

Comparative Independent Laboratory Evaluation of the 3M™ Petrifilm™ Lactic Acid Bacteria Count Plate Method for the Enumeration of Lactic Acid Bacteria in a Variety of Foods and Environmental Surface

Abstract

The 3M™ Petrifilm™ Lactic Acid Bacteria Count Plate method is designed for the detection and enumeration of lactic acid bacteria from select food matrices and environmental surfaces. The 3M Petrifilm Lactic Acid Bacteria Count Plate method was evaluated in a method comparison study according to current AOAC® guidelines. The method was compared to the Compendium of Methods for the Microbiological Examination of Foods, 5th Edition (CMMEF) Chapter 19 as well as the ISO 15214: *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of mesophilic lactic acid bacteria — colony-count technique at 30°C*, First Edition, 1998-08-01 for cold smoked salmon, cream pastry, creamy salad dressing, deli chicken, deli ham, deli turkey, duck pâté, pickled herring, kimchi, mayonnaise, mustard potato salad, terrine, yogurt, chicken sausage, pepperoni, cottage cheese, ready to bake pizza and stainless steel (environmental surface). A total of five replicates were analyzed for each of three different levels of microbial contamination for each matrix. An uninoculated level with five total replicates was also analyzed for cream pastry, mustard potato salad, herring, cold smoked salmon and the stainless steel environmental surface.

In the method comparison study, a paired t-test was used to determine if the mean of the replicate samples at each contamination level for each matrix was different between the 3M Petrifilm Lactic Acid Bacteria Count Plate method, the CMMEF Chapter 19 and ISO 15214 reference methods. The repeatability was also determined. The 3M Petrifilm Lactic Acid Bacteria Count Plate method demonstrated reliability as an accurate alternative to the reference methods for the enumeration of lactic acid bacteria for all 17 food matrices and the one environmental surface.

This paper presents the analytical results for the comparison of the 3M Petrifilm Lactic Acid Bacteria Count Plate method to the CMMEF Chapter 19 and the ISO 15214: *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of mesophilic lactic acid bacteria — colony-count technique at 30°C*, First edition, 1998-08-01 reference methods. All analyses were conducted at Vanguard Sciences, Inc. (North Sioux City, SD).

Material and Methods

Test Product

All required 3M Petrifilm Lactic Acid Bacteria Count Plates for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method were provided by 3M Company (St. Paul, MN). Vanguard Sciences (North Sioux City, SD) purchased all matrices: smoked deli ham, pepperoni, deli turkey, deli chicken, chicken sausage, duck pâté, herring, cold smoked salmon, cottage cheese, yogurt, creamy salad dressing, terrine, ready to bake pizza, mustard potato salad, mayonnaise, kimchi and cream pastry. Vanguard Sciences provided all general lab equipment and other testing materials. For the reference methods, ISO 15214 and the Compendium of Methods for the Microbiological Examination of Foods (5th Edition), EMD Millipore GranuCult MRS Agar (EMD Millipore Product no. 110660) was utilized.

Test Organisms

All food matrices were pre-screened for levels of lactic acid bacteria. Cold smoked salmon, cream pastry, herring and mustard potato salad were not naturally contaminated and were inoculated with lactic acid bacteria, see Table 1. The strains that were used to inoculate the selected matrices were grown overnight in MRS broth under anaerobic conditions at 32°C. Serial dilutions of the overnight broths were prepared in 0.1% peptone water to achieve the desired inoculation levels.

Table 1. Lactic acid bacteria strains used to inoculate food matrices without naturally occurring lactic acid bacteria.

Inoculation Strain	Matrices
<i>Lactococcus lactis</i> ATCC® 11454™	Cream pastry
<i>Lactobacillus plantarum</i> ATCC® 8014™	Mustard potato salad
<i>Pediococcus pentosaceus</i> ATCC® 33316™	Herring
<i>Lactococcus garvieae</i> ATCC® 43921™	Cold smoked salmon
<i>Lactobacillus fermentum</i> NCIMB 6991	Stainless steel

Product Inoculation

The food matrices that were not naturally contaminated with lactic acid bacteria were inoculated in bulk at three contamination levels: a low level (near the detection limit of the method) and two additional levels covering the detection range. An uninoculated set of samples was also tested for these food matrices.

