NSW GOVERNMENT | Department of Primary Industries

BIOSECURITY & FOOD SAFETY

Listeria Outbreak Investigation

Summary Report for the Melon Industry, October 2018

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More information

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Acknowledgments

NSW Health

[Cover image: NSW DPI]

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Introduction

The investigation of foodborne illness in NSW is a collaboration between NSW Health and NSW Department of Primary Industries (NSW DPI) Biosecurity & Food Safety. A brief summary of how food investigations commence and are investigated is available online at http://www.foodauthority.nsw.gov.au/aboutus/science/foodborne-illness-case-studies and http://www.health.nsw.gov.au/Infectious/Pages/foodborne-outbreaks.aspx.

Any investigation involves both epidemiological and environmental aspects. Findings of the epidemiological aspects of the investigation into the 2018 *Listeria* outbreak linked to Rombola Family Farms (RFF) at Nericon is summarised in the report prepared by Health Protection NSW titled: Summary of national *Listeria monocytogenes* (MLST 240) outbreak Investigation 27 July 2018 (Attachment A).

In that report Health Protection NSW concluded:

- Twenty-two human cases of listeriosis occurred in Australia between January 16 and April 10, 2018. The strain of *Listeria monocytogenes* causing these infections was related by whole genome sequencing (phylogenetic analysis) to isolates recovered from samples taken from 37 rockmelons sourced from the marketplace originating from the Farm, 1 swab of melons at the Farm, and 1 isolate from an environmental swab taken at the Farm. This detailed laboratory testing information, combined with epidemiological analysis, purchase history and product trace back, indicate that rockmelon produced at the Farm is the source of infection for the people infected with this strain of *Listeria monocytogenes*.

This report outlines the findings of the environmental investigation conducted by the NSW DPI into the food processing and handling practices on the farm implicated as the source of the 2018 *Listeria monocytogenes* outbreak.

Listeria in the environment and human pathogenicity

Listeria species, including *L. monocytogenes* are naturally found in the farm environment, including soil and water. Research papers give the survival range for *Listeria monocytogenes* of 7 days up to 84 days depending on soil ecology and climatic conditions. The pathogen can also be introduced by animals, pests, contaminated water, raw organic manure and dust. *Listeria monocytogenes* in low to very low levels produces an invasive systemic infection or for higher numbers (through significant post process contamination and/or temperature abuse) a non-invasive foodborne illness. [2][3]

The essential delineation between these two types of listeriosis is the health status of the affected cases. The invasive form has a predicted mortality rate up to 30% for immunocompromised individuals through underlying medical conditions or age status. Healthy consumers do not normally contract invasive listeriosis but are affected by the non–invasive kind resulting in the more common gastrointestinal symptoms. [4]

Epidemiological and environmental test result summary

The 2018 listeriosis outbreak linked to rockmelons shares many characteristics with previous overseas outbreaks. The pathogen was most likely present on the rockmelon surface at a very low level and scattered over a wide number of growing paddocks on the Rombola Family Farms property at Nericon, NSW. Consequently, onsets of illness were distributed between 17 January – 10 April 2018, with no obvious clustering at one point in time.

As summarised below, the cases were immunocompromised and predominantly elderly, with the exception of one case that resulted in a miscarriage.

Case demographics as of 27 July 2018

- Confirmed cases: 22
- Gender: 9 male (41%); 13 females (59%)
- Age: average 70yo; range 0-94yo (0yo - live birth at 36 weeks)
- Jurisdictions: NSW (6), VIC (8), QLD (7), TAS (1)
- Onset dates of illness: from 17 January 2018 to 10 April 2018 (Figure 1)
- Deaths: 7, plus 1 miscarriage

Listeriosis cases with the outbreak whole genome sequence (WGS) were first detected in late January and increased through February 2018. This was a previously unknown sequence type and was subsequently linked to rockmelons (predominantly sold through Retailer X) through the epidemiological investigation.

In response to the listeriosis increase, NSW DPI undertook a survey of fruit, meat, dairy, and vegetable products at retail level. *Listeria monocytogenes* was detected in whole rockmelons and half rockmelons at several Retailer X supermarkets across Sydney, including where listeriosis cases had shopped.

