Appendix IV. 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 V. Food safety risks and their managment during watermelon harvesting

Watermelons are grown in close proximity to the ground, hand picked, cleaned/wiped with cloths and then packed in bulk bins for the market. Along this process, watermelons encounter a multitude of microbial contamination risks., Many of these risks come from the direct contact of fruit with ground, contact surfaces and workers which can lead to the transfer of harmful pathogens.

1. Ground contact

- Use plastic mulch to minimise contact between ground and fruit
- Reduce microbial contamination risk of soil through amendments and water
- Prevent wild/domestic animals from entering the growing site
- Don't harvest melons immediately after rainfall.

2. Human Contact

- Workers practice personal hygiene including hand washing with soap and using clean gloves and knives
- Provision of workers facilities at harvest site is critical.

3. Conveyor belts

- Clean and sanitise conveyor belts and other contact surfaces of harvesting machinery after use.
- Follow cleaning and sanitisation recommendations in **NSW DPI Melon Food Safety Toolbox 2019**

4. Wiping and cleaning material

- Use single use wiping material such as Chux Wipes to ensure material used does not become a direct source of contamination
- Avoid using wet wiping material and replacing for dry cloths to reduce spread of any bacteria picked up in the cleaning process

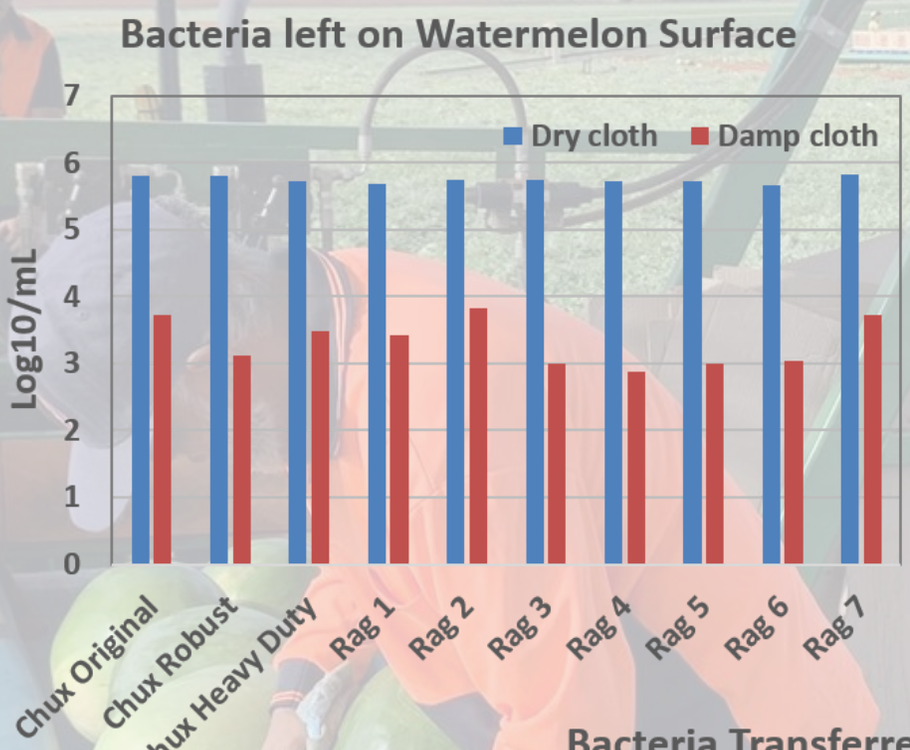
5. Grading and packing

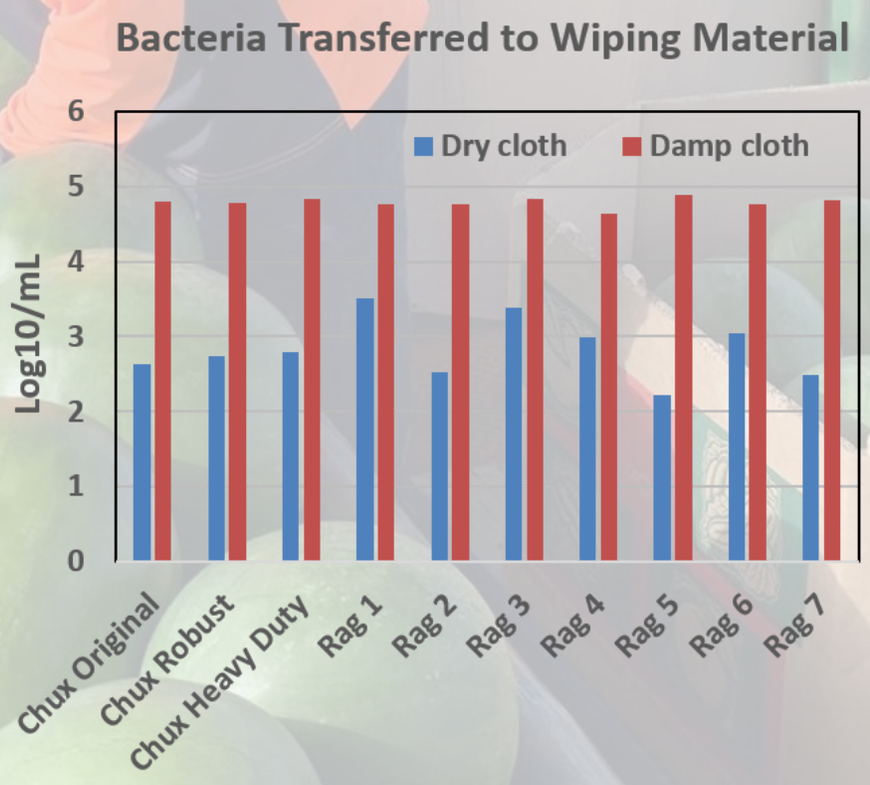
- Damaged and bruised fruit should be culled and removed from field.
- Packing material should be safely stored to prevent being contaminated
- Ensure that depths of stacked watermelons does not exceed 1 m
- Ensure to stack watermelons to the side rather than on their end to reduce risk of cracking

Appendix VI. Role of Cleaning/Wiping Material in (Cross) Contamination of Watermelon during Field Harvest

To simulate the role of pathogen spread from a contaminated fruit with a clean wiping cloth, watermelon fruit surfaces were inoculated with a culture of *Salmonella* species. These were then wiped with different wiping materials either wet or dry. We found that:

- The type of fabric of the wiping material did not influence the pathogen transfer
- Damp cloth was more effective in removing the inoculated pathogen from the fruit surface
- However dry wiping material was more effective in minimising the cross-contamination.