For the stainless steel surfaces, there were two sets of five 4" x 4" stainless steel coupons inoculated at low, medium and high levels because of differences in the diluents required for the reference methods. The inoculum was added to the squares and allowed to dry overnight. Five additional un-inoculated stainless steel coupons were tested for each diluent.

For the naturally contaminated food matrices, three sets of each matrix were purchased and tested as is, with some temperature abuse, or toward end of product shelf-life to achieve three separate contamination levels (low, medium and high) of lactic acid bacteria.

Creamy salad dressing, deli chicken, deli turkey, duck pâté, kimchi, mayonnaise, deli ham, terrine and yogurt were temperature abused to achieve the medium and high lactic acid bacteria levels. The medium level was achieved by storing the samples at room temperature overnight and the high level samples were achieved by incubating the samples at 35°C overnight.

Microbial Analyses

Sponges used for testing the stainless steel surface with the 3M Petrifilm Lactic Acid Bacteria Count Plate method or the CMMEF Chapter 19 reference method were moistened with 10mL of 0.1% Peptone Water (PW). For testing with the ISO 15214 reference method, sponges were moistened with 10mL of Peptone Salt diluent (PS). The surfaces were tested by swabbing in north-south direction. The sponges were then transferred to sterile stomacher bags and 25mL of the same diluent used to moisten the sponges was added. The samples were homogenized by stomaching for one minute. The homogenized samples were ten fold serially diluted in the same diluent used to moisten the sponge to achieve samples at three levels of lactic acid bacteria (low, medium and high) within the countable range of the method. The samples were tested as described below according to the 3M Petrifilm Lactic Acid Bacteria Count Plate method, CMMEF Chapter 19 or ISO 15214 reference methods.

For the food matrices, a 1:10 dilution was prepared by combining a 10g sample with 90mL of the appropriate diluent. For the samples to be tested with the 3M Petrifilm Lactic Acid Bacteria Count Plate method and the CMMEF Chapter 19 reference method, PW was used. The samples were blended or homogenize for two minutes and then diluted with PW for three additional dilutions. One mL (1mL) of each dilution was plated onto four 3M Petrifilm Lactic Acid Bacteria Count Plates and two Petri dishes. Tempered MRS agar was added to the Petri dishes, swirled and allowed to set at room temperature. The 3M Petrifilm Lactic Acid Bacteria Count Plates were incubated aerobically at two incubation temperatures (two 3M Petrifilm Lactic Acid Bacteria Count Plates per temperature: 37°C ± 1°C for 48h ± 3h and 28°C ± 1°C for 48h ± 3h). The MRS agar pour plates were incubated in an anaerobic box with an anaerobic sachet at 32°C ± 1°C for 48h ± 3h for cottage cheese and yogurt, and 35°C ± 1°C for 48h ± 3h for all other matrices. For samples to be tested by the ISO 15214 reference method, PS diluent was used. Samples were prepared as described above for the CMMEF Chapter 19 reference method. The MRS agar pour plates were incubated in an anaerobic box with an anaerobic sachet at 30°C ± 1°C for 72h ± 3h. After incubation, all typical colonies were counted and recorded. The percentage of lactic acid bacteria was confirmed by Gram stain and catalase reaction. Five colonies were confirmed from each duplicate plate, if available. The total count of lactic acid bacteria was reported based on the percentage of the five colonies that confirmed as lactic acid bacteria (Gram positive, catalase negative).

Statistical Analysis

The counts for each of the duplicate plating were averaged and converted to logarithmic scale for data analysis. A paired t-test was used to determine if the mean of the replicate samples at each contamination level for each matrix was equivalent between the 3M Petrifilm Lactic Acid Bacteria Count Plate method, the CMMEF Chapter 19 and ISO 15214 reference methods. The repeatability was also determined.

Results and Discussion

Cold smoked salmon was not naturally contaminated with lactic acid bacteria and was inoculated. The low contamination level of cold smoked salmon had a mean level of lactic acid bacteria of 3.2 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 2). The medium contamination level of cold smoked salmon had a mean level of lactic acid bacteria of 4.23–4.31 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of cold smoked salmon had a mean level of lactic acid bacteria of 5.23–5.29 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and at 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at low ($P=0.512-0.88$), medium ($P=0.34-0.42$) and high contamination levels ($P=0.22-1.00$). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (1.00–4.00, Table 20) except when comparing the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C to the ISO 15214 reference method on the medium contamination level ($CV=8.03$) and the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C ($CV=11.11$) where the ISO 15214 reference method had significantly better repeatability.