Rockmelons from RFF product boxes were sampled by NSW DPI at Flemington Markets. Whole melons and a composite sponge swab of melons were positive for *Listeria monocytogenes.* Concurrently the Rombola Packing shed environment, rockmelon packing line and product were also sampled. *Listeria monocytogenes* was found on the floor around the melon packing area and from a composite swab of washed melons. All *Listeria monocytogenes* positives were further identified as the outbreak WGS strain. A summary of this testing is at Attachment B.

The incubation period for listeriosis cases was 2-4 weeks. This would put the rockmelon harvest date range from mid-December 2017 to the beginning of January 2018 for the first notified case from New South Wales. Detection of listeriosis cases continued into February and March with the consumption of rockmelon occurring before 28 February when the trade recall and consumer alert[1] took effect.

[1] http://foodauthority.nsw.gov.au/news/newsandmedia/departmental/2018-02-28-listeriosis-outbreak-link-to-rockmelon

Suspected cause of the outbreak

The hygiene and sanitation practices of the RFF packing facility and farming operation at Nericon were on par with, or better than most other rockmelon growing operations across Australia. This observation is derived from onsite inspections with other growers in NSW and feedback from other sources into operations in other parts of Australia.

Despite this, several factors appear to have combined such that the procedures and processing of melons by RFF was not able to reduce a higher prevalence of *Listeria monocytogenes* on fruit.

Adverse weather events (heavy rainfall in December prior to harvest, followed by dust storms) are likely to have significantly increased the organic load and amount of *Listeria monocytogenes* present on rockmelons prior to harvest. The netted skin of rockmelons makes this fruit particularly hard to clean and sanitise.

Prior to the detection of the outbreak, RFF utilised a 1 minute and 30-40 second pre-wash and scrubbing step to reduce organic load, followed by a 35 second sanitising step of 100ppm chlorine sprays and scrubbing. There were no specific concerns noted with the operation of these steps as a result of the investigation. The wash water was not recirculated, sanitiser was constantly monitored and applied through an auto-dosing system, and all water coming into the facility was treated and considered potable.

It is likely that the 35 seconds at 100ppm sanitising step was effective in reducing *L. monocytogenes* to a very low level, but these levels still resulted in illness when rockmelons were consumed by immunocompromised individuals.

There were other peripheral issues noted in the packing facility during the investigation. These included some dirty fans that were used to reduce the level of moisture on melons after washing, and some spongy material on packing tables that was not able to be easily cleaned. These may have been contributing factors to the outbreak but are not considered to be the major underlying causes.

The packing shed itself was a large, relatively new and purpose-built facility. Overall hygiene and dust control were very good. Despite extensive sampling (over 140 swabs) only one boot swab in the rockmelon processing area on the first inspection (21 February 2018) was positive for *L. monocytogenes*, and one composite swab of melons after washing (out of 100 swabs in total), was also positive on 21 February 2018.

This outbreak highlights the need for improved control measures and awareness of external threats to food safety in the rockmelon industry (such as adverse environmental conditions) and possible impacts on the efficacy of established control measures and sanitising of fruit.

Post-outbreak controls implemented by Rombola Family Farms

Following the outbreak and as a result of the investigation, significant changes were implemented in the packing shed to reduce further risk of illness. These included extensive modifications to equipment and the packing line itself, and changes to cleaning procedures and documentation.

Significant changes are summarised below:

- **Washing and sanitising**
    - The rockmelon pre-wash was dosed with 200ppm chlorine water during use. Similarly, the concentration of chlorine in the sanitiser wash step was increased to 200ppm. This gives a total contact time for chlorine of over 2 minutes (noting that some of the early contact time will be affected by a higher organic load).
- **Changes to equipment**
    - The fungicide tank and post wash drying fans have been made more accessible and easily cleaned. Black sponge material on the packing table has been removed and replaced with more suitable material.
- **Other rectifications**
    - Cleaning equipment (such as squeegees, mops) has been replaced and labelled for specific areas of the packing shed
- **Hot water to the hand wash basin area for staff is now functional**
    - Procedures for cleaning and maintenance have been updated to be more systematic and adequately reference key equipment in the packing shed.
    - Use of equipment such as high-pressure cleaning guns, which can increase the spread of *L. monocytogenes* throughout a facility, is restricted.

The business was closely monitored since harvesting and packing recommenced on 4 April 2018, including testing of fruit at wholesale level. No *L. monocytogenes* was detected on any fruit.