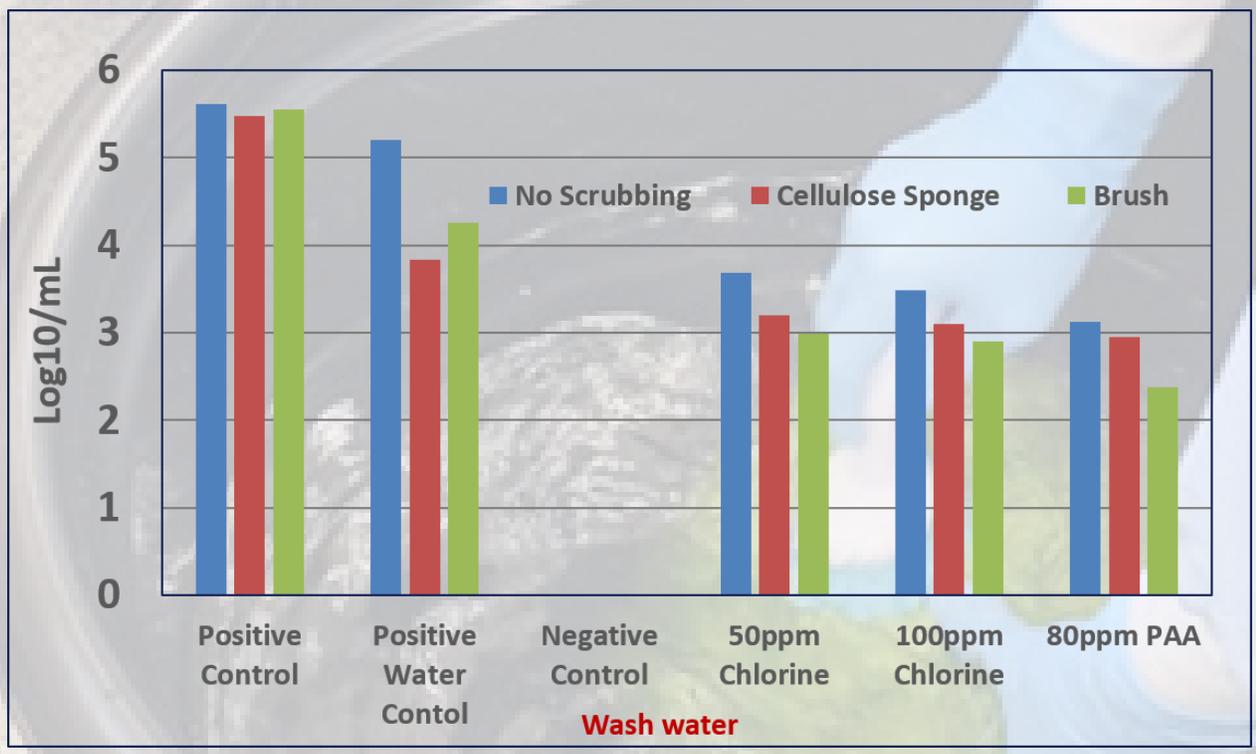


Appendix VII. Role of washing, brushing and sanitising in food safety of watermelons

Washing and brushing is currently not an industry practice in Australia.To demonstrate the importance of this practice to both growers and cut melon retailers, watermelon fruit surface was inoculated with a culture of *Salmonella* and were subjected to washing (and/brushing-scrubbing) with water containing no sanitiser, 50 or 100 ppm of chlorine and 80 ppm of peracetic acid.

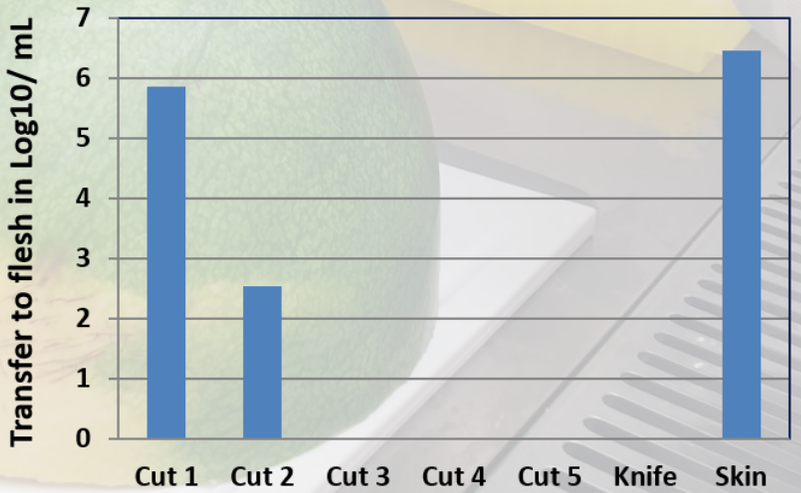
We found that:

