system and encourages a greater level of industry compliance.

Progressive changes to importing country requirements have also influenced the modernisation of the Australian meat safety system. Australia must meet the many and varied legislative requirements of all the countries to which meat is exported. It is not feasible to implement a separate system which exactly equals that required by each importing country, so the emphasis has been on implementing an Australian meat inspection system which is accepted by overseas authorities as 'equivalent'.

Australia also participates fully in international standard-setting organisations of relevance to meat production and inspection, including the Codex Alimentarius Commission and the OIE (World organisation for animal health), and ensures that national meat safety systems are consistent with these standards.

**Table II**  
**Approximate timeline showing influences for change in the Australian meat inspection system and the actual changes implemented by the Australian Quarantine and Inspection Service and meat processing industry**

Date (approx.)	Influence for change	Changes implemented in the Australian meat inspection system
1965	United States (US) Federal Meat Inspection Act	Australian export legislation updated
1960s	Mandatory cattle identification introduced to eradicate bovine tuberculosis and brucellosis	Traceback system from abattoirs to farms implemented
1980s	European Union meat directives introduced	Australian export legislation updated
1981	Australian meat substitution scandal	Australian export legislation updated to emphasise integrity
1987	Organochlorine residues found in Australian beef	Traceback system from abattoirs to farms and database refined
1987-1989	Quality systems penetrating the food processing industry	First basic regulatory quality systems implemented at export meat plants
1990s	International Organization for Standardization (ISO) standards required of suppliers to major Australian meat retailers	Meat processors adopt commercial ISO quality systems
1993-1994	US <i>Escherichia coli</i> O157:H7 incident. Codex Alimentarius Commission publishes hazard analysis critical control point (HACCP) guidelines	Co-regulation, voluntary meat safety quality assurance (MSQA) (ISO QA/HACCP)
1994	Chlorfluazuron residues found in Australian beef	Vendor (farmer) declaration system introduced for cattle sales
1995-1996	Australian <i>E. coli</i> O111 incident. US introduces final rule on pathogen reduction for <i>Salmonella</i>	Scientific review/update of standards undertaken. Mandatory HACCP introduced. MSQA refined

Table II provides an approximate timeline of the major influences for change in the Australian meat inspection system.

## An overview of quality assurance in meat inspection

In Australia, six levels of verification are applied to ensure AQIS and industry operations comply with regulatory requirements. These levels are diagrammatically demonstrated in Figure 1.

Quality assurance is applied to AQIS regulatory activities (Levels 2 to 6) and also to industry processes (Level 1). These different levels of verification are interdependent, and an understanding of the system as a whole is necessary to appreciate how each level is integrally linked.

Level 6, external audits of the AQIS system, are periodically conducted by overseas authorities such as the US Food Safety and Inspection Service, or the Food and Veterinary Office of the European Union.

Level 5, the AQIS Compliance and Investigations Unit audit, educates AQIS officers and industry parties on their responsibilities under co-regulation and the relevant legislation. The Compliance and Investigations Unit audit aims to maximise voluntary compliance, but also to provide a strong deterrent to deliberate criminal activity through investigation and prosecution. The business practices of the Compliance and Investigations Unit are certified to the International Organization for Standardization (ISO) standard of ISO 9001:2000.

Levels 4, 3 and 2 are further steps in the direct AQIS auditing of meat industry operations. Quality assurance at these levels occurs through the national plant management system (NPMS), the scheme for corrective action (SCA) and the electronic documentation system (EXDOC). These QA functions are detailed in the section below, 'Quality assurance elements of the meat inspection service'.

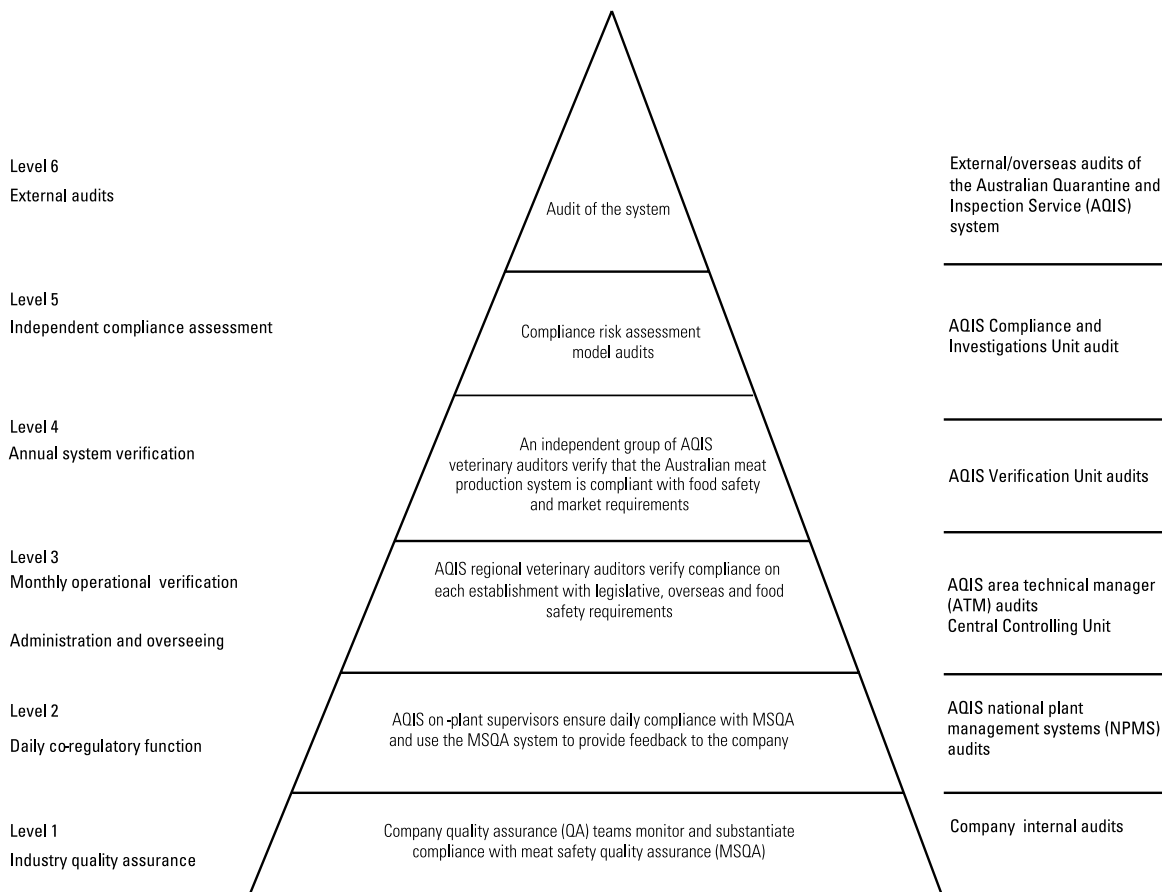
Level 1, comprising HACCP-based QA programmes in the meat industry, is based on the meat safety quality assurance (MSQA) model, underpinned by documented standard operating procedures (SOPs) and work instructions, and supported through monitoring programmes such as meat hygiene assessment (MHA), and *Escherichia coli* and *Salmonella* monitoring (ESAM). These QA functions are detailed in the section below, entitled 'Quality assurance of meat industry processes'. Individual company MSQA programmes are linked to industry 'whole of chain' QA systems which operate on-farm, during the transportation of live animals, and during the transportation and distribution of the finished product. These aspects are briefly covered in the 'Pre-harvest and post-harvest quality assurance programmes' section below.

