Dairy Food Safety Victoria

Product Surveillance Program report

2016–2017

Contents

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Executive summary

The Dairy Food Safety Victoria (DFSV) Product Surveillance Program (the program) evaluates the microbiological and physicochemical status of dairy food products manufactured in Victoria. The data enables assessment of compliance with the Australia New Zealand Food Standards Code (the Code), provides verification of the effectiveness of the industry's food safety systems and supplies valuable data for determining the ability of various products to support the growth of pathogens.

Depending on the assigned sampling plan, products were tested for hygiene indicators (coliforms and *E. coli*), pathogens (coagulase-positive staphylococci, Salmonella and Listeria) and physicochemical properties (pH, water activity, moisture, salt concentration and lactic acid concentration). A total of 3131 samples were tested across 656 batches of dairy foods collected from 149 manufacturers.

The results demonstrated good compliance with the Code. Only five of the 656 batches (0.76%) did not comply with the relevant criteria in Schedule 27 of Standard 1.6.1. No Salmonella or Listeria species were detected in any sample and coagulase-positive staphylococci were detected in only two samples and not at levels of concern.

Smear-ripened cheese, surface-ripened cheese and ice cream were the categories with the highest incidence of coliform detections. The presence of coliforms in high numbers may indicate potential failures in hygiene or process control. Coliforms were detected at high levels (>100 MPN/g) in a high proportion of smear and surface-ripened cheese batches (42.9% and 26.3% respectively), suggesting that process control in these types of products may require attention. For all other product categories, the results suggest that hygiene is generally well controlled.

E. coli were detected in a high proportion of cream cheese dips, smear-ripened cheese and surface-ripened cheeses. Surface-ripened cheese, fermented milk products, semi-soft cheese, and fresh cheese showed a high incidence of *E. coli* at elevated levels (>10 MPN/g). Where high levels of *E. coli* were observed, follow up action was undertaken by the relevant DFSV Food Safety Manager to address any potential risk to consumers.

The water activity, pH, moisture content, salt and lactic acid concentration of dairy products considered higher risk in terms of food safety were also measured. This data is used to assess the risk of pathogen growth in different types of dairy products and to better inform predictive modelling and technical support activities by DFSV.

Background

The program is an annual survey of the microbiological and physicochemical status of dairy foods produced by licensed dairy manufacturers in Victoria. Product testing is coordinated by DFSV and is additional to manufacturers' normal in-house testing as detailed in their food safety programs.

This is the second year of an expanded program designed to align with the guideline *Microbiological testing criteria – minimum testing requirements for manufacturers of dairy food products* (2015) and to reflect the sampling requirements of Standard 1.6.1 (Schedule 27) of the Code.

The data supports other compliance monitoring activities conducted by DFSV and provides additional verification of the food safety systems of both individual dairy manufacturers and the Victorian dairy industry. Analysis of the data provides DFSV with an enhanced understanding of food safety risk across the industry at product and manufacturer level and informs technical support activities.

Methods

Microbiological testing

Dairy products were assigned to one of 14 categories based on product characteristics and further allocated to a targeted or baseline testing plan. This determined the sampling frequency and testing requirements. A summary of the product categories and tests applied to each are listed in Appendix 1. Samples were collected twice per year during the scheduled DFSV audit. Samples were collected from two batches of product from each targeted category, and from one batch from the baseline categories at each audit.

Five samples per batch were collected and tested for coliforms, *E. coli* and where required, coagulase-positive staphylococci. Where relevant, the five samples were composited for analysis for Salmonella and Listeria species (25g per sample). This sampling plan enabled products to be assessed for compliance with Schedule 27 of the Code.

All testing was undertaken at a commercial testing laboratory according to Australian standard methods (AS 5013 series). Coliforms and *E. coli* were tested using the most probable number (MPN) technique while coagulase-positive staphylococci and standard plate count were tested by the colony-count technique.

Physicochemical testing

One sample per batch of products within the targeted program was also tested for relevant physicochemical parameters (see Appendix 1).

Results and discussion

In 2016–2017, 3131 samples from 656 batches collected from 149 different licensees were analysed. A summary of the number of samples and batches tested in each product category and the number of dairy manufacturer licensees submitting products in each category are provided in Appendix 2.

Microbiological testing

Hygiene indicators – Coliforms

Coliforms are a group of closely related, predominantly harmless, lactose fermenting bacteria that inhabit soil and water. They do not necessarily indicate the presence of pathogens but are a useful measure of hygiene control in food manufacturing premises. High levels may suggest a failure of process control and highlight where improvements to good manufacturing practice (GMP) and good hygienic practice (GHP) may be required.

The incidence of coliform detections in each product category are in Table 1. Results are expressed as the percentage of batches in which coliforms were detected and the number of batches in which coliforms were detected out of the total number of batches tested.

	Percentage of batches with coliform detections (number batches positive / total number of batches tested)		**Percentage of batches in which coliforms were detected at greater than 10 MPN/g** (number of batches positive/total number of batches tested)		**Percentage of batches in which coliforms were detected at greater than 100 MPN/g** (number of batches/total number of batches tested)	
Smear-ripened cheeses	61.9%	(13/21)	47.6%	(10/21)	42.9%	(9/21)
Ice cream	41.8%	(23/55)	29.1%	(16/55)	5.5%	(3/55)
Surface-ripened cheese	38.6%	(22/57)	31.6%	(18/57)	26.3%	(15/57)
Semi-soft cheese	27.5%	(22/80)	16.3%	(13/80)	6.3%	(5/80)
Fresh cheese	25.5%	(24/94)	13.8%	(13/94)	6.4%	(6/94)
Hard cheese	20.0%	(8/40)	12.5%	(5/40)	7.5%	(3/40)
Spreads	19.2%	(5/26)	3.8%	(1/26)	3.8%	(1/26)
Dairy desserts	15.0%	(3/20)	10.0%	(2/20)	5.0%	(1/20)
Shredded, grated, cut cheese	14.5%	(12/83)	6.0%	(5/83)	2.4%	(2/83)
Yoghurt-based dips	14.3%	(2/14)	7.1%	(1/14)	7.1%	(1/14)
Cream cheese-based dips	14.3%	(2/14)	0.0%	(0/14)	0.0%	(0/14)
Fermented milk products	14.1%	(11/78)	10.3%	(8/78)	6.4%	(5/78)
Liquid cream	11.5%	(3/26)	7.7%	(2/26)	7.7%	(2/26)
Liquid milk	4.2%	(2/48)	2.1%	(1/48)	0.0%	(0/48)

Table 1: Percentage of batches sampled within each product category that were positive for coliforms.

The major cheese categories (particularly smear-ripened and surface-ripened), as well as ice cream, are most frequently contaminated with coliforms. The production of many cheese types involves extensive post-pasteurisation handling and environmental exposure, providing numerous opportunities for contamination. This is especially so for smear-ripened and surface-ripened cheeses and may explain the very high incidence of coliforms in these products. Additionally, cultures used in the production of some surface and smear-ripened cheeses may contain organisms which ferment lactose and produce gas and hence may return positive results in coliform tests. Products in which such cultures are used, may be expected to exhibit high coliform counts but this would not necessarily indicate a breakdown in hygiene control. It is important to differentiate between these two situations, and the use of *E. coli* as a hygiene indicator in these products may be more appropriate.