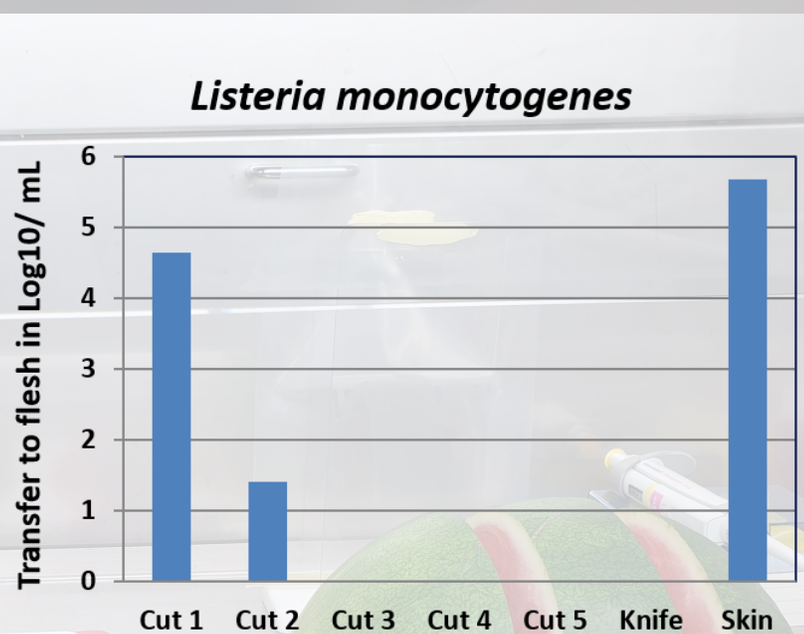
- Washing fruit with water containing a sanitiser was more effective in reducing the bacterial load.
- Brushing or scrubbing the fruit surface during washing further enhanced the efficacy of washing process.



Appendix VIII. Potential of pathogen transfer from cutting equipment to cut melons

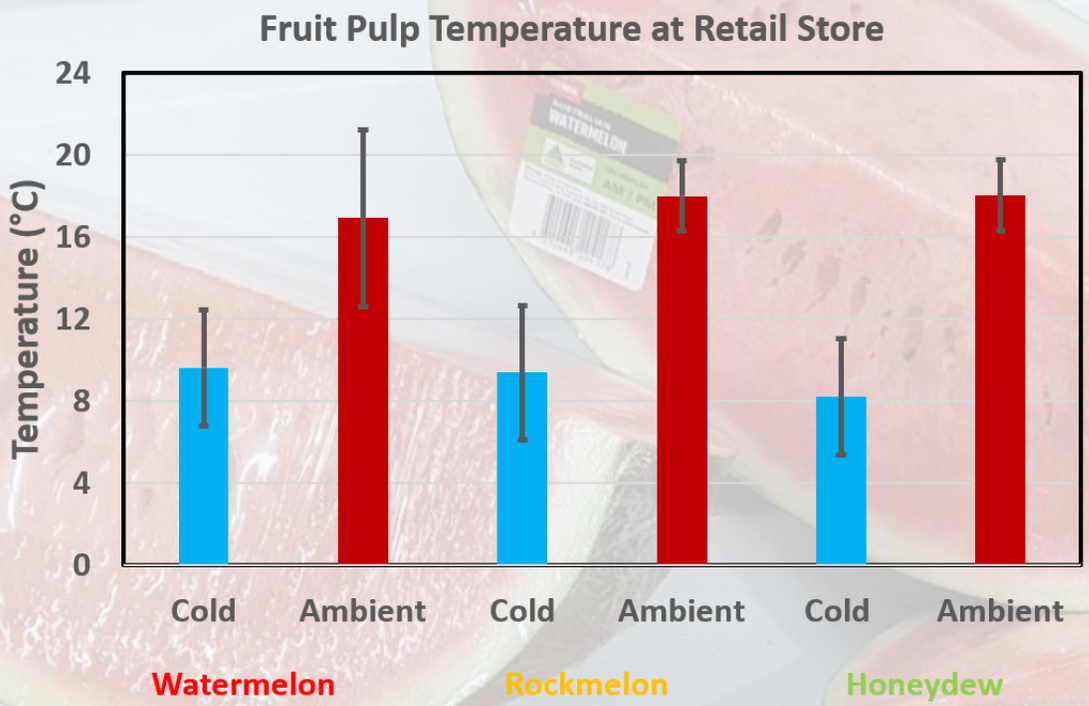
Watermelons are generally retailed bu cutting into halves or quarters which is done at the retail stores premises. The cutting equipment such as knives have potential for transferring pathogens from the skin into the flesh and to subsequent fruits. We demonstrated that foodborne bacteria such as *Salmonella* and *Listeria monocytogenes* can be transferred from the skin into the flesh through cutting. A contaminated knife can transfer the pathogens to subsequent cut fruit as shown in the data below:



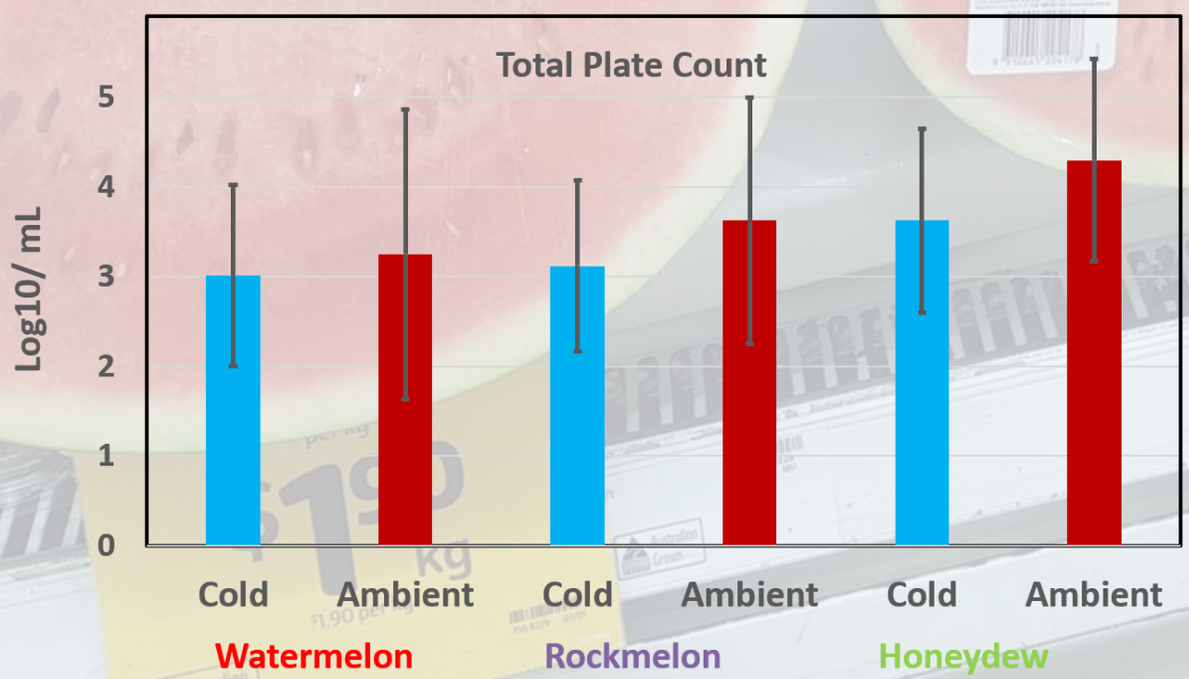


Appendix IX. A snapshot of current retail conditions of cut melons

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:

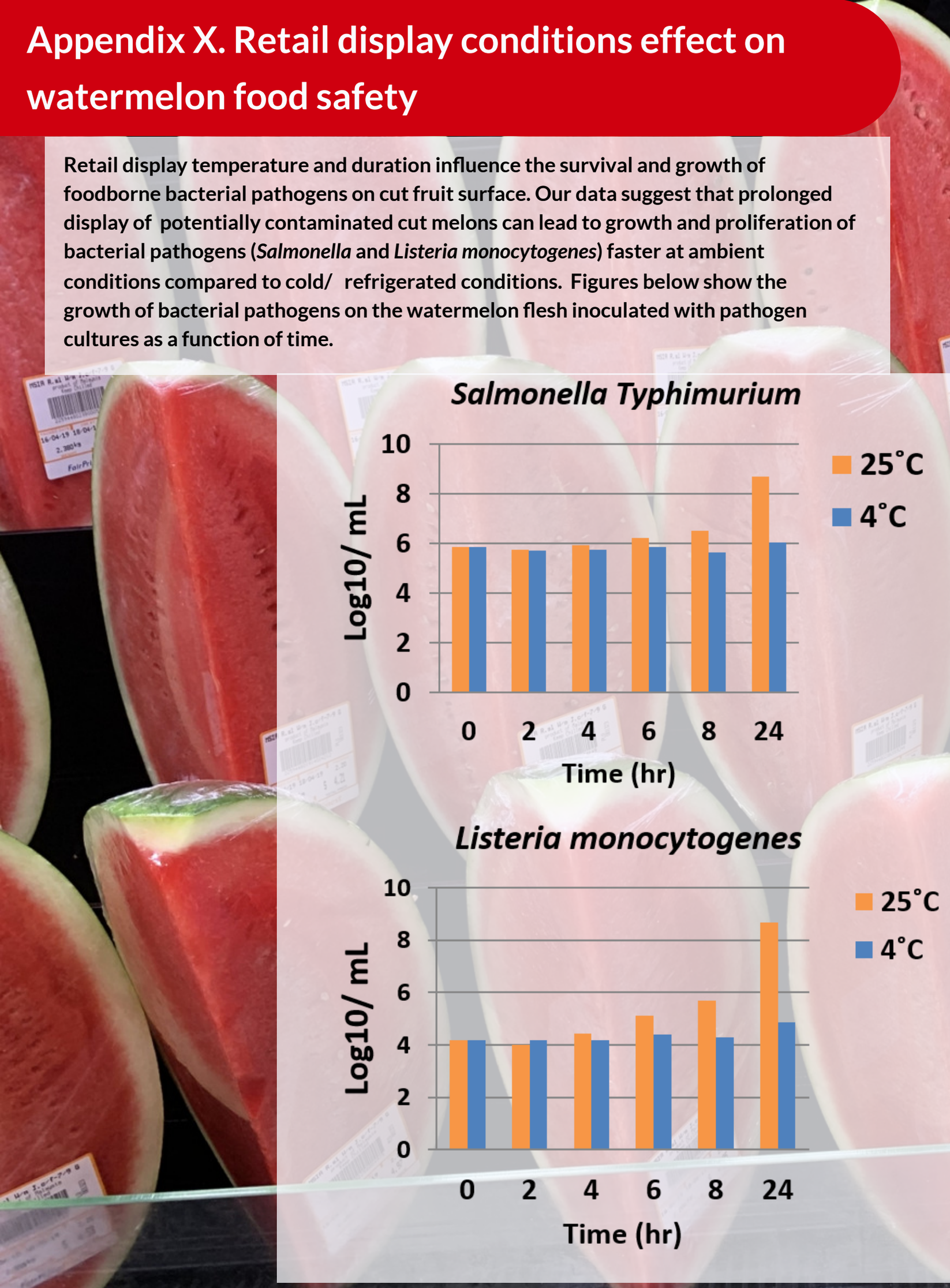


Higher total plate counts have been observed in samples collected from ambient display in retail stores as shown in the figure below:

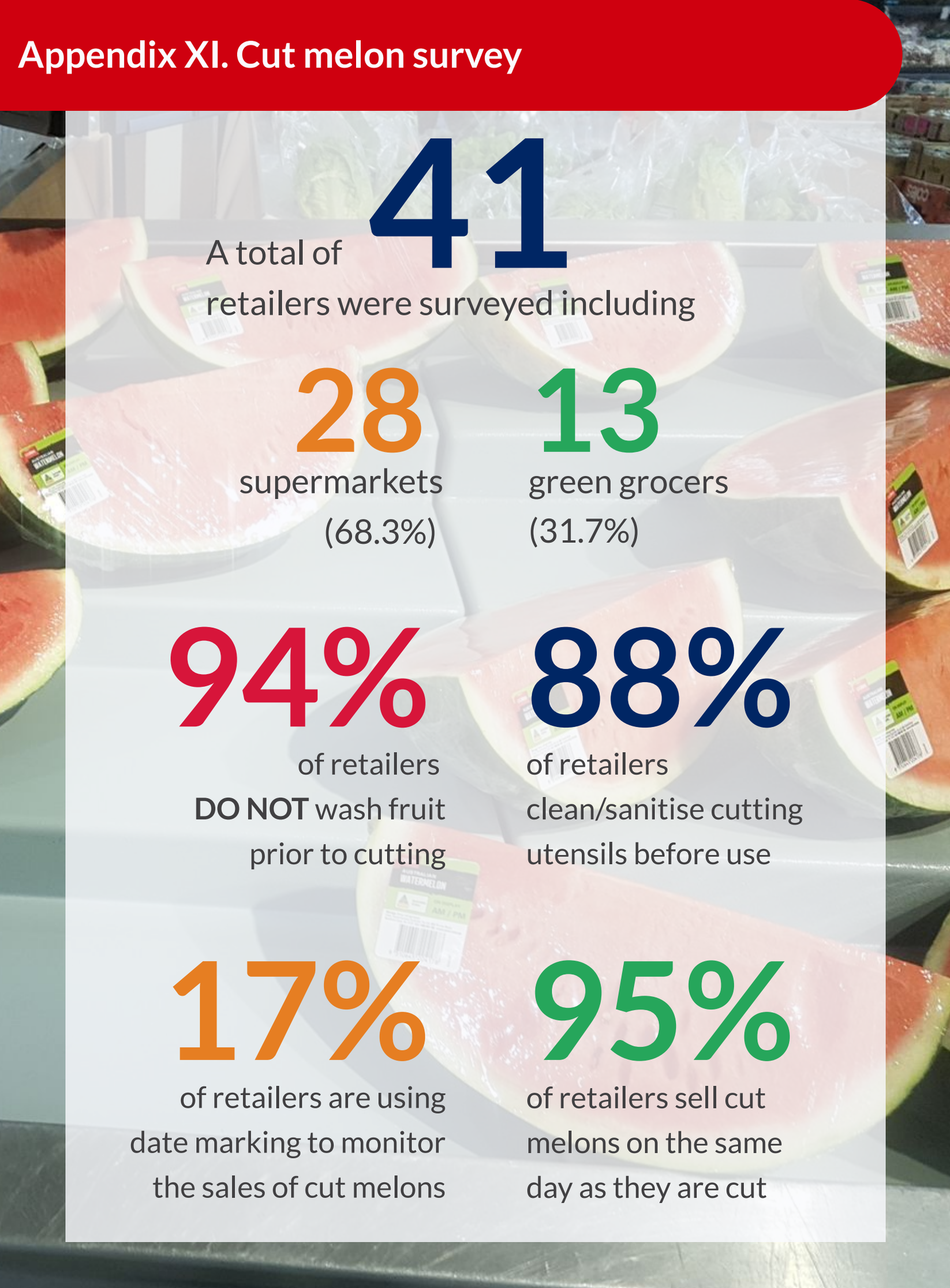


Appendix X. Retail display conditions effect on watermelon food safety

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 XI. Cut melon survey



A total of **41** retailers were surveyed including

28 supermarkets (68.3%)

13 green grocers (31.7%)