## Quality assurance elements of the meat inspection service

### National plant management system

In the mid-1990s, system audits conducted by overseas authorities and senior AQIS reviewers identified systematic meat safety defects across a range of meat establishments. These findings confirmed the importance of a disciplined and structured approach to the consistent maintenance of standards in all establishments.

To help address these concerns, AQIS introduced NPMS to meat processing establishments in 1996 as a QA management tool for AQIS auditors. This system provides the AQIS on-plant



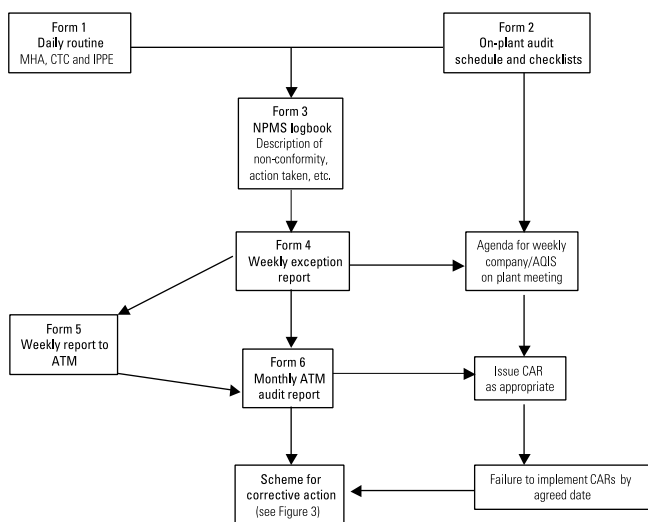
**Fig. 1**  
**The six levels of verification applied to the meat inspection programme, involving the compliance of the Australian Quarantine and Inspection Service and industry operations with regulatory requirements**

veterinarian (Level 2); the AQIS regional veterinary auditors (area technical managers or ATMs) (Level 3); and the Central Controlling Unit in Canberra (Level 3) with a system which enables them to manage the meat inspection programme effectively in a nationally consistent manner. The system was put through extensive trials before introduction and has been progressively refined. In addition, NPMS is closely integrated with the MSQA system and its supporting monitoring systems, in that NPMS interacts directly with the MSQA system in the company (the link or ‘interface’ between Level 1 and Level 2), and also allows verification of the co-regulatory approach on-plant (the interface between Level 2 and Level 3). The inter-relationship of NPMS components in an establishment is diagrammatically illustrated in Figure 2.

The NPMS is a comprehensive daily monitoring and reporting system which uses check-lists and reporting forms to record accurately non-conformities (deficiencies) in company processes. Corrective action requests (CARs) are used by AQIS to agree on corrective or preventative measures with the company managers and to verify the completion of these actions by the agreed dates. Therefore, CARs issued by AQIS have a similar purpose to those issued by third-party auditors

of ISO quality systems. The NPMS is uniformly implemented throughout Australia, ensuring national consistency and permitting the systematic analysis of outcomes at individual establishments and at both regional and national levels. The scheduling of audits and lodging NPMS forms is facilitated by an intranet system and electronic mail connections between the AQIS on-plant veterinarian, the relevant ATM and the Central Controlling Unit of AQIS in Canberra. The NPMS is supported by a series of seventeen work instructions which provide administrative guidance to AQIS staff.

The on-plant veterinarian, through the NPMS, is a crucial element in ensuring that the company MSQA system continues to meet regulatory requirements. He or she conducts scheduled structured ‘mini-audits’ of different components of the MSQA system. These findings are then integrated with the findings of more frequent, direct verification of the controls on the process, to ensure that the MSQA system is operating effectively and that meat safety requirements are being met. One monitoring function performed by the AQIS on-plant veterinarian is called ‘check the checker’ (CTC), in which the veterinarian directly monitors the competence of the company staff performing MHA. A description of MHA is provided later in this paper.



