CUT MELON SURVEY

Department of Primary Industries
Food Authority

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Contents

Introduction

Melons and papaya are a popular food across Australia, particularly as a refreshing snack, dessert or ingredient.

The main types of melons produced (and consumed) in Australia are watermelon, rockmelon and honeydew melon. Melons are produced across mainland Australia with harvest occurring throughout the year depending on location of crop. Harvest time for NSW is December until April whereas the north of the country harvests from May until November. In the year 2010-11, over 210,000 tonnes of melons were grown in Australia with NSW producing approximately 28% of these.

Two types of papaya are produced in Australia; red and yellow, and there are several popular hybrids of each. Papaya is harvested all year round with increased supply in spring and autumn. Papaya is predominantly grown in northern Queensland with a small percentage being grown in central Queensland, Sunshine Coast, north Western Australia, Darwin and northern NSW.

Other melons consumed in Australia include winter melon, casaba and piel de sapo.

Supermarkets and greengrocers often sell melons that have been cut and wrapped in cling film on-site. Major supermarkets often refrigerate cut rockmelon, honeydew and papaya but not necessarily cut watermelon. Most greengrocers do not display these products under temperature control. Some retailers have expressed concern that storing cut melons under refrigeration will require a relatively large amount of refrigeration space, increasing the cost of melon and placing the product away from high traffic areas, and this will result in reduced consumption of Australian melons.

There have been several notable outbreaks linked to melons in Australia recently.

In 2016 a large outbreak of *Salmonella* was linked to rockmelons contaminated at the growing farm. There were a total of 86 cases reported across several states. *Salmonella* was detected on the surface of some rockmelons from the supplier. A large recall was instigated and investigation conducted (NSW Food Authority, 2016).

In 2010, there was a multi-state outbreak of listerioisis linked to honeydew melons with nine confirmed cases and two deaths. All cases were immunocompromised and *Listeria* was detected in wash water used to rinse a honeydew melon and in leftover waste juice (OzFoodNet, 2012).

In 2009 there was an outbreak of *Salmonellla* Saintpaul in Western Australia linked to paw paw (OzFoodNet, 2009). There were 17 notified cases with three requiring hospitalisation. Paw paw from one grower was found to be contaminated with *S*.Saintpaul. The washing process was determined to be the case of the contamination.

In 2006/7 there were 26 cases of *Salmonellla* Litchfield linked to contaminated papaya. *S.* Litchfield was detected on the skin of papaya purchased from different retail outlets and trace back found that three farms supplied the contaminated papaya. Untreated washing water was suspected as the cause of the contaminated papayas (ProMED-mail, 2006).

Internationally there have also been numerous large outbreaks involving melons and papayas. A summary of these and the Australian outbreaks is listed in Appendix 1.

Aim

The purpose of this survey was to gather data on the prevalence of pathogenic bacteria on cut melons and papayas and the handling of these products at retail level to better inform risk management. This survey was not conducted for compliance or enforcement purposes.

Method

Samples of pre-cut melons and papayas were purchased from 45 greengrocers and supermarkets across Sydney between January and August 2015. Samples were photographed and transported under temperature control to DTS Food Laboratories and the top 1-1.5 cm layer of the cut melon or papaya was tested for Standard plate count (SPC), *E. coli*, *Salmonella* and *Listeria monocytogenes* (Table 1).

At time of sampling a questionnaire was also administered to collect information on handling and storage of the melons and papayas at retail level. The placement of the produce on display was also recorded.

In addition, pH and water activity was also measured for a portion of samples to assist with modelling of bacteria growth. Only samples of ½ melons and papaya (including ¼ watermelons) that were already cut, wrapped and on display for sale were included in this survey. Other cut fruit included in this survey were jackfruit, dragon fruit, winter melon, casaba and piel de sapo. Diced or peeled fruit was not included in this survey. Cut fruit from stores that only cut fruit by request also were not included. Pineapple was also excluded from this survey.

