

Final Report

Food safety training, extension and capacity for the melon industry - Phase 2

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Food safety training, extension and capacity for the melon industry - Phase 2 (VM18003)

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Summary

Food safety incidents within any horticulture industry are an unwanted, challenging occurrence. Severe or persistent incidences can threaten the profitability of the horticultural sector. In this regard, the Australian melon industry is no exception. Recent food safety incidents have resulted in concern from consumer and regulatory authorities. This concern is highlighted by the classification of melons as a high-risk horticultural product by Food Standards Australia and New Zealand (FSANZ). The high-risk horticultural products are currently being reviewed, which could lead to a regulation for these industries in the near future. Therefore, the Australian melon industry faces two important challenges – get prepared to meet upcoming regulatory requirements and maintain consumers' and trading partners' confidence in Australian melons. Adoption of best practice is considered one of the best ways to strengthen food safety systems. To achieve this, the Food Safety Training, Extension and Capacity for the Melon Industry project was created. Phase 1 (VM17002) focused on improving the food safety systems of rockmelons, honeydews and speciality melons. This project (Phase 2 - VM18003) continued to develop and nurture a culture of food safety across the melon industry, this time for watermelons. To achieve this, we examined the food safety practice of watermelon growers' and retailers' and developed best practice recommendations to reduce microbial risks along the watermelon supply chain. The best practice guide is based on scientific evidence within the literature and laboratory experiments conducted by NSW DPI. It is a practical resource for watermelon growers and other supply chain participants to mitigate food safety risks. The guide provides invaluable insights for implementing food safety requirements to comply with various quality assurance schemes and to meet the expectations of export markets. Best practice adoption was further boosted by food safety training and extension activities, including individual grower consultation, group meetings, workshops and webinars, and a food safety helpdesk service. Some face-to-face workshops were replaced with webinars due to COVID-related disruptions. Three webinars on melon food safety were delivered through regional organisations, and were well attended by a range of stakeholders. Webinars were recorded and uploaded on YouTube as training material. The melon food safety helpdesk service was used extensively by several stakeholders including growers, regulators and importers. It provided technical support for their enquires regarding melon food safety best practice. This project also included a melon food safety surveillance component. It was undertaken to assess food safety risks along the supply chain, and predict the threat of any market failure. The food safety surveillance data was supportive of the industry's ability to supply safe melons to the consumers. Because of this, and the services delivered by this project, the melon industry is well placed to transition successfully into a regulated food safety environment.

Keywords

Melons, watermelons, food safety, postharvest, Salmonella, Listeria, traceability

Introduction

Supplying safe food to the public is not only a moral responsibility but a legal requirement. However, preventing contamination of field produced crops is a great challenge. Driving this risk is the number of external factors within a supply chain that can cause contamination. Furthermore, once contamination occurs, it is irreversible for fresh uncooked products. Consumers' expectations for fresh produce quality and safety are quite high. This perception is based on the health and nutritional value of these products. Not only this, but in the event of a food safety incident, fresh produce recalls generally attract more media attention. As a result, food safety best practice within fresh produce supply chains is vital. Growers and the industry must follow a proactive and preventative approach to minimise food safety risks.

Since 2014, there have been several foodborne illness incidents involving fresh produce in Australia. Rockmelon incidents in 2016 and 2018 were multi-jurisdictional and affected a large number of consumers. It resulted in a loss of confidence by consumers, regulators and melon importers in Australia's export markets. These incidents caused substantial economic and reputational losses to the industry in both domestic as well as export markets. As a result, small growers have been driven out of businesses, and large growers have struggled due to breakdown of export channels.

'Safe Melons' is a NSW DPI initiative aimed at safeguarding the Australian melon industry against food safety risks. It began pre melon levy and was primarily aimed at providing R&D and regulatory compliance support to the NSW melon industry. From 2014-17, Safe Melons was co-funded by the Australian Centre for International Agricultural Research (ACIAR) and NSW DPI. Since June 2018 the initiative has been co-funded by NSW DPI and Hort Innovation. The first investment phase of the Melon Fund (project VM17002) intensified the project activities nationally. It widened the range of stakeholders to growers, packers, exporters, food and health regulators and other supply chain participants. The current investment (VM18003) ensured continuity of the Safe Melon initiative and, with the inclusion of watermelons, provided the melon industry with increased capacity to meet food safety challenges.

The outcomes of NSW DPI melon food safety projects have provided enormous value to the Australian Melon Industry. There is no greater evidence of this than in the wake of the 2018 rockmelon *Listeria* outbreak. Results from these two projects provided key information used by the melon industry representatives and food safety experts during in-market visits to reassure regulators and importers that Australian melons are safe. The outcomes of VM17002 and VM18003 were shared with importers, food and health regulators and supermarkets in seven countries viz., Japan, Singapore, Malaysia, the United Arab Emirates, Bahrain, Saudi Arabia and Kuwait. They provided clear evidence of best practice implementation occurring within the industry. As a result, recovery of exports to the affected markets has occurred (Melon exports statistics, April 2020).

Evolving regulatory landscape

Globally, the number of foodborne illness outbreaks related to fresh produce has increased. This is, in part, due to the enhanced surveillance, better diagnostics and improved supply chain traceability. Recently, the application of whole-genome sequencing has increased the ability for rapid traceback investigations and outbreak containment. As such, diagnostic and surveillance developments to protect the public health has outpaced the evolution of food safety systems and risk mitigation tools available to horticultural growers. Recognising this gap, food and health regulators are progressing towards greater food safety regulation for high-risk fresh produce in Australia. Unlike other primary industries such as meat, dairy and poultry, the horticultural industry is currently exempt from the Primary Production and Processing (PPP) Standards of Food Standards Australia and New Zealand (FSANZ). Except for seed sprouts, there are no food safety requirements in the Food Standards Code for horticultural produce.

In April 2017, the Australia and New Zealand Ministerial Forum on Food Regulation identified three priority areas to strengthen food safety systems. One of the priorities is to reduce foodborne illness, particularly related to *Campylobacter* and *Salmonella*, through a national approach. As part of this initiative, FSANZ is reviewing chapters 3 and 4 of the Food Standards Code to ensure a consistent approach to through-chain food safety management in Australia. FSANZ is also considering potential development of PPP standard for "High-risk horticulture" products. It is likely to introduce on-farm food safety requirements, including new traceability technologies. The high-risk horticultural products identified for the PPP standard include:

- melons,
- leafy green vegetables,
- berries,
- sprouts and
- fresh-cut ready to eat fruit and vegetables.

Given this, the introduction and enforcement of the PPP standard seems imminent for the melon industry.

Watermelon food safety

Unlike rockmelons, watermelons have not been implicated in any known food safety incident in Australia. However, this does not mean they are without risk. For instance in 2011/12 Brazilian watermelons were implicated in a *Salmonella* outbreak across Europe [1]. While the field production risks for watermelon are quite similar to that of rockmelons i.e. similar contagions and infection source, there is greater potential for reducing postharvest risk in watermelon. This is due to watermelons having smoother skin, which is easier to wash and sanitise. However, without industry-wide postharvest washing and sanitising this potential will not be realised. Currently within the Australian watermelon industry it is common for fruit to be picked and packed in the large bins in the field. The packed fruit are then transported to the packing shed. Some packers do another round of wiping the fruit in the top layers of the bins before shipping to the market. As a result of the current practice, the presence of dust and dirt on watermelons is common.