MHA : meat hygiene assessment  
 CTC : 'check the checker'  
 IPPE : independent product and process examination  
 NPMS : national plant management system  
 AQIS : Australian Quarantine and Inspection Service  
 ATM : area technical manager  
 CAR : corrective action request

**Fig. 2**  
**National plant management system: the inter-relationship of monitoring and reporting systems at a meat processing establishment**

Another AQIS monitoring function is called independent product and process examination (IPPE). In IPPE, AQIS assesses a product or process to identify deviations from the approved MSQA system (the HACCP plan, SOPs or work instructions), or to verify that effective corrective action has been implemented to resolve an identified MSQA non-conformity. In addition, NPMS ensures weekly reports are provided to the relevant ATM on the performance of the company MSQA system.

At the scheduled monthly audit, the ATM can assess how the MSQA system of the company has performed since the last audit, as NPMS has gathered and collated objective data in the intervening period. Therefore, the assessment of a company performance is based on records from the past month, rather than purely on the results of an 'on-the-day' inspection. This limits the potential for reviewer bias. Important recent modifications to the NPMS system mean that the company is allocated an objective performance score at the end of the scheduled monthly audit. This performance score can then be ranked against that of other companies in the industry. This process is designed to encourage a positive performance approach from one scheduled audit to another. If AQIS determines that the company has failed to maintain continuous operational compliance with legislative requirements through the QA system, AQIS then instigates sanctions through the SCA.

The effective and consistent performance of the meat inspection service is supported through extensive training of AQIS staff in HACCP, quality system auditing and other regulatory activities. The AQIS staff who perform MSQA audits are qualified ISO quality system auditors. Furthermore, AQIS has a Training Services organisation which provides accredited training in HACCP, quality system development and auditing, and food safety for both AQIS and industry staff. The business activities of AQIS Training Services are certified to ISO standards.

### The scheme for corrective action

If failure occurs in the quality system or an individual process at a meat processing establishment, AQIS takes a QA approach to applying sanctions. This approach enables AQIS to apply these sanctions in a structured, nationally uniform way. In general, sanctions are imposed when remedial measures have consistently failed to achieve compliance with regulatory meat safety standards or other regulatory requirements.

The SCA was developed and implemented in parallel with NPMS. This scheme is based on a point-scoring system, within a 'moving window' of six months. That is, SCA points remain in place for the following six months (the window) and are then removed. Points may be accumulated as a result of the following:

- poor ratings at scheduled monthly MSQA audits
- the rejection of individual meat consignments by overseas authorities at the port-of-entry inspection
- unsatisfactory testing results for *Salmonella* within the ESAM programme.

The points score is cumulative during the six-month period and allows for multiple incidents, factors or triggers to contribute to the sanctions pathway and outcome. The point scoring system is shown in Table III. A score of one, two or three results in AQIS issuing a CAR to the managers of the establishment. A score of four or more involves the issuing of a CAR, but also requires the managers to develop and implement a corrective action plan (CAP). This plan must detail the following:

- the investigation of the cause of the non-conformities
- consideration of corrective and preventative measures
- the implementation of these corrective and preventative measures
- verification that the non-conformities in the system have been resolved.

A CAP is agreed between AQIS and the managers of a meat establishment and aims to ensure that deficiencies do not reoccur.

Further sanctions may include the following:

- SCA audits
- suspension of a meat-processing operation

**Table III**  
**Point scoring system under the scheme for corrective action**

Incident/factor/trigger	Points allocated
First marginal audit, undertaken by area technical managers (ATMs)	1
Second marginal audit by ATM	2
Third and subsequent marginal audits by ATM	3
Any unacceptable ATM audit	4
First overseas rejection of a shipment <sup>(a)</sup>	1
Second overseas rejection of a shipment <sup>(a)</sup>	2
Third and subsequent overseas rejection of a shipment <sup>(a)</sup>	3
Failure of first <i>Salmonella</i> sample window <sup>(b)</sup>	1
Failure of second <i>Salmonella</i> sample window <sup>(b)</sup>	2
Failure of third <i>Salmonella</i> sample window	4

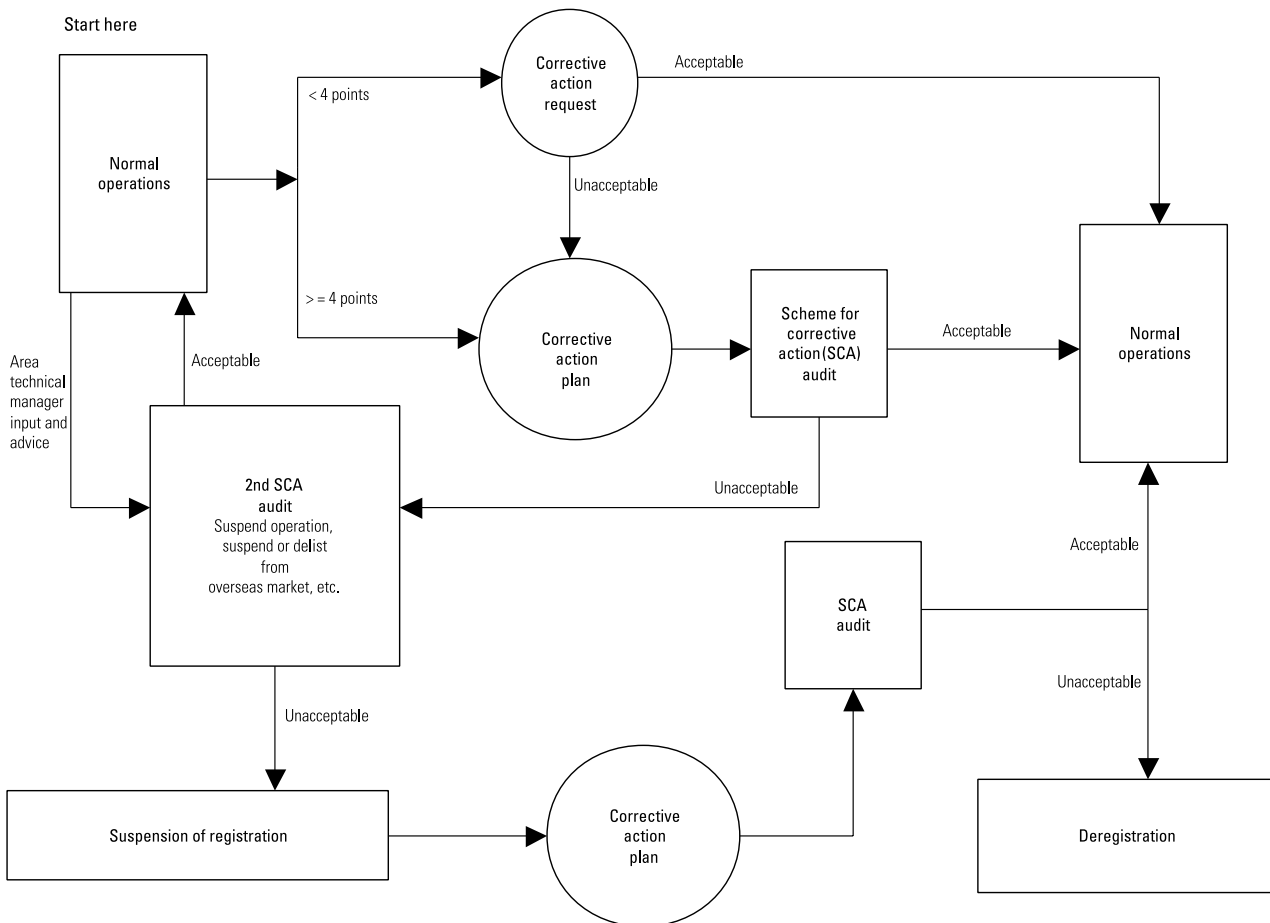
a) Rejection of shipment related to contamination, unsound condition of meat, or processing and pathological defects