The high proportion of surface-ripened cheese batches (26.3%) with coliforms present at levels greater than 100 MPN/g is consistent with results from the 2015–2016 year when coliforms were observed at both a high incidence and at high levels in surface-ripened cheese (smear-ripened cheese was not a category in the 2015–2016 program.

Results and discussion

A relatively low proportion of coliform detections were observed in cut, grated and shredded cheese, which is somewhat surprising given the additional processing and/or handling of these products. This result indicates good management of hygiene by manufacturers of cut, grated and shredded cheese.

A high incidence of coliforms was observed in ice cream, with detections in 41.8% of batches. However, coliforms were much less commonly present in higher numbers, only 5.5% of batches were at levels greater than 100 MPN/g. This pattern of high incidence but low levels of coliforms in ice cream has been observed repeatedly during previous years of the program.

For categories other than smear–ripened and surface–ripened cheese, coliforms were detected in a very low proportion of batches (<10%) at high levels (greater than 100 MPN/g).

To assess whether post-pasteurisation inclusions may be responsible for the high coliform counts, the incidence of coliforms in products with and without inclusions was compared. Ice cream without inclusions had a consistently higher incidence of coliforms compared to those with inclusions, suggesting coliforms are not related to the presence of inclusions (Table 2).

Coliforms were more frequently detected in fermented milk products with inclusions compared to those without inclusions. In these products it is likely that inclusions may, at least in part, be a cause of coliform contamination. Dairy desserts showed a similar pattern, although there was a very low sample number (Table 2).

	Coliform detections		Coliform detections at >10 MPN/g		Coliform detections at >100 MPN/g	
Ice cream with inclusions	35%	(7/20)	25.0%	(5/20)	5.0%	(1/20)
Ice cream without inclusions	46.9%	(15/32)	31.3%	(10/32)	6.3%	(2/32)
Fermented milk products with inclusions	18.2%	(4/22)	13.6%	(3/22)	9.1%	(2/22)
Fermented milk products without inclusions	12.5%	(7/56)	8.9%	(5/56)	5.4%	(3/56)
Dairy desserts with inclusions	33.3%	(2/6)	16.7%	(1/6)	0.0%	(0/6)
Dairy desserts without inclusions	7.1%	(1/14)	7.1%	(1/14)	7.1%	(1/14)

Table 2: Number of batches in which coliforms were detected at >0 MPN/g, >10 MPN/g and >100 MPN/g, the number of batches tested and percentage of batches detected in ice cream, fermented milk products and dairy desserts with and without inclusions.

Hygiene indicators – *E. Coli*

While coliforms are a well-established and useful indicator of hygiene, *E. coli* are a more specific indicator of potential enteric contamination. Testing for *E. coli* assesses the potential for pathogens to be present in dairy products and is evidence of failures in process control. Its detection, especially in high numbers, should trigger urgent corrective action.

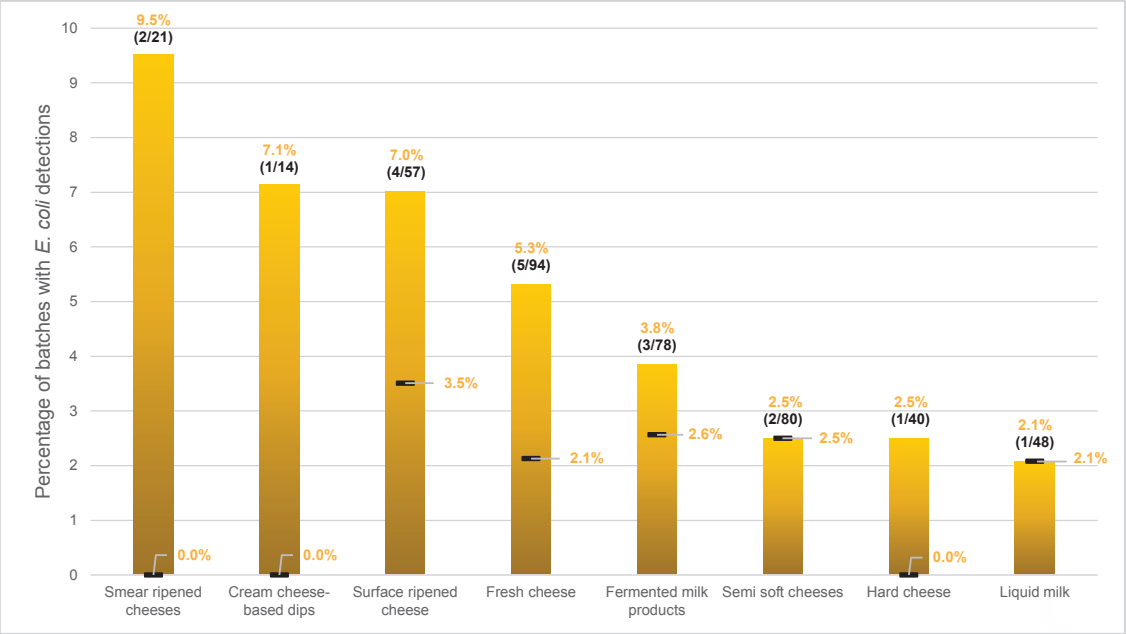

Figure 1: Proportion of batches in which *E. coli* were detected, and in which *E. coli* were detected at levels of greater than 10 MPN/g (black line). Data labels indicate the percentage of batches with coliform detections and number of batches in which *E. coli* were detected out of the total number of batches tested.

E. coli were detected in 19 of 656 (2.9%) batches tested, and at levels greater than 10 MPN/g in nine out of 656 batches (1.4%). *E. coli* were present in four out of 57 batches (7%) of surface-ripened cheese and five out of 94 batches (5.3%) of fresh cheese. In these two categories there was also a tendency for *E. coli* to be present in higher numbers with 3.5% and 2.1% of batches greater than 10 MPN/g and 3.5% and 1.1% of surface-ripened and fresh cheese batches higher than 100 MPN/g. This suggests that surface-ripened cheese and fresh cheese have a higher potential for contamination with enteric pathogens compared to other categories and may be especially prone to failures in process control. Manufacturers of these products need to be particularly diligent with GHP and GMP.

While smear-ripened cheese and cream cheese-based dips showed the highest proportion of batches with *E. coli* detections, these figures are based on a small sample size and relate to only two batches of smear-ripened cheese and one batch of cream cheese dip. Additionally, *E. coli* was not present at greater than 10 MPN/g in either of these categories. In the case of smear-ripened cheese, *E. coli* was detected in only one of the five samples in the batch at 2 MPN/g. This suggests that while these categories are generally well controlled, there may have been intermittent hygiene issues in a small number of batches resulting in low level *E. coli* contamination.

The lower incidence of *E. coli* in fermented milk, semi-soft cheese, hard cheese and liquid milk suggests that the process for the manufacture of these types of dairy product is generally well controlled but susceptible to occasional lapses resulting in the presence of *E. coli*.

E. coli was not detected in dairy desserts (20 batches tested), ice cream (55 batches), liquid cream (26 batches), shredded, grated and cut cheese (83 batches), spreads (26 batches), or yoghurt-based dips (14 batches). This suggests that hygiene is well controlled for these categories. While coliforms were present in a very high proportion of ice cream samples, *E. coli* were not detected.

E. coli did not appear to be associated with the presence of inclusions, and were only detected in fermented products without inclusions.