To understand the potential impact of current supply chain practice the NSW Food Authority conducted a cut melon food safety survey between January and August 2015. A total of 191 samples were collected from supermarkets and independent retailers and tested for microbiological quality [2]. Participants were also interviewed on current practice. Supermarkets and independent retailers indicated they only washed the watermelon fruit if it appeared dirty. No respondent store used detergent or sanitiser during washing and those that indicated they washed the fruit used a dry or wet cloth or paper towel. The survey also found that it was 'normal practice' across the sector to cut melons into pieces and display these pieces at room temperature. When testing samples for microbiological quality, *Escherichia coli* was detected in one sample of watermelon at 1,100 cfu/g. *Listeria monocytogenes* was detected in one sample of honeydew but at a level under the limit of quantification (10 cfu/g). *Salmonella* was not detected in any samples. The report concluded that while microbiological quality of cut melons was very good at the retailer level there were improvements that could further reduce risk of contamination. The major areas for improvement were cleaning and sanitising of cutting equipment and not storing cut fruit overnight.

Preventing contamination is the most effective and economical approach in minimising food safety risks during field production and postharvest handling. To achieve this, knowledge of potential sources and routes of contamination is a prerequisite. Development of this knowledge involves understanding a number of risk factors that are complex. To be effective though this knowledge requires translation into uncomplicated food safety risk factors and procedures. This process ensures the greatest likelihood of adoption to minimise risk and achieve safe supply of fruit. The services delivered through this project strengthened knowledge and adoption of best practice in food safety for melons across the supply chain. It has improved the food safety of Australian melons by:

- developing evidence-based and practical resources;
- delivering training material and activities to farm managers and key farm staff;
- reinforcing food safety capacity across the supply chain; and
- contributing to the development of a food safety culture in the industry.

Methodology

PROJECT ACTIVITY 1: Visit large watermelon growers and suspended rockmelon growers not visited in VM17002 to review and audit current practice and critical control points and provide one-on-one food safety consultations with growers, managers and key farm staff. The schedule of consultation across key regions should align with supply timeframes to retailers. Key focus areas should include field hygiene, equipment management, sanitation, process and record keeping.

More than 10 watermelon growers and Select Melons Australia (a melon marketing group) were consulted to

understand their current food safety practices for growing and supplying watermelons. Microbial food safety risks associated with various steps in supply chain were identified which guided the development of best practice document. Some of the key food safety issues identified, included:

- limited control and management of environmental factors,
- lack of postharvest washing and sanitising of watermelon fruit,
- inadequate understanding of the risks of fruit wiping material (e.g. cloth) as a source of cross-contamination,
- lack of predetermined replacement frequency of wiping material,
- risks associated with wet/damp fruit wiping,
- compounding effect of environmental factors (rainfall and dust storms) on watermelon food safety,
- postharvest cooling – not a common practice,
- handling and storage of watermelons at ambient conditions,
- potential compression damage due to packaging of fruit in large bulk bins, and
- transportation of fruit at ambient environments.

The critical control points along the watermelon supply chain are shown in appendix I and the key food safety risks associated with watermelon production and postharvest handling at grower levels are presented in appendix II.

To understand the food safety practices at retail we surveyed 41 supermarkets that included large chains such as Coles, Woolworths, IGA and green grocers. Majority of the watermelons were cut into quarters/halves and displayed at either ambient or cold conditions. The potential food safety issues during retail of cut watermelon included (Appendix III):

- a lack of washing and sanitising step prior to cutting into halves or quarters
- Irregular schedule of cleaning and sanitisation of cutting equipment and surfaces
- Improper labelling without detailed information on cutting date and time or best before
- Retailers display of cut watermelons at ambient conditions
- Inadequate cooling of refrigerated shelves

Further, analysis of critical food safety practices at retail level are shown in the appendix IV and included:

- Majority (94%) of retailers did not wash or sanitise fruit prior to cutting
- Most retailers (88%) claim to clean and sanitise cutting equipment and surfaces, however, don't have a regular sanitisation schedule
- Only 17% retailers used some form of labelling on cut melons
- 56% of the retailers displayed cut melons at ambient conditions
- 95% of retailers cut fruit in small batches and sell on the same day.

Retail conditions are critical to the food safety of cut-melons. Displaying cut melons at ambient conditions is still a common practice. The cut melon pulp temperatures recorded at the retail outlets revealed that the fruit were either not properly cooled prior to cutting or retail shelves were not maintained at 5°C. In cut-melon survey, 56% (251) of samples were collected from ambient fruit displays with 44% (197) collected from cold/refrigerated displays (Appendix V). Fruit pulp temperatures recorded at the retail displays showed a great variation across the stores. Even refrigerated shelves were not maintained at 5°C. Higher total plate counts have been observed in samples collected from ambient display in retail stores as shown in appendix V.

To further investigate the potential food safety risks associated with the cut-melons, we collected 448 samples (252 watermelons, 123 rockmelons, 65 honeydews and 8 specialty melons) during October 2019 to April 2020 from various supermarkets and retail stores. None of the samples tested positive for target pathogens such as *Listeria monocytogenes*, *Salmonella species* and *E. coli O157:H7* (Appendix VI). The data suggested that microbiological quality of cut-melons was good, but the growers and retailers should continue to manage food safety risks with a higher degree of precaution while producing and retailing the product.

Our laboratory experiments showed that retail display temperature and duration influence the survival and growth of foodborne bacterial pathogens on cut-melon surface. The data suggest that prolonged display of potentially contaminated cut-melons can lead to growth and proliferation of bacterial pathogens (*Salmonella* and *Listeria monocytogenes*) faster at ambient conditions compared to cold/ refrigerated conditions. Appendix VII shows the

growth of bacterial pathogens on the watermelon flesh inoculated with pathogen cultures as a function of time.

PROJECT ACTIVITY 2: Develop a Best Practice Guide (Back to Basics) for melon food safety informed by the findings from consultations with growers and packhouses.

A Best Practice Guide for watermelon food safety has been developed for the industry. This guide covers food safety principles and practices pertaining to preharvest and postharvest handling of melons. The main purpose of this guide is to provide a practical food safety resource to growers, packers, transporters, wholesalers, retailers and others involved in the supply chain. The existing melon food safety resources available within Australia and from overseas were reviewed to develop this guide. The latest scientific research on food safety of melons was incorporated in this document. The food safety information collected during the consultation process was used to tailor these guidelines for quick and easy adoption to mitigate food safety risks. The Best Practice Guide Document is attached with the report and will be uploaded on the websites of NSW DPI and Australian Melon Association. Appendix VIII is the cover page of the guide.

PROJECT ACTIVITY 3: Conduct melon food safety workshops across all watermelon growing regions to train and educate all supply chain participants.