b) Failure of sample accompanied by unsatisfactory investigation or corrective action

- an increased AQIS inspection presence at the establishment
- an increased frequency of MHA checks.

In extreme cases, the offending establishment may be suspended or delisted from relevant overseas markets until satisfactory controls are re-established over the processing system. Ultimately, the establishment may be deregistered.

Accumulated SCA points can be deleted in two ways. If an establishment accumulates fewer than four points during a six-month moving window, each point will be deleted at the start of the seventh month after the point was allocated, provided that effective corrective action was implemented in response to the CAR. If four or more points are accumulated, points will be removed after a mandatory CAP has been implemented and the effective corrective action has been verified by an SCA audit. A flow chart for the application of sanctions within SCA is diagrammatically illustrated in Figure 3. More detailed information on the implementation of SCA is available on the internet (10).



**Fig. 3**  
**Scheme for corrective action: a flow chart for the application of sanctions on the points accumulated within a six-month moving window**

The role of the AQIS Verification Unit is to independently assess sustained operational compliance with the meat inspection programme throughout the country. The Verification Unit achieves this through the three following types of audits:

- SCA audits
- annual MSQA audits
- systems audits.

An SCA audit is undertaken by a veterinary auditor from the AQIS Verification Unit (Level 4), together with the ATM, to assess the operational compliance of the company. Verification Unit audits of the entire MSQA system of a company are usually conducted annually. However, if a company has developed a history of good operational compliance, such audits may be conducted less frequently. A systems audit is an audit of the entire MSQA system, plus the AQIS on-plant inspection system. Information from these Verification Unit audits is assessed and reported to the National Manager of the AQIS meat inspection programme, with a view to implementing systematic improvements to ensure national consistency in the programme.

## Linking quality assurance outcomes to electronic documentation

The QA measures described above should help to ensure the following:

- that the meat has been hygienically prepared
- that the meat will meet the requirements of export and domestic markets
- that the meat is true to the description on the label.

Since 1992, an electronic documentation system, EXDOC, has established processes to ensure that only meat which has passed the QA checks can be certified by AQIS for export. This system provides links between the producing establishment, the exporter, and the storage or loading establishments, and allows AQIS endorsement of export permits and health certificates. More recently, EXDOC has been extended to provide an equivalent service for dairy, fish, grains and horticultural exports. The establishment register (ER) system is closely integrated with EXDOC and is used to maintain an official register of establishments under AQIS jurisdiction.

The EXDOC receives the details of all proposed exports from commercial parties and links these details with the results of AQIS product inspection. Then, if AQIS authorises the product as eligible for export, health certificates and export permits are issued by EXDOC. This process involves extensive electronic

QA checks. These checks include verification against ER records to ensure that the producing establishment was eligible to produce export meats for the nominated market at the time of slaughter and packing. The electronic documentation system has an integrated audit trail sub-system, which can be used to establish a complete history of each request for an export permit, from the time it was first submitted to the time the health certificate was produced. Electronic documentation also aids the exporter by allowing the electronic lodgement of all export documentation through a single electronic access 'window' with AQIS, the Australian Customs Service and the Australian Bureau of Statistics.

In 1998, the concept of electronic documentation was extended to the electronic transmission of health certificates for meat exported to Japan. This was achieved through the sanitary/phytosanitary certificate message (SANCRT) system, developed to the electronic data interchange for administration, commerce and transport (EDIFACT) standards of the United Nations. Trials of the SANCRT system have been conducted with the co-operation of a number of other countries. The electronic transmission of health certificates has a number of QA advantages, due to automated data capture. These advantages include the following:

- removing the possibility of transcription errors
- enabling automated distribution to the customs, quarantine and veterinary public health authorities in the receiving country
- eliminating the risk of forged health certificates being presented for illegal meat shipments.

At present, AQIS is working with key trading partners to develop and implement an alternative, more easily adopted, web-based system called E-cert, which is based on an XML format.

## Quality assurance of meat industry processes

### Hazard analysis and critical control point-based quality assurance systems

Individual meat companies have implemented comprehensive HACCP-based QA systems with the aim of achieving consistent compliance with regulations and standards, in a co-regulatory partnership with AQIS. The integral links between company processes, the company QA system and the AQIS NPMS system are diagrammatically illustrated in Figure 4.