Results and discussion

Site analysis – coliforms

The proportion of manufacturing sites with coliform detections in each product category was analysed to determine whether contamination was limited to a small number of sites or if it was common across many sites. A high percentage of sites with high coliform counts could suggest that the observed detections in a particular category may be related to the process for making these types of products, rather than due to a small number of sites with poorly managed hygiene or process control failures.

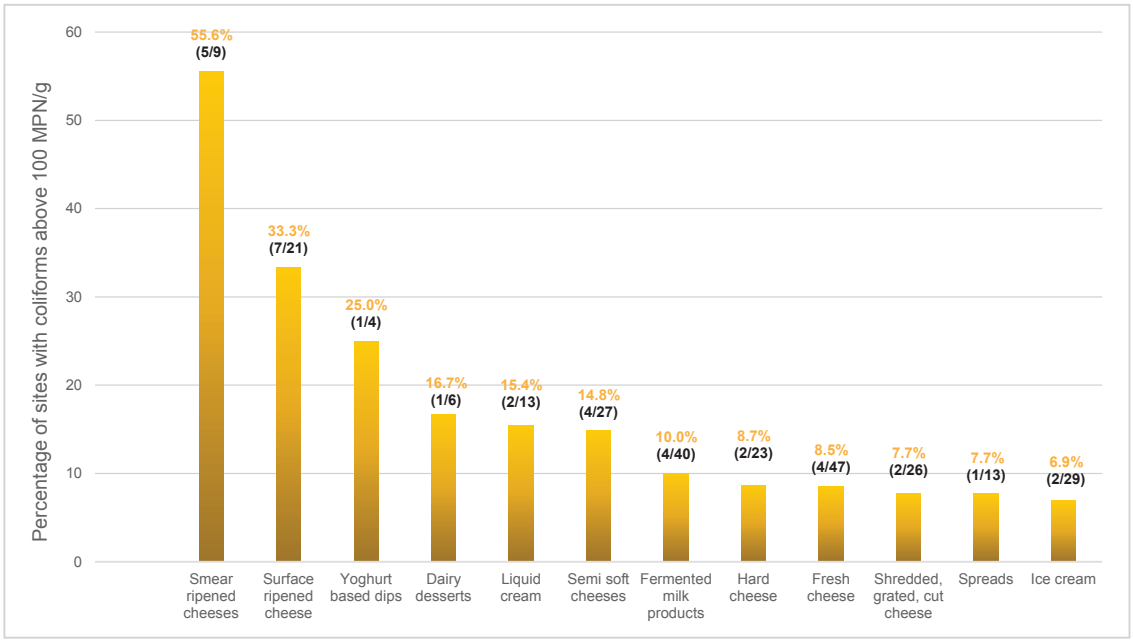

Figure 2: The proportion of sites for each product category in which coliforms were detected at greater than 100 MPN/g. Data labels indicate percentage of sites with coliform detections >100 MPN/g and the number of sites with coliform detections at >100 MPN/g / total number of sites submitting samples in that category.

Almost 56% of smear-ripened cheese manufacturers and 33.3% of surface-ripened cheese manufacturers had at least one batch of product with coliforms present at >100 MPN/g. The observation that a large proportion of these manufacturers are experiencing high coliform results suggests that the production methods for these types of cheese pose a higher risk of contamination with hygiene indicators compared to other product categories. This is not surprising as these types of cheese are subjected to extensive handling and environmental exposure during manufacturing and ripening, providing many opportunities for contamination. As already mentioned, the use of secondary starter cultures may return a positive coliform result and hence may be a contributing factor in the high number of manufacturers experiencing high coliform counts for these products.

Coliforms were present at greater than 100 MPN/g in 25% of sites making yoghurt-based dips, however this represented only one of the four dip manufacturing sites, making it a large proportion of the total. It does not necessarily suggest that the yoghurt-based dip category is more susceptible to coliform contamination than other categories.

For other product categories, the low percentage of sites with coliform detections greater than 100 MPN/g may be due to breakdowns in hygiene control at these sites rather than the manufacturing process itself. Coliforms greater than 100 MPN/ml or g were not detected in liquid milk (27 batches) and cream cheese-based dips (4 batches).

Site analysis – E. Coli

The proportion of sites in which *E. coli* was detected at levels greater than 10 MPN/g are provided in Figure 3. Surface-ripened cheese had the largest proportion of sites with *E. coli* detections greater than 10 MPN/g, again suggesting that the process for this product results in higher levels of contamination compared to other products.

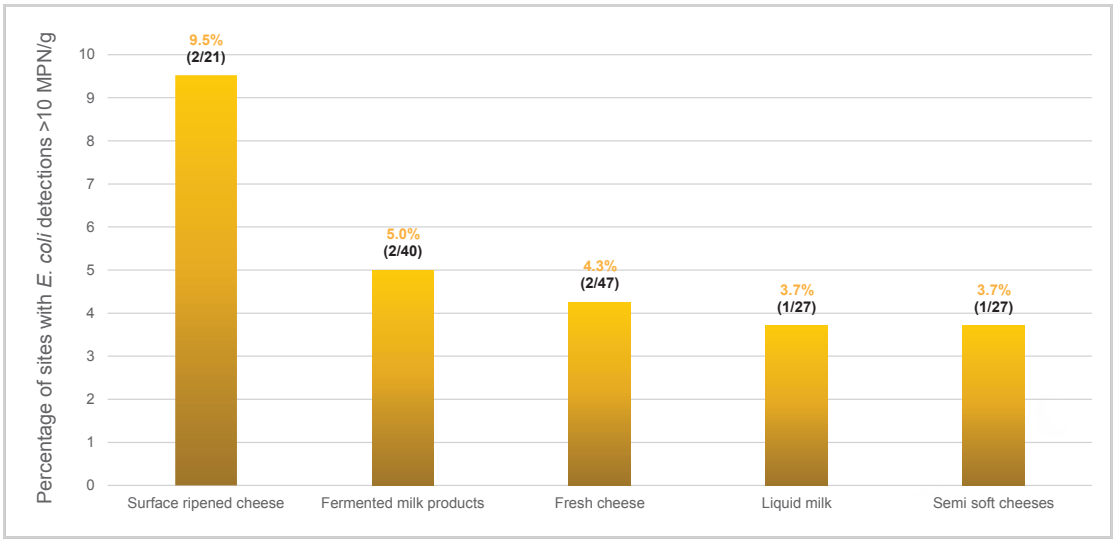

Figure 3: The proportion of sites for each product category in which *E. coli* were detected at greater than 10 MPN/g. Data labels indicate percentage of sites with *E. coli* detections >10 MPN/g and the number of sites with *E. coli* detections at >10 MPN/g/total number of sites submitting samples in each category.

The results indicate that for other product categories, *E. coli* are well controlled in the majority of sites. There were no detections of *E. coli* above 10 MPN/g in smear-ripened cheeses (9 batches), cream cheese-based dips (4 batches), hard cheese (23 batches), dairy desserts (6 batches), ice cream (29 batches), liquid cream (13 batches), shredded, grated and cut cheese (26 batches), spreads (13 batches), or yoghurt-based dips (4 batches).