Melon food safety workshops were originally planned to be delivered in all melon producing regions. However, one food safety workshop was delivered in Griffith NSW and another workshop in Sunraysia, Victoria was cancelled due to some organisational issues. Other workshops planned for Western Australia, Northern Territory and Queensland were also cancelled due to COVID- related inter-state travel restrictions. To replace face-to-face workshops as a mean of engagement and training, three webinars were delivered in collaboration with other organisations. The recordings of the webinars are currently available on YouTube through channels of VegetablesWA (<https://www.youtube.com/watch?v=zf3j2Zyh6Ao&t=2789s>), Northern Territory DPI (<https://www.youtube.com/watch?v=2kdk5aZBXr8&t=25s>), and Australian Melon Association (<https://www.youtube.com/watch?v=FFCBjh1vWuw&feature=youtu.be>). The detailed analysis of the participants in the workshop and webinars along with the snippets of feedback are presented in Appendix IX. The Australian Melon Industry Conference which was planned to be held in March 2020 was also cancelled due to COVID. It was another missed opportunity to engage with growers through a presentation and food safety helpdesk in the exhibition.

PROJECT ACTIVITY 4: Develop Food Safety Best Practices Toolbox with resources for farm and packing sheds to support the Best Practice Guide. This should include standard operating procedures, risk assessment templates and record sheets to support Food Safety programs. A central hub of resources is to be developed for the Australian Melon Association's websites for grower reference.

A Best Practice Toolbox has been developed that integrates new knowledge focused on risk-reduction strategies along with a compilation of related resources and information. The toolbox as part of the best practice guide contains following:

- Best practice guide
- Environmental factors in watermelon food safety
- Assessing agricultural water for melons
- Food safety risks and their management during watermelon harvesting
- A video on best practice in watermelon harvest and postharvest
- Microbial food safety risks with wiping of watermelons
- Watermelon washing and sanitisation-critical control points
- Potential vectors and routes of transfer of pathogens into melon fields and packhouses
- Packhouse environmental management program
- Packhouse layout design and processing flow
- Packhouse equipment design
- Packhouse identification zones
- Cleaning and sanitisation schedule
- Seek and destroy the bugs

- Transient versus resident pathogens in packhouse operations
- Food safety recommendations to retailers of cut-watermelons
- Traceability in the melon supply chain
- End-to-end supply chain traceability

PROJECT ACTIVITY 5: Consult with growers and packing sheds staff to ensure adoption of Food Safety Best Practice Toolbox and implantation of Best Practice Guide

Melon food safety surveillance is a key quantitative measure of ensuring the best practice is adopted and the supply of fruit to consumers in domestic and export markets is safe. In this project, a comprehensive food safety sampling plan was followed to cover all melon types with a major focus on watermelons. The samples represented all major melon growing regions in Australia and various stages of supply chain (growers, packer, wholesaler, supermarket retailers) during September 2019 to August 2020. The detailed report on melon food safety surveillance is attached (Appendix XI). A total of 1019 samples were collected, and 3057 tests performed to detect the presence of foodborne bacterial pathogens such as *Salmonella species*, *Listeria monocytogenes* and *E. coli* O157:H7. Only 3 samples tested positive, one for each pathogen. After positive detections, traceback investigations were undertaken to establish the potential sources and routes of contamination. The positive detections were proceeded with the follow-up microbiological testing and tracing the fruit in the markets until it was established that the contamination was a random event. One traceback investigation on *Listeria* contamination was also subjected to root-cause analysis for the grower's education and a case study on the effect of weather events on the microbial contamination (Appendix XI).

PROJECT ACTIVITY 6: Provide a food safety helpdesk for the project's duration which will be delivered to all melon growers and other stakeholders such as retailers, food and public health regulators.

The helpdesk is a technical support hub for the industry to address their food safety enquiries. The scope of this service included addressing scientific and technical enquiries related to melon food safety. The endorsement of any commercial brands and products was not included in the scope of this service. We addressed over 70 technical enquiries related to a variety of topics including microbial food safety risks, routes of contamination and preventive measures, selection of sanitisers and their concentrations, water treatment options, interpretation of microbial results, packhouse hygiene, traceability and supply chain conditions etc. Growers, food regulators and packhouse staff were the main users of this service. However, enquiries were also received from other supply chain participants such as agronomists, chemical resellers, extension officers, and exporters. FSANZ and AMA have been the largest users of this service while addressing their enquiries related to the high-risk horticulture regulation and exports project. The project team has addressed FSANZ's data collection enquiries and facilitated their visits to melon farms and packing sheds. The service was also extended to the importers and regulators in export markets during an export mission of the Australian melon industry to UAE, Saudi Arabia, Kuwait and Bahrain. The data on number of enquiries addressed along with stakeholder type is presented in Appendix XII.

PROJECT ACTIVITY 7: Liaise with the Australian Melon Association and Hort Innovation to provide relevant communications about the project, in particular, in communication the availability of resources, planned visits and roadshows.

The project team worked closely with the AMA and Hort Innovation to deliver project communications. The support to AMA's melon export restoration project was provided as and when required. The project activities were shared with the AMA and communicated through their Melon News and Melon E-news. A project reference group including a representative of Hort Innovation was formed to share the project progress and seek feedback from the industry members.

PROJECT ACTIVITY 8: Identify opportunities for future R & D investment to ensure ongoing food safety and prevention of food-borne pathogen contamination.

Recommendations for future R&D investment:

- Support food safety improvement program of the melon industry to nurture a food safety culture and helpdesk service to all melon supply chain participants.
- Strengthen melon food safety surveillance program as a risk-forecasting and risk-reduction tool to avoid

food safety crisis.

- Postharvest handling, processing and packaging of watermelons to minimise food safety risks and to reduce value chain losses.
- Preparedness and technical support to the Australian melon industry to meet the requirements of high-risk horticulture regulation (which is likely to be legislated).

Outputs

The following outputs have been delivered:

- a Best Practice Guide and toolbox for melon food safety addressing key knowledge gaps for the industry and providing practical solutions to embed food safety across the supply chain
- a melon food safety workshop in Griffith, NSW and three webinars with recordings available on YouTube
- melon food safety surveillance report as a quantitative measure of the best practice adoption
- a Food Safety Helpdesk for technical support to stakeholders
- opportunities for future R & D investment to support ongoing food safety in the industry
- a final report.

Outcomes

The main outcomes of this project were:

- *Knowledge and awareness of food safety raised to develop and nurture a food safety culture:* The food safety project has provided continued technical support to the Australian melon industry in managing their food safety risks proactively and reactively. The improvement of food safety knowledge and awareness has contributed to effectively managing food safety risks. The ongoing trust-based relationships with melon growers, which have been developed through R&D projects, are crucial to gain deeper insights into the root cause of various food safety issues facing the industry. The growers and packers have been sharing their practices and food safety information as they were assured of their privacy protection and commercial-in-confidence. The scientific evidence-based best practice recommendations were developed. These are practical and adoptable in consonance with the food safety requirements of quality assurance programs.
- *Best practice implemented for food safety management along the supply chain across the melon industry:* Investigation of watermelon food safety practices along the supply chain revealed the potential areas of improvement. The identification of food safety hazards led to the development of management strategies to mitigate the risks through the adoption of best practice. The foundation of Best Practice Guide and its content are based on the knowledge gaps which were highlighted during consultation with watermelon growers and other supply chain stakeholders and melon food safety surveillance program. The food safety topics in the guide and other resources in the toolbox are practical solutions to effectively managing risks ensuring the safe supply of fruit to consumers.
- *Economic and reputational losses to the industry reduced due to food safety failures:* The growers have been supplying safe melons with zero product recall during the past 2.5 years, even under heavy surveillance by the food and health regulators. This can be, in part, attributed to the enhanced capacity and knowledge of growers in successfully managing food safety risks. The project outputs have contributed to the delivery of safe melons to the Australian and export market consumers with zero foodborne outbreak linked to melon reported (April 2018 to October 2020).
- *Consumer confidence rebuilt in food safety of Australian melons:* The Australian melon industry has recovered from the *Listeria* outbreak in 2018 in both domestic and export sectors. The export statistics show the recovery of export volumes and value in major export markets. In an export trade mission led by the Australian Melon Association, the outcomes of food safety projects (VM17002, VM18003) were shared with the food regulators, importers and supermarkets in the export markets to ensure they have confidence in the food safety of Australian melons.