Table 1: Tests and method

Test	Method reference
Standard Plate Count (SPC)	AS 5013.1&5:2004
E. coli enumeration	ISO 16649-2: 2001 (E)
Listeria monocytogenes presence/absence.	BAX System User Guide, Dupont Qualicon 2005-2007, VIDAS AOAC 2004.06
L. monocytogenes enumeration	ISO enumeration method ISO 11290-2:1998
Salmonella	VIDAS (NF VALIDATION (BIO 12/10-09/02)); AOAC 996.08
Water activity	Aqua Lab Manual
pH	AOAC 970.21

Results

Microbiological results

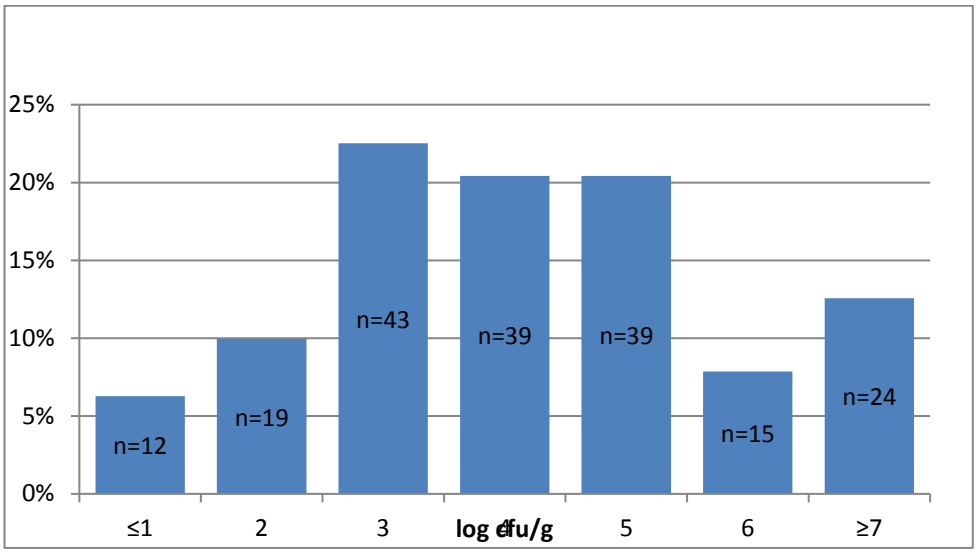
A total of 191 samples were tested for microbiological quality. Overall the microbiological quality of samples tested was very good. *Salmonella* was not detected in any sample. *E. coli* was detected in one sample of watermelon at 1,100 cfu/g and *L. monocytogenes* was detected in one sample of honeydew with a level under the limit of quantification (10 cfu/g).

Of more interest were the differing levels of SPC (Figure 1). SPC can provide a general indication of the microbiological quality of a food. However, it does not differentiate between the natural microflora of a food and spoilage microorganisms. It should not be used to predict the safety of the product and will be influenced by the storage conditions of the product. As cut melons and papaya are a raw food it is expected that they will have a low to medium SPC. A high standard plate count may indicate that the product has been prepared unhygienically, stored inappropriately or nearing the end of its shelf life. The NSW Food Authority's *Microbiological quality guide for ready-to-eat foods* (NSW Food Authority, 2009) categorises fresh cut fruit as Category C and thus no limit has been set for an unsatisfactory SPC.

Only 3 (1.6%) samples did not have a SPC above the level of detection (10 cfu/g). These were a paw paw and two watermelon samples, purchased during summer and stored at ambient temperature inside the store. The majority (63%) of samples had a SPC between 1,000 and 100,000 cfu/g.

Thirteen (7%) samples had a SPC greater than the maximum level of quantification (30,000,000 cfu/g). These were all purchased in summer and consisted of eight honeydews, one papaya, three rockmelons and one watermelon sourced from 11 stores. It was difficult to ascertain how long prior to purchase these samples were cut. Most greengrocers indicated that the fruit was cut on day of sampling however some of these same greengrocers also indicated that leftover cut fruit was stored overnight for sale the next day. Fruit stored for the next day was generally trimmed and rewrapped before being placed on display again so it was difficult to determine which sample was cut the day before or cut the morning of sampling. Only one store surveyed displayed day old cut fruit discounted and labelled 'reduced to clear' in a separate section to the freshly cut fruit.

