Program Achievement Report

Food Safety
Market Access Science
2016-17



Meat & Livestock Australia – Research Development & Innovation
&
Australian Meat Processor Corporation – Process Hygiene, Quality

July 2017

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Executive Summary

The Food Safety / Market Access Science Program arises from the Meat Industry Strategic Plan (MISP), which identifies the need to ensure market access. This is the first Achievement report in this area that responds to the MISP 2020.The program supports the activities of SAFEMEAT, the primary role of which is to oversee and promote management systems that will deliver safe and hygienic product to the marketplace.

This is the first Achievement report from the Joint MLA/AMPC Portfolio Management Team in food safety, which was formed in November 2015.

The Program has maintained the same approach for a number of years, while responding to changes in the expression of food safety / market access objectives by the industry. Needs are assessed, scientific research and development activities are undertaken and these are communicated widely to industry, government and scientific stakeholders both nationally and internationally. Change in practice may occur within the industry as a result of research, resulting in lower risk of non-conforming or unsafe product, or achieving safety more efficiently. Australia has an accepted excellent reputation internationally, thus, the majority of efforts are I efficiency of achieving safety. The safety of product then needs to be measured, and communicated to stakeholders as a preliminary activity to addressing existing technical barriers to trade or preventing the formation of new barriers. The latter activity requires data to be available well ahead of time so that industry/government can rapidly respond to proposals by other countries for new regulations.

Major outputs resulting from the food safety program over the past twelve months have been made available to the industry:

- Shelf life prediction model has been developed and trialled in supply chains and is demonstrating value for solving problems, helping supply chains consider their risks and redesign supply chains to reduce complexity. The model is currently being validated through a number of projects, and the model is made available to processors and exporters wishing to use it on a research basis.
- Data on the hygienic status of beef carcases has been determined using a method similar to the US FSIS so that the industry and government can respond with data when the FSIS publishes the results of their survey. A survey on Salmonella in lymph nodes has also been published.
- Additions have been made to MLA's website to make it easier for stakeholders to locate information about food safety. The University of Tasmania has developed a website to communicate the results of their work, the shelf life model, new antimicrobial interventions and reviews of new scientific research
- Wide communication to our own industry as well as importing countries about the shelf life of Australian meat and prediction of shelf life in the supply chain which has resulted in changes to the allowable shelf life in the UAE, which will hopefully extend to other GCC countries
- Promising minimal intervention approach to effective control of microorganisms such as E. coli and Salmonella on beef carcases are being trialled at industrial scale over several days (data collection is almost complete)

A stakeholder survey revealed that x% of respondents agreed that they were satisfied with MLA's performance.

1. Reason for Being

1.1 Meat Industry Strategic Plan

The Food Safety / Market Access Science Program arises from the Meat Industry Strategic Plan (MISP)[1], The MISP does not have a section which addresses food safety specifically, which is seen to reflect the absence of market access failures relating to food safety and the maturity of the industry in incorporating food safety issues as a component of everyday business. The text of the MISP that aligns with this program:

MARKET GROWTH AND DIVERSIFICATION FOR AUSTRALIAN RED MEAT AND LIVESTOCK

Gaining competitive access to global markets with customer and consumer preference for our products based on quality and integrity systems.

Key issues

- We are an export industry and must be focussed on reducing barriers to trade.

Addressing the issues

- Efficiency and value in trade and market access
  - Reducing technical barriers to trade

MISP Objective progress in reducing technical barriers to trade new market opportunities are made available or cost savings achieved worth $100 million by 2020 and $250 million by 2030 with stakeholders satisfied with service providers' contribution to these results

SUPPLY CHAIN EFFICIENCY AND INTEGRITY ACROSS OUR INDUSTRY

Enhancing and ensuring the integrity of our whole of supply chain quality/integrity systems and paying all sectors in the supply chain on objective performance.

Key issues

- We must ensure our integrity systems deliver the products that we promise.

Addressing the issues

- Livestock and **product assurance through integrated integrity systems**

MISP Objective As technological advances become available and as customer requirements change, ongoing development of red meat and livestock integrity systems occurs to the satisfaction of stakeholders

[1] The Red Meat Advisory Council (RMAC) was formed in 1998 as a single industry touch-point for the Federal Government when dealing with cross-sectoral matters. RMAC comprises a membership of five Peak Industry Councils: Cattle Council of Australia, Sheepmeat Council of Australia, Australian Lot Feeders' Association, Australian Livestock Exporters' Council and Australian Meat Industry Council. The Goat Industry Council of Australia also maintains a link, but not as a member.

1.2 Joint Program

Over the past few years, the Australian Meat Processor Corporation (AMPC) has operated a food safety program. Since late 2015, MLA and AMPC have agreed to operate the food safety program jointly.

A joint approach to portfolio development and project contracting, management and extension will ensure that the strategic priorities of each sector can be addressed in an efficient manner while avoiding duplication of effort and resources. Similarly, adoption of outcomes from these portfolio areas typically impacts across the value chain and a collaborative approach between AMPC and MLA will serve to reinforce and underpin the importance of a whole-of-industry approach.

Meat & Livestock Australia and the Australian Meat Processor Corporation are required to incorporate MISP strategic themes into their own strategic planning. The plan is also endorsed by SAFEMEAT. The program therefore supports the activities of SAFEMEAT, the primary role of which is to oversee and promote management systems that will deliver safe and hygienic product to the marketplace.[2]

[2] SAFEMEAT is a partnership between the Australian meat and livestock industry and State and Federal governments. SAFEMEAT's primary role is to oversee and promote sound management systems. SAFEMEAT also initiates R&D projects, particularly in relation to microbiology and food-borne pathogens and examines emerging issues, such as gene technology, that could have an impact on the red meat industry at some point in the future.

2. Program Overview

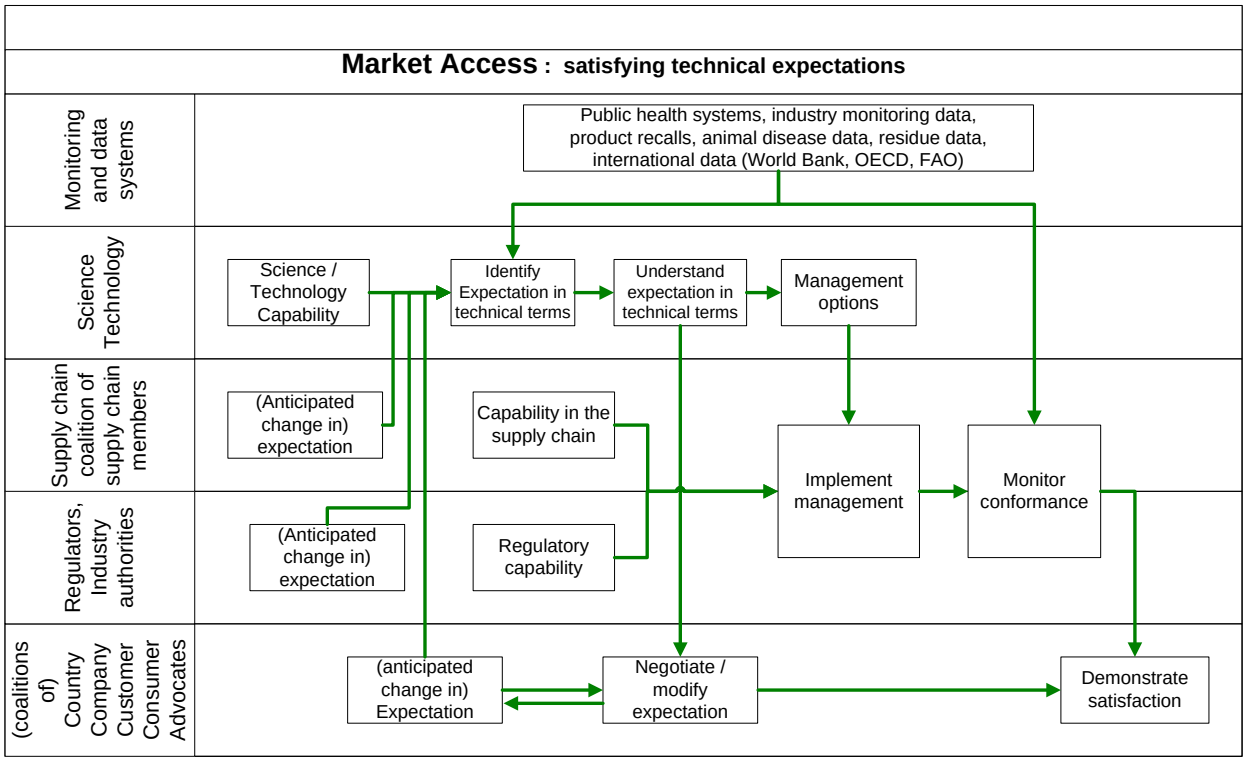
The joint program strategy addresses externally-facing technical market access, and internally-facing process effectiveness and efficiency, both leading to safe product and supply chain confidence at a competitive price.

The *R&D-oriented component* can be divided into two areas of work:

- address key access issues and demonstrate technical quality of product & systems
- research and development and science-based evidence for safety and integrity systems employed or introduced

Other issues are monitored and managed when required.