Total plate count

Total plate count is a measure of the number of total viable organisms in a food sample and provides a gauge of the level of post-pasteurisation contamination. Five product categories were tested for total plate counts and the average log counts for these products are given in Figure 4. These results do not suggest that post-pasteurisation contamination is occurring in these products at levels of concern. *The Compendium of Microbiological Criteria for Food* (FSANZ, 2016) cites total counts less than 10^3 cfu/g (log 3 cfu/g) as satisfactory. Average counts for all product categories were under this threshold.

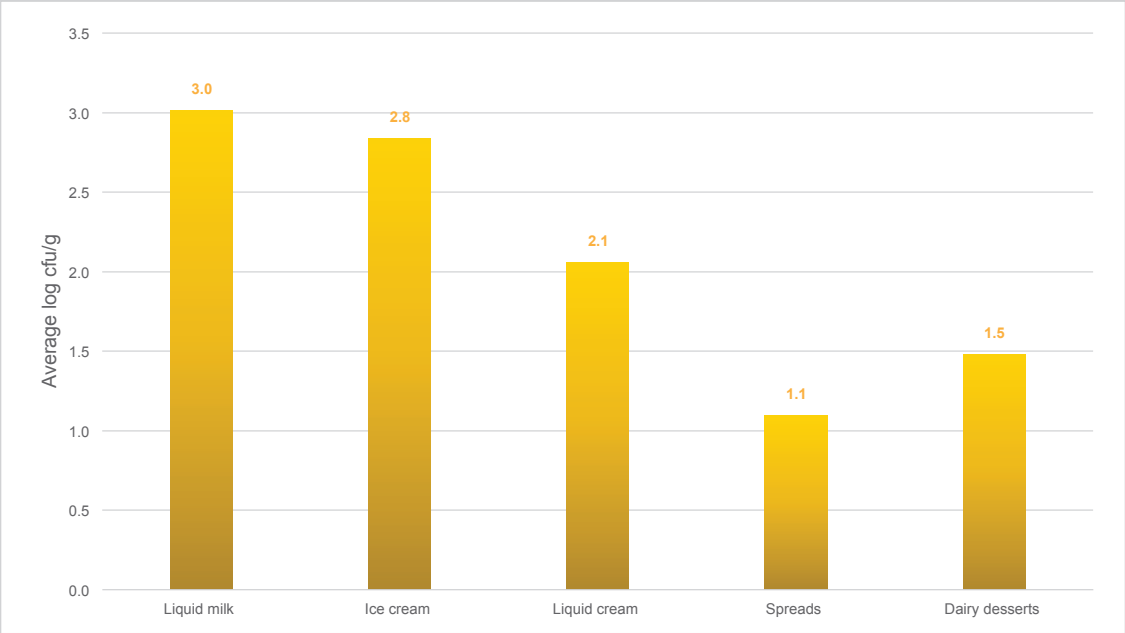

Figure 4: Total plate count results (average log cfu/g) for relevant product categories during the 2016–2017 testing year.

Factory size analysis – coliforms

Manufacturing sites were categorised according to the volume of product they make to analyse the relationship between production volume and the incidence of coliforms and *E. coli*. The criteria for allocating manufacturers to size categories are specified in Appendix 4. The incidence of coliforms at high levels (>100 MPN/g) for sites that manufacture cheese are presented in Figure 5 and other product categories in Figure 6.

For cheese, there was a general tendency for smaller manufacturers, particularly the 'micro' category to have a higher incidence of coliforms at high levels. This was particularly so for smear-ripened and surface-ripened cheese. For product categories other than cheese, small and medium sites tended to have a higher proportion of batches with high coliform counts. With the exception of liquid cream, coliforms were not detected at levels greater than 100 MPN/g in any sites classified as large. These observations are consistent with the notion that large sites generally tend to have more automated processes and greater resources in terms of hygiene, sanitation and technical expertise. Products more susceptible to contamination due to processing methods involving a large amount of handling and environmental exposure also tend to be produced at smaller sites.

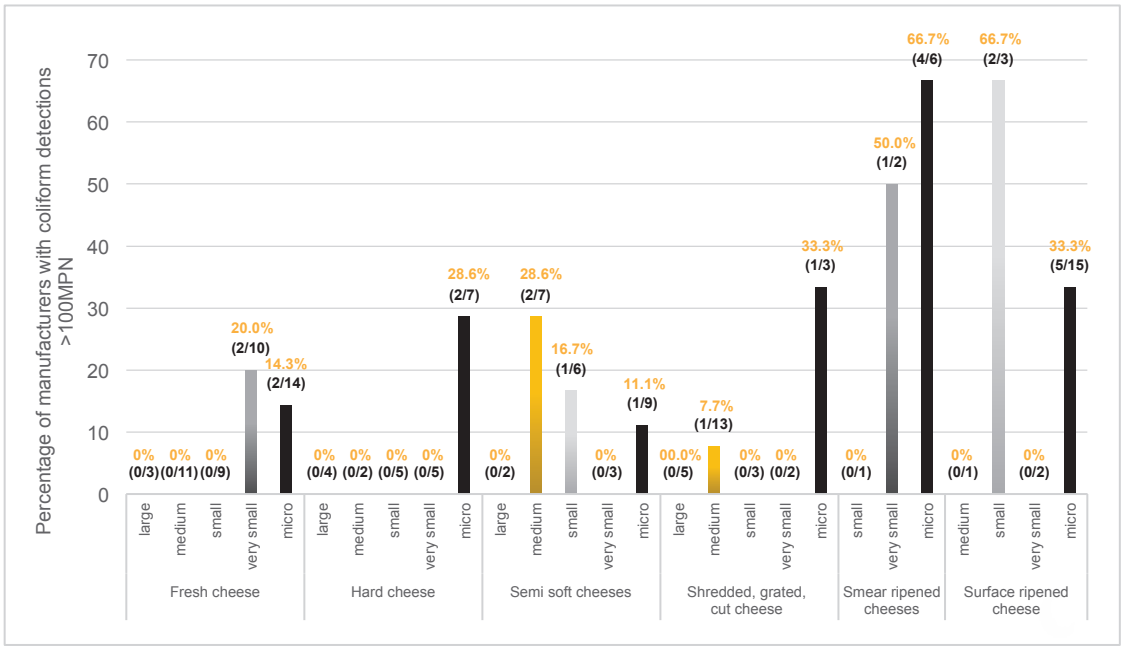

Figure 5: The percentage of coliform detections in cheese manufacturer sites classified as large, medium, small, very small and micro (classification criteria are provided in Appendix 4). Data labels indicate the percentage of sites with coliform detections >100 MPN/g and the number of sites with coliform detections at >100 MPN/g/total number of sites participating.