Risk minimisation and consumer advice

The *L. monocytogenes* prevalence and contamination level on the rockmelon surfaces during the outbreak was most likely very low (under 100 cfu/g based on the epidemiological data). Whole pieces of fruit grown near the ground in the open farm environment are not expected to be free from *Listeria*. Equally, the washing process even under the best circumstances is not a guarantee that every packed melon is *Listeria* free. Fine tuning the washing process will reduce the relative risk but not the absolute risk of listeriosis from a farm grown whole piece of fruit. To help manage the risk, a unified communication strategy across regulatory bodies and industry associations is required to further educate vulnerable consumers and their carers about the risks of listeriosis and practical solutions to maintaining a balanced diet. This strategy should include recommending that vulnerable populations do not consume rockmelons, consistent with current consumer advice[2].

[2] https://www.health.nsw.gov.au/Infectious/factsheets/Pages/Listeriosis.aspx

Recommendations for industry/growers

1. All growers should review the entirety of their operations and food safety plans as a matter of priority. These plans need to ensure that external environmental factors are taken into account (e.g. adverse weather events, propensity for soil to adhere to rockmelon surfaces) and that processing/packing operations are able to adjust or cope with significant variations in soil/bacterial load.
2. All wash steps (e.g. pre-wash, sanitiser wash, fungicide treatment) should be reviewed as a matter of priority, to ensure that best practice is utilised across the industry as a whole. This review should include the in-house expertise and understanding of growers and staff, that adequate sanitisers are being applied and at an appropriate concentration and contact time, depending on conditions.
3. Aspects of washing systems should also be reviewed to ensure the adequacy of the sanitiser type, the effectiveness in the number of spray heads in sanitiser tanks and their design, that immersion tanks have sufficient available free sanitiser concentration, and that recirculated water is dumped at appropriate intervals.
4. Packing sheds need to have sufficient structural integrity to minimise the presence of dust and soil.
5. Cleaning and sanitising procedures within the general shed environment need to include steps for:
    a. regular removing and cleaning of dusty surfaces at all levels in the shed;
    b. water treatment to render water potable for cleaning and hand washing;
    c. cleaning and sanitising harvest equipment and tools;
    d. cleaning and sanitising cleaning implements;
    e. no high-pressure cleaning in the packing shed;
    f. entry foamers and/or airlocks could also be considered.
6. Growers should also consider implementation of Standard Plate Count or other testing on fruit as an early indicator that higher bacterial loads are present, requiring additional control measures (such as increased sanitiser strength during washing).

Attachment A: Summary of national *Listeria monocytogenes* (MLST 240) outbreak Investigation

As at 27 July 2018

Summary

Twenty-two people were infected with the same strain of *Listeria monocytogenes* MLST 240 between 17 January 2018 and 10 April 2018. All cases met the confirmed outbreak case definition (Box 1). Twenty cases recalled consumption of rockmelon in their incubation period.

Rockmelon samples were collected from retail stores identified by cases as the place of purchase of rockmelon consumed during their incubation period and through traceback activities. Rockmelon samples and environmental swabs were also collected from the Rombola Farm ("the Farm").

A total of 39 food and environmental *Listeria monocytogenes* isolates were identified as related to human cases by whole genome sequencing (phylogenetic analysis):

- 38 isolates from rockmelon
    - 26 collected by the NSW Food Authority from retail outlets and at wholesale
    - 9 collected by Victorian local councils at retail stores
    - 1 collected by the NSW Food Authority from the Farm
    - 1 isolate from a wholesaler in Victoria
    - 1 isolate from a distributor of rockmelon from the Farm
- 1 isolate from a swab of the production environment at the Farm collected by the NSW Food Authority.