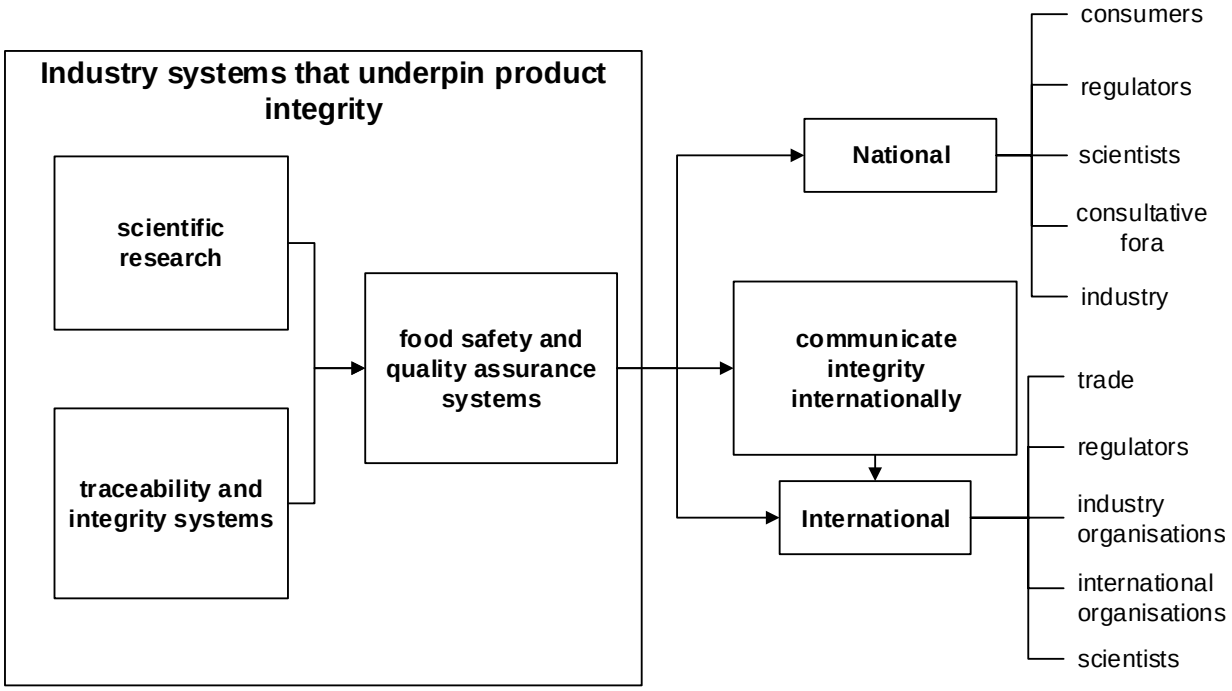
The R&D is conducted within the framework of satisfying the expectations of customers (whether they be countries, companies or consumers) and considering the expectations of advocacy organisations. The needs may be expressed by customers, in which case there is usually a short-term need to satisfy the expectation. On the other hand, it is also the role of the program to anticipate future expectations, and to provide the scientific basis for meeting future expectations. The diagram below shows how the components of the science program interact with customers and the major stakeholder groups.



Model for the cooperation of science providers, regulators, public health systems and industry in meeting customer requirements through the work of the food safety / market access science program

The Food Safety / Market Access Science Program focuses on communicating knowledge about food safety risks and technical access expectations in the red meat supply chain, and their control, so that industry, regulators and the marketplace worldwide are aware and satisfied that risks are understood and are being controlled effectively. The communications components ensure that the high level of food safety of Australian meat is acknowledged. MLA international offices, websites with a focus on food safety, and materials for industry/regulator use (brochures, downloadable reports and tools etc.) are all key communication channels. The work of the program is often transmitted to the target audience through other activities in MLA. The diagram below illustrates the linkages between this program, other MLA activities in delivering integrity systems and reducing economic barriers, and recipients of information including decision-makers.

Section 4 of this report will describe the outputs of the scientific research program.



How the science projects in the Food Safety Program lead to the development of systems to deliver safety, quality and integrity and are used to influence key stakeholders nationally and internationally.

The activities of the Food Safety / Market Access Science Program will utilise methods that are:

- **Science-based** – producing credible scientific data and information to support its strategies.
- **Risk-based** – concerned with addressing real food safety issues and the protection of public health.
- **Efficient and effective** – are economic for industry to implement

3. Food Safety / Market Access Science Program and KPI Achievement

Both AMPC and MLA express the MISP aspirations and objectives in their own plans.

3.1 Program position in the plan

In MLA's Strategic Plan 2016-2020[3], two priorities relating to this program area are identified:

- Efficiency and value in trade and market access: taking action to reduce economic and technical barriers to trade in global markets
- Guaranteeing product quality and systems integrity; enhance our systems and technologized to keep ahead of our competitors and maintain our point of difference

The following table describes the initiatives in the 2016-17 MLA Annual Investment Plan (AIP)[4].

MISP Objective	Program
Through progress in reducing technical barriers to trade new market opportunities are made available or cost savings achieved worth $100 million by 2020 and $250 million by 2030 with stakeholders satisfied with service providers' contribution to these results	**Product quality and systems** - Conduct research to address key access issues and demonstrate technical quality of product & systems to trading partners and customers
As technological advances become available and as customer requirements change, ongoing development of red meat and livestock integrity systems occurs to the satisfaction of stakeholders	**Integrity systems: food safety** - Ensure integrity systems are underpinned by rigorous food safety research and development and science-based evidence

3.2 Program budget

The budget for the work of the joint program, as described in detail in the following section has funds from two sources:

MLA Annual Plan (25% producer, 25% processor, 50% Commonwealth)
AMPC funds (50% processor, 50% Commonwealth

Irrespective of the source of funds, the Food safety Joint Portfolio Management Team determines which of the RDCs is in the best position to manage the research contract.

[3] http://www.mla.com.au/About-the-red-meat-industry/About-MLA/Company-overview/Corporate-documents
[4] http://www.mla.com.au/About-MLA/Planning-and-reporting/Annual-reporting

3.3 Key Performance Indicators

The MLA Annual Investment Plan specifies Key Performance Indicators:

Program Area	Key Performance Indicator	Status	Further information
Product quality and systems - Conduct research to address key access issues and demonstrate technical quality of product & systems to trading partners and customers	Quality research results (3 papers per annum) are being produced and being communicated to relevant audiences to influence development processes and address existing issues to the satisfaction of government and industry stakeholders		3 papers published and a further 2 accepted (see 4.2 Scientific / Technical publications) Program satisfaction survey will be conducted during July 2017
Integrity systems: food safety - Ensure integrity systems are underpinned by rigorous food safety research and development and science-based evidence	• Maintain 85% stakeholder satisfaction level • Maintain global recognition of research quality evidenced by at least three papers accepted by international peer reviewed journals		1 paper published and a further 1 accepted (see 4.2 Scientific / Technical publications) Program satisfaction survey will be conducted during July 2017

4. Current status of Program activities and outputs

4.1 Current status of Projects

The current status of the specific projects agreed with SAFEMEAT are presented below:

Project	*Progress*
Information and program management Monitor scientific developments in meat food safety research to respond, as needed, at an international level.	MLA will continue to produce the news digest of food safety research, circulate it to interested parties and upload it to an interactive website maintained by the University of Tasmania: http://blogs.utas.edu.au/promep/. The MLA website now has a page dedicated to food safety information with links to reports, publications, fact sheets etc. https://www.mla.com.au/research-and-development/food-safety/ The scientific risk management panel met in May to provide advice on future projects, current projects on risks associated with Australian meat and new technologies for bacterial identification.
Ensure risks associated with Australian meat are known and controlled.	The risk assessment project is due for completion in early 2018. A particular focus is identifying risks with product supply chains and red meat uses that have not been previously recognised or managed. Information is being collected particularly on 'unusual' uses of red meat that may pose higher food safety risks in our major markets. A workshop was held in May with key stakeholders to identify risks associated with the full range of red meat products and will be followed with a survey to confirm the findings and select hazards and products for further evaluation.
Promote the exceptional shelf life of Australian meat.	The second edition of the *Shelf life of Australian red meat* has been completed, following the successful first edition and new research information made available (some MLA funded) after its publication. The second edition was launched at the MINTRAC conference in October 2016. Hard and soft copies are available from MLA at *https://www.mla.com.au/globalassets/mla-corporate/research-and-development/program-areas/food-safety/pdfs/shelf-life-of-australian-red-meat-2nd-edition.pdf* Work continues with a number of processors, exporters, importers and other researchers to validate the shelf life models for vacuum-packed, chilled beef and lamb. Domestic and international supply chains are being evaluated to determine actual shelf life, and opportunities to derive value from product shelf life. To date, the model is providing adequate predictions. An agreement has been reached with the University of Tasmania that will allow processors/exporters to licence the model for research purposes.