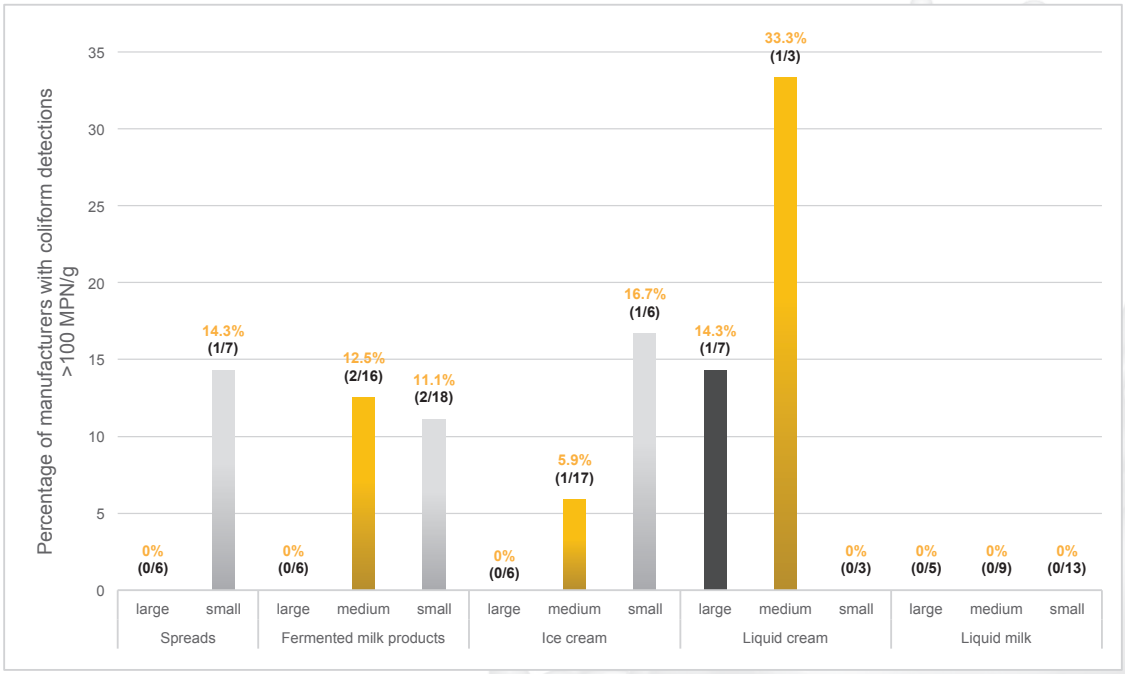

Figure 6: The proportion of coliform detections in dairy manufacturer sites classified as small, medium and large. Data labels indicate the percentage of sites with coliform detections >100 MPN/g and the number of sites with coliform detections at >100 MPN/g/total number of sites participating.

Results and discussion

Factory size analysis – *E. coli*

E. coli were only detected at levels greater than 10 MPN/g in five categories. The proportion of sites in each category with detections at this level is shown in Figure 7. As seen with coliforms, the smallest sites tended towards a high incidence of *E. coli* in surface-ripened cheese and milk categories. However, for semi-soft cheese and fermented milk products, medium sized sites showed the highest incidences of *E. coli*. *E. coli* were detected in two fresh cheese samples, one in a medium and one in a small site.

The trends seen for both coliforms and *E. coli* in sites of different sizes should be considered in context of the small number of sites and detections in each category. Coliforms and *E. coli* were detected in only one or two sites within each category, making it difficult to draw significant conclusions. However, the observation of smaller sites tending towards a higher proportion of coliform and *E. coli* detections seen during the 2015–2016 surveillance program does reinforce this observation.

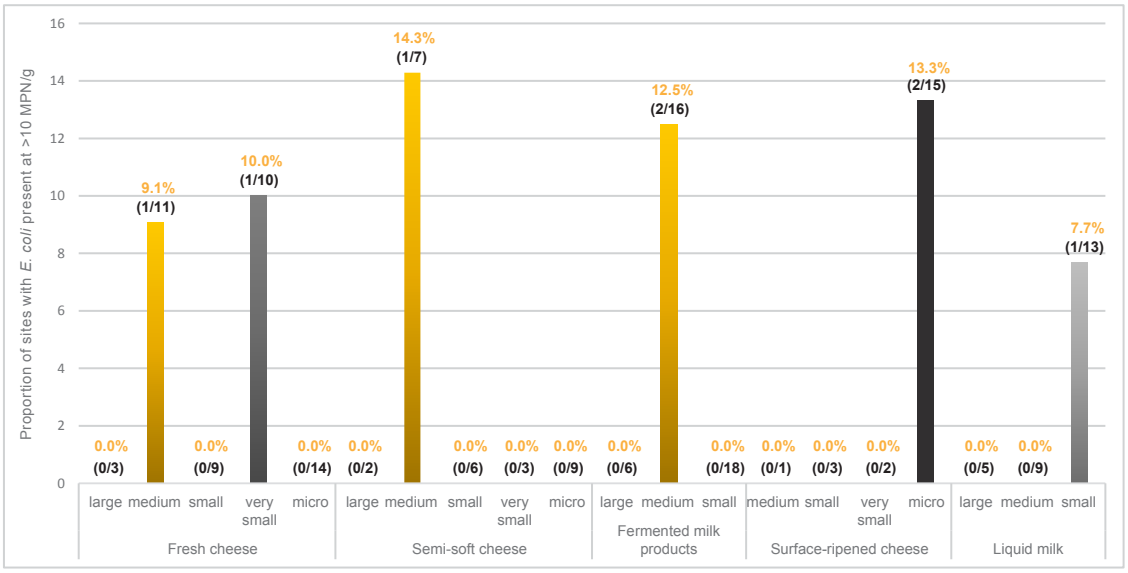

Figure 7: The proportion of *E. coli* detections greater than 10 MPN/g in dairy manufacturer sites classified as small, medium and large. Data labels indicate the percentage of sites with *E. coli* detections >10 MPN/g and number of sites with *E. coli* detections at >10 MPN/g out of the total number of sites participating.

Pathogens – coagulase-positive staphylococcus

Coagulase-positive staphylococci are killed by pasteurisation and are normally associated with post-pasteurisation contamination and/or poor food handler hygiene. All samples with the exception of ice cream and pasteurised liquid milk and cream were tested for coagulase-positive staphylococci.

Coagulase-positive staphylococci was detected in one sample from a batch of semi-soft cheese (at 100 cfu/g) and in one sample from a batch of fresh cheese (paneer at 200 cfu/g). These low levels do not suggest a major breakdown in process control or a food safety risk in either of these products, but may serve as a warning of hygiene problems.

Pathogens – Salmonella and Listeria

Salmonella was not detected in any of the 304 samples tested and Listeria was not detected in any of the 353 samples tested.

Compliance with the Code

A major function of the program is to monitor compliance with the Code. The criteria in Standard 1.6.1 (Schedule 27) of the Code which apply to the dairy products evaluated in the program are in Table 3.

No Salmonella or Listeria species were detected in any products tested during the program. Of the 656 batches of dairy products analysed, five batches (0.76%) did not comply with the Code due to the presence of *E. coli* at levels which did not meet the microbiological criteria in Schedule 27.

These included one batch of fresh cheese and two batches each of semi-soft cheese and surface-ripened cheese. These non-conformances were addressed directly with the licensees by the relevant Dairy Food Safety Victoria food safety manager.

This is the second year of the expanded program. In 2015–2016, eight of 618 (1.3%) batches tested did not comply with Schedule 27 of the Code.

		n	c	m	M
All cheese	*Escherichia coli*	5	1	10/g	10^2/g
Soft and semi-soft cheese (moisture content >39%) with pH >5.0	*Salmonella*	5	0	not detected in 25g	
Ready-to-eat food in which growth of *Listeria monocytogenes* can occur	*Listeria monocytogenes*	5	0	not detected in 25g	
Ready-to-eat food in which growth of *Listeria monocytogenes* will not occur	*Listeria monocytogenes*	5	0	10^2 cfu/g	

Table 3: Microbiological criteria from Schedule 27 of Standards 1.6.1 of the Australia New Zealand Food Standards Code.