Box 1: Case definition

Confirmed outbreak case: Isolation of *L. monocytogenes* MLST 240 which is 'highly related' to MJOI (2018_001) outbreak cases as determined by whole genome sequencing (phylogenetic analysis), in a person with illness onset since 1 January 2018

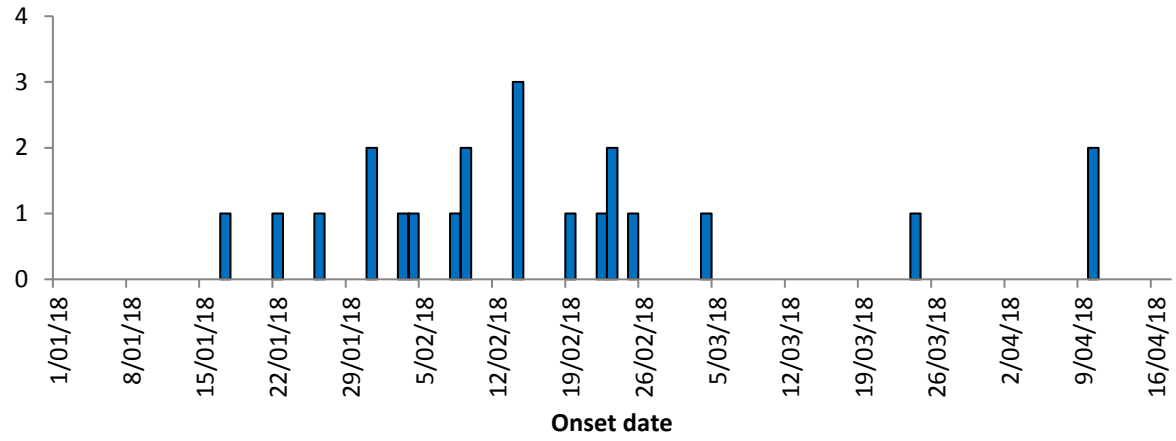
MJOI: multi-jurisdictional outbreak investigation

EPIDEMIOLOGICAL INVESTIGATION

Case demographics

- Confirmed cases: 22
- Gender: 9 male (41%); 13 females (59%)
- Age: average 70yo; range 0-94yo (0yo - live birth at 36 weeks)
- Jurisdictions: NSW (6), VIC (8), QLD (7), TAS (1)
- Onset dates of illness: from 17 January 2018 to 10 April 2018 (Figure 1)
- Deaths: 7, plus 1 miscarriage
- Institutional residents: 0

Figure 1: Epicurve of the 2018 Listeria monocytogenes MLST 240 outbreak, Australia.



Food exposure analysis

All cases of listeriosis are interviewed at the time of diagnosis about foods consumed in their incubation period. This includes asking specifically about consumption of a list of approximately 70 high risk foods using a nationally consistent questionnaire.

Note: Food exposure information is limited to 20 cases:

- One case was lost to follow-up
- One infection acquired in utero, and food consumption is not described; however rockmelon exposure can be attributed to this infection via the mother.

Food exposure information (n=20)

- All cases indicated they consumed rockmelon in the weeks prior to illness onset.
- No cases reported consumption of rockmelon after removal of the produce from sale on 28 February 2018.

Table 1: Top 3 frequently consumed foods from interviews of confirmed cases, 2018 *Listeria monocytogenes* MLST 240 outbreak, Australia.

Food item	Frequency	Percent
Rockmelon	**20 / 20**	100%
Whole lettuce	11 / 20	55%
Watermelon	10 / 20	50%

Food borne disease outbreak investigations in NSW occur in collaboration between NSW Health and the NSW Food Authority. A brief summary of how food investigations commence and are investigated by NSW Health is available online at http://www.health.nsw.gov.au/Infectious/Pages/foodborne-outbreaks.aspx.

Foodborne disease outbreaks affecting more than one jurisdiction in Australia are conducted collaboratively by affected jurisdictions through the OzFoodNet network. A description of how such investigations are conducted is available online at http://health.gov.au/internet/main/publishing.nsf/Content/BA8ABBB4031EF7B6CA25801A00203B3C/$File/guide-epi-invest-multi-jurisdictional.pdf

LABORATORY INVESTIGATION

Whole genome sequencing (WGS) is the process of determining the complete DNA sequence of an organism's genome at a single time.

- WGS-based surveillance is used in routine national surveillance for *Listeria monocytogenes*, and analysis is conducted at the Microbiological Diagnostic Unit (MDU) Public Health Laboratory in Melbourne, VIC. The database includes isolates dating back to 2010.
- A detailed explanation of how WGS is conducted for *Listeria monocytogenes* at MDU is available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4733179/

Whole genome sequencing results

A total of 61 isolates of *Listeria monocytogenes* MLST 240 clustering with the outbreak strain were received by MDU-PHL during the period 30 January 2018 to 7 May 2018.