Table 2. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Cold Smoked Salmon.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Uninoculated	1	<10	<1	<10	<1	<10	<1	<10	<1
	2	<10	<1	<10	<1	<10	<1	<10	<1
	3	<10	<1	<10	<1	<10	<1	<10	<1
	4	<10	<1	<10	<1	<10	<1	<10	<1
	5	<10	<1	<10	<1	<10	<1	<10	<1
	Mean	<10	<1	<10	<1	<10	<1	<10	<1
Low	1	1,500	3.18	1,700	3.23	1,800	3.26	1,500	3.18
	2	1,900	3.28	1,700	3.23	1,900	3.28	1,900	3.28
	3	1,200	3.08	1,200	3.08	1,000	3.00	1,700	3.23
	4	1,600	3.20	1,700	3.23	1,400	3.15	1,500	3.18
	5	1,400	3.15	1,500	3.18	1,700	3.23	1,300	3.11
	Mean	1,520	3.18	1,560	3.19	1,560	3.18	1,580	3.20
	Sr		0.07		0.07		0.11		0.06
	RSDr, %		2.20		2.20		3.41		1.88
	P-Value (vs CMMEF)		0.88		0.83				
	P-Value (vs ISO)		0.62		0.90				
P-Value (vs 37°C incubation)		0.51							
Medium	1	17,000	4.23	18,000	4.26	18,000	4.26	15,000	4.18
	2	16,000	4.20	17,000	4.23	16,000	4.20	15,000	4.18
	3	27,000	4.43	25,000	4.40	24,000	4.38	16,000	4.20
	4	12,000	4.08	12,000	4.08	13,000	4.11	19,000	4.28
	5	31,000	4.49	40,000	4.60	19,000	4.28	20,000	4.30
	Mean	20,600	4.29	22,400	4.31	18,000	4.25	17,000	4.23
	Sr		0.17		0.20		0.10		0.06
	RSDr, %		3.97		4.35		2.34		1.42
	P-Value (vs CMMEF)		0.42		0.36				
	P-Value (vs ISO)		0.47		0.36				
P-Value (vs 37°C incubation)		0.34							
High	1	140,000	5.15	130,000	5.11	160,000	5.20	180,000	5.26
	2	200,000	5.30	120,000	5.08	130,000	5.11	320,000	5.51
	3	360,000	5.56	330,000	5.52	490,000	5.69	130,000	5.11
	4	140,000	5.15	150,000	5.18	140,000	5.15	180,000	5.26
	5	210,000	5.32	190,000	5.28	170,000	5.23	220,000	5.34
	Mean	210,000	5.29	184,000	5.23	218,000	5.28	206,000	5.29
	Sr		0.17		0.18		0.24		0.14
	RSDr, %		3.21		3.41		4.59		2.64
	P-Value (vs CMMEF)		0.77		0.34				
	P-Value (vs ISO)		1.00		0.67				
P-Value (vs 37°C incubation)		0.22							

The cream-filled puff pastry was not naturally contaminated with lactic acid bacteria and was inoculated. The low contamination level of cream-filled puff pastry had a mean level of lactic acid bacteria of 3.1 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 3). The medium contamination level of cream-filled puff pastry had a mean level of lactic acid bacteria of 4.2 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and at 37°C, and the reference methods. The high contamination level of cream-filled puff pastry had a mean level of lactic acid bacteria of 5.32–5.35 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at low (P=0.37–0.93), medium (P=0.18–0.68) and high contamination levels (P=0.09–0.44) except between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C compared to the CMMEF Chapter 19 reference method on the high samples (P=0.02). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.00–2.25, Table 20).