- *Food safety risks to consumers and industry minimised through a preventative and proactive approach:* Melon food safety surveillance data shows an excellent score card of the melon industry in delivery of safe melons. The surveillance for target foodborne bacterial pathogens on all melon types grown in different parts of Australia revealed no persistent food safety risks and reinforced the industry's success in adoption of proactive and preventative measures in mitigating risks to consumers and industry. We have followed scientific evidence and data-driven approach to effectively communicate the project outputs with a final goal of industry adoption, hence mitigating food safety risks to consumers and industry leading to rebuilding of consumer confidence.

Monitoring and evaluation

Challenges

- Following up from the phase-1 of melon food safety project, NSW DPI team has continued to engage with the melon growers in different production regions. Due to established relationships, there were no major challenges in consultation with growers. Some watermelon growers wanted to differentiate themselves from rockmelon growers and considered their product not to be compared with those involved in food safety incidents. However, we made these growers aware that the upcoming high-risk horticulture regulation considers “melons” as one category among the high-risk products. Now there is awareness in the industry about this fact.
- A few melon growers expressed their concerns of supplying commercial-in-confidence information and hesitated in offering the fruit and environmental samples from their fields and packing sheds. These growers were targeted through the sampling of their fruit from the wholesalers and retailers and subsequently engaged with the microbiological test results which were generally negative.
- COVID- related disruption was a major challenge in delivering the face-to-face workshops. The restriction on interstate travel and gatherings were the major challenges in delivery of workshops and collection of fruit samples for surveillance from Western Australia. The face-to-face workshops were replaced with live webinars and their recordings available on YouTube to reach the growers and packers in all regions. In fact, the webinars were well received and recommended to be the future mode of engagement. Regarding sample collection, the project team collaborated with a private service provider in Western Australia, and developed a sampling plan to ensure the targeted growers are covered in the surveillance program. Further, the state government agencies from NT, WA and Qld were cooperative in grower engagement and project delivery.

Key evaluation questions

Effectiveness

Has the project team consulted watermelon growers in melon producing states and territories? Is there evidence of adoption of best practice (practice change or introduction of new food safety practice)?

Have all activities, KPIs and outputs been achieved?

This project had an extensive outreach to watermelon growers across Australia. We had proposed to consult 10 large-scale watermelon growers. However, we consulted over 15 watermelon growers who contribute to the majority of watermelon supply in the country. We have recommended some changes in watermelon food safety practices (e.g. washing and sanitising) whose adoption may take a few years as it needs large infrastructural changes. Due to the lack of evidence of food safety failure linked to watermelons, the drive to change is expected to be slow. However, a progressive watermelon grower from Qld will be the first in the country to adopt a proper watermelon washing and sanitising system. A best practice guide has been developed along with several other resources to train and educate melon growers in identification and management of food safety risks. The proposed number of face-to-face workshops could not be delivered due to COVID-related disruption. However, webinars as a substitute of workshops proved to be effective in communicating and engaging with the industry. The recording and podcasts have been uploaded on YouTube channels of various organisations. These recordings have been viewed in excess of 150 times and positive comments have been received. We have achieved the targets of food safety surveillance (>1000 samples) which is an indirect measure of the success of food safety systems adopted by the industry. The helpdesk service was extensively used by growers and other stakeholders directly benefitting from the independent and unbiased technical advice in decision making involved in food safety practices.

Relevance

Did target beneficiaries participate in the project and had access to technical information and advice as proposed? To what extent has the project met the needs of Australian melon industry? Are there any gaps or additional opportunities for research?

Participation of target beneficiaries was satisfactory in this project. The technical presentations on best practice have been delivered, uploaded and shared for wider circulation. NSW DPI's Safe Melons program is continuing the

outreach activities with melon growers through other projects as well. As the industry potentially moves into the regulated environment in 2022, the project outcomes would have laid a strong foundation for their compliance with upcoming regulation.

Food safety is a high priority for the melon industry. The project deliverables have supported the industry to recover from the listeria outbreak through consultation, provision of food safety practical resources and training opportunities and helpdesk services. There are additional opportunities for R&D to minimise microbial food safety risks in the melon industry. These are included in the recommendations section of the report.

Process appropriateness

Did the project engage with industry levy payers through appropriate methods? How appropriate were the project activities and outputs for achieving its intended outcomes? How appropriate were the management and governance processes and the resources used for delivering the project?

There were different levels and methods of engagement with levy payers such as one-on-one consultation, group meetings, workshops, live webinars, and a helpdesk service. One-on-one consultation through helpdesk service was probably the most effective method of achieving positive food safety outcomes. The project activities were also communicated through melon news. The intended outcomes of the project were achieved and supported by quantitative measures such as the microbiological survey. The traceback and traceforward activities were undertaken in response to the positive detection during the food safety surveillance. NSW DPI's project management systems were used to monitor project progress and the utilisation of resources. The project progress was presented to the Project Reference Group in June 2020.

Efficiency

Did the project identify opportunities to improve efficiencies? (including implementation of new technology, technique, practices, workflow etc.)

The project involved consultation, training and outreach activities. Despite COVID-related disruption, the project team improved their engagement efficiency through live webinars and teleconferences with the target growers. The adaptation to virtual mode of delivery was originally a challenge, but eventually turned out to be an opportunity to engage with growers nationally. This project was an opportunity to combine an old-style extension and advisory service with the contemporary virtual approaches to deliver the services. There is a significant scope of improving the efficiencies in project delivery through equal weightage to traditional extension and virtual delivery. Sensitive matters such as food safety still require face-to-face interactions and build trust-based relationships to achieve the desired positive outcomes.