Project	*Progress*
	The exceptional shelf life of Australian beef has been recognised by the UAE, increasing its maximum shelf life for beef from 70 to 120 days and for sheep meat from 70 to 90 days. Discussions have been held with Egyptian government officials and importers/users of Australian beef about increasing the regulated shelf life of beef in Egypt, which currently restricts the trade to air shipments. Cold chain workshops were conducted in China in May to explain the importance of managing the cold chain to achieve long shelf life for chilled vacuum packed meat. There is greater interest in chilled meat in China, and a slightly increased ability to manage the product. It is proposed to develop a practical manual for cold chain management to assist exporters and importers to successfully trade in chilled meat. An expression of interest on shelf life of frozen meat has been sent out, this work will determine the frozen shelf life of Australian beef and lamb, and the results would be used to potential extent the shelf life to 24 months for international markets. Related to this is the continued progress of a CSIRO project managed by AMPC aiming to: • Determine the chilled beef product temperature fluctuations which occur during typical international shipping regimes to markets such as China. • Demonstrate that a longer shelf-life for exported chilled beef can be supported, aiming for 120 (17 weeks) to 140 days (20 weeks). • Provide Australian beef processors with evidence based recommendations for achieving longer shelf-life of chilled beef for international export markets, such as China. AMPC is managing a project to identify storage thresholds in both frozen and chilled red meat.
Demonstrate the very low risk of enteric pathogens (*E. coli*, salmonella) in Australian beef.	Investigations are underway to improve the screening and confirmation procedure for Shiga toxin-producing E. coli (STEC). The diversity of STEC strains has been investigated and a number of existing diagnostic kits and new methods are being evaluated to determine which are most effective for Australian strains and conditions. A guide on STEC testing (screening and confirmation) meeting in Melbourne and Brisbane in early June 2017. This meetings provided industry with an opportunity to consider using new methods, the meeting report can be found in this link: https://www.mla.com.au/research-and-development/search-rd-reports/final-report-details/Product-Integrity/Molecular-characterisation-of-STEC-for-continued-market-access/3473 The survey on salmonella in bovine lymph nodes is completed. A total of 197 cattle lymph nodes sets were analysed. No STEC were detected and salmonella was detected in six nodes, taking the total prevalence to

Project	*Progress*
	3.05% of animals. It can be concluded that there is a low risk of Australian trim contributing to salmonella contamination and the extra cutting and handling during the removal process would likely contribute to the increased in contamination. The final report will be released shortly on the MLA website and a paper has been submitted to the Journal of Food Protection. This survey will help MLA respond to US customers and regulators who are considering the control of salmonella in their beef supply. Large carcase surface swabbing to detect salmonella on beef and veal carcases pre and post intervention has been completed. The final report has been published on the MLA website. The salmonella prevalence pre-intervention is 1.43% for beef and 3.75% for veal. Post-intervention shows a significant drop in the prevalence for beef and veal of 0.38% and 1.30% respectively. The reduction in prevalence shows processors have effective processes in place without the use of multiply interventions. Both reports can be accessed via the link below: https://www.mla.com.au/research-and-development/search-rd-reports/final-report-details/Product-Integrity/Baseline-survey-of-salmonella-in-Australian-beef-to-export-markets/2928 The FSIS survey results and their regulator intentions are yet to be made public, we will continue to monitor this area and provide a response if required.
Demonstrate appropriate post-mortem procedures for a risk-based approach.	Work on cadmium in adult sheep offal (liver and kidney) is progressing at a slow pace. The aim is to understand how the risk of exceeding international cadmium MRLs varies according to the geographic origin of sheep. Early analysis shows sheep from high rainfall have less correlation of cadmium in kidney and liver and are more likely to exceed international MLs. Sampling has slowed for both studies (large geographic liver sampling, and liver and kidney correlation), due to the recent shortage of sheep coming from direct consignment and low rainfall areas. Plans to start sampling from more sheep establishments are being investigated, to increase sampling numbers. Sheep and lamb stock is forecast to make a recovery in 2019. MLA will provide a risk-based justification for the revision of the post-mortem inspection methods and dispositions in the Australian Standard via a number of projects. The umbrella project is being conducted with a steering group chaired by DAWR. Discussions are underway with a number of stakeholders including the Australian Meat Regulators Group. Discussion with AMRG on the principles for the review will be held at their next meeting. The post-mortem work such as efficient detection of Caseous Lymphadenitis (CLA) in ovines, alternative post-mortem inspection methods, and risk management for O. gibsoni in bovines has started. A risk assessment on the effect of alternate inspection methods on T.

Project	*Progress*
	saginata (C. bovis) infection in humans has been completed. These projects aim to provide data that will allow revision of post-mortem inspection schedules and gain acceptance from major trading partners. Projects have been initiated with processors through the Plant Initiated Projects program to investigate the post mortem classification and disposition of carcases affected by pneumonia and arthritis. This work is coordinated with the Rural R&D for Profit project, Health 4 Wealth, which seeks to create value from collecting post-mortem inspection data. A manuscript on the scientific/epidemiological assessment of Australia's tuberculosis freedom has been accepted for publication.
Responding to international standards changes to keep the risk of residue violation in international markets low.	MLA continues to respond to Technical Barriers to Trade (TBT) notifications on MRLs for the red meat industry. MLA has developed, and agreed with SAFEMEAT, a protocol for raising these issues to an industry level when a response is required. The National Residue Survey has informed MLA that Korea may potentially have a nil limit approach for all MRLs unless they are registered for use in Korea. This may come into effect in 2018. MLA has submitted to NRS a list of 465 chemicals which may be affected. We have reviewed 12 chemicals with high potential to impact production for the red meat industry, with a further 12 chemical with moderate risk to the industry reviewed. MLA is working with NRS who will be collating other industry advice.. MLA will continue to provide advice if the restrictions are imposed. The results from this work will allow the Australian industry or drug manufacturers to respond to Korea and seek registration of high-impact chemicals if required. In May 2017, the GCC issued a large number of chemicals (152) MRL changes, An analysis of the notification shows majority of the changes are in line with codex, these results has been sent to NRS to collate with other industry to respond.
Controlling the risks of Toxoplasma gondii	There has been increased attention to the significance of T. gondii as a public health hazard in sheepmeat. Work commenced in November 2016 to produce risk assessment data on the prevalence and concentration of T. gondii cysts in sheep meat for human consumption.
Controlling the potential risks associated with enteric pathogens in sheep.	MLA has commissioned CSIRO to undertake a baseline survey on the prevalence of pathogenic bacteria and their antibiotic resistance in sheep. Contacts have been made with processing establishments via AMIC and directly, so far only 6 plants have responded to contribute to the study. We hope to involve more establishments in the survey. This work commenced in late October 2016 and ends in late 2018, with interim results available in late 2017.

Project	*Progress*
	MLA expects the results to demonstrate a low prevalence of antimicrobial resistance in sheep. STECs will be isolated and characterised, as they may become a more significant trade issue in the future. The work will fulfil the expectations of Australia's antimicrobial resistance strategy.
Demonstrate that antimicrobial resistance risks in Australian livestock are low.	The antibiotic resistance of enterococci (a concern as human pathogens and indicators of resistance) demonstrated low levels of resistance. A scientific paper has been submitted for publication. This will support the finding that there are low levels of antimicrobial resistance in the Australian red meat industry. Peak Councils have been provided with advice in response to a DAWR request for submissions about the classification of coccidiostats as antibiotics, because these compounds, with no use in human medicine are classed as antibiotics in the statistics on antibiotic usage. MLA is working with other animal industries to produce a document explaining to external stakeholders the antimicrobial stewardship practices being followed and the results in terms of antimicrobial resistance. It is expected that the document will be finalised in time of Antibiotic Awareness Week in November.
Assessing new technologies for application by the program.	Discussions are being held with the Australian Meat Processor Corporation (AMPC) on projects to review technologies that may increase the ability of the industry to produce a safer product. AMPC is proposing a project to develop a method for the rapid detection (within 5 min) of specific microorganisms on carcasses and surfaces in red meat processing facilities. This technology will allow near real-time monitoring of contamination of raw product and equipment, which will enable a much faster response to potential contamination events than is currently possible. MLA is seeking opportunities through the MLA Donor Company to co-invest in technologies that may provide the industry with significant advantages in the detection and destruction of foodborne hazards, and in ensuring product integrity.
Ensuring the system meets market expectations.	MLA is maintaining oversight of technical requirements for red meat products and how the industry can best respond to these requirements.
Maintaining and improving control of food safety and associated hazards.	Work has commenced on microbiological testing for process control. A review of systems and requirements for assessing microbial levels on meat carcase surfaces has been completed Initial studies will focus on the most appropriate sampling sites and steps in the process for beef and sheep carcase testing. An AMPC managed project recommended an industry-funded trial of a

Project	*Progress*
	revised PHI system that would be simpler to understand and operate, and be more cost-effective for processors. The purpose of the trial is: 1) To generate and analyse comparative data between the existing and proposed PHI systems, as the basis for an equivalence submission that DAWR can use in negotiations with international markets 2) To generate data to evaluate the integrity of the proposed system – this includes the validation of microbiological parameters for end product testing. Another opportunity exists also, to amalgamate the above information, together with relevant publications on the microbiology of Australian meat products, into a monograph showcasing the status of the Australian industry as an international leader in food safety and storage quality. The publication will focus on how Australia's food safety status places it at the global forefront for storage life of chilled vacuum packed meats. Trials over several days in a commercial chiller on whole carcases evaluated the use of oxidising agents (such as acidified sodium chlorite or chlorine dioxide) during the (spray) chilling process on E. coli. This work confirms an intervention during chilling is effective under commercial conditions. In the laboratory the same impact is noted for Salmonella. Further extensive trials using carcases inoculated with E. coli, which will more accurately determine the size of the effect are underway. This intervention requires a low capital investment and could potentially replace other interventions.
Maintaining and improving quality systems and building capability	AMPC is developing a project on the harmonisation of audit requirements. Work may be based on the success of the horticulture sector of standardising requirements across retailers (HARPS). This would entail a scoping Analysis for standards consolidation in red meat processing, commencing with the domestic market but with consideration of the implications for international trade, and recommending the best institutional mechanism (e.g. AFGC/DPI etc), and development path with industry consultation.
Achieving optimum shelf life of Australian meat	Processors wishing to obtain advice have been invited to share their shelf life data, or questions about shelf life in supply chains, with the University of Tasmania. Establishments are sending enquiries which will help build an understanding of both supply chains and the impact of temperature on shelf life. A number of supply chain studies have commenced and others are under discussion. Some processors are negotiating access to the shelf life modelling tool for research purposes. An agreement allowing licencing for research purposes has been finalised.
Controlling the known risks associated with Australian red meat.	Work in this area will be determined by the outcome of the topic ‘Ensure risks associated with Australian meat are known and controlled’.