Table 3. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Cream Filled Puff Pastry.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Uninoculated	1	<10	<1	<10	<1	<10	<1	<10	<1
	2	<10	<1	<10	<1	<10	<1	<10	<1
	3	<10	<1	<10	<1	<10	<1	<10	<1
	4	<10	<1	<10	<1	<10	<1	<10	<1
	5	<10	<1	<10	<1	<10	<1	<10	<1
	Mean	<10	<1	<10	<1	<10	<1	<10	<1
Low	1	1,200	3.08	1,200	3.08	1,200	3.08	1,200	3.08
	2	1,500	3.18	1,500	3.18	1,500	3.18	1,500	3.18
	3	1,400	3.15	1,300	3.11	1,400	3.15	1,300	3.15
	4	1,500	3.18	1,500	3.18	1,500	3.18	1,600	3.18
	5	1,300	3.11	1,300	3.11	1,300	3.11	1,300	3.11
	Mean	1,380	3.14	1,360	3.13	1,380	3.14	1,380	3.14
	Sr		0.04		0.04		0.04		0.05
	RSDr, %		1.27		1.28		1.27		1.59
	P-Value (vs CMMEF)		ND*		0.37				
	P-Value (vs ISO)		0.93		0.37				
P-Value (vs 37°C incubation)		0.37							
Medium	1	14,000	4.15	14,000	4.15	15,000	4.18	14,000	4.15
	2	16,000	4.20	16,000	4.20	16,000	4.20	15,000	4.18
	3	18,000	4.26	18,000	4.26	18,000	4.26	17,000	4.23
	4	13,000	4.11	13,000	4.11	13,000	4.11	13,000	4.11
	5	14,000	4.15	15,000	4.18	15,000	4.18	15,000	4.18
	Mean	15,000	4.17	15,200	4.18	15,400	4.19	14,800	4.17
	Sr		0.06		0.05		0.06		0.04
	RSDr, %		1.44		1.20		1.43		0.96
	P-Value (vs CMMEF)		0.18		0.37				
	P-Value (vs ISO)		0.68		0.18				
P-Value (vs 37°C incubation)		0.37							
High	1	190,000	5.28	180,000	5.26	190,000	5.28	180,000	5.26
	2	240,000	5.38	230,000	5.36	240,000	5.38	230,000	5.36
	3	160,000	5.20	160,000	5.20	180,000	5.26	150,000	5.18
	4	260,000	5.41	250,000	5.40	260,000	5.41	230,000	5.36
	5	250,000	5.40	250,000	5.40	260,000	5.41	280,000	5.45
	Mean	220,000	5.34	214,000	5.32	226,000	5.35	214,000	5.32
	Sr		0.08		0.09		0.09		0.11
	RSDr, %		1.50		1.69		1.68		2.07
	P-Value (vs CMMEF)		0.24		0.02				
	P-Value (vs ISO)		0.44		0.85				
P-Value (vs 37°C incubation)		0.09							

*The counts were not different between the methods therefore a P-Value could not be calculated.

The low contamination level of creamy ranch dressing had a mean level of lactic acid bacteria of 2.65–2.91 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 4). The medium contamination level of creamy ranch dressing had a mean level of lactic acid bacteria of 3.61–3.87 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of creamy ranch dressing had a mean level of lactic acid bacteria of 5.80–6.02 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at low (P=0.15–0.71), medium (P=0.12–0.65) and high contamination levels (P=0.09–0.04) except the ISO 15214 reference method had significantly higher level of lactic acid bacteria than the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C for the high contamination level (P=0.04). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.11–4.94, Table 20) except the repeatability of the ISO 15214 reference method was significantly better than the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures for the low contamination level (CV=10.80 [28°C], 8.16 [37°C]) and the 28°C method for the medium contamination level (CV=7.72).

Table 4. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Creamy Ranch Dressing.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	210	2.32	260	2.41	230	2.36	720	2.86
	2	670	2.83	730	2.86	550	2.74	660	2.82
	3	540	2.73	550	2.74	550	2.74	830	2.92
	4	720	2.86	740	2.87	710	2.85	1,000	3.00
	5	310	2.49	340	2.53	370	2.57	910	2.96
	Mean	490	2.65	524	2.68	482	2.65	824	2.91
	Sr		0.23		0.20		0.19		0.07
	RSDr, %		8.69		7.45		7.16		2.40
	P-Value (vs CMMEF)		0.71		0.17				
	P-Value (vs ISO)		0.16		0.18				
P-Value (vs 37°C incubation)		0.15							
Medium	1	8,300	3.92	8,400	3.92	7,700	3.89	5,700	3.76
	2	1,900	3.28	2,300	3.36	2,600	3.41	7,300	3.86
	3	5,700	3.76	4,500	3.65	5,300	3.72	6,900	3.84
	4	3,000	3.48	4,100	3.61	3,800	3.58	9,700	3.99
	5	4,300	3.63	5,100	3.71	5,100	3.71	8,300	3.92
	Mean	4,640	3.61	4,800	3.65	4,900	3.66	7,580	3.87
	Sr		0.25		0.20		0.18		0.09
	RSDr, %		6.92		5.48		4.91		2.32
	P-Value (vs CMMEF)		0.23		0.65				
	P-Value (vs ISO)		0.13		0.12				
P-Value (vs 37°C incubation)		0.40							
High	1	640,000	5.81	620,000	5.79	530,000	5.72	1,700,000	6.23
	2	930,000	5.97	950,000	5.98	850,000	5.93	1,300,000	6.11
	3	470,000	5.67	720,000	5.86	570,000	5.76	850,000	5.93
	4	890,000	5.95	1,100,000	6.04	940,000	5.97	840,000	5.92
	5	390,000	5.59	370,000	5.57	400,000	5.60	770,000	5.89
	Mean	664,000	5.80	752,000	5.85	658,000	5.80	1,092,000	6.02
	Sr		0.17		0.18		0.15		0.15
	RSDr, %		2.93		3.08		2.59		2.49
	P-Value (vs CMMEF)		0.99		0.09				
	P-Value (vs ISO)		0.04		0.16				
P-Value (vs 37°C incubation)		0.22							