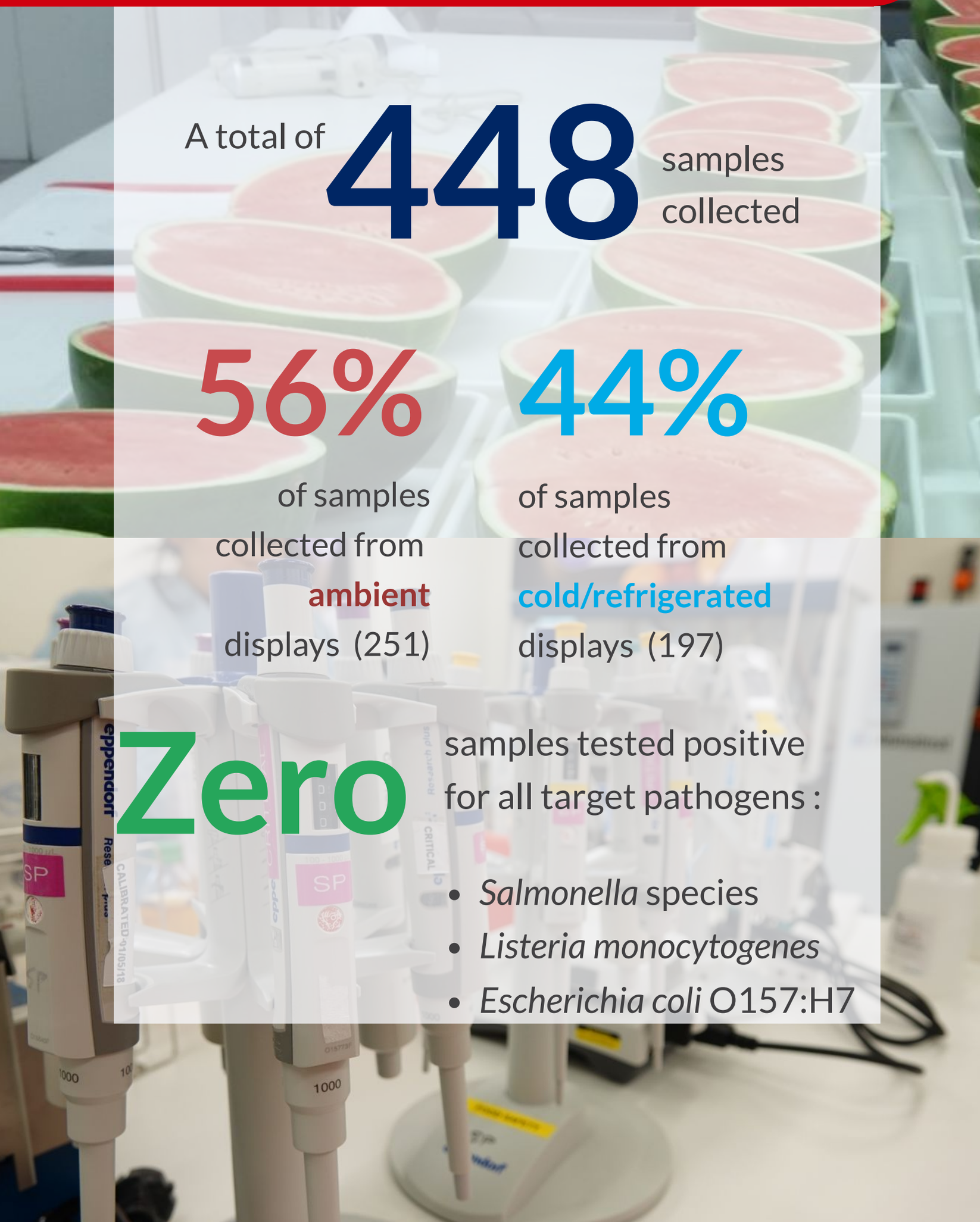
94% of retailers **DO NOT** wash fruit prior to cutting

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 XII. 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