Project	*Progress*
Implement a risk management plan for Toxoplasma gondii.	Work in this area will be determined by the outcome of the topic 'Controlling the risks of Toxoplasma gondii'.
Implement new post-mortem procedures based on risk approach.	Work in this area will be determined by the outcome of the topic 'Demonstrate appropriate post-mortem procedures for a risk-based approach'.
Plant toxins Prepare a position on pyrrolizidine alkaloids and plant toxins	No action has been necessary at the Codex level. MLA is not continuing to fund work on the toxicology of indospicine, but keeps a watch on this area.

4.2 Scientific / Technical Publications

Communication to scientists and technologists, both nationally and internationally holds a critical place in the strategy of the food safety program. There is a demand within government for risk-based and science-based transparent regulation with demonstrated cost-benefit. Communication through the scientific literature in peer-reviewed publications makes this information available to governments over a long period of time. It also influences scientific/technological thinking about meat safety and risk management

The following is a list of publications, made by scientists and technologists working on MLA-funded projects.

AIP area	KPI area	Citation	Status*
address key access issues and demonstrate technical quality of product & systems	shelf life	Kaur, M. JP Bowman, B Porteus, AL Dann and M Tamplin (2017) Effect of abattoir and cut on variations in microbial communities of vacuum-packaged beef. Meat Science 131:34-39.	published
		Kaur M., Shang H., Tamplin M., Ross T. and Bowman J. (2017) Culture-dependent and culture-independent assessment of spoilage community growth on VP lamb meat from packaging to past end of shelf-life. *Food Microbiology*.	accepted
	enteric pathogens	Bailey, G., L. Huynh, L. Govenlock, D. Jordan and I. Jenson. Lymph nodes as a potential source of Salmonella and Shiga tocin-producing Escherichia coli in Australian beef. Journal of Food Protection	Under revision
		Mellor, G.E., Fegan, N., Duffy, L.L., McMillan, K.E., Jordan, D., Barlow, R.S. (2016). National Survey of Shiga Toxin-Producing *Escherichia coli* Serotypes O26, O45, O103, O111, O121, O145, O157 in Australian Beef Cattle Feces. Journal of Food Protection 79(11)1868-1874.	Published
		Ahlstron, C., P. Muellner, G. Lammers, M. Jones and J. Heller. E. coli O157 shedding dynamics in Australian beef cattle – gearing up for high-resolution studies.	submitted

	post-mortem procedures	Sergeant, ESG, J Happold and I Langstaff (2017) An evaluation of Australian surveillance for freedom from bovine tuberculosis. Australian Veterinary Journal	accepted
		Pointon, A., A Kiermeier, D Hamilton. Review of the post-mortem inspection of beef, sheep, goats and pigs in Australia: approach and qualitative risk-based assessment results. Food Control	In preparation
		Kiermeier, A., D Hamilton and A. Pointon. Quantitative risk assessment for Human T. saginata infection from consumption of Australian beef.	In preparation
	antimicrobial resistance	Barlow, R.S., McMillan, K.E., Duffy, L.L., Fegan, N., Jordan, D., Mellor, G.E. (2017). Antimicrobial resistance status of *Enterococcus* from Australian cattle populations at slaughter. PLoS ONE 12(5): e0177728. https://doi.org/10.1371/journal.pone.0177728	Published
Ensure integrity systems are underpinned by rigorous food safety research and development and science-based evidence	improving control of food safety	Kocharunchitt, C., Gardner, T., Mellefont, L., Bowman, J.P. and Ross, T. Viable but non-culturable state of *Escherichia coli* as induced by combined cold and water activity stresses.	In preparation
		Porteus, B.F., Kocharunchitt, C., Bowman, J.P., Mellefont, L. and Ross, T. Oxidants targeting the reduction of *Escherichia coli* O157:H7 during carcase chilling.	In preparation
		King, T., Kocharunchitt, C., Gobius, K., Bowman, J.P. and Ross, T. Molecular response of *Escherichia coli* O157:H7 Sakai during dynamic changes in growth kinetics induced by an abrupt downshift in temperature and water activity *Molecular and Cellular Proteomics*.15:3331-3347	published
	Achieving optimum shelf life of Australian meat	Sumner, J., P. Vanderlinde, M. Kaur and I. Jenson. The changing shelf life of chilled, vacuum-packed red meat. In PJ Taormina and MD Hardin (eds) Food safety and quality based shelf life of perishable foods. Springer.	accepted
		Zhang P., Kaur M., Bowman J.P., Ratkowsky D.A. and Tamplin M. (2017) Effect of environmental factors on intra-specific inhibitory activity of *Carnobacterium maltaromaticum*. *PloS ONE*.	Revised, resubmitted
		Kaur *et al*. Core microbial communities of VP Australian red meat, their spatial and temporal dynamics during storage at different temperature.	In preparation
		Kaur *et al*. Potential and comparison of NIR and RAMAN spectroscopic techniques in meat industry for shelf-life prediction of beef and lamb.	In preparation
		Kaur *et al*. Monitoring metabolites in Australian VP beef and lamb stored at different temperatures.	In preparation

* status is classified as: in preparation, submitted, under revision, accepted, published (either on line or in print)

5. Communications

The table below indicates, for each target group (identified in the diagram on p. 4), the kinds of activities and the nature of the activities conducted, either directly by the MLA staff working on the Food Safety R&D Program, or by the scientists who work most closely with the program.

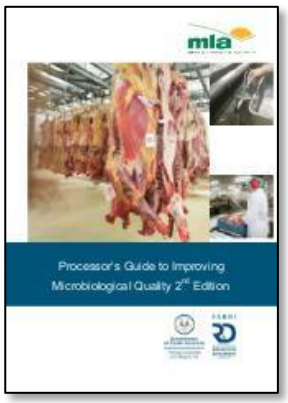
5.1 Communication, education and promotion of food safety and integrity

Arena	Group	Activity	Nature of interaction
NATIONAL	**Consumers**	Website information	MLA's consumer website, www.beefandlamb.com.au, is used as a way of communicating specific meat safety messaged to consumers. The FAQ section can be updated in response to consumer concerns.
	Regulators	Food Standards Australia New Zealand	MLA communicates with FSANZ about meat-related food safety matters. There are no current issues in this area.
		Standards Australia	Participating in the development and review of Australian Standards, as well as the development of International Standards through the International Standards Organisation.
	Scientists	Australian Association for Food Protection	A professional association, where the position of the Australian industry as technically competent is communicated.
		Australian Society for Microbiology	A professional association, where the position of the Australian industry as technically competent is communicated.
		Australian Institute of Food Science and Technology	A professional association, where the position of the Australian industry as technically competent is communicated.
	Consultative	SAFEMEAT	An opportunity to regularly update all red meat industry sector participants on the progress of the program.
		Export Meat Industry Advisory Committee	Provides an opportunity to gain agreement between export processors and Department of Agriculture on the application of MLA research to the industry. Sometimes responsive projects are developed.
		Export Meat Industry Advisory Committee Food Safety and Animal Health Subcommittee	The food safety subcommittee provides opportunities to discuss food safety and microbiological issues in detail. Some activities, such as revision of microbiological methods for the industry, will require professional input from MLA and consultants.
	Industry	Meat Inspection Quality Assurance (MIQA) Network,	About 12 presentations were given in the past year to industry QA Managers in all states on antimicrobial resistance, trends in ESAM data and process control. Also an opportunity to learn

			about industry needs.
		MINTRAC MIQA Conference	This popular conference for industry QA Managers and trainers was an opportunity to share R&D relating to shelf-life, antimicrobial interventions, and process control and the changes that are being made by processors as a result of following the approaches developed.
		MLA publications	Contribution to articles in MLA's magazine, feedback, on how research contributes to optimising processing, improving hygiene and new regulations *See section 9.2 for further information*.
		Enquiry services	MLA provides an enquiry service for processors, exporters, customers, regulators etc. who require technical information on the safety of meat.
		E. coli panel	MLA runs an E. coli expert panel to interact with stakeholders on this important issue. MLA also provides advice to Department of Agriculture and Water Resources and AMIC in dealing with their own interests in this area.
INTERNATIONAL	**Trade**	Working relationship with North American Meat Institute, National Cattlemen's Beef Association	MLA keeps in touch with like organisations in the USA, as well as individual processors to discuss issues of common interest.
		Enquiry services	Enquiries are often directed through MLA regional offices to provide information, or technical support, on trade enquiries.
	Regulators	Australia's position at Codex Alimentarius	Reviewing the development of Codex documents, which are a basis for international trade, to ensure that they reflect Australia's approach to meat safety. Particular attention is being paid to documents on Salmonella in beef, the development of a standard for chilled and frozen meat, pyrrolizidine alkaloids and to guides on control of parasites in the supply chain.
		Opportunity to input into Australia's position at OIE	Reviewing the development of documents to ensure that they do not impinge negatively on Australia's meat safety approach.
		National food control systems	Opportunities, through MLA regional offices, to make technical representations to assist in policy development relating to Australian meat products.
	Industry organizations International organizations	International Standards Organisation- ISO standards and working groups	Opportunity to comment on the development of International Standards, including participation on working groups, and obtaining advance notice of standards being developed.
		International Association for Food Protection	A professional association, where the position of the Australian industry as technically competent is communicated.