Figure 1: SPC frequency



pH and water activity

The pH and water activity of 149 samples was analysed. Results are outlined in Table 2. All samples had pH above 4.6 and high water activity classifying cut melons and papaya as potentially hazardous as specified in the NSW Food Authority's guidance document *Potentially Hazardous Foods*.

Table 2: pH and water activity of melons and papaya

Category	No samples	pH mean (range)	Water activity mean (range)
Rockmelon	33	6.28 (5.12 - 6.63)	0.99 (0.98-0.99)
Watermelon	35	5.55 (5.16 – 6.48)	0.99 (0.98-0.99)
Honey dew	31	5.87 (5.42 – 6.69)	0.99 (0.98-0.99)
Papaya	40	5.43 (4.66 – 6.46)	0.99 (0.98-0.99)
Other	10	5.79 (5.14 – 6.36)	0.98 (0.98-0.99)

Food handling questionnaire

A total of 35 questionnaires were completed (Table 3). All questionnaires were completed in summer. The majority of stores sold cut fruit that are covered in this survey. No store received fruit already cut.

Table 3: Types of businesses surveyed

Store category	No of businesses surveyed
Major supermarkets1	5 (14%)
Independent/minor supermarkets2	8 (23%)
Independent greengrocers	22 (63%)

Frequency

The majority of stores indicated that they cut fruit at least 3 times a day (Table 4). They also indicated that the frequency of cutting was dependent on the season and day of the week, with increasing frequency on weekends and in summer. Verbally many greengrocers also indicated that they cut small amounts frequently; during busy times this could be once every hour for fruit stored at ambient temperatures. This was especially prevalent in the larger independent stores and medium chains. Supermarkets that tended to display cut fruit under refrigeration (except watermelon) cut less frequently if they had the storage capacity.

Table 4: The frequency of fruit being cut per day

fruit (total answers)	less than once	1	2	3	more than 3
Rockmelon (32)	0 (0%)	2 (6%)	8 (25%)	6 (19%)	16 (50%)
Watermelon (32)	1 (3%)	1 (3%)	5 (16%)	7 (22%)	18 (56%)
Honey dew melon (30)	1 (3%)	3 (10%)	8 (27%)	5 (17%)	13 (43%)
Papaya (28)	0 (0%)	2 (7%)	9 (32%)	4 (14%)	13 (46%)
Other (17)	0 (0%)	1 (6%)	4 (24%)	3 (18%)	9 (53%)

Preparation of fruit

Many respondents indicated they only wash the fruit if it appears dirty; with watermelon being the most washed fruit (18 respondents). Rockmelon was the least washed (20 respondents). No respondent used detergent or sanitiser during washing and those that indicated they washed the fruit used a dry or wet cloth or paper towel. One

[1] Coles and Woolworths
[2] Harris Farm, Thomas Dux, IGA

greengrocer commented that they don't generally wash the fruit as the cling film will not adhere to the fruit if the skin of the fruit is wet.

Cutting equipment

All greengrocers indicated they cut fruit at the back of the shop. Only one indicated that occasionally during busy times fruit gets cut at the front of the shop. The majority of greengrocers used a knife with plastic handle (32 respondents) and a plastic chopping board (33 respondents). One greengrocer used a wooden chopping board, one used a glass chopping board and another used their stainless-steel bench.

Use of sanitiser for cleaning cutting equipment

The majority of greengrocers indicated they used sanitiser but it must be noted that when asked about the brand of sanitiser used, at least two greengrocers did not know and had none on site. Many were also unsure whether they cleaned and/or sanitised between fruit, at the end of cuttings or at the end of the day. There was no evidence of written documents for cutting fruit (although this question was not specifically asked). A few indicated they washed between different types of fruit and cuttings and sanitised at the end of trade. Worryingly, a few also indicated they used neither detergent nor sanitiser (5 respondents). Only six greengrocers used both detergent and sanitiser. It appears that the distinction between detergent and sanitiser is not clear.