- Isolates with WGS and phylogeny belonging to MLST240:
  - 22 human cases
  - 39 non-human isolates (29 from NSW, 10 from VIC)

The 39 non-human isolates which are clustering with human cases in this outbreak include:

- 38 isolates from rockmelon sources (28 from NSW, 10 from VIC)
  - 26 isolates collected by NSW Food Authority from rockmelon at retail and wholesale supplied by the Farm – including from retail stores where two patients purchased their rockmelon.
  - 9 isolates collected by city councils from Victorian retail stores supplied by the Farm. Retail stores are where four patients purchased their rockmelon.
  - 1 isolate from a distributor of rockmelon from the Farm (collected 2/3/18).
  - 1 isolate from a swab of melons obtained by NSW Food Authority at the Farm
  - 1 isolate from a wholesaler in Victoria supplied by the farm
- 1 isolate from an environmental swab of the melon processing area collected by NSW Food Authority at the Farm during inspection on 21/2/18.

The genomic diversity observed across the 22 isolates from human clinical samples was consistent with that observed in other Listeria monocytogenes outbreaks across known epidemiologically linked cases (e.g., Kwong et al. 2016 J. Clin Micro 54: 333-342), supporting our interpretation of the epidemiological data and relatedness to non-human isolates.

CONCLUSION

Twenty-two human cases of listeriosis occurred in Australia between January 16 and April 10, 2018. The strain of *Listeria monocytogenes* causing these infections was related by whole genome sequencing (phylogenetic analysis) to isolates recovered from samples taken from 37 rockmelons sourced from retail and wholesale supplied by the Farm, 1 isolate obtained from melons on farm, and 1 isolate from an environmental swab taken at the Farm. This detailed laboratory testing information, combined with epidemiological analysis, purchase history and product trace back, indicate that rockmelon produced at the Farm is the source of infection for the people infected with this strain of *Listeria monocytogenes*.

Attachment B: Summary of *Listeria monocytogenes* with the outbreak strain obtained by NSW DPI

Product name	Sampling date	Retailer	Retailer suburb
Rockmelon (half)	15/2/18	Retailer X	Eastwood
Rockmelon (half)	15/2/18	Retailer X	Eastwood
Rockmelon (half)	15/2/18	Retailer X	Smithfield
Rockmelon (whole)	16/2/18	Retailer X	Turramurra
Rockmelon (half)	16/2/18	Retailer X	Ryde
Rockmelon (whole)	19/2/18	Retailer X	Penrith
Rockmelon (half)	19/2/18	Retailer X	Blacktown
Rockmelon (half)	21/2/18	Retailer X	Roselands
Rockmelon (half)	21/2/18	Retailer X	Warriewood
Rockmelon (half)	21/2/18	Retailer X	Warriewood
Rockmelon (whole)	21/2/18	Retailer X	Roselands
Rockmelon (whole)	21/2/18	Retailer X	Roselands
Rockmelon (whole)	21/2/18	Retailer X	Roselands
Rockmelon (half)	21/2/18	Retailer X	Ramsgate
Rockmelon (whole)	21/2/18	Retailer X	Ramsgate
Rockmelon (whole)	22/2/18	Retailer X	Bondi (confirmed RFF)*
Rockmelon (whole)	22/2/18	Retailer X	Bondi (confirmed RFF)
Rockmelon (whole)	22/2/18	Retailer X	Bondi (confirmed RFF)
Rockmelon (whole)	22/2/18	Retailer X	Bondi (confirmed RFF)
rockmelon (whole)	22/2/18	Retailer X	Bondi (confirmed RFF)

*RFF (Rombola Family Farms)

Product name	Sampling date	Venue
whole rockmelon	20/2/18	Sydney Market
whole rockmelon	20/2/18	Sydney Market
whole rockmelon	20/2/18	Sydney Market
whole rockmelon	20/2/18	Sydney Market

Product name	Sampling date	Venue
whole rockmelon	20/2/18	Sydney Market
rockmelons x 8 (swab)	20/2/18	Sydney Market
Rockmelons x 5 (swab)	21/2/18	Packing shed (Nericon, NSW)
Melon processing area	21/2/18	Packing shed (Nericon, NSW)