		(IAFP), member	
	Industry organizations	International Commission on Microbiological Specifications for Foods	Scientists close to MLA are members of this group which is the leading international scientific food safety influencer.
	International organizations	Consultants to FAO/WHO	A number of scientists close to MLA work as consultants for the FAO/WHO food safety program.
		FAO/WHO Joint Expert Meetings on Risk Assessment (JEMRA)	Several scientists close to MLA are on the roster of experts for JEMRA. MLA has participated in JEMRA on the control of Shiga toxin-producing E. coli and Salmonella through the supply chain.
	Scientists	Editorial Board, *Applied and Environmental Microbiology*	AEM is a leading food microbiology journal and MLA staff are frequently asked to peer review papers prior to publication.
		Reviewer for *International Journal of Food Microbiology* and *Meat Science*	The IJFM and Meat Science are leading food safety and meat science journals internationally. MLA staff are sometimes asked to peer review papers prior to publication.
		Editorial Board, *Food Protection Trends*	MLA staff have been invited to be members of this IAFP journal. It provides international recognition for the Australian industry.
		Invited speaker, international conferences	MLA staff and scientists working closely with MLA are frequently invited to be keynote and major speakers at international conferences
		Publications	See 4.2 Scientific / Technical publications

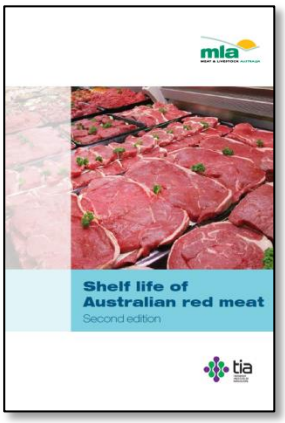
5.2 Publications for industry



Processor's guide to improving microbiological quality 2nd edition

This booklet contains the reports of processing establishments that participated in investigation training for microbiological testing of meat. The aim is to inform staff at establishments about possible experiments that can be run to investigate ways to improve their process hygiene and control. The second edition contains 39 case studies across the whole beef and sheep meat processing system.

https://www.mla.com.au/globalassets/mla-corporate/research-and-development/program-areas/food-safety/pdfs/processors-guide-to-improving-microbiological-quality-2nd-edition.pdf
September, 2016



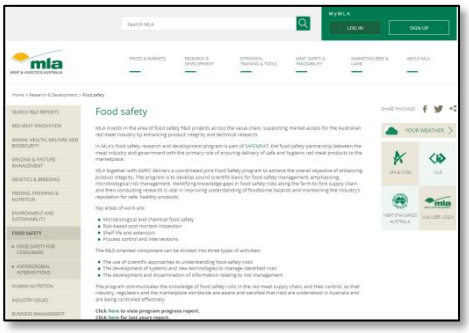
Shelf life of Australian red meat 2nd edition

The purpose of this book is to explain the important elements that contribute to shelf life so that everyone in the supply chain can do their part to maintain a superior standard. It is also intended for Australian meat customers so that they can understand the technical aspects of the product, what to expect of Australian meat and how to set appropriate criteria for product acceptance.

https://www.mla.com.au/globalassets/mla-corporate/research-and-development/program-areas/food-safety/pdfs/shelf-life-of-australian-red-meat-2nd-edition.pdf

Seminar report: Shiga toxin-producing Escherichia coli in manufacturing beef:
This seminar was held to review the current position with testing in June 2017. The prevalence of STEC are reviewed, the nature of the organisms and detection methods are explained and comparisons of test methods is presented.
The seminar also looked at the testing system that has been implemented in New Zealand, and the direction that STEC testing may take internationally, as the significance of these microbes are reviewed, and further new molecular methods are implemented.

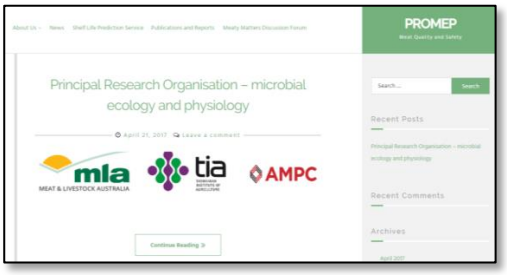
https://www.mla.com.au/research-and-development/search-rd-reports/final-report-details/Product-Integrity/Molecular-characterisation-of-STEC-for-continued-market-access/3473



Food Safety website

The Food Safety website has gone through significant changes. The new webpage is part of the MLA website and provide a point of reference on all things related to food safety. Contents on the website is significantly streamlined, to provide an overview of all our activities and the range of information and resources available, with links to more detailed reports on the MLA comprehensive reports database.

https://www.mla.com.au/research-and-development/food-safety/



Microbial Ecology and Physiology The UTas PRO website

The University of Tasmania is working on the website which will be the main source of provide an overview of all the latest activities, information related to the Principal Research Organisation: microbial ecology and physiology II project.

http://blogs.utas.edu.au/promep/

6. Program evaluation: outcome and impact

6.1 Periodic program evaluation

The next comprehensive program evaluation is not due until 2020, at the end of the current MISP.

6.2 Towards outcomes and impact

The definition of outcomes and then determining the impact on the industry is a complex and time consuming task, which is why it is only performed periodically. This section indicates the potential outcomes of current work and identifies the potential resultant impact. Outcomes and impact are the result of cumulated efforts of many organisations over a long period of time; the research program only plays one part of delivering on behalf of industry.

Project	Potential outcome / impact
Ensure risks associated with Australian meat are known and controlled.	1. The outcome of this project will insure risks associated with Australian meat are known and controlled extending into export markets.
Promote the exceptional shelf life of Australian meat.	1. Recent UAE changes to shelf life is estimated to return $60m to the Australian industry 2. Change to shelf life by other GCC countries would have a sizeable impact 3. Greater access to the Egyptian market through shelf life would have an impact
Demonstrate the very low risk of enteric pathogens (E. coli, salmonella) in Australian beef.	1. Australia is well-prepared to respond to US actions on Salmonella / process control in beef processing/ lymph nodes. The impact can only be determined once Australia has negotiated compliance with US requirements
Demonstrate appropriate post-mortem procedures for a risk-based approach.	1. Agreement to change post mortem inspection changes could have a large impact on cost of inspection, and/or condemnation of carcases and carcase parts
Responding to international standards changes to keep the risk of residue violation in international markets low.	1. Reduced risk of violating an importing country's residue limits 2. responding to new regulations to keep residue within an acceptable limit
Demonstrate that antimicrobial resistance risks in Australian livestock are low.	1. Outcomes (avoidance of adverse publicity, avoiding implementation of ongoing surveillance programs) may accrue from having good antimicrobial resistance data which is well-known by stakeholders

6.3 Research on maximising program impact

MLA staff are conducting research to better understand how research outputs are implemented (that is, become innovation). The innovation systems approach is being studied to determine how the components of an innovation system - the structures that need to be in place and the functions that need to be performed - can influence the success of conducting research and taking actions to ensure that innovation occurs and that there is benefit for the industry and society.

Two approaches to innovation systems have been studied to determine their ability to predict innovation outcomes. Both innovation system theories are sufficient to explain innovation (or lack of innovation) in food safety in the Australian red meat industry. From the available data it also appears that all of the components of these systems need to be operating effectively for innovation to occur[5]. Through a range of MLA-conducted projects, similar weaknesses in the same structures and functions were found to be associated with failure to innovate, suggesting that greater attention to these factors would lead to greater innovation success.[6] The importance of effective involvement of a large number of groups, and especially the role of MLA were demonstrated.[7]

The result of this research is being implemented in the design of the program to respond to MISP 2020.

[5] Jenson, I., Leith, P., Doyle, R., West, J., Miles, M.P., 2016. Testing innovation systems theory using Qualitative Comparative Analysis. Journal of Business Research 69, 1283-1287.
[6] Jenson, I., Doyle, R., Leith, P., West, J., Miles, M.P., 2016. Innovation system problems: causal configurations of innovation failure. Journal of Business Research http://dx.doi.org/10.1016/j.jbusres.2016.04.146
[7] Jenson, I., Doyle, R., Miles, M.P., 2016. The significance of actors in innovation system performance. submitted.

7. Government Research Priorities

The program is responsive to government policies and frameworks on research, development and innovation.

7.1 Science and Research priorities

In May 2015, the Government established a set of Science and Research Priorities, and corresponding Practical Research Challenges.[8] These Priorities and Challenges will be reviewed every two years. Food is identified as one of the priorities. It is suggested that priority be given to research that will lead to:

1. knowledge of global and domestic demand, supply chains and the identification of country specific preferences for food Australia can produce.
2. knowledge of the social, economic and other barriers to achieving access to healthy Australian foods.
3. enhanced food production through:
    - novel technologies, such as sensors, robotics, real-time data systems and traceability, all integrated into the full production chain.
    - better management and use of waste and water; increased food quality, safety, stability and shelf life.
    - protection of food sources through enhanced biosecurity.
    - genetic composition of food sources appropriate for present and emerging Australian conditions.

With respect to food safety, the program is responding to the priorities for research:

Knowledge of global and domestic demand, supply chains and the identification of country specific preferences for food Australia can produce.

It is fundamental to the planning process for the program, and also continued development in areas such as shelf life, that the program develops an understanding of safety and quality expectations and that we develop reliable ways of meeting those expectations.

Knowledge of the social, economic and other barriers to achieving access to healthy Australian foods

Some work in the program is devoted to technical barriers to trade and overcoming those barriers through the provision of information to government and educating supply chains about the safety and suitability of our products.

Enhanced food production through novel technologies, such as sensors, robotics, real-time data systems and traceability, all integrated into the full production chain

The program has a clear vision to utilise supply chain data and research results to enhance the quality and safety of food delivered to consumers.

Enhanced food production through better management and use of waste and water; increased food quality, safety, stability and shelf life

Increased meat quality, safety, and shelf life is at the core of the market access science/ food safety program at MLA. Appropriate attention is given to improving management to achieve outcomes and to reducing water use where possible.

[8] http://www.science.gov.au/scienceGov/ScienceAndResearchPriorities/Pages/default.aspx

Enhanced food production through protection of food sources through enhanced biosecurity
Attention is given in the food safety program, where appropriate, to the impact of microorganisms originating from animals, and how they can be best controlled through the supply chain.