To improve the safety of all meat and meat products, Australian governments decided that all Australian meat processing establishments must have quality systems which are based on HACCP principles in place by 1 January 1997 (1). The elements essential to the proper operation of HACCP-based



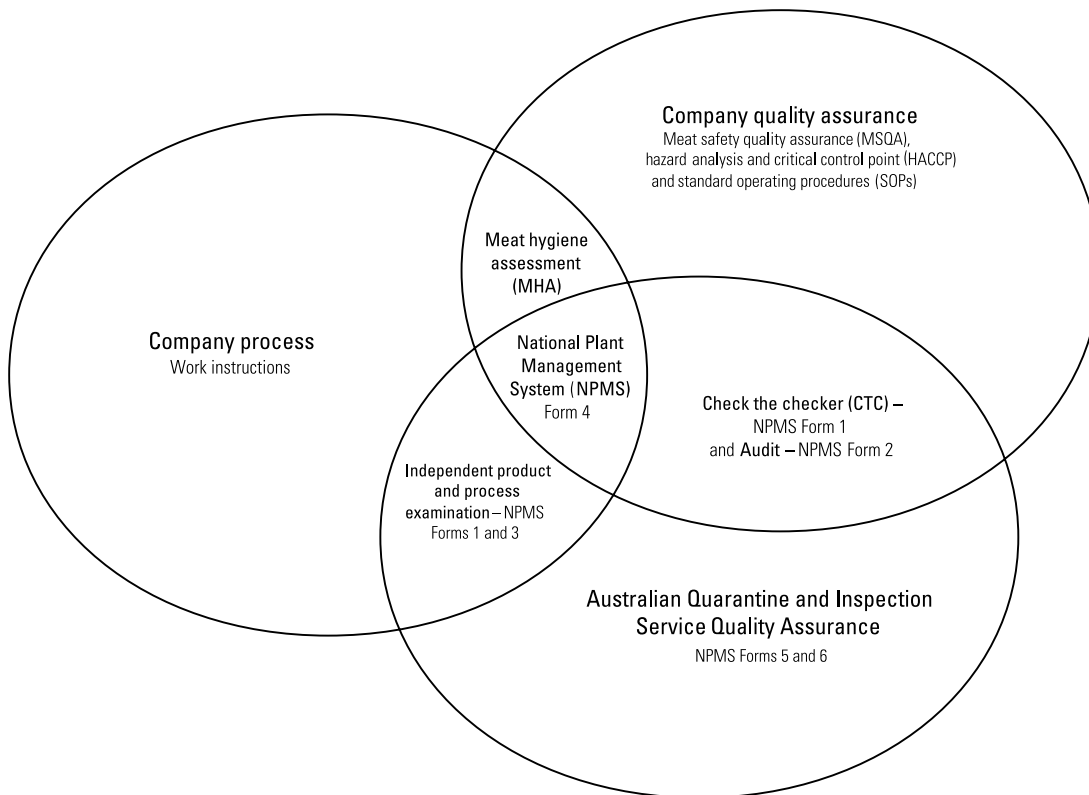


Fig. 4

**Co-regulatory management system: the integral links between company processes, the company meat safety quality assurance system and the Australian Quarantine and Inspection Service national plant management system**

QA systems were put through exhaustive trials in the export sector during 1995 and 1996. At about the same time, the United States Department of Agriculture (USDA) published a final rule on reducing pathogens which made the progressive introduction of HACCP systems and SOPs mandatory (23).

Meat safety QA was designed to meet both domestic needs and the requirements of authorities in importing countries, by allowing AQIS and the processing industry to demonstrate effective meat inspection controls. The MSQA approach aimed to achieve an integrated company QA system which was based on HACCP principles but also addressed all remaining regulatory requirements, such as the following:

- animal health
- animal welfare
- hygiene and sanitation
- the on-plant use of industrial chemicals
- product integrity and security.

As the MSQA format is consistent with the ISO 9000 series of quality standards, MSQA is also compatible with the direction taken by some companies to obtain ISO quality system certification by third parties for commercial purposes.

The role of the managers of meat establishments is to develop, implement and ensure compliance with the documented MSQA system, incorporating HACCP plans, SOPs and work instructions based on good manufacturing practice. In addition, managers should implement objective ways to assess meat hygiene through MHA. The role of AQIS is as follows:

- for the on-plant veterinarian to assist in the preparation of the company system
- for the ATM to approve the final company MSQA manual
- for staff at all six AQIS levels of verification to monitor the performance of the system through NPMS.

The MSQA system was substantially revised and updated in 1998. The revised system provides an enhanced role for industry in the co-regulatory meat inspection process.

*A Guide for the Preparation of the MSQA System* (the 'MSQA Guide') has been published to provide a template for national uniformity. The *MSQA Guide* is also available in full on the internet (8). It is designed as a practical 'how-to' manual to assist companies in developing an MSQA system. The principles of HACCP described in the *MSQA Guide* reflect the standard for HACCP defined by the Codex Alimentarius Commission (13). The contents of the *MSQA Guide* are detailed below in Table IV, demonstrating a format consistent with the ISO 9000 series of quality systems.