Recommendations

Key recommendations to the melon industry:

- Food safety is non-negotiable and fundamental to the sustainability and profitability of the Australian melon industry. The growers and packers should follow a continuous improvement process in their food safety systems and adopt scientific evidence-based best practice provided to them.
- End the crisis before it begins. The melon industry should take proactive and bold steps to adopt best food safety practice to safeguard the industry against food safety crisis and to adapt to evolving regulatory needs.
- Preparedness with robust food safety systems to face regulatory changes. To remain compliant with regulatory requirements in domestic and export sectors, consistent supply of safe fruit is required to maintain consumer confidence and access to premium markets.
- Key food safety hazards in production and postharvest handling of melons should be identified and managed using business-specific food safety plans.
- Current practice of cleaning and wiping watermelon fruit with a range of materials (e.g. cloths and rags) poses a risk of cross-contamination. Watermelon fruit are generally not washed and sanitised prior to shipping to markets. Currently, there is no evidence of market failure linked to the current practice.
- Considering the potential cross-contamination risks, the industry should be prepared in the near future to switch to washing and sanitising watermelons like other melons.
- Preharvest food safety controls such as no use of soil amendments containing animal manures, irrigation water quality control, drip irrigation system, using windbreaks to minimise dust load on fruit and preventing wildlife and livestock incursions in the field are effective in minimising microbial contamination risks in the field.
- Postharvest practices such as precooling, drinking quality wash water containing an effective sanitiser, proper contact time of fruit with the sanitised water and brushes, and automation of sanitiser injection and monitoring should be followed.
- A robust packhouse environment management program should be followed to prevent the entry and establishment of environmental pathogens into the facility. The resident pathogens pose serious cross-contamination risks in the facility. “Seek and Destroy” approach should be implemented to eradicate the resident foodborne pathogens from the facilities.
- The demand for end-to-end traceability is strongly emerging to meet or exceed consumers’ and regulators’ expectations. A digital traceability system should be followed to manage internal (inputs) and external traceability of fruit which should be capable of rapidly recalling the produce during a food safety emergency.
- The physical identification of fruit through labelling on individual fruit is strongly recommended to manage brand identity and targeted product recall at consumer level.
- Train workers in the field and postharvest sheds about the basics and importance of hygiene and food safety and it can contribute significantly to nurturing a food safety culture in the industry.

Recommendations for future R&D investment:

- Support food safety improvement program of the melon industry to nurture a food safety culture and helpdesk service to all melon supply chain participants.
- Strengthen melon food safety surveillance program as a risk-forecasting and risk-reduction tool to avoid food safety crisis.
- Postharvest handling, processing and packaging of watermelons to minimise food safety risks and to reduce value chain losses.
- Preparedness and technical support to the Australian melon industry to meet the requirements of high-risk horticulture regulation, if legislated.

Refereed scientific publications

None to report

Intellectual property, commercialisation and confidentiality

No project IP, project outputs, commercialisation or confidentiality issues to report.

Acknowledgements

We are thankful to melon growers, packers and other supply chain players who participated in this project. The project team is acknowledged for accomplishing various project tasks and delivering services to the industry. The team included Zabrina Khan, Kasia Strojny, Andrew Creek, and Amanda Warren-Smith. Thanks to Stela Gkoutina for technical support and to Carly Murray for quality assurance management of PC2 laboratory. The project delivery was successful due to national collaborative efforts supported by a number of individuals and their organisations.

Appendices

- I. Critical control points along the watermelon supply chain
- II. Key food safety risks associated with watermelon production and postharvest handling
- III. Key food safety risks associated with watermelon retail
- IV. Watermelon retail food safety practices
- V. A snapshot of current retail conditions of cut melons
- VI. Cut-melon food safety surveillance
- VII. Retail display conditions effect on watermelon food safety
- VIII. A snapshot of watermelon food safety- best practice guide and toolbox
- IX. Melon food safety workshops and webinars
- X. Food safety helpdesk
- XI. Melon food safety surveillance 2019-20

Appendix I - Critical control points along the watermelon supply chain

1 Field



- **Growing field**
 - Irrigation water
 - Soil amendments
 - Weather events (rainfall, dust storms)
- **Fruit harvesting**
 - Harvesting equipment
 - Fruit cleaning/wiping

2 Packhouse



- Precooling/cooling
- Washing and sanitisation
- Environmental monitoring
- Workers' hygiene and facilities

3 Retail



- Washing and sanitisation
- Equipment hygiene (e.g. knives)
- Fruit contact surface hygiene (e.g. preparation and cutting table)
- Labelling (Best before/ use by)
- Display conditions (e.g. refrigerated or ambient)
- Environmental monitoring

Appendix II - Key food safety risks associated with watermelon production and postharvest handling

- 
- Limited control and management of environmental factors
 - Lack of postharvest washing and sanitising of watermelon fruit
 - Fruit wiping material (e.g. cloth) as a source of cross-contamination
 - No predetermined replacement frequency of wiping material to control cross-contamination
 - Risks associated with dry wiping versus wet/damp wiping
 - Compounding effect of environmental factors (rainfall and dust storms) on watermelon food safety
 - Postharvest cooling – not a common practice
 - Handling and storage of watermelons at ambient conditions
 - Compression damage due to packaging of fruit in bulk bins
 - Transportation of fruit at ambient conditions

Appendix III - Key food safety risks associated with watermelon retail

- Lack of washing and sanitising step prior to cutting into halves or quarters for retail display
- Irregular schedule of cleaning and sanitisation of cutting equipment and surfaces
- Improper labelling without detailed information on cutting date and time or best before
- Retail display of cut watermelons at ambient conditions
- Inadequate cooling of refrigerated shelves holding fruit
- Inconsistent retail policies and practices in regards to the duration of cut melon display and their disposal



Appendix IV - Watermelon retail food safety practices

41

A total of
retailers were surveyed including

28

supermarkets
(68.3%)

13

green grocers
(31.7%)

94%

of retailers
DO NOT wash fruit
prior to cutting

88%

of retailers
clean/sanitise cutting
utensils before use

17%

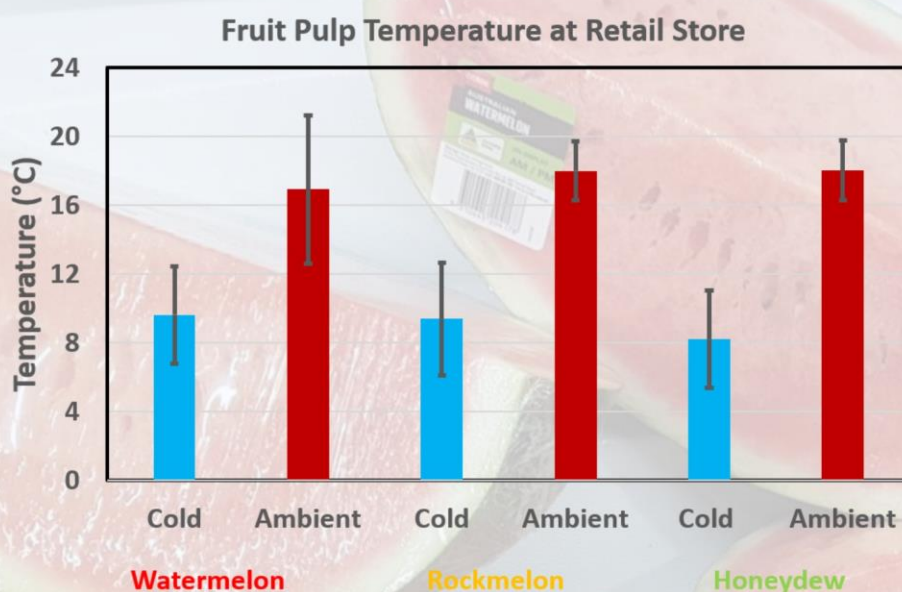
of retailers are using
date marking to monitor
the sales of cut melons