Display and storage of fruit

All independent and medium sized chain greengrocers displayed their cut fruit at ambient temperatures. One major supermarket predominantly displayed cut watermelon at ambient but all other cut fruits under refrigeration. Retailers were asked why they store the fruit where they do; A portion of independent retailers said they had tried selling cut fruit under refrigeration (if they had the space) but said that there was a decrease in sales. They thought that either customers preferred it at room temperature or that customers did not know to look for or see cut fruit in the refrigeration section. When probed further, no greengrocer who had tried displaying cut melon under refrigeration had erected a sign informing customers of the change in display. One store of a smaller chain, who stored all cut fruit under refrigeration except for watermelon, had a sign above the watermelon directing customers to the refrigeration section where the cut fruit was stored.

Date marking

Only a handful of stores (6) had date marking on fruit (see case study below).

An independent store cut fruit in the morning and then as needed throughout the day. A time sticker was placed on the fruit with a time frame of roughly 6 hours. After this time the fruit was discarded or price reduced for sale. Cut fruit was displayed at ambient temperature in an open store in a large indoor shopping complex. At the end of trade any leftover fruit (that was cut within 6 hours) was stored in the coolroom overnight. The next day the fruit was trimmed and re-wrapped. This fruit was then discounted and sold separately to the fruit that was freshly cut that day. Both fruit that was cut on day of sampling and the previous day were purchased and tested. No pathogens or indicator organisms were detected however there was a marked increase in SPC of samples that were stored overnight and sold the next day.

Fruit	freshly cut fruit	re-trimmed, discounted fruit
Rockmelon	8.0 x 105	>3.0 x 107
Honeydew	3.2 x 104	8.6 x106
Paw paw	1.6 x 104	9.0 x 105

Leftover fruit at end of trade

A significant portion of independents and minor supermarkets store cut fruit for the next day if not sold (15). This fruit is stored in the coolroom overnight, re-trimmed and re-wrapped for sale the next day. When asked how they determine if the product is still safe for sale, all indicated they do a visual inspection. No major supermarket kept leftover fruit.

Discussion

Handling

The microbiological quality of the cut fruit in this survey was very good. It appears that 'normal practice' across the sector is to cut small amounts and often, which should be encouraged, especially if displaying at room temperature. However, it is clear that there is room for improvement in cleaning and sanitising of cutting equipment and storing cut fruit overnight.

Education of the difference between, and the need for both detergent and sanitiser should be conducted. As well as the importance of cleaning and sanitising often and between cutting different types of fruit to prevent cross contamination.

The practice of re-trimming melons should be discouraged, especially if the fruit is displayed at room temperature. While this may improve the aesthetics of the stored cut fruit any bacteria on the surface of the fruit may be able to penetrate through the soft flesh.

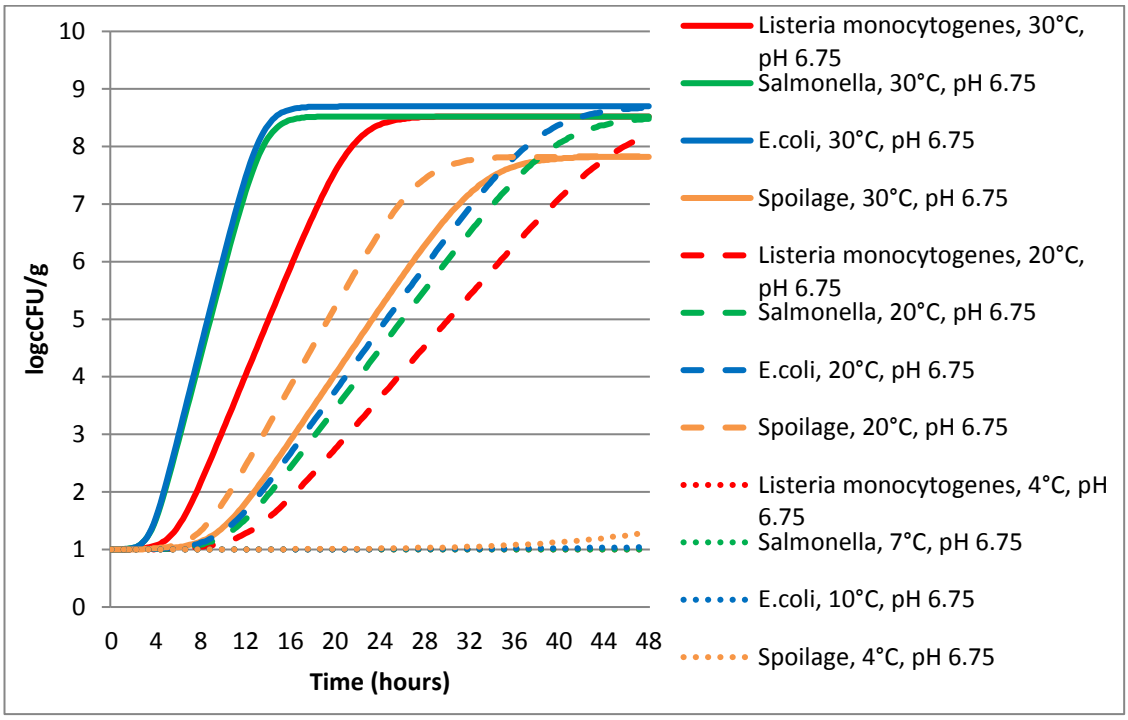
Pathogenic growth potential in Melons and Papaya