7.2 Rural research and development priorities[9]

Productivity and Adding Value: improving the productivity and profitability of existing industries.
The Food Safety / Market Access Science rogram has a very clear focus on providing a sound scientific basis for continued development of quality systems within the Australian red meat industry. Providing a sound scientific basis for regulations allows the industry and regulators to control meat processing in a cost-effective way, by concentrating attention on the critical issues, and allowing the industry to innovate while maintaining food safety.

Supply Chain and Markets: understanding and responding to domestic and international market and consumer requirements through the whole supply chain, including to consumers.
MLA is leading or actively involved in a number of key initiatives designed to maintain and improve consumer confidence in the integrity of products produced by the beef and sheep meat industries based on sound science, risk analysis and the adoption and communication of research outcomes. The program also collects data that demonstrate the effectiveness of the Australian supply chain in producing quality products.

The sound scientific approach being taken to substantiate claims for market access is seen as a key factor for current and future market access. The Food Safety R&D Program develops information to support market access and also develops approaches to process validation and data collection and analysis to support future actions for technical market access.

Biosecurity: protecting Australia's community from biosecurity threats.
Threats in other countries are assessed and protocols for assessing their significance to Australia are part of the program's approach to pro-active management of food safety issues. Biosecurity is an approach that is relevant to ensuring that problems in overseas countries do not become established in Australia.

Supporting the Rural Research and Development Priorities: improving the skills to undertake research and apply its findings.
Undergraduate training: The program works with students and processors to work on projects that have real benefit to the industry, thus giving both parties the opportunity to innovate and see the potential for further innovation within the industry.

Post-graduate training: MLA and AMPC continue to support investment in post-graduate training with PhD and masters students currently supported through our post-graduate scholarship program and project-based support.

Researcher training: Funds are provided to support researchers to attend leading conferences to present their R&D results and to network with the world's leading scientists in this area.

Industry training: Workshops, network (professional development) meetings, and tools are provided to the industry to increase their knowledge and skills in doing their jobs but also to increase their ability to take up the results of research.

[9] http://www.agriculture.gov.au/ag-farm-food/innovation/priorities

Supporting the Rural Research and Development Priorities: promoting the developing of new and existing technologies.

Researchers working on MLA projects are using cutting-edge proteomic and genomic technologies to provide an understanding of food safety issues and possibly find breakthroughs in food safety. We continue to keep the Australian industry ahead of the world in application of new ideas and approaches to food safety.

7.3 Agricultural Competitiveness white paper priorities[10]

The Government released a white paper in July 2015 with the aim of strengthening the sector and ensuring it remains as competitive as possible.

The Government acknowledges that the RD&E system will give our farmers access to the latest innovations, new technologies and best management knowledge available to seize opportunities.

The food safety / market access science program responds to priorities in the white paper. In particular the program responds by:

- developing and evaluating advanced technologies that lead to innovative processes and practices;
- evidence-based control of food safety risks for improving market access;
- emphasising the adoption of R&D through multiple channels

[10] http://agwhitepaper.agriculture.gov.au/

8. Where to from here

8.1 A new structure for MLA's Annual Investment Plan

MLA has restructured its Annual Investment Plan (AIP) for 2017-18. AIPs are prepared each financial year to guide the practical delivery of MLA's long-term investment priorities and outcomes, which are set out in MLA's Strategic Plan 2016-2020. The work described here is positioned in the AIP as follows:

Program; **Integrity Systems**

MLA's integrity systems program assists MLA to foster the prosperity of the Australian red meat and livestock industry by protecting its disease-free status and underpinning the marketing of Australian product as clean, safe and natural. It also helps Australia capture price premiums from customers and consumers willing to pay more for higher levels of product assurance.

Sub-program **Market access science**

MLA's market access science sub-program delivers assurance of product safety to customers and reduce non-tariff (technical) barriers to trade by applying science and technology to the supply chain.

Product groups:

Market access research and development (AMPC managed)

The 'market access research and development (AMPC managed)' product group includes AMPC-funded and managed initiatives that align with the AMPC and MLA strategic plans.

Market access technical research

Initiatives within the 'market access technical research' product group include:

assessing market-specific product risks
demonstrating low E. coli and Salmonella risk in beef
ensuring Maximum Residue Limits are appropriate
estimating Toxoplasma risk in sheep
demonstrating low Antimicrobial resistance in beef and sheep
determining geographical disposition of sheep offals for Cadmium
demonstrating the shelf life of vacuum packed meat
demonstrating the exceptional shelf life of chilled vacuum pack meat
determining the shelf life of frozen products
determining appropriate post-mortem inspection procedures
investigating new technology for safe products
improving process control in meat processing
developing through-chain quality assurance systems.

8.2 Joint AMPC-MLA Program Management

Both MLA and AMPC have a shared interest in developing a portfolio of RD&E initiatives in the important investment areas of Food Safety. There presents significant opportunities for RD&E and innovation that will deliver benefits and risk mitigation outcomes across the whole value chain for both producers and processors. A joint approach to portfolio development and project contracting, management and extension will ensure that the strategic priorities of each sector can be addressed in an efficient manner while avoiding duplication of effort and resources.

Similarly, adoption of outcomes from these portfolio areas typically impacts across the value chain and a collaborative approach between AMPC and MLA will serve to reinforce and underpin the importance of a whole-of-industry approach. As noted, it is the intent of both organisations to develop a framework that is efficient and effective. The current joint-program may be subject to modification, based on the AMPC-MLA Relationship Agreement underway.

AMPC and MLA will continue to meet on a regular basis to:

1. Regularly review progress of all projects against milestones, expenditure, and deliverables

2. Sign off all milestone and final reports and make recommendations regarding go/no go decisions in accordance with agreed delegations

3. Agree on issues related to communication, extension/commercialisation and evaluation with actions being assigned to either AMPC or MLA as appropriate.

4. Facilitate industry networking activities and review of food safety and market access risks in red meat supply chains, including participation in MINTRAC meetings.

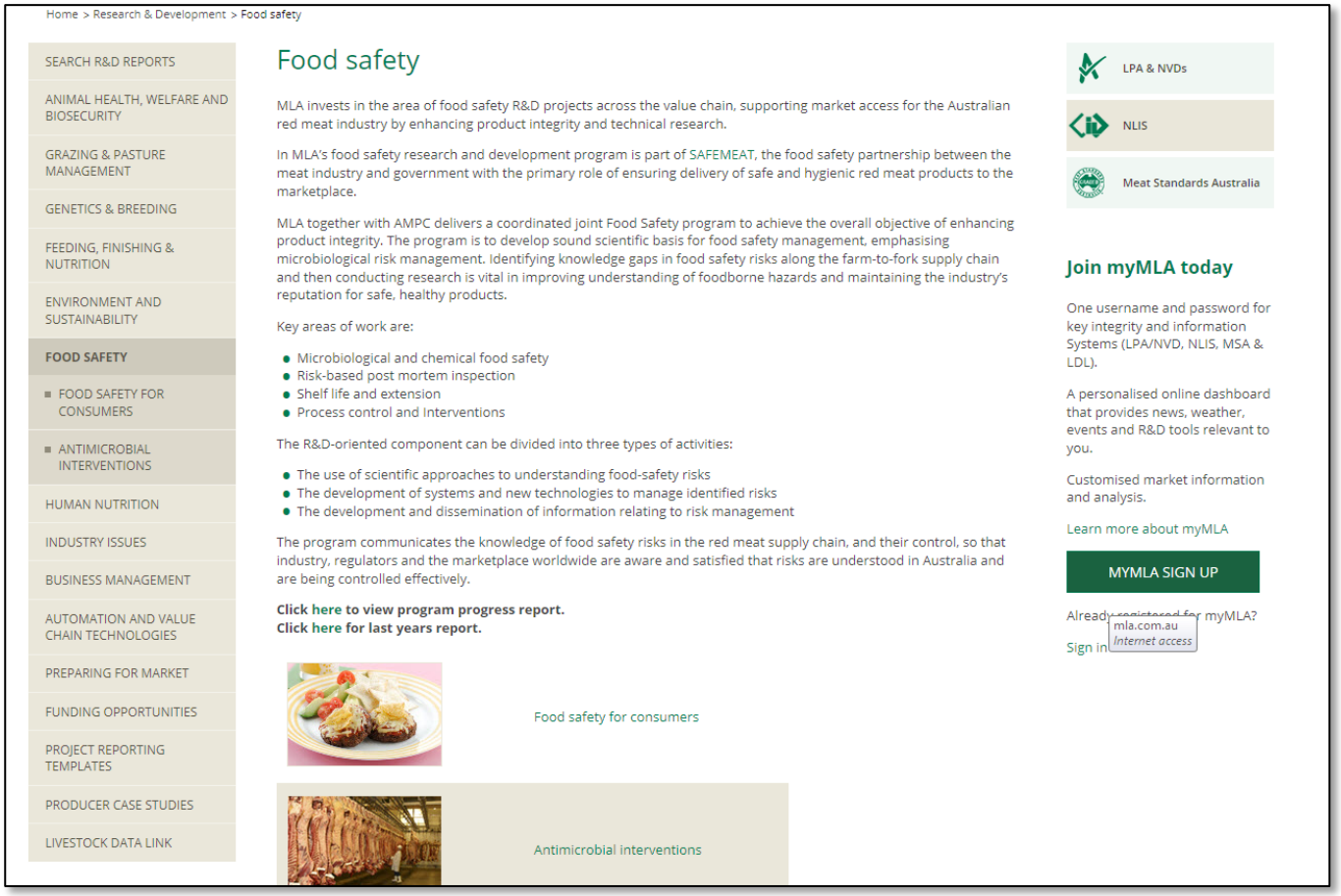
9. In detail

9.1 Communication with food safety Stakeholders

A new Food Safety page has been added to the MLA website. It provides a point of reference on all things related to food safety. It creates awareness, and demonstrates the relevance and value of food safety programs and activities to members and key stakeholders.