The low contamination level of deli chicken had a mean level of lactic acid bacteria of 2.34–3.02 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 5). The medium contamination level of deli chicken had a mean level of lactic acid bacteria of 5.86–5.98 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of deli chicken had a mean level of lactic acid bacteria of 7.93–8.07 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at low (P=0.10–0.48), medium (P=0.14–0.80) and high contamination levels (P=0.05–0.92) except the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C had a significantly higher level of lactic acid bacteria than the method incubated at 37°C for the low (P=0.01) and medium contamination level (P=0.04). The 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C also had a significantly lower level of lactic acid bacteria for the low contamination level than both reference methods (P=0.01 and 0.03). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.00–3.10, Table 20).

Table 5. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Deli Chicken.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	960	2.98	130	2.11	810	2.91	160	2.20
	2	520	2.72	150	2.18	370	2.57	1,500	3.18
	3	700	2.85	200	2.30	830	2.92	630	2.80
	4	6,900	3.84	560	2.75	4,400	3.64	1,400	3.15
	5	550	2.74	220	2.34	350	2.54	730	2.86
	Mean	1,926	3.02	252	2.34	1,352	2.92	884	2.84
	Sr		0.47		0.25		0.44		0.39
	RSDr, %		15.54		10.70		15.09		13.74
	P-Value (vs CMMEF)		0.10		0.01				
	P-Value (vs ISO)		0.48		0.03				
P-Value (vs 37°C incubation)		0.10							
Medium	1	610,000	5.79	590,000	5.77	1,000,000	6.00	580,000	5.76
	2	870,000	5.94	740,000	5.87	625,000	5.80	920,000	5.96
	3	840,000	5.92	690,000	5.84	1,100,000	6.04	1,000,000	6.00
	4	690,000	5.90	650,000	5.81	1,200,000	6.08	980,000	5.99
	5	1,000,000	6.00	990,000	6.00	1,000,000	6.00	760,000	5.88
	Mean	822,000	5.91	732,000	5.86	985,000	5.98	848,000	5.92
	Sr		0.08		0.09		0.11		0.10
	RSDr, %		1.35		1.54		1.84		1.69
	P-Value (vs CMMEF)		0.32		0.14				
	P-Value (vs ISO)		0.80		0.32				
P-Value (vs 37°C incubation)		0.04							
High	1	150,000,000	8.18	140,000,000	8.15	120,000,000	8.08	67,000,000	7.83
	2	140,000,000	8.15	120,000,000	8.08	120,000,000	8.08	110,000,000	8.04
	3	110,000,000	8.04	74,000,000	7.87	100,000,000	8.00	130,000,000	8.11
	4	100,000,000	8.00	96,000,000	7.98	57,000,000	7.76	80,000,000	7.90
	5	95,000,000	7.98	63,000,000	7.80	100,000,000	8.00	61,000,000	7.79
	Mean	119,000,000	8.07	98,600,000	7.98	99,400,000	7.98	89,600,000	7.93
	Sr		0.09		0.14		0.13		0.14
	RSDr, %		1.12		1.76		1.63		1.76
	P-Value (vs CMMEF)		0.13		0.92				
	P-Value (vs ISO)		0.12		0.67				
P-Value (vs 37°C incubation)		0.05							