**Table IV**  
**Contents of A Guide for the Preparation of the Meat Safety Quality Assurance System**

<b>Part 1</b>	<b>The company quality system</b>	<b>Part 2</b>	<b>The application of hazard analysis and critical control point (HACCP) and good manufacturing practice</b>
I	Introduction and scope of meat safety quality assurance (MSQA)	22	Introduction
II	MSQA manual format and layout	23	Definitions
	a) general approach	24	Pre-requisite programmes
	b) manuals and work procedures	25	Work instructions
	c) format	26	Monitoring
	d) alignment of the MSQA system with International Organization for Standardization (ISO) 9002:1994	27	Purpose and principles of the hazard analysis critical control point (HACCP)
		28	Develop the HACCP plan
		28.1	Assemble the MSQA team
		28.2	Describe the product and the method of distribution
		28.3	Identify the intended use and consumers of the product
		28.4	Construct a flow diagram which describes the process
		28.5	Verify the flow diagram
			<b>Principles</b>
		28.6	Principle No. 1: hazard analysis
		28.7	Principle No. 2: identify the critical control points (CCPs) in the process
		28.8	Principle No. 3: establish critical limits
		28.9	Principle No. 4: establish monitoring procedures
		28.10	Principle No. 5: establish corrective action to be taken
		28.11	Principle No. 6: establish verification procedures
		28.12	Principle No. 7: establish record-keeping procedures
			<b>Appendix A</b> Examples of questions to be considered in a hazard analysis
			<b>List of figures</b>
		Fig. 1	Examples of quality system documentation
		Fig. 2	Company organisational chart
		Fig. 3	An example of an MSQA amendment register
		Fig. 4	Relationship between good manufacturing practice and HACCP
		Fig. 5	Logic sequence for developing an HACCP plan
		Fig. 6	Example of a simple flow diagram for part of a beef kill floor
		Fig. 7	Example 1 of a CCP decision tree
		Fig. 8	Example 2 of a CCP decision tree
		Fig. 9	Example of corrective action decision tree for company monitors
		Fig. 10	Model of relationship between verification and management review

Source: Australian Quarantine and Inspection Service, 1998 (8)

## Meat hygiene assessment

Meat hygiene assessment was developed by AQIS as a tool to assist industry in the implementation of HACCP plans. The MHA system was originally developed during 1993. Further trials and refinements occurred in consultation with the industry before the compulsory introduction of the system in 1996.

Meat hygiene assessment provides a standardised monitoring approach in which trained company staff objectively measure the adequacy of the HACCP-based MSQA process controls, at

specific steps in the processing line. Corrective action is required wherever the system performance is inadequate, for example, through adjusting SOPs or work instructions where necessary. The MHA system helps to ensure uniformity of processing results across the export meat industry in Australia, and reflects the need for a zero tolerance of visible faecal and ingesta contamination on meat. Through CTC, the AQIS on-plant veterinarian directly monitors the company staff performing MHA. The objective measurements obtained through MHA, as well as the CTC findings, are recorded by the AQIS on-plant veterinarian in NPMS.

Meat hygiene assessment comprises two parts: one system for process monitoring and the other for product monitoring. The two systems are designed to operate in unison and complement each other.

Product monitoring assesses the level of macroscopic contamination of carcasses, offal and cartoned meat, and indicates which company staff may not be following SOPs or work instructions. Representative samples are routinely examined using a consistent methodology, including a defined classification of defects and their respective tolerances. Weightings are applied to defects according to their classification and this information is then condensed to a single value, called a 'defect rating'. The defect rating provides an overall picture of the hygienic condition of meat and confirms that the process controls used in its production are adequate. Corrective action is required when the defect rating falls outside a target value or when zero tolerance standards are not achieved.

Process monitoring assesses the disease-control operations on the slaughter floor and in the offal room which are described in SOPs and work instructions, and identifies which company staff may require further training. Process monitoring also requires the performance of company staff to be routinely examined at each step of the process in these two production areas. Weightings are applied to any defects whenever an operation is found to be marginal or faulty. This information is then condensed to a single value called a 'conformity index'. As in product monitoring, corrective action is required when the conformity index falls outside a target value.

Furthermore, AQIS has introduced QA methods to analyse trends in such defect ratings and conformity indices, and uses graphing and trend analysis to assist with decision-making on whether adjustments are required to the process controls at individual establishments.

### Microbiological monitoring of process controls

In 1997, Australian establishments entitled to produce export meats for the market in the USA began microbiological testing of carcasse surfaces for generic *E. coli* and *Salmonella* spp. This action came in response to the US Final Rule on Pathogen Reduction and HACCP Systems (23). At the same time, the Australian Government made microbiological testing mandatory to validate HACCP-based QA systems at all Australian slaughtering establishments.

Federally inspected abattoirs have since been required to participate in the ESAM programme, which is an integral part of MSQA. *Escherichia coli* and *Salmonella* monitoring requires the testing of carcasse surfaces for *E. coli* to verify process controls. In addition, *Salmonella* spp. testing is required to verify pathogen reduction. Testing carcasse surfaces for total

viable bacterial counts is encouraged, to aid in monitoring the effectiveness of the process controls at an establishment.

Trends in *E. coli* levels which are above the national average, detection of *E. coli* clusters, or the detection of *Salmonella* spp. all indicate that the HACCP component of the MSQA system at a particular meat processing establishment has failed at one or more critical control points. The company concerned must then investigate the cause and implement appropriate corrective action, in consultation with AQIS.

A comprehensive manual which details the individual components of the ESAM programme is available on the internet (9).

## Pre-harvest and post-harvest quality assurance programmes

### Whole of chain programmes

The 'whole of chain' approach to QA means that the QA programmes detailed above do not operate in isolation but are linked to other programmes which operate 'from the paddock to the plate', for a significant and growing proportion of the industry. Meat safety will undoubtedly be compromised if meat inspection is considered to begin and end at the meat processing establishment. In Australia, voluntary pre-harvest and post-harvest QA programmes extend the reach of meat inspection and enhance its effectiveness.

On-farm QA programmes are in place for grass-fed cattle, feedlot cattle, sheep and pigs (3, 4, 5, 6). A review of on-farm QA programmes has been published (20). These programmes aim to address on-farm hazards, such as those posed by faecal contamination, animal feeding and the use of agricultural and veterinary chemicals. Quality assurance systems implemented by the transport industry and at livestock saleyards operate between the farm and the abattoir. Commercial QA programmes operated by meat companies and transport companies also extend beyond production to cover refrigeration, storage and transport.