The page provides an overview of all our activities and the range of information and resources available, with links to more detailed reports on the MLA comprehensive reports database. This ensures everyone has quick access to newest available information, and latest research within the food safety program.

https://www.mla.com.au/research-and-development/food-safety/



9.2 Communication to producers

Feedback, Sep/Oct 2016 p5

New three year project with the University of Tasmania on shelf life and antimicrobial interventions

Partnering for productivity

Four major red meat and livestock industry research projects involving MLA were recently announced.

Northern gains: The Northern Beef Collaborative Partnership between MLA Donor Company and The University of Queensland is worth up to $8 million a year for a minimum of three years and targets productivity improvement research projects in three main areas:

- → animal nutrition, supplementation and feedbase
- → cattle health and welfare
- → reproductive efficiency and management.

Information: www.uq.edu.au

Phosphorus-focused future: MLA will manage a $3.46 million Australian Government Rural R&D for Profit project which aims to reduce the phosphorus dependence of Australian pasture systems. Reducing the requirements for phosphorus fertiliser will achieve multiple benefits including nitrogen use efficiency, water efficiency and improved productivity for Australia's pasture systems. The project will also develop the knowledge and necessary protocols to equip and inform producers about how to improve their phosphorus efficiency.

Information: www.agriculture.gov.au and search 'approved projects round 2'.

Securing the safety net: Another Rural R&D for Profit investment, this $5.8 million project will be managed by MLA to improve surveillance, preparedness and return to trade for emergency animal disease incursions, using foot and mouth disease as a model.

Information: www.agriculture.gov.au and search 'approved projects round 2'.

Maintaining our reputation: MLA is providing $1.5 million in funding to the Tasmanian Institute of Agriculture to develop new food safety technologies and management tools for temperatures for domestic and export red meat. The research is funded through MLA's food safety program, jointly funded by producer and processor levies.

The three-year project will develop a tool that helps manage the shelf life of vacuum packed beef and lamb and will further develop technologies to reduce bacterial contamination on carcases.

The TIA Food Safety Centre's Associate Professor in Food Microbiology Tom Ross with MLA Manager Market Access Science and Technology Ian Jenson at the announcement of the food safety research project.

Feedback Sep/Oct 2016 page 12

PhD student working on Shiga toxin-producing E. coli in cattle

Geraldine Lammers
Associate lecturer in veterinary epidemiology and public health, Charles Sturt University, Wagga Wagga

What is your area of research? I recently finished my PhD, which looked at the dynamics of *Escherichia coli* (*E. coli*) O157 in grassfed beef cattle.

What question does your research aim to answer? Which factors, if any, contribute to the development of cattle shedding the pathogen?

In what way could your research help livestock producers? Gaining more knowledge about *E. coli* O157 dynamics in beef cattle will contribute to a safer food supply, which is important for maintaining our trade relations with North America, which has stringent *E. coli* testing protocols. If we can find predictors for shedding, or can point out specific periods when shedding is much higher, we could control the timing of the animals going to slaughter. This would reduce the load of contamination on animals going into processing, keeping the numbers of *E. coli* O157 to a minimum in abattoirs.

→

Dry aging of beef

Product development

Welcome to the dry age

Dry-aged beef is trending on high-end restaurant menus and in gourmet butcher display cabinets. MLA, via MLA Donor Company (MDC), is backing the process with science to maintain product integrity and premiums.

Dry ageing is a traditional method of ageing beef to increase flavour and tenderness. The process, which involves storing meat in a low-humidity chiller, was overtaken by wet ageing with the development of vacuum-seal Cryovac technology in the 1960s.

Butchers, wholesalers, restaurants and supermarkets are now using dry-aged beef as a handcrafted point of difference to tempt the tastebuds of consumers and chefs.

MLA Project Manager for Meat Technology and Safety Long Huynh (pictured right) said that while tenderness improved with dry ageing, research showed little shear force (a tenderness-related characteristic) difference between wet and dry-aged product. The resurgence of dry-aged beef was more about creating a distinct flavour profile, which requires attention to several factors.

"Some dry ageing practices can cause undesirable changes in eating quality and food safety, so achieving the desired end product requires fine-tuning of the chiller conditions, such as humidity, air speed, temperature and use of UV lights," Long said.

To support red meat value-adders and retailers to achieve consistent, high-quality dry-aged product, MDC worked with Top Cut Foods - a division of food company Simplot - to develop guidelines for preserving the economic, quality and food safety characteristics of dry-aged beef. See side article 'Recipe' for dry-aged beef. No producer levies were used in this project.

Learning more about lamb

MLA has also backed the concept of dry-aged lamb, overturning the perception that dry ageing small, lean cuts of meat could result in high yield losses and have a negative effect on flavour.

Proof-of-concept trials found that after trimming and boning lamb to be 'plate ready', there was only 11% more yield lost from dry-aged lamb than the same wet-aged cut.

"We found dry ageing didn't have a negative impact on flavour; in fact, the biochemical process actually mellowed the flavour profile in stronger-tasting meat," Long said.

MLA Research, Development and Innovation General Manager Sean Starling said this could pave the way for producers to capture premiums for mutton and hogget, with the trial suggesting dry-aged sheepmeat products could sell for a 20-30% price premium over wet-aged lamb, based on the significant positive characteristics dry ageing adds to flavour.

"We've initially estimated that dry ageing just 10% of the available mutton supply could conservatively deliver more than $3.5 million of new value to the sheepmeat industry," he said.

MLA is also investing in projects to better understand the biochemical processes during the dry ageing process and any pre-wet ageing treatment, and to evaluate the effectiveness of dry ageing red meat in shipping containers while in transit to overseas markets.

Meat Standards Australia protocols for dry-aged beef are in the pipeline in response to growing demand in Japan's steakhouse market.

Long Huynh // E: lhuynh@mla.com.au
Sean Starling // E: sstarling@mla.com.au

To view the final report and results of MLA's dry ageing trials go to: **www.mla.com.au/dryageing**

Watch MLA's chef Sam Burke explain the dry ageing process by going to YouTube and searching "exploring dry age beef."

February / March 2017, page 12-13

Technical Trade Barriers

Meat safety

Food safety research breaking down barriers

Maintaining access to critical export markets and ensuring Australia's red meat products are both hygienic and high quality are the twin aims of MLA's investment in food safety research.

"MLA has a two-pronged approach to food safety research," said Ian Jenson, MLA's Manager of Market Access Science and Technology.

"The first is about ensuring markets continue to accept our product by overcoming technical or non-tariff barriers to trade."

Non-tariff barriers are a major impost on the red meat industry; currently costing about $1.3 billion annually.

They include rules and requirements around issues such as sanitation, cut size, transport and shelf life, that are additional to requirements for the domestic market.

"When importing countries implement new rules we are usually only given a short period of time to implement them or negotiate an alternative," Ian said.

"Once the issue has arisen we don't have time to commission research to support our arguments. For this reason we conduct research on a range of food safety issues so we can provide our trade negotiators from the Department of Agriculture and Water Resources (DAWR) with the most up-to-date information to argue on our industry's behalf."

Ian said MLA's second approach to research was about continually seeking improvements to food safety, while ensuring eating quality was not compromised.

Below is a snapshot of recent MLA Food Safety Program projects:

Ahead of the game

Project: Survey of beef products' *Salmonella* status

"We are expecting markets such as the US to introduce new rules about the presence of *Salmonella* and some kinds of *E. coli* in a wider range of beef products," Ian said.

"We know the US Government is under pressure to reduce salmonella in their food supply. They have been petitioned by consumer groups and have conducted surveys of their own product as a preliminary step.

"We are doing similar survey work here and producing data to ensure the DAWR is armed with the most up-to-date information about our *Salmonella* status once the new rules are announced."

The resistance movement

Project: Anti-microbial resistance survey

MLA is continuing to work closely with the Australian Government and research sector to monitor the levels of antibiotic use and antimicrobial resistance in the cattle industry, and encourage producers and feedlot operators to incorporate antimicrobial stewardship in their animal health programs.

"The United Nations convened a high-level meeting about antimicrobial resistance in September, which shows it remains a significant issue," Ian said.

"Compared to other countries, however, Australia's cattle industry doesn't have high levels of antibiotic-resistant bacteria, and we have the data to prove it."

The data was collected as part of an MLA project which analysed faecal samples collected from grassfed and grainfed cattle, plus cull dairy cows, at the point of slaughter.

The project concluded in 2014 and a similar project has just begun to assess microbial resistance in the sheep industry.

Inspecting the inspections

Project: Review of post-mortem inspection procedures

MLA is involved in a major review of post-mortem inspection procedures which are carried out by meat inspectors in Australian abattoirs.

"Due to improved animal health internationally, the value of

Using Australia's food safety record to grow markets: MLA's Master Chef Tarek Ibrahim being interviewed by Australian Ambassador Neil Hawkins for a local Egyptian TV station. Ambassador Hawkins speaks fluent Arabic and questioned Chef Tarek on the quality attributes of Australian beef and lamb and the integrity of Australian halal systems. They are pictured at an MLA market access program event held at the Ambassador's residence in Cairo. Among the guests were trade, government and foodservice stakeholders. The market access program involved a series of workshops with an Australian technical delegation to discuss changes to restrictive trade barriers related to shelf life and manufacturing beef.

traditional meat inspection procedures has declined," Ian said.

"We're now going through a process of asking 'What do we get out of inspection?' and 'Are there practices that can be eliminated because they don't contribute to the safety of our meat?'"

In the EU, for example, there has been wide adoption of visual-only inspection due to recognition that traditional inspection procedures may actually cause cross-contamination within and between carcases.