95%

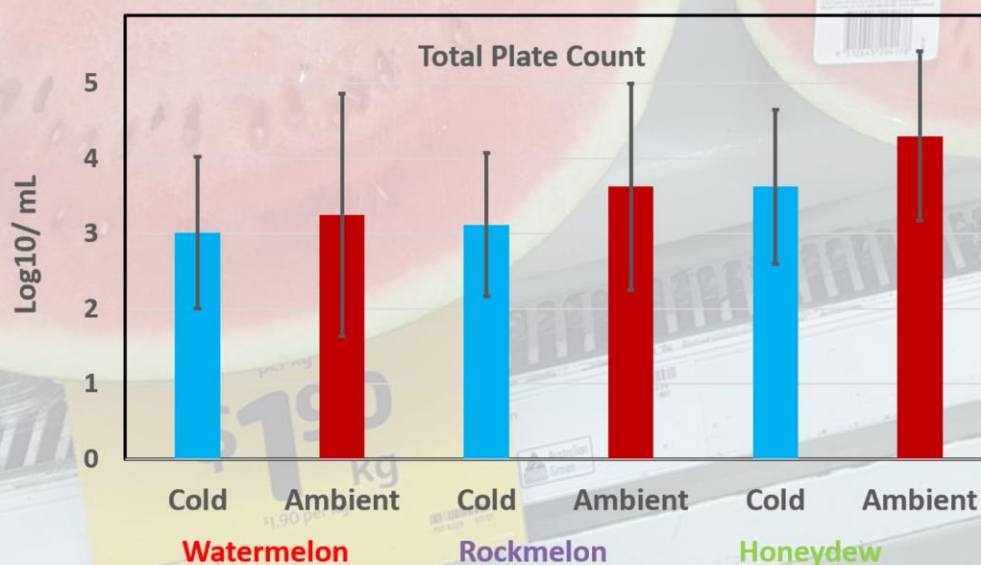
of retailers sell cut
melons on the same
day as they are cut

Appendix V - A snapshot of current retail conditions of cut melons

Retail conditions are critical to the food safety of cut melons. Displaying cut melons at ambient conditions is still a common practice as evident from the data. In our cut melon survey, 56% (251) of samples were collected from ambient fruit displays with 44% (197) collected from cold/refrigerated displays. Fruit pulp temperatures recorded at the retail displays showed a great variation across the stores. Even refrigerated shelves were not maintained at 5°C as shown in the figure below:



Higher total plate counts have been observed in samples collected from ambient display in retail stores as shown in the figure below:



Appendix VI

Cut-melon food safety surveillance

A total of **448** samples collected

56%

of samples collected from **ambient** displays (251)

44%

of samples collected from **cold/refrigerated** displays (197)

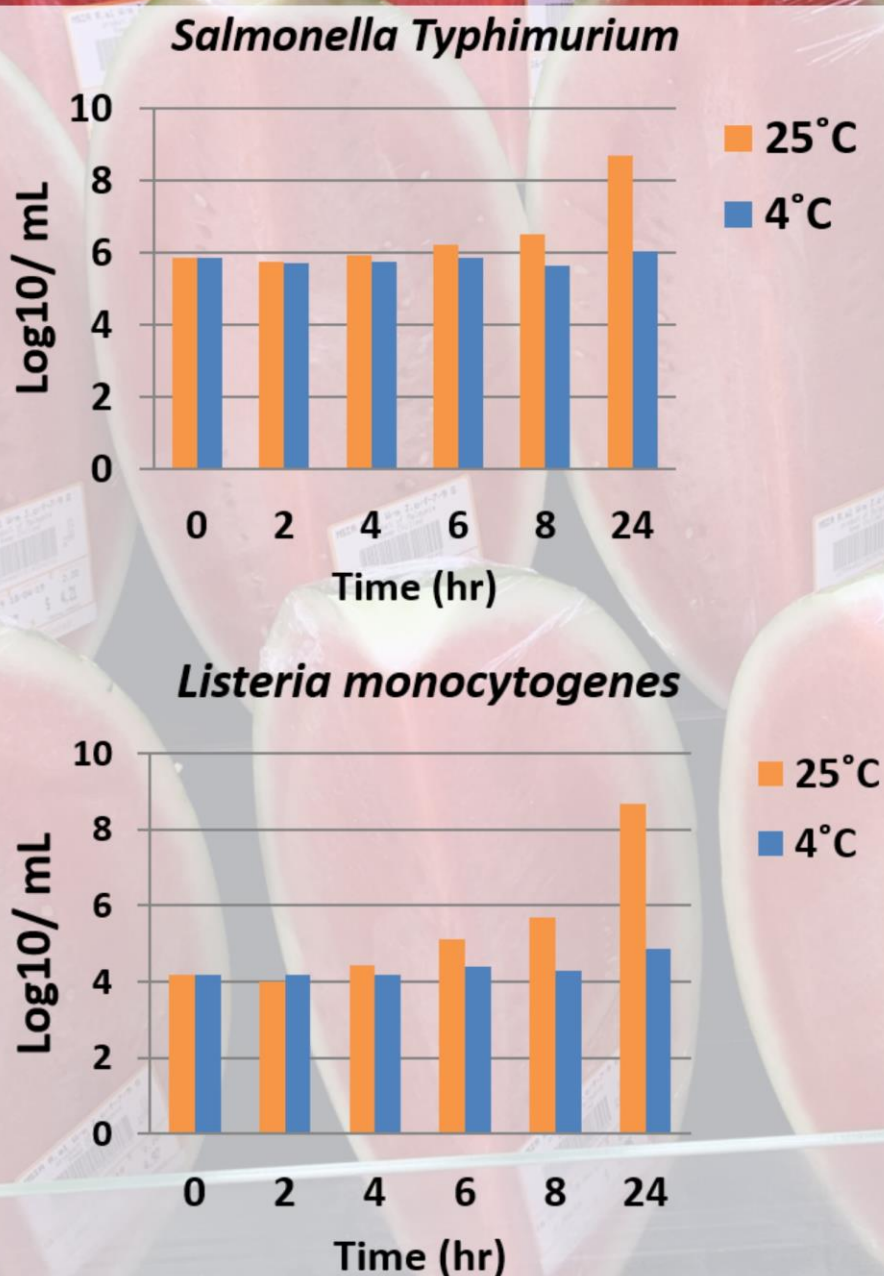
Zero

samples tested positive for all target pathogens :

- *Salmonella* species
- *Listeria monocytogenes*
- *Escherichia coli* O157:H7

Appendix VII - Retail display conditions effect on watermelon food safety

Retail display temperature and duration influence the survival and growth of foodborne bacterial pathogens on cut fruit surface. Our data suggest that prolonged display of potentially contaminated cut melons can lead to growth and proliferation of bacterial pathogens (*Salmonella* and *Listeria monocytogenes*) faster at ambient conditions compared to cold/ refrigerated conditions. Figures below show the growth of bacterial pathogens on the watermelon flesh inoculated with pathogen cultures as a function of time.