Traceback and traceforward are important components of 'whole of chain' QA systems in Australia. Identification of livestock and traceability of their products and other inputs, such as stockfeeds, are important to ensure that meat safety hazards are not introduced into the system (11). Identification and traceability are also important elements of QA for product tracing and recall in the event of a system failure. The national livestock identification scheme in Australia enables the permanent identification of cattle by using devices embedded with an electronic microchip. This system complements cattle identification systems which have been in place in Australia

since the 1960s (19). Flock identification schemes for sheep are currently being refined, and mandatory identification of pigs has been in place for many years.

### Continuous improvement and surveillance

Continuous improvement in the QA of meat inspection in Australia has been a key focus over the last ten years. The significance of continuous improvement can best be demonstrated by examining national statistics for the percentage rejection rate of Australian meat consignments at US port-of-entry inspection (Fig. 5). After the introduction of more stringent US import requirements in 1993, rejections doubled, as a percentage, from an historically low base. From 1994 onwards, the progressive implementation and continuous improvement of the QA initiatives described earlier in this paper led to a steady decrease in the percentage rejection rate to below historical levels. The contribution of HACCP-based process controls to this decrease can be appreciated when assessing the parallel decrease in the percentage rejection rate for contamination and pathology.

The meat inspection system in Australia uses NPMS to systematically monitor and evaluate system performance. This feedback on performance can be used at individual establishments and at the regional or national level to redesign or refine system elements which are not performing at optimal levels, thus promoting continuous improvement. In a broader

sense, Australian health authorities have identified that an optimal food safety monitoring and evaluation system requires a national surveillance system which reports adverse events and is linked to appropriate data sources (Fig. 6) (14).

Such feedback into QA systems is used to update the AQIS meat inspection programme through risk assessment, and can also help in predicting future hazards, which are either currently unknown or thought to be unimportant. However, in the future, these hazards could contribute to increased morbidity, requiring that they be taken into consideration in the design of the meat inspection system. Keeping abreast with progress in scientific knowledge, implementing comprehensive surveillance systems and continuously improving the meat inspection system will be essential in combating future hazards.

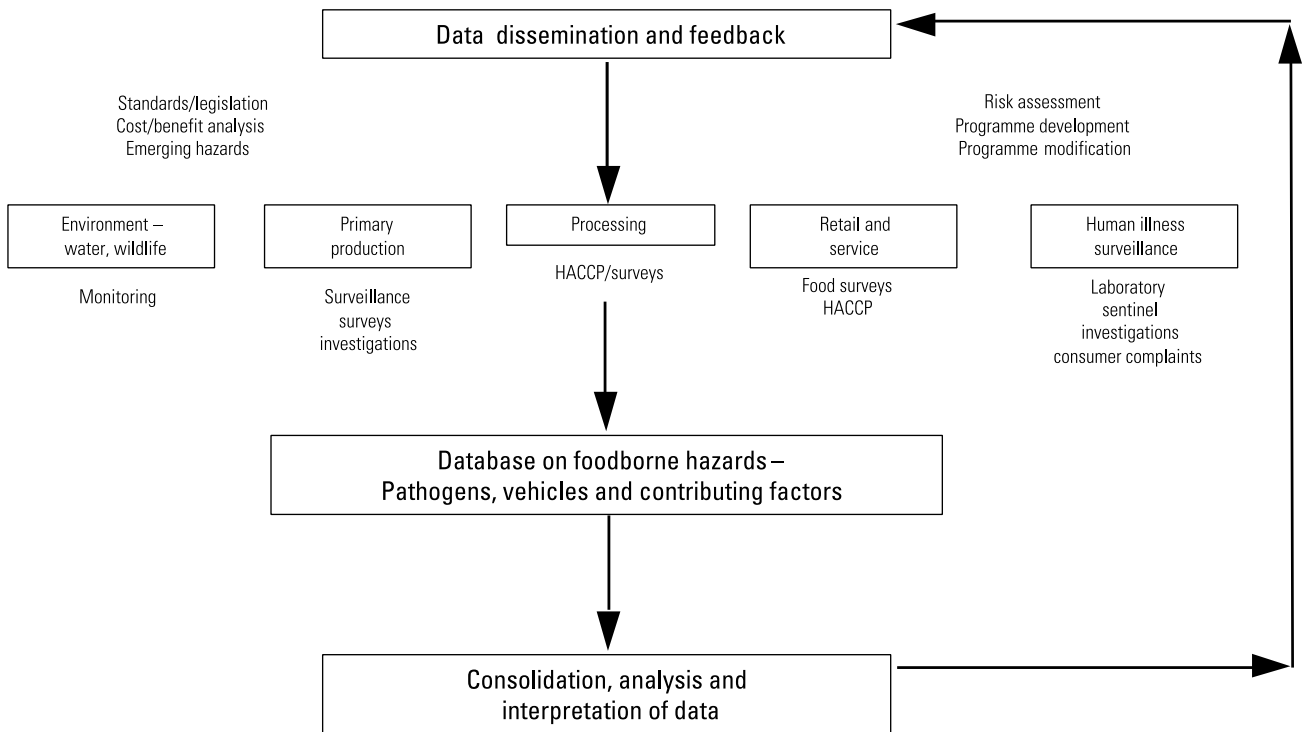
### Emergency planning

Emergency planning is an important element of the Australian meat inspection system. Meat safety emergencies, due to real or perceived hazards, can occur from time to time in any country. When such emergencies do arise, it is crucial to be able to respond quickly and effectively. Emergency management of meat safety incidents in Australia is based on the same emergency management QA principles which are applied to other emergencies, such as floods, fires and animal health emergencies.