The low contamination level of deli turkey had a mean level of lactic acid bacteria of 4.30–4.43 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 6). The level of lactic acid bacteria was significantly higher on the CMMEF Chapter 19 reference method than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at 37°C (P=0.01). The medium contamination level of deli turkey had a mean level of lactic acid bacteria of 6.11–6.25 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at medium contamination level (P=0.07–0.83). The high contamination level of deli turkey had a mean level of lactic acid bacteria of 7.25–8.05 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was significantly higher on the ISO 15214 reference method than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at both incubation temperatures for the high contamination level samples (P=0.02). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.33–5.90, Table 20) except the repeatability of the CMMEF Chapter 19 reference method was significantly better than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at 37°C for the high contamination level (CV=9.00) and the 3M Petrifilm Lactic Acid Bacteria Count Plate at 37°C repeatability was significantly better than the method at 28°C for the low contamination level (CV=9.00).

Table 6. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Deli Turkey.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	140,000		22,000	4.34	31,000	4.49	31,000	4.49
	2	29,000	4.46	22,000	4.30	26,000	4.41	27,000	4.43
	3	21,000	4.32	18,000	4.26	29,000	4.46	23,000	4.36
	4	21,000	4.32	18,000	4.26	25,000	4.40	20,000	4.30
	5	26,000	4.41	22,000	4.34	23,000	4.36	21,000	4.32
	Mean	22,200	4.38	20,000	4.30	26,800	4.43	24,400	4.38
	Sr		0.12		0.04		0.05		0.08
	RSDr, %		2.74		0.93		1.13		1.83
	P-Value (vs CMMEF)		0.8		0.01				
	P-Value (vs ISO)		0.57		0.06				
P-Value (vs 37°C incubation)		0.60							
Medium	1	950,000	5.98	1,200,000	6.08	1,100,000	6.04	1,500,000	6.18
	2	1,800,000	6.26	1,700,000	6.23	2,200,000	6.34	2,500,000	6.40
	3	1,800,000	6.26	1,800,000	6.26	2,000,000	6.30	1,500,000	6.18
	4	1,100,000	6.04	1,800,000	6.26	1,600,000	6.20	1,800,000	6.26
	5	1,100,000	6.04	1,300,000	6.11	1,000,000	6.00	1,700,000	6.23
	Mean	1,350,000	6.11	1,560,000	6.19	1,580,000	6.18	1,800,000	6.25
	Sr		0.13		0.08		0.15		0.09
	RSDr, %		2.13		1.29		2.43		1.44
	P-Value (vs CMMEF)		0.13		0.83				
	P-Value (vs ISO)		0.07		0.24				
P-Value (vs 37°C incubation)		0.16							
High	1	31,000,000	7.49	37,000,000	7.57	22,000,000	7.34	30,000,000	7.48
	2	18,000,000	7.26	14,000,000	7.15	24,000,000	7.38	110,000,000	8.04
	3	18,000,000	7.26	17,000,000	7.23	27,000,000	7.43	230,000,000	8.36
	4	14,000,000	7.15	14,000,000	7.15	19,000,000	7.28	170,000,000	8.23
	5	15,000,000	7.18	14,000,000	7.15	22,000,000	7.34	140,000,000	8.15
	Mean	19,200,000	7.26	19,200,000	7.25	22,800,000	7.36	136,000,000	8.05
	Sr		0.14		0.18		0.06		0.40
	RSDr, %		1.93		2.48		0.82		4.97
	P-Value (vs CMMEF)		0.21		0.27				
	P-Value (vs ISO)		0.02		0.02				
P-Value (vs 37°C incubation)		0.59							

The low contamination level of duck pâté had a mean level of lactic acid bacteria of 3.20–3.38 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 7). The level of lactic acid bacteria was significantly lower on the ISO 15214 reference method than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at both incubation temperatures (P=0.00). The medium contamination level of duck pâté had a mean level of lactic acid bacteria of 4.13–4.23 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at the medium contamination level (P=0.07–0.87). The high contamination level of duck pâté had a mean level of lactic acid bacteria of 5.10–5.21 log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at the high contamination level (P=0.017–0.43). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.08–3.20, Table 20) except the repeatability of the ISO 15214 reference method was significantly better than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at both incubation temperatures for the low (CV=13.8 [28°C] and 10.8 [37°C]) and medium contamination level (CV=11.39 [28°C] and 19.14 [37°C]).