Appendix VIII - A best practice guide on watermelon food safety



Department of
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Innovation**
Strategic Levy Investment

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FUND**

Watermelon food safety

A best practice guide and toolbox

FIRST EDITION 2021



Dr Sukhvinder Pal (SP) Singh

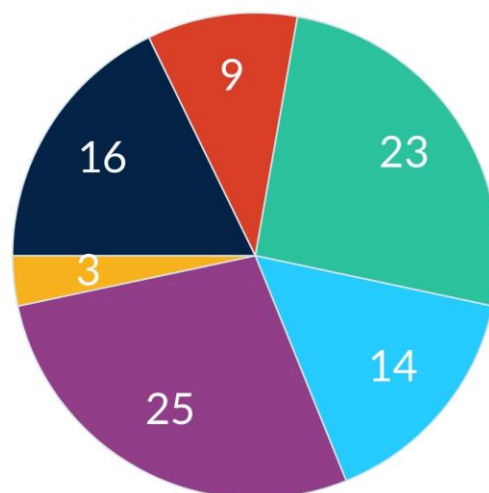
www.dpi.nsw.gov.au

Appendix IX - Melon food safety workshops and webinars

Schedule

Region	Host	Date	Participants
Riverina, NSW	NSW DPI, Griffith	20 Jan 2020	18
NT	NT DPIR	3 Jul 2020	29
WA	Vegetables WA	24 Jul 2020	44
QLD	Melons Australia	12 Sep 2020	N/A
QLD	Bundaberg Fruit and Vegetable Growers	Tentative 5th of Nov 2020	N/A

Total participants = 91



Collaborators



**NORTHERN
TERRITORY**
GOVERNMENT



FOOD STANDARDS
Australia New Zealand
Te Mana Kounga Kai - Ahitereiria me Aotearoa



**Hort
Innovation**
Strategic levy investment

**MELON
FUND**



Bundaberg
Fruit & Vegetable
Growers



vegetablesWA

Appendix IX - cont.

Workshop - Griffith, NSW

Workshop was hosted by NSW DPI at the NSW DPI Griffith site on 20th of January 2020. The workshop focused on melon food safety and included topics such as:

- Best practice in melon food safety (SP Singh, NSW DPI)
- An update on the melon industry (Dianne Fullelove, AMA)
- Current status of the proposed food standard for high-risk horticulture (Food Standards Australia and New Zealand - FSANZ)

The workshop was followed by a field visit to local melon growers in the Griffith area. FSANZ's team working on the high risk horticulture project was taken to the melon farms and packing sheds for their better understanding of the food safety systems adopted by the melon industry.



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FOOD STANDARDS
Australia New Zealand
Te Mana Kounga Kai – Ahitereiria me Aotearoa

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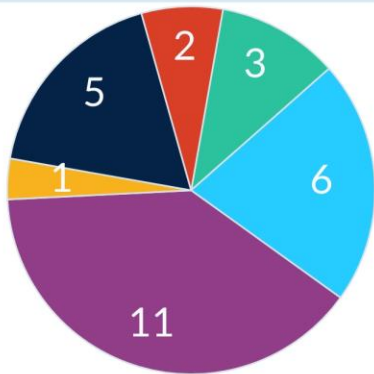


Appendix IX - cont.

Webinar- Northern Territory

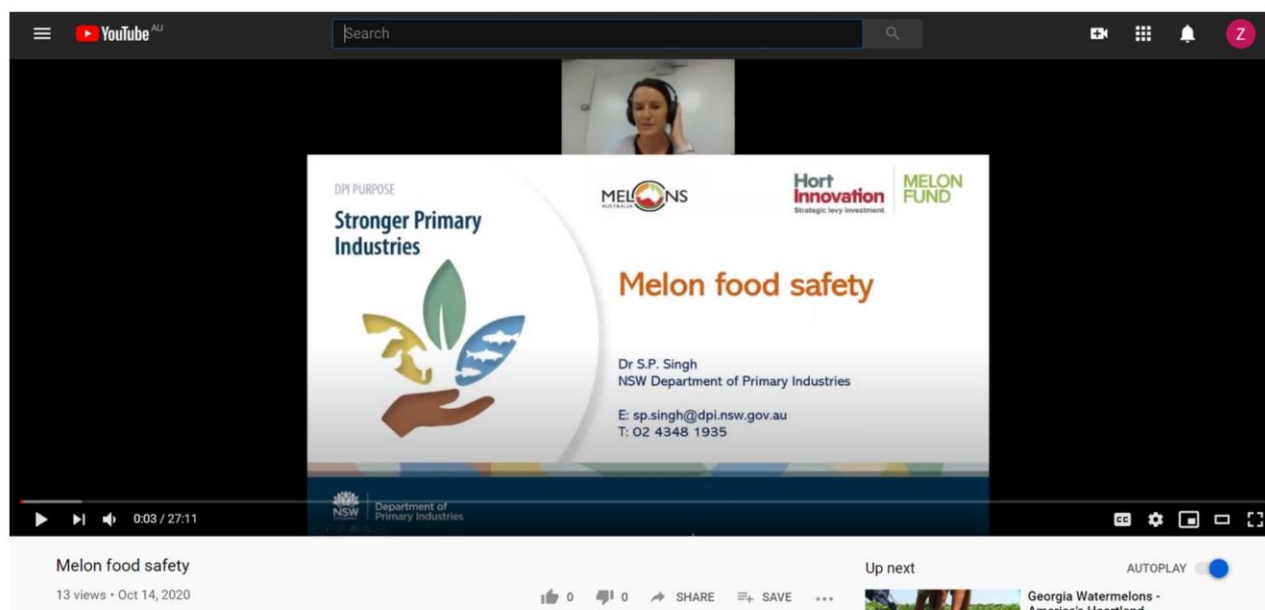
Hosted by:
Northern Territory
Department of Primary
Industry & Resources

Date: 3 July, 2020
Time: 11:00am
Participants: 29



Participant makeup

Growers 10.7%
Consultants 21.4%
Researcher 39.3%
Importer 3.6%
Regulator 17.9%
Student 7.1%



Link: <https://youtu.be/2kdk5aZBXr8>



Appendix IX - cont.

Webinar- Western Australia

Hosted by
Vegetables WA

Bilingual powerpoint presentation
available in (English/Vietnamese)