Physicochemical testing

Product categories in the targeted program were tested for pH, water activity, moisture, lactic acid concentration and salt concentration. These measurements allow assessment of the ability of dairy products to support the growth of pathogens and are useful for providing input data for predictive modelling which can assist with process validation and troubleshooting activities.

The physicochemical results may vary widely due to the unique nature of individual products, even within a category of similar products. This can be seen in the wide range of values observed, especially for pH, salt and lactate concentrations. Results for cheese samples also need to be considered in context of the type of manufacturing process. The physicochemical properties of ripened cheeses will change during the ripening process, hence different results will be observed depending on the stage of maturation and age of a product. This, in addition to the variation in formulations for different products and the effects of the environment during ripening results in the high variation within cheese categories.

pH

The pH results are shown in Figure 8. The pH of the cream cheese dips and the yoghurt-based dips fell within a narrow range, while other products exhibited a wide range of pH values. Many products were well within the pH range in which pathogens can grow.

Results and discussion

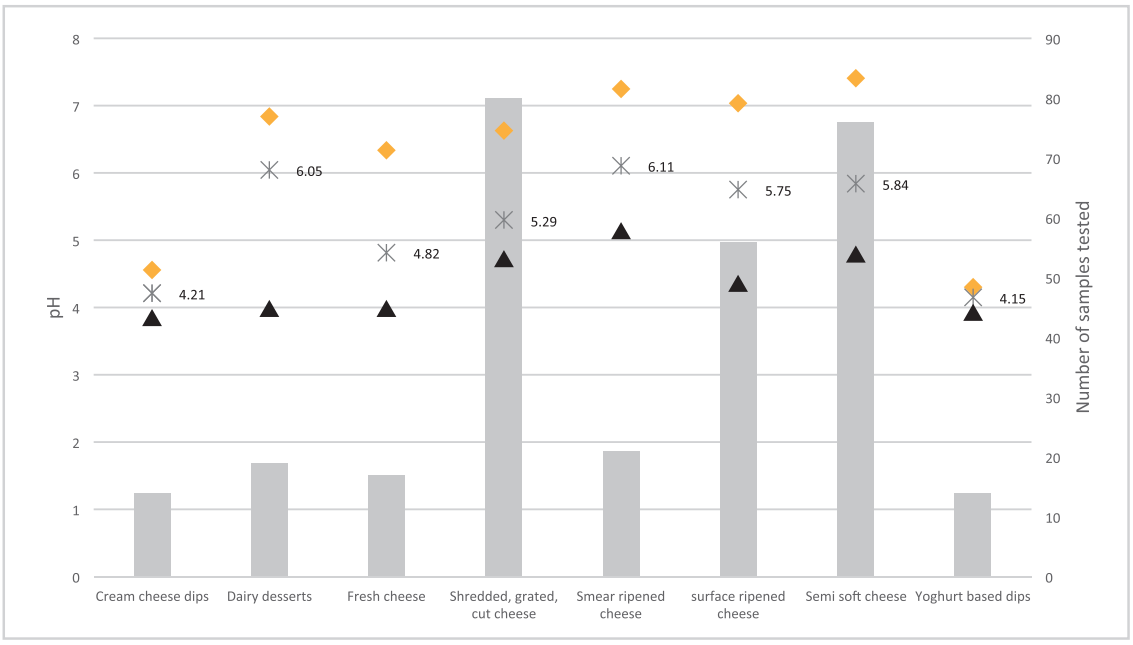

Figure 8: pH values of samples within each category (average (✳), minimum (▲) and maximum (◆)). Bars indicate the number of samples tested.

Water activity

Water activity is a measure of unbound water in a product which is available for microbial growth. Most bacteria are unable to grow at water activities below 0.92. The average, maximum and minimum water activities for each product category are given in Figure 9. A wide range of water activities was observed, due to the wide range of product characteristics and formulations. The water activity of a large number of products was within the range in which pathogens can grow.

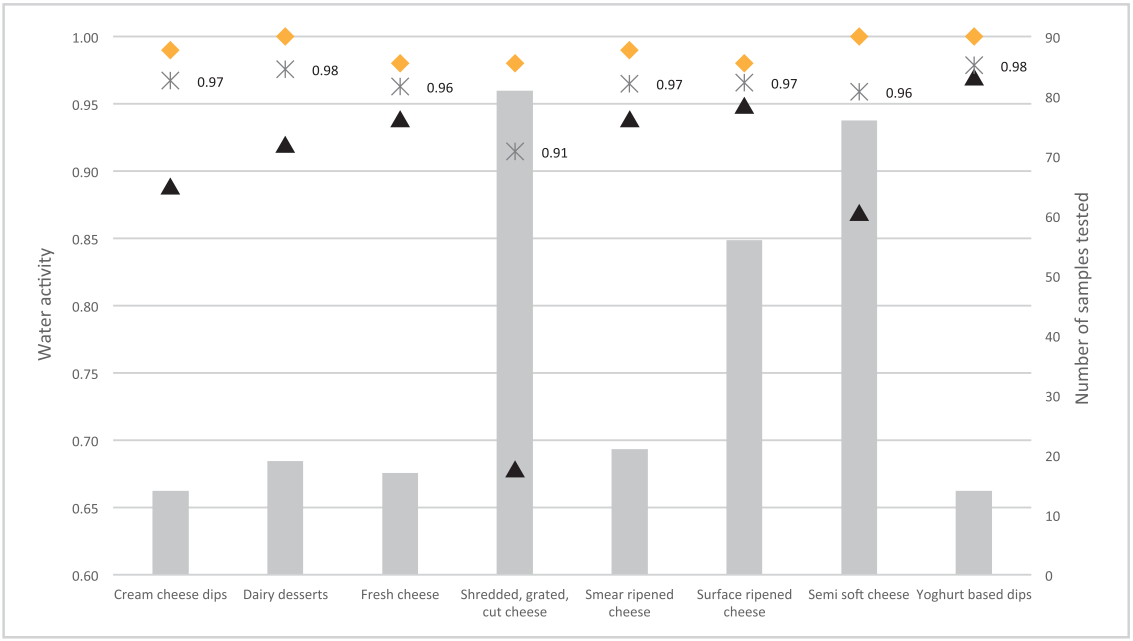

Figure 9: Water activity values of samples within each category (average (✳), minimum (▲) and maximum (◆)). Bars indicate the number of samples tested.

Moisture

The moisture measurements are indicative of the total amount of water in a product. This does not take into account the water which is bound to other food components such as salt and sugar, so is not a good indicator of whether the product will support the growth of pathogens and other bacteria. The results of moisture testing are in Figure 10.