There has been significant research into growth of pathogenic, spoilage and indicator organisms in minimally processed fruit. Fang, Liu & Huang (2013) examined the growth kinetics of *L. monocytogenes* and background microflora of rockmelons and concluded that there was very short or practically no lag phase for growth at temperatures ranging from 4 to 43°C. Using the predicative modelling tool ComBase (Baranyi & Tamplin, 2004) and using pH and water activity data from this survey potential growth rates for *L monocytogenes*, *Salmonella, E. coli* and a spoilage organism was calculated at refrigerated (4°C), ambient (20°C) and high temperatures (30°C for rockmelon) (Figure 2). The generation time (GT = the time taken for bacteria to double in numbers) was estimated in addition to a lag phase duration (LPD = the time taken for bacteria to adapt to their environment before they begin to grow). LPD was initially calculated using the lag time to GT ratio from Ross (1999) which estimates that most lag times are 4–6 times the length of the GT, however a final conservative value of 3 x GT was used in these calculations.

Being motile over 20°C *L. monocytogenes* can penetrate through the cut surface into the fruit so the practice of re-trimming fruit may not improve the microbiological quality of the fruit.

Using an initial load of 1 log cfu/g Listeria at 30°C will achieve a log increase in 7.6 hour. After 10 hours, levels would increase to 3 log. In comparison at 20°C a log increase would occur after 16.4 hours and at 4°C no significant increase would be seen at 60 hours. *Salmonella* and *E. coli* would see a log increase at 30°C after 5 hours reducing to 14 and 13 hours respectively at 20°C. At 4°C no significant increase would be seen after 60 hours.

Figure 2: Potential growth rates



Conclusion

The microbiologically quality of the cut fruit tested in this survey was very good and this reflects the finding that many of the outbreaks have been caused by poor practices by a producer rather than through the practices at retail level. Cut melons and papaya are classified as potentially hazardous but our survey found that they are safe to be displayed at room temperature for a period of time. Improvement is needed in the handling, cleaning and sanitation practices used in cutting fruits at the retail level. Fruits should also be regularly cut throughout the day using safe methods and sold on the day they are cut.

References

Baranyi, J., & Tamplin, M. (2004). ComBase: A Common Database on Microbial Responses to Food Environments. *Journal of Food Protection*, *67* (9), 1967-71

Byrne, L., Fisher, I., Peters, T., Mather, A, Thomson, N., & Rosner, B. (2014). A multi-country outbreak of *Salmonella* Newport gastroenteritis in Europe associated with watermelon from Brazil confirmed by whole genome sequencing: October 2011 to January 2012. *Eurosurveillance*, *19*(31),

Fang, T., Liu, Y., & Huang, L. (2013). Growth kinetics of *Listeria monocytogenes* and spoilage microorganisms in fresh-cut cantaloupe. *Food Microbiology*, *34*, 174-181