Table 7. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Duck Pâté.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method			
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g		
Low	1	1,800		1,800	3.26		2,900	3.46	2,300	3.36
	2	3,000	3.48	2,900	3.46		3,600	3.56	1,900	3.28
	3	3,300	3.52	3,700	3.57		3,700	3.57	2,000	3.30
	4	2,400	3.38	1,800	3.26		1,800	3.26	900	2.95
	5	750	2.88	950	2.98		1,200	3.08	1,300	3.11
	Mean	2,250	3.31	2,230	3.30		2,640	3.38	1,680	3.20
	Sr		0.26		0.23			0.21		0.26
	RSDr, %		7.85		6.96			6.21		8.12
	P-Value (vs CMMEF)		0.25		0.10					
	P-Value (vs ISO)		0.00		0.00					
P-Value (vs 37°C incubation)		0.95								
Medium	1	22,000	4.34	26,000	4.41		26,000	4.41	23,000	4.36
	2	29,000	4.46	35,000	4.54		31,000	4.49	22,000	4.34
	3	6,500	3.81	4,500	3.65		6,000	3.78	16,000	4.20
	4	12,000	4.08	9,500	3.98		15,000	4.18	15,000	4.48
	5	9,000	3.95	13,000	4.11		15,000	4.18	11,000	4.04
	Mean	15,700	4.13	17,600	4.14		18,600	4.21	17,400	4.23
	Sr		0.27		0.35			0.28		0.27
	RSDr, %		6.54		8.45			6.66		6.39
	P-Value (vs CMMEF)		0.14		0.21					
	P-Value (vs ISO)		0.07		0.12					
P-Value (vs 37°C incubation)		0.87								
High	1	320,000	5.51	280,000	5.45		250,000	5.40	280,000	5.45
	2	280,000	5.45	290,000	5.46		200,000	5.30	230,000	5.36
	3	95,000	4.98	50,000	4.70		85,000	4.93	170,000	5.23
	4	150,000	5.18	85,000	4.93		160,000	5.20	75,000	4.88
	5	90,000	4.95	90,000	4.95		110,000	5.04	130,000	5.11
	Mean	187,000	5.21	159,000	5.10		161,000	5.17	177,000	5.21
	Sr		0.26		0.34			0.19		0.26
	RSDr, %		4.99		6.67			3.67		4.99
	P-Value (vs CMMEF)		0.43		0.41					
	P-Value (vs ISO)		0.17		0.43					
P-Value (vs 37°C incubation)		0.14								

The pickled herring was not naturally contaminated with lactic acid bacteria and was inoculated. The low contamination level of pickled herring had a mean level of lactic acid bacteria of 3.2 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 8). The medium contamination level of pickled herring had a mean level of lactic acid bacteria of 4.3 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of pickled herring had a mean level of lactic acid bacteria of 5.30–5.34 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at low (P=0.12–0.98), medium (P=0.15–0.53) and high contamination levels (P=0.45–0.97) except the level of lactic acid bacteria on the ISO 15214 reference method was significantly different than that of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C (P=0.01). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.00–2.56, Table 20).