Date: 24 July, 2020

Time: 11:00am

Participants: 44



Participant makeup

Growers 22.7%

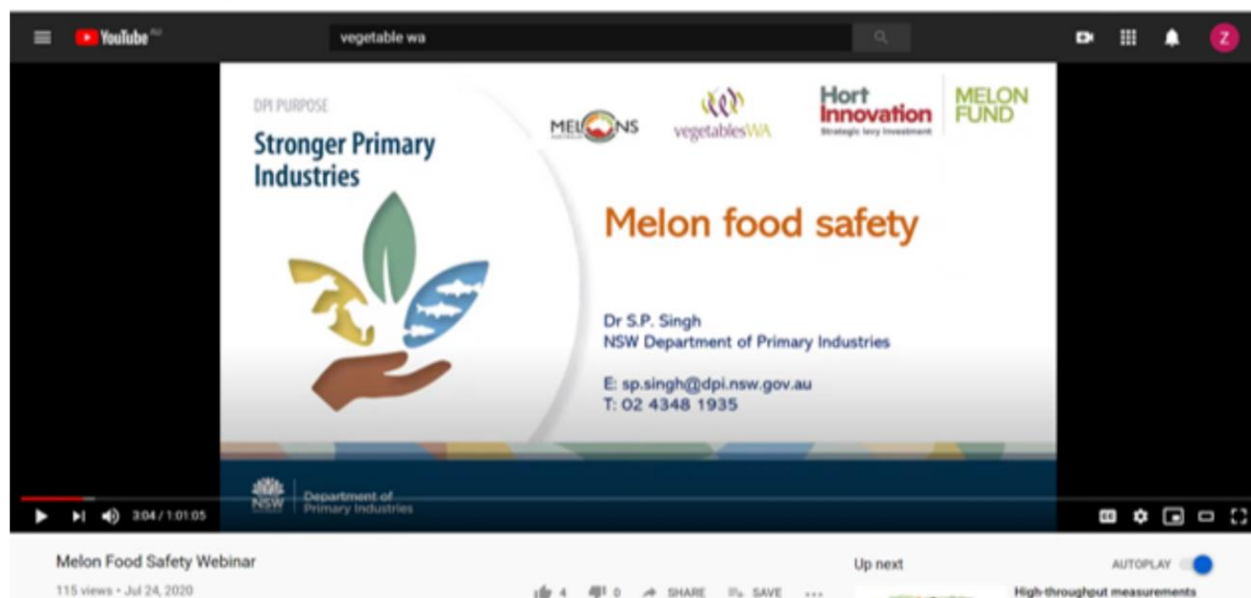
Consultants 15.9%

Researcher 22.7%

Distributor 4.5%

Regulator 18.2%

Other 15.9%



Link: <https://youtu.be/zf3j2Zyh6Ao>



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Innovation**
Strategic levy investment

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Appendix IX - cont.

Webinar- Talking Melons 2020

Hosted by
Melons Australia

The series of webinars has been made available on a number of platforms including Youtube, Apple Podcast, Stitcher as well as being available in pdf form.

The image displays three screenshots related to the 'Talking Melons 2020' webinar series.

Top Left Screenshot (Apple Podcasts): Shows the 'Talking Melons 2020' podcast page. The title is 'Packhouse Environmental Management by Dr S.P. Singh'. It includes a 'Listen on Apple Podcasts' button and a description of Dr. S.P. Singh's role at the NSW Department of Primary Industries.

Top Right Screenshot (Talking Melons 2020 Website): Shows the 'TALKING MELONS 2020' website. It features an 'Introducing Talking Melons for 2020' section, a 'Webinar Playlists' section with links to YouTube, Apple Podcasts, and Stitcher, and a specific episode titled '5. Packhouse Environmental Management by Dr SP Singh'.

Bottom Screenshot (YouTube): Shows a YouTube video player for the webinar. The video title is 'Talking Melons 2020 - Packhouse Environmental Management - Dr SP Singh'. The video content shows a presentation slide with the title 'Stronger Primary Industries' and 'Packhouse Environmental Management' by Dr S.P. Singh, NSW Department of Primary Industries. The slide also includes contact information: E: sp.singh@dpi.nsw.gov.au, T: 02 4348 1935.

Link: <https://youtu.be/2kdk5aZBXr8>



Department of
Primary Industries

Appendix IX - cont.

Workshop and webinar feedback

Participant Feedback

“I have already registered for the webinar the other day! I thought it would be very useful for us and to make the most of these webinars seeing we can’t travel anywhere! I personally think webinars are a great way of getting information across to growers. We are all very time poor and to travel to places is a pain. Looking forward to it!”

- Melon grower in Katherine, NT

“I’ll forward this on to the other melon growers here in Kununurra”

- Melon grower in Kununurra, NT

“Great talk today at the webinar! The most important thing was the holistic approach rather than addressing incoherent bits of the problem” – **Plant and Food Research NZ**

“You all did an incredible job! I couldn’t be happier with the outcome” – **Vegetables WA**

“Great webinar – thanks to the team” – **FreshCare**

“Thank you so much SP.. that was one of our best attended webinars!! And as usual, your ability to make the science around food safety understandable and less scary is beyond impressive! Also I think the questions (and who they were asked by) will give the VegWA team a few leads for industry engagement and support moving forward” – **WA APC**

“Excellent presenter... broad practical knowledge... helping to improve my knowledge of the wider Hort Industry!” – **WA Market Agent**

“Very interesting. It's useful even if not doing melons.”

“An excellent webinar. Good to hear science-based recommendations and a great blend of industry experience with solid science and knowledge”

“An outstanding presentation on best practices on melon food safety highlighting the hot steps, cross-contamination, and control measures. This is will be valuable information for my teaching classes. Looking forward to more such webinars with practical knowledge.”

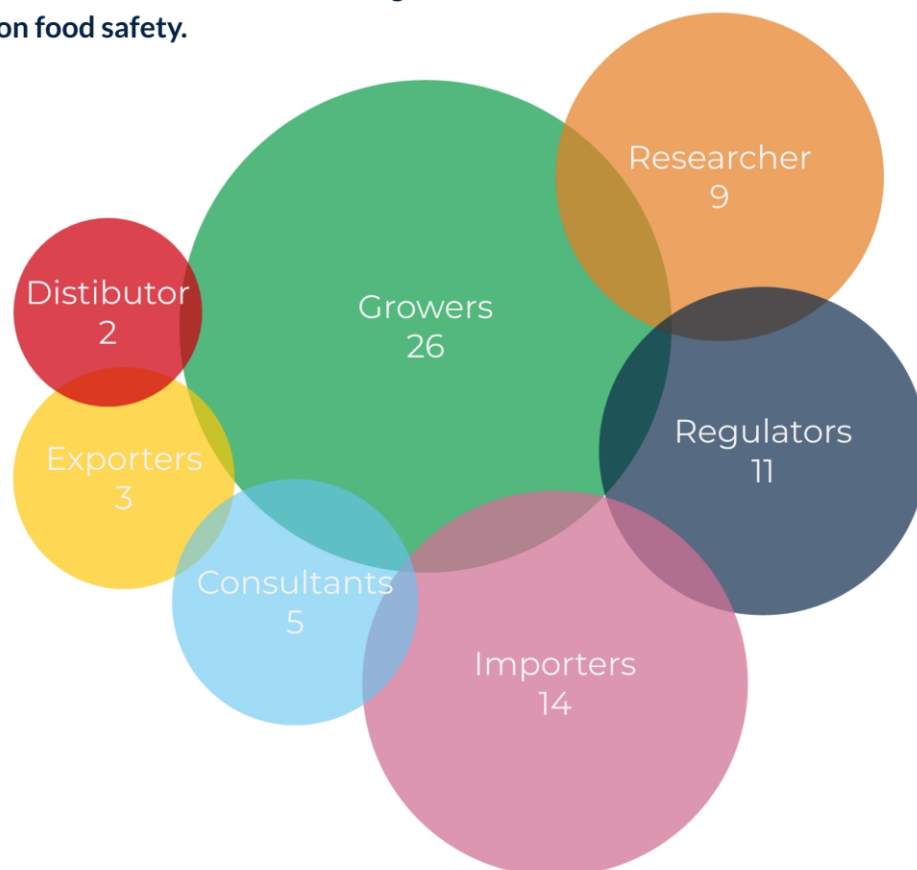
Appendix X - Food safety helpdesk

Food safety helpdesk

The helpdesk is a technical support hub for the industry to address their food safety enquiries. The scope of this service included addressing scientific and technical enquiries related to melon food safety.

- Email
- Phone
- Teleconference

A TOTAL OF **70**
TECHNICAL ENQUIRIES
ADDRESSED FROM
VARIOUS
STAKEHOLDERS.



Enquiry topics



*FONT SIZE INDICATES HOW FREQUENTLY THE TOPICS WERE BROUGHT UP (THE LARGER THE WORD THE MORE FREQUENTLY IT WAS DISCUSSED)