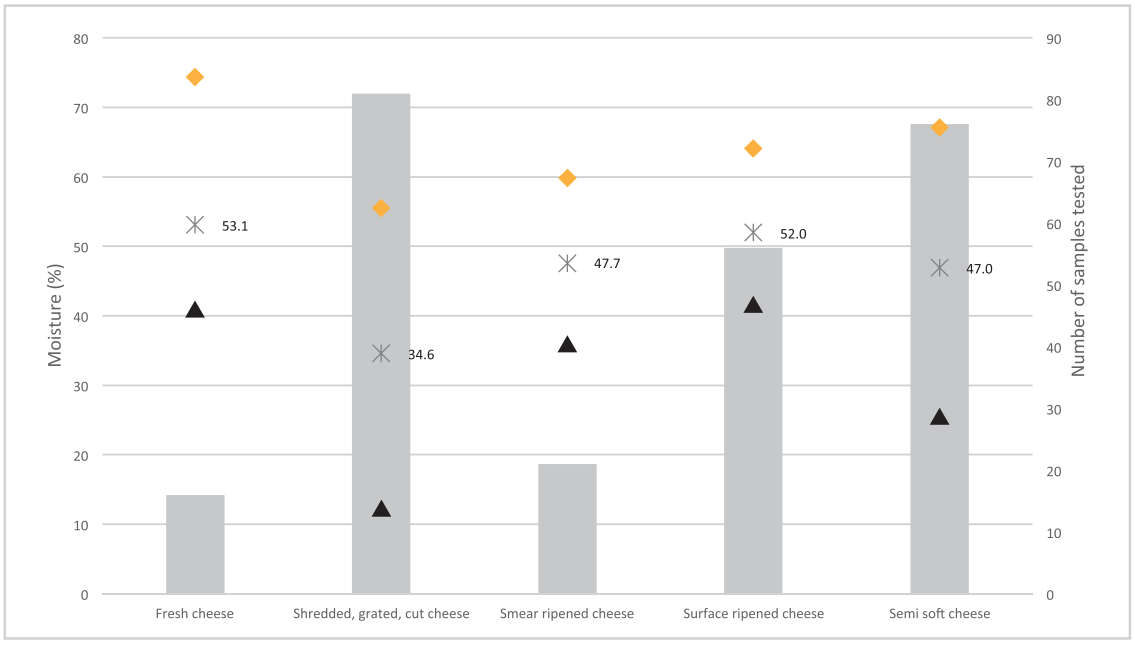

Figure 10: Moisture values of samples within cheese categories (average (✳), minimum (▲) and maximum (◆)). Bars indicate the number of samples tested.

Salt concentration

Salt is added to many dairy products to enhance flavour and control bacterial growth. The levels of salt varied widely both within and between categories and is dependent on individual product formulations and characteristics. The salt concentration of samples within each product category tested in the targeted program are in Figure 11.

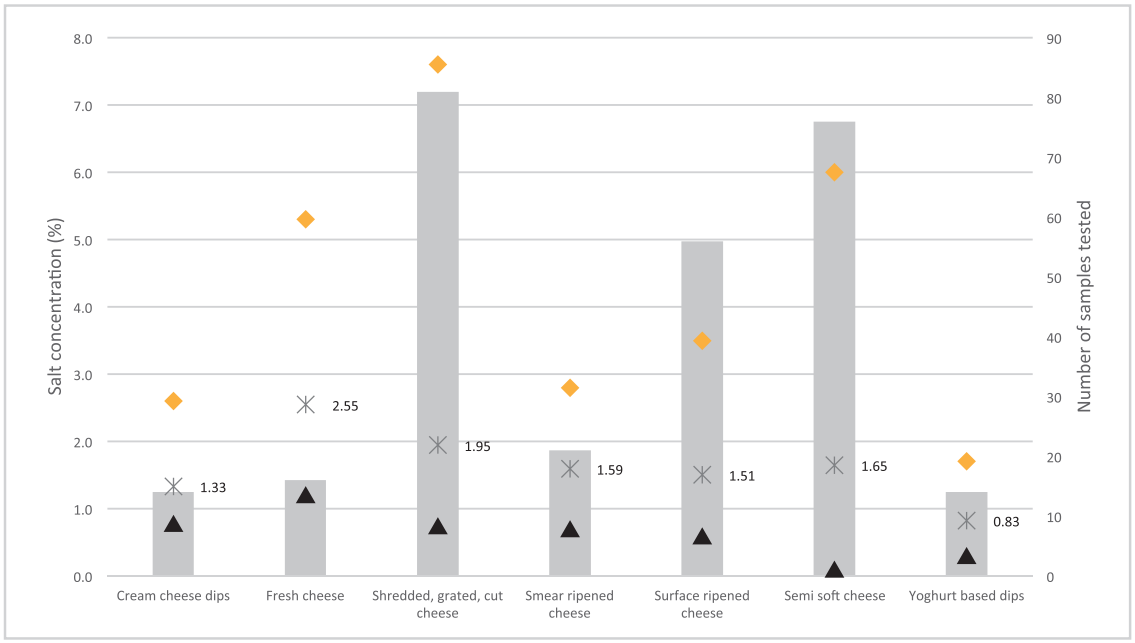

Figure 11: Salt concentration of samples within each dairy category (average (✳), minimum (▲) and maximum (◆)). Bars indicate the number of samples tested.

Lactic acid concentration

Lactic acid is generated during fermentation of dairy products. High levels of lactic acid are inhibitory to pathogens and other bacteria. An understanding of the level of lactic acid can provide information about the ability of a product to support the growth of pathogens and allow more accurate predictive modelling. The level of lactic acid will vary widely depending on the production method and the results shown in Figure 12 demonstrate this.

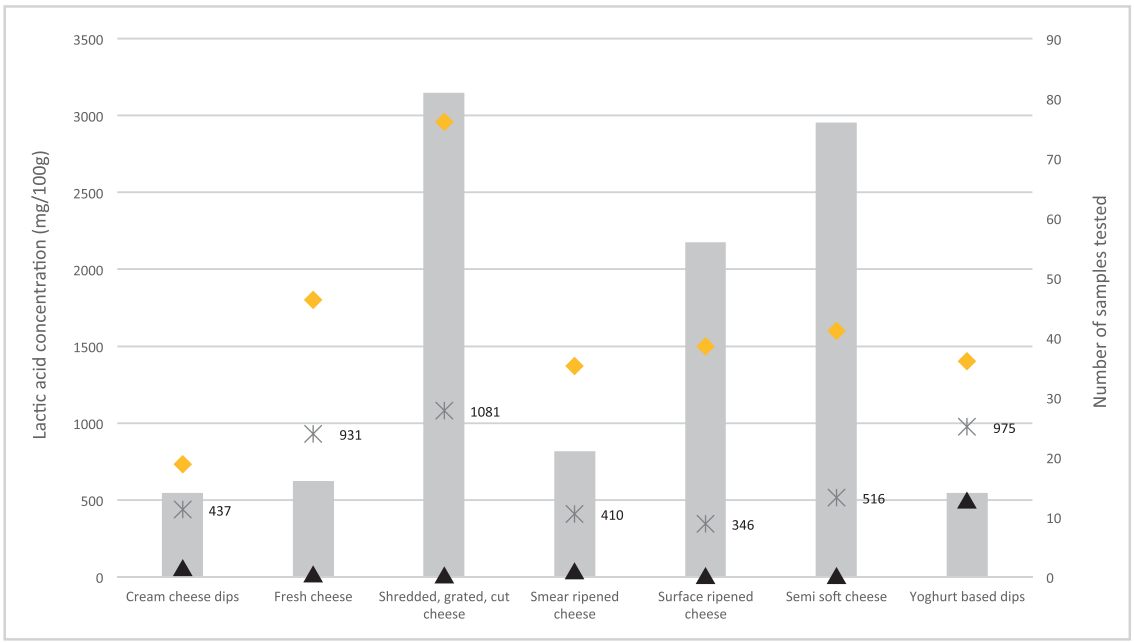

Figure 12: Lactic acid concentration of samples within each category (average (✳), minimum (▲) and maximum (◆)). Bars indicate the number of samples tested.