Supply chain gain

Project: Animal health feedback from abattoirs to producers

MLA and Australian Pork Limited (APL) are working together on a Rural R&D for Profit project aimed at capturing, recording and utilising carcase and offal condemnation data.

"At the moment condemnation data is not routinely collected by processors, but doing so could potentially increase profitability for both producers and processors," Ian said.

"For example, if two-thirds of livers from Farm A are being condemned due to a problem and the producer could change their husbandry practices and solve that problem, then the whole supply chain would share the value of those livers."

Adding to the toolkit

Project: Shelf-life science

An MLA-funded project conducted by the Tasmanian Institute of Agriculture (TIA) has produced a tool that assesses the impact of any temperature changes on quality or shelf life.

The tool has been used to provide a free advisory service to processors and exporters, and researchers are now looking at how value gained from using the tool can be returned to the Australian industry.

Barriers to bacteria

Project: Minimising microbes

This project – part of ongoing work with the Tasmanian Institute of Agriculture (TIA) – involves the commercial trial of a treatment that effectively reduces bacteria, including *E. coli*, on carcases while maintaining meat quality.

This project is supported by funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit programme.

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9.3 Confidence for markets, efficient processes

Preparing to respond to the USA on new rules

In addition to seeking the removal of existing technical barriers to trade, the program also seeks to prepare the industry for new rules that may be introduced by importing countries.

A known risk comes from the United States and the possible new rules relating to Salmonella and process control. The US domestic market is Australia's largest beef export market. The US Food Safety Inspection Service (FSIS) is under pressure from consumer lobby groups to declare specific strains of *Salmonella* to be an adulterant in ground beef. The FSIS has undertaken a survey of their own processors and is examining contamination levels on beef carcases. Concerns have been raised that bovine lymph nodes are a potential source of *Salmonella* and suggestions that they should be removed from carcases at time of slaughter.

The program has completed two scientific data collection surveys to reinforce Australia's meat safety standards in anticipation of potential new trade requirements for beef into the United States.
A survey of Australian processing facilities has established that lymph nodes are rarely contaminated with *Salmonella*. The resulting report has been submitted for publication in a scientific journal. A separate survey of Australia's processing systems has been conducted, to match a similar FSIS survey on the transfer of pathogens such as *Salmonella* and *E. coli* to beef carcases, and how they are removed through processing.

These surveys are aimed at protecting access to the US market and ensuring the Australian beef industry is prepared for any new FSIS regulations and result in technical trade barriers. In 2007, new rules about testing for E. coli O157 were quickly implemented in Australia, after the Department of Agriculture and Water Resources was able to negotiate very favourable conditions, based on the system the program had facilitated and on available research results.

Shelf life for technical market access

MLA's work on shelf life has included the development of some up-to-date science and information and the ability to predict vacuum packed chilled shelf life. This work provides a platform for businesses to improve their shelf life and supply chain performance, and for MLA, AMPC, and the Australian Government, to discuss restrictive shelf life regulations with importing countries.

The shelf life of our products allow us to reach distant markets with confidence and gain a premium price. Greater value for supply chains can be gained by better managing shelf life (for example, reducing wastage) and gaining approval for longer shelf life.

China cold chain seminars

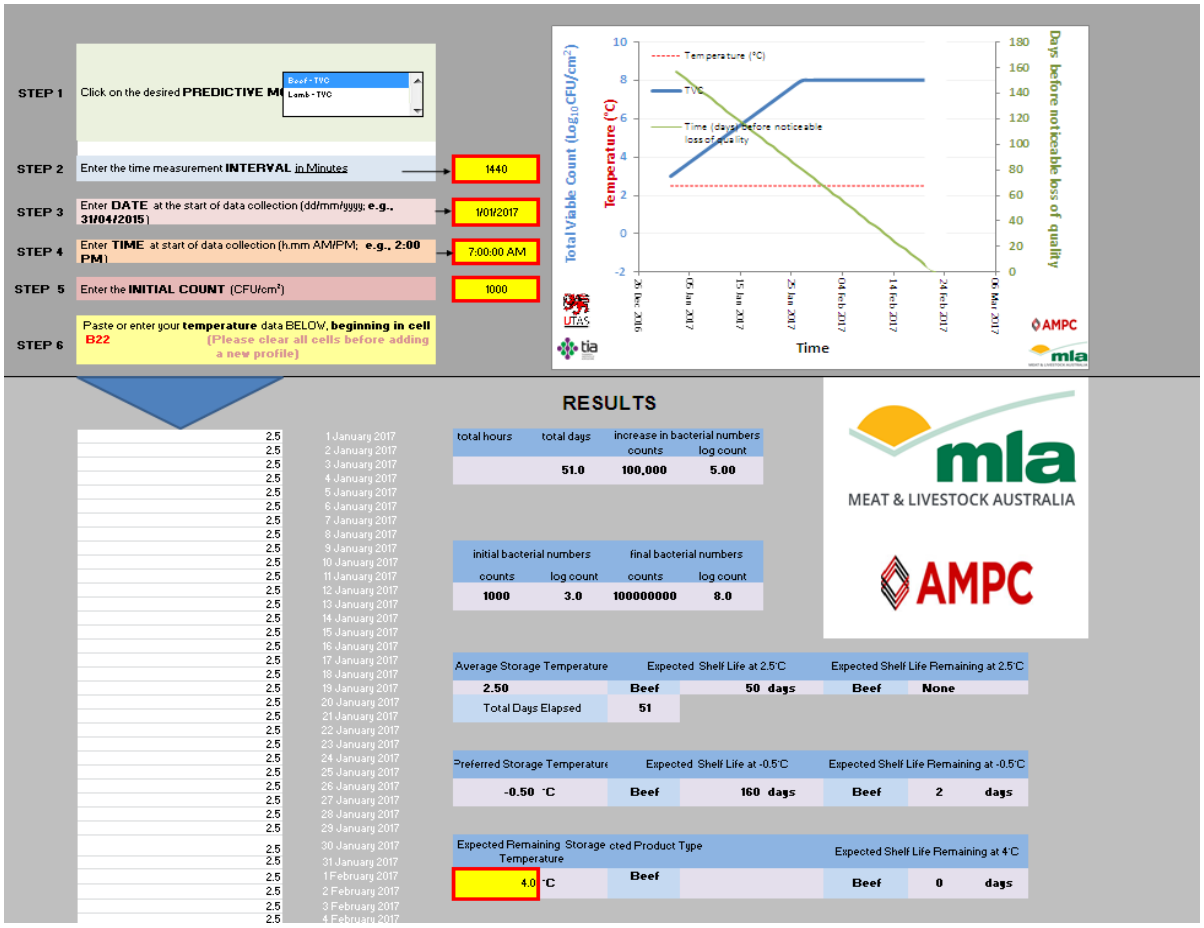
Cold chain seminars were held in China in April 2017 to support importing companies and traders to have greater confidence in chilled Australian meat and learn important aspects of cold chain management to ensure that product is maintained in good condition through to the consumer. 95% of attendees rated the program is excellent or very good. Presentations on factors affecting product quality, quality through the supply chain and cold chain management were well received and the Q&A period was most valued by participants.

Seminars in developing markets such as this will reduce the likelihood of problems, and restrictions on the trade. They also provide opportunities to influence the direction of standards setting and regulator attitude toward products, thus keeping markets free of technical barriers.

Shelf life prediction

MLA commissioned University of Tasmania to develop a shelf life prediction tool for vacuum packaged beef and lamb primals. The tool is based on the growth and development of bacterial counts and odour as a function of storage temperature. An establishment will need to know the TVC at packing, plus the temperature:time record of meat in the container. When these parameters are entered into the tool, predictions of TVC at the end of the journey, together with days remaining until detection of off odours; this latter can be estimated for a range of temperatures. Ultimately this tool can aid decisions by analysis of the situation and gives the ability to respond with confidence based on science. Leading to fewer products discarded or devalued due to cold chain disruptions.

Data are currently being collected from research laboratories, processor shelf life tests, national and international supply chains to validate the model; so far, the results are very encouraging. The ways that the model can be used for supply chains to gain value is also being investigated.



9.4 Change to shelf life restrictions in UAE

A major technical trade barrier to the UAE removed.

Improved market access for beef and sheep meat worth up to $60 million annually.

Will give industry more flexibility when sending Australia's premium products overseas.

The Australian beef and sheep meat industries have had a win in improved chilled access to the United Arab Emirates, one of our largest red meat markets in the Middle East region.
After considerable lobbying from industry and government on scientific grounds the UAE has extended the accepted shelf life boundaries for Australian vacuum-packaged beef and sheep meat. The technical trade barrier is estimated to have cost industry up to $60 million per year.

The new protocol increases shelf life from 90 to 120 days for vacuum-packed beef, and from 70 to 90 days for sheep meat, giving the industry more flexibility, reducing freight cost and increasing demand.

Sea-freight shipping times to the Middle East from Australia means that under current protocols there is often little usable life left on chilled shipment to the market after arrival. Some produce was frozen down as a result of the unnecessarily right regulation, which was out of context with science-based shelf –life limits placed on Australian beef in almost all other customer markets.
Australian Meat Industry Council, backed by technical and scientific data generated through people like Ian Jenson at MLA, and AMPC, has for some years one a lot of behind0the-scenes in-market education work about cold chain and shelf-life performance of Australian beef and sheep meat. The work finally paid off with a surprise breakthrough in the regulations agreed to by the UAE last week.

The UAE is a sophisticated importer and re-exporter of food products and a food distribution hub for other markets in the region. Shelf life remains a trade barrier in other Middle East countries, with a total cost to industry of up to $86 million each year. We will use the UAE's leadership and reputation to push for change in shelf life in other countries in the region.