Foodborne illness outbreak database. (2011a). *Agromod produce papayas 2011*. Retrieved 21 October 2014 from website: http://outbreakdatabase.com/details/agromod-produce-papayas-2011/?vehicle=papaya

Foodborne illness outbreak database. (2011b). *Del Monte fresh produce cantaloupe 2011*. Retrieved 21 October 2014 from website: http://outbreakdatabase.com/details/jensen-farms-rocky-ford-cantaloupe-2011/?vehicle=cantaloupe

Foodborne illness outbreak database. (2012). *Multistate outbreak of Salmonella linked to cantaloupe July 2012*. Retrieved 21 October 2014 from website: http://outbreakdatabase.com/details/multistate-outbreak-of-salmonella-linked-to-cantaloupe-july-2012/?vehicle=cantaloupe

Gibbs, R., Pingault, N., Mazzucchelli, T., O'Reilly L, MacKensie, B., & Green, J., et al. (2009). An outbreak of *Salmonella* enterica serotype Litchfield infection in Australia linked to consumption of contaminated papaya. *Journal of Food Protection, 72*5), 1094-8

McCollum, J.T, Cronquist, A.B., Silk, B.J., Jackson, K.A., O'Connor, K.A., & Cosgrove, S., et al. (2013). Multistate outbreak of Listeriosis Associates with Cantaloupe. *New England Journal of Medicine*, 369 (10) 944-953

Munnoch, S.A., Ward, K., Sheridan, S., Fitzsimmons, G.J., Shadbolt, C.T., & Piispanen, J.P. et al. (2009). A multi-state outbreak of *Salmonella* Saintpaul in Australia associated with cantaloupe consumption. *Epidemiology and Infection*, 137(3), 367-374.

NSW Food Authority. (2009). *Microbiological quality guide for ready-to-eat foods*. Retrieved 4 March 2016 from website:http://www.foodauthority.nsw.gov.au/_Documents/scienceandtechnical/microbiological_quality_guide_for_RTE_food.pdf

NSW Food Authority. (2016). *Salmonella linked to NT rockmelon grower*. Retrieved from NSW Food Authority website: http://www.foodauthority.nsw.gov.au/news/newsandmedia/departmental/2016-08-03-salmonella-nt-rockmelon-grower

OzFoodNet. (2009). OzFoodNet quarterly report, 1 July to 30 September 2009. *Communicable Diseases Intelligence. 33*(4), 426-432

OzFoodNet. (2012). Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2010. *Communicable Diseases Intelligence*, *36*(3), 213-231

Ross, T. (1999), *Predictive Microbiology Models in the Meat Industry*, MLA.

Appendix 1

Year	State/ country	Product	Organism	Cases (hospitalised)	References
2006	Australia (multistate)	Rockmelon	*Salmonella.* Saintpaul	36	Munnock et al, 2009
2006/07	Australia QLD & WA	Cut Papaya (washed in untreated water)	*S.* Litchfield	11 (3)	Gibbs et al, 2009
2009	Australia WA	Pawpaw/papaya	*S.* Saintpaul	17 (3)	OzFoodNet, 2009
2010	Australia (multistate)	Rockmelon and Honeydew melon	*L. monocytogenes*	9(8) 2 deaths	OzFood Net, 2012
2016	Australia (multistate)	Rockmelon	S. Hvittingfoss	86	NSW Food Authority, 2016
2011	USA	Papaya	*S.* Agona	106 (10) 15% of papaya entering from Mexico were contaminated with *Salmonella*	Foodborne illness outbreak database, 2011a
2011	USA	Cantaloupe	*L. monocytogenes*	147 (143) 33 deaths	McCollum et al, 2013
2011	USA	Cantaloupe	*S.* Panama	20	Foodborne illness outbreak database, 2011b
2012	Europe	Watermelon (imported from Brazil, packs of sliced watermelons)	*Salmonella*	50 1 death	Byrne et al, 2014
2012	USA	Cantaloupe	*S.* Typhimurium	261 (94)	Foodborne illness outbreak database, 2012

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