Conclusion

The Dairy Food Safety Victoria Product Surveillance Program is one means of verifying the food safety programs of Victorian dairy manufacturers. Six hundred and fifty six batches of product from 14 different product categories were sampled and tested. Five batches (0.76%) did not comply with the Australia New Zealand Food Standards Code due to the presence of *E. coli* at levels higher than the criteria specified in Schedule 27 of Standard 1.6.1. These were two batches of semi-soft cheese (both mozzarella), two batches of surface mould-ripened cheese from two different manufacturers and one batch of goat fetta. This compares favourably with the 2015–2016 year when 1.3% of batches did not comply with the Code due to the presence of *E. coli*.

Cheese categories were particularly prone to the presence of hygiene indicators such as coliforms and *E. coli*. Surface-ripened cheese and smear-ripened cheese had high incidences of coliforms. This is reflective of the manufacturing process which, in most cases, involves significant handling and environmental exposure, and illustrates the need for additional attention and/or improvement to hygiene control within plants that manufacture these products.

Ice cream was observed to have a very high incidence of coliform contamination but no *E. coli* detections. This is a pattern that has been observed in previous years of the program and demonstrates a need to improve hygienic practices in ice cream manufacturing sites. DFSV is currently working to provide specific information to ice cream manufacturers to assist in improving hygiene control.

The physicochemical data obtained provides valuable information which is being used for assessing the risk of pathogen growth in products and other technical support activities.

The results obtained during this program indicate that the food safety programs of Victorian dairy manufacturers are generally very effective. In the 2016–2017, the program identified five instances of process control failures resulting in non-compliance with the Code.

The program in itself cannot identify all instances of loss of control as sampling only occurs twice per year on a subset of products made by each manufacturer. The Product Surveillance Program along with a manufacturer's in-house testing and other internal verification activities, and DFSV audits, all combine to verify the effectiveness of the food safety programs within the Victorian dairy industry.

References

Australia New Zealand Food Standards Code: ***Standard 1.6.1, Microbiological limits in food.***

Australia New Zealand Food Standards Code: ***Schedule 27, Microbiological limits in food.***

Australian Standard AS 5013 Series 2014–2017, ***Food microbiology.***

Dairy Food Safety Victoria 2015, ***Microbiological testing criteria – Minimum testing requirements for manufacturers of dairy food products,*** DFSV, Melbourne.

Appendix 1

Baseline program:

Product category description	Microbiological tests
Fermented milk products	*Coliforms* *E. coli* *Staphylococcus aureus*
Fresh cheese	*Coliforms* *E. coli* *Staphylococcus aureus*
Hard cheese	*Coliforms* *E. coli* *Staphylococcus aureus*
Ice cream	*Coliforms* *E. coli* *Total plate count* *Listeria*
Spreads	*Coliforms* *E. coli* *Staphylococcus aureus* *Total plate count*
Pasteurised liquid milk	*Coliforms* *E. coli* *Total plate count*
Pasteurised liquid cream	*Coliforms* *E. coli* *Total plate count*

Appendix 1

Targeted program:

Product category description	Microbiological tests	Physicochemical tests
Cream cheese-based dips	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.*	pH Water activity Salt concentration Lactic acid concentration
Yoghurt-based dips	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.*	pH Water activity Salt concentration Lactic acid concentration
Semi-soft cheese	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.*	pH Water activity Moisture Salt concentration Lactic acid concentration
Smear-ripened cheese	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.*	pH Water activity Moisture Salt concentration Lactic acid concentration
Shredded, grated, cut cheese	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.*	pH Water activity Moisture Salt concentration Lactic acid concentration
Surface-ripened cheese	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.*	pH Water activity Moisture Salt concentration Lactic acid concentration
Dairy desserts	*Coliforms* *E. coli* *Staphylococcus aureus* *Listeria spp.* *Salmonella spp.* *Total plate count*	pH Water activity

Appendix 2

The number of participating licensees, batches and samples tested during the 2016–2017 Product Surveillance Program.

	Number of participating licensees	Number of batches	Number of samples
Cream cheese-based dips	4	14	70
Dairy desserts	6	20	100
Fresh cheese	47	94	455
Fermented milk products	40	78	368
Hard cheese	23	40	192
Ice cream	29	55	253
Liquid cream	13	26	125
Liquid milk	27	48	237
Shredded, grated, cut cheese	26	83	404
Smear-ripened cheese	9	21	89
Spreads	13	26	128
Surface-ripened cheese	21	57	260
Semi-soft cheese	27	80	380
Yoghurt-based dips	4	14	70
Total	149	656	3131

Appendix 3

Summary of *E. coli* detections in batches tested during the 2016–2017 Product Surveillance Program.

	Percentage of batches with *E. coli* detections (number batches positive/total number of batches tested)		Number of batches in which *E. coli* were detected at greater than 10 MPN/g (number of batches positive/ total number of batches tested)		Number of batches in which *E. coli* were detected at greater than 100 MPN/g (number of batches/total number of batches tested)	
Cream cheese-based dips	7.1%	(1/14)	0.0%	(0/14)	0.0%	(0/14)
Dairy desserts	0.0%	(0/20)	0.0%	(0/20)	0.0%	(0/20)
Fresh cheese	5.3%	(5/94)	2.1%	(2/94)	1.1%	(1/94)
Fermented milk products	3.8%	(3/78)	2.6%	(2/78)	2.6%	(2/78)
Hard cheese	2.5%	(1/40)	0.0%	(0/40)	0.0%	(0/40)
Ice cream	0.0%	(0/55)	0.0%	(0/55)	0.0%	(0/55)
Liquid cream	0.0%	(0/26)	0.0%	(0/26)	0.0%	(0/26)
Liquid milk	2.1%	(1/48)	2.1%	(1/48)	0.0%	(0/48)
Shredded, grated, cut cheese	0.0%	(0/83)	0.0%	(0/83)	0.0%	(0/83)
Smear-ripened cheeses	9.5%	(2/21)	0.0%	(0/21)	0.0%	(0/21)
Spreads	0.0%	(0/26)	0.0%	(0/26)	0.0%	(0/26)
Surface-ripened cheese	7.0%	(4/57)	3.5%	(2/57)	3.5%	(2/57)
Semi-soft cheeses	2.5%	(2/80)	2.5%	(2/80)	2.5%	(2/80)
Yoghurt-based dips	0.0%	(0/14)	0.0%	(0/14)	0.0%	(0/14)

Appendix 4

Criteria for categorising manufacturing sites based on production volume.

Product	Micro	Very small	Small	Medium	Large
Cheese	<20 tonnes	20–100 tonnes	100–500 tonnes	500–5,000 tonnes	>5,000 tonnes
Cream			<20,000 litres	100,000–1,000,000 litres	>1,000,000 litres
Dairy desserts	All				
Dips	All				
Dried milk powders			<1,000 tonnes	1,000–10,000 tonnes	>10,000 tonnes
Fermented milk products			<100 tonnes	100–10,000 tonnes	>10,000 tonnes
Ice cream			<5,000 litres	5,000–1,000,000 litres	>1,000,000 litres
Milk			<1,000,000 litres	1,000,000–50,000,000 litres	>50,000,000 litres
Spreads			<5,000 tonnes		>5,000 tonnes

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