**Fig. 5**  
**Australian meat exports to the United States of America: underlying rejection rates, 1992 to 2001**

Source: Australian Quarantine and Inspection Service (AQIS)



HACCP: hazard analysis and critical control points

**Fig. 6**  
**Food safety system evaluation through collection, analysis and interpretation of data**  
 Source: Crerar et al.(14)

Each government and industry sector involved in meat production and inspection has a documented, up-to-date emergency response plan, based on QA principles, which is followed if and when required. In general, responding to an emergency has five stages, some or all of which may overlap, operationally and chronologically. The pre-emergency stage involves prevention and preparedness strategies, including risk minimisation, risk awareness and emergency training. The ‘trigger’ or initiating stage focuses on investigating the suspect incident. The scoping phase attempts to quantify the extent of the possible impacts, enabling an appropriate response strategy to be chosen. The last two phases are the response phase and the ‘stand down’ phase. The emergency management system is tested through simulated emergencies, which may involve desk-top exercises, field exercises or both.

## Conclusion

Government and the meat-processing industry have adopted a co-regulatory approach to meat inspection in Australia which is designed to address contemporary meat safety issues. Both the AQIS meat inspection services and the industry use QA elements that operate jointly to consistently meet national and international meat safety requirements.

The Australian meat inspection system incorporates a combination of documented, nationally consistent HACCP-based QA programmes, supported by auditing, laboratory testing, and a flexible design for the system, to ensure that contemporary and emerging veterinary public health risks are addressed.

However, QA systems at meat establishments are not sufficient on their own to guarantee meat safety adequately. These systems should be linked in a ‘whole of chain’ approach to pre-harvest and post-harvest QA systems. Such an approach is designed to control potential hazards from inputs at all stages of production. Links to emergency preparedness plans based on QA principles should also be established to allow any failures in the meat inspection system to be effectively addressed.

Continuous improvement of these QA systems, enabling them to address future hazards, will remain a challenge. Continuing and extending a collegiate, multidisciplinary approach to the design of the meat inspection system will be important in this regard.

## L'assurance qualité et l'inspection des viandes en Australie

R.J. Butler, J.G. Murray & S. Tidswell

### Résumé

En Australie, l'inspection des viandes vise à s'assurer de l'innocuité et de la salubrité des aliments produits, à respecter les exigences des pays importateurs et à participer à la réalisation des objectifs nationaux en matière de santé animale. Une étude a été réalisée en vue d'apprécier l'impact de l'assurance qualité sur les systèmes d'inspection des viandes en vigueur dans les établissements soumis au contrôle fédéral. Elle a révélé que l'Australie devait son rang dominant parmi les exportateurs de viande en partie à son système d'inspection, fondé sur un cadre réglementaire partagé et une démarche d'assurance qualité s'appliquant à toutes les espèces présentées à l'abattoir. Les années 1990 ont été marquées par une évolution des techniques d'inspection des viandes au niveau national et international qui a entraîné une amélioration significative des systèmes d'assurance qualité. L'assurance qualité repose sur des procédures écrites et harmonisées au plan national, conçues pour garantir des normes invariables de sécurité sanitaire de la viande. Ces dispositifs sont complétés par des programmes d'assurance qualité assortis d'une analyse des risques et des points critiques pour leur maîtrise conformes aux normes de qualité de l'Organisation internationale de normalisation.

Les programmes d'assurance qualité visent à garantir l'intégralité de la chaîne alimentaire. Leur but est d'établir un système allant « de la fourche à la fourchette » (des premiers aux derniers stades situés en amont et en aval de l'abattage) qui concernera, par exemple, les pratiques d'élevage mais aussi la réfrigération, le stockage et le transport. Les éléments d'assurance qualité de l'inspection des viandes qui ont été introduits dans les systèmes de production australiens ont contribué significativement à la cohérence des objectifs de sécurité sanitaire et à leur bonne adaptation aux risques actuels.

### Mots-clés

Assurance qualité – Australie – Inspection des viandes – Sécurité sanitaire des aliments – Service vétérinaire.



## Aseguramiento de calidad e inspección de carnes en Australia

R.J. Butler, J.G. Murray & S. Tidswell

### Resumen

La inspección de la carne en Australia persigue varios fines: contribuir a la producción de alimentos inocuos y saludables; satisfacer los requisitos impuestos por los países importadores; y facilitar el cumplimiento de los objetivos nacionales en materia de sanidad animal. El análisis de la función de la aseguramiento de calidad en los sistemas de inspección de carnes que se aplican en establecimientos bajo control del Gobierno federal pone de relieve que el destacado lugar de Australia como país exportador de carne es deudor en parte de la existencia de un sistema de inspección corregulado y basado en la

aseguramiento de calidad, aplicable indistintamente a todas las especies faenadas en el matadero. El progreso que experimentaron en los años noventa las técnicas de inspección de la carne, tanto dentro como fuera del país, se tradujo en un notable perfeccionamiento de los sistemas de aseguramiento de calidad, que hoy se aplican mediante sistemas de información homogéneos a escala nacional, pensados para lograr normas constantes de inocuidad de la carne. Estos sistemas se complementan con programas de aseguramiento de calidad basados en el análisis del riesgo y control de puntos críticos que cumplen los estándares de calidad de la Organización Internacional de Normalización.

Los programas de aseguramiento de calidad aspiran a poner en práctica un planteamiento global, que abarque toda la cadena alimentaria y se aplique por lo tanto "de la granja a la mesa" (a todas y cada una de las fases del proceso, es decir, desde los métodos de producción en la granja hasta las etapas de refrigeración, almacenamiento y transporte posteriores al sacrificio). El hecho de que los sistemas de producción australianos hayan incorporado elementos del sistema de aseguramiento de calidad de las inspecciones cárnicas ha contribuido en no poca medida a que se cumplan regularmente los objetivos establecidos en materia de inocuidad de la carne, cuyo nivel de exigencia está a la altura de los riesgos sanitarios de hoy en día.

#### Palabras clave

Aseguramiento de calidad – Australia – Inocuidad de los alimentos – Inspección de productos cárnicos – Servicio Veterinario.



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