Table 8. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Pickled Herring.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Uninoculated	1	<10	<1	<10	<1	<10	<1	<10	<1
	2	<10	<1	<10	<1	<10	<1	<10	<1
	3	<10	<1	<10	<1	<10	<1	<10	<1
	4	<10	<1	<10	<1	<10	<1	<10	<1
	5	<10	<1	<10	<1	<10	<1	<10	<1
	Mean	<10	<1	<10	<1	<10	<1	<10	<1
Low	1	1,800	3.26	1,800	3.26	1,700	3.23	1,400	3.15
	2	1,600	3.20	1,500	3.18	1,500	3.18	2,200	3.34
	3	1,400	3.15	1,600	3.20	1,400	3.15	1,500	3.18
	4	1,900	3.28	2,000	3.30	1,900	3.28	1,900	3.28
	5	1,600	3.20	1,700	3.23	1,700	3.23	1,700	3.23
	Mean	1,660	3.22	1,720	3.23	1,640	3.21	1,740	3.23
	Sr		0.05		0.05		0.05		0.08
	RSDr, %		1.55		1.55		1.56		2.47
	P-Value (vs CMMEF)		0.62		0.12				
	P-Value (vs ISO)		0.69		0.98				
P-Value (vs 37°C incubation)		0.33							
Medium	1	14,000	4.15	15,000	4.18	15,000	4.18	14,000	4.15
	2	17,000	4.23	16,000	4.20	16,000	4.20	18,000	4.26
	3	20,000	4.30	23,000	4.36	19,000	4.28	18,000	4.26
	4	23,000	4.36	26,000	4.41	25,000	4.40	26,000	4.41
	5	26,000	4.41	26,000	4.41	19,000	4.28	18,000	4.26
	Mean	18,500	4.29	21,200	4.31	18,800	4.27	18,800	4.27
	Sr		0.11		0.12		0.09		0.10
	RSDr, %		2.56		2.78		2.11		2.34
	P-Value (vs CMMEF)		0.49		0.15				
	P-Value (vs ISO)		0.53		0.26				
P-Value (vs 37°C incubation)		0.22							
High	1	240,000	5.38	260,000	5.41	240,000	5.38	300,000	5.48
	2	270,000	5.43	190,000	5.28	230,000	5.36	200,000	5.30
	3	180,000	5.26	200,000	5.30	190,000	5.28	220,000	5.34
	4	140,000	5.15	160,000	5.20	140,000	5.15	170,000	5.23
	5	200,000	5.30	210,000	5.32	220,000	5.34	220,000	5.34
	Mean	206,000	5.30	204,000	5.30	204,000	5.30	222,000	5.34
	Sr		0.11		0.08		0.10		0.09
	RSDr, %		2.07		1.51		1.89		1.69
	P-Value (vs CMMEF)		0.96		0.93				
	P-Value (vs ISO)		0.45		0.01				
P-Value (vs 37°C incubation)		0.97							

The low contamination level of kimchi had a mean level of lactic acid bacteria of 4.44–5.34 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 9). The medium contamination level of kimchi had a mean level of lactic acid bacteria of 5.41–6.85 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of kimchi had a mean level of lactic acid bacteria of 6.47–7.85 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was significantly different ($P=0.00-0.05$) between the 3M Petrifilm Lactic Acid Bacteria Count Plate methods and the reference methods at all three levels as the yeast in the kimchi outgrew the lactic acid bacteria on the reference method media such that no or few lactic acid bacteria colonies were confirmed on the reference method media. For the low contamination level, the level of lactic acid bacteria was significantly different between the two incubation temperatures of the 3M Petrifilm Lactic Acid Bacteria Count Plate method ($P=0.03$). With the reference methods having fewer samples with lactic acid bacteria being confirmed compared to the 3M Petrifilm Lactic Acid Bacteria Count Plate method, the repeatability of the 3M Petrifilm Lactic Acid Bacteria Count Plate method was better than the reference methods in half of the repeatability comparisons ($CV=1.78-42.25$ with significance at 6.59–224.6, Table 20). There was no significant difference in the repeatability between the two incubation temperatures of the 3M Petrifilm Lactic Acid Bacteria Count Plate method ($CV=1.62-3.06$ with significance at 6.39).

Table 9. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Kimchi.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	37,000	4.57	30,000	4.48	200,000	5.30	340,000	5.53
	2	28,000	4.45	28,000	4.45	110,000	5.04	280,000	5.45
	3	34,000	4.53	28,000	4.45	130,000	5.11	110,000	5.04
	4	45,000	4.65	29,000	4.46	190,000	5.28	<1,000	<3.00
	5	35,000	4.54	24,000	4.38	160,000	5.20	<1,000	<3.00
	Mean	35,800	4.55	27,800	4.44	158,000	5.19	243,333	5.34
	Sr		0.07		0.04		0.11		0.26
	RSDr, %		1.54		0.90		2.12		4.87
	P-Value (vs CMMEF)		0.00		0.00				
	P-Value (vs ISO)		0.03		0.03				
P-Value (vs 37°C incubation)		0.03							
Medium	1	310,000	5.49	280,000	5.45	<10,000	<4.00	3,400,000	6.53
	2	310,000	5.49	210,000	5.32	<10,000	<4.00	4,400,000	6.64
	3	350,000	5.54	310,000	5.49	6,400,000	6.81	5,000,000	6.70
	4	250,000	5.40	260,000	5.41	<10,000	<4.00	2,100,000	6.32
	5	400,000	5.60	240,000	5.38	7,900,000	6.90	<10,000	<4.00
	Mean	324,000	5.51	260,000	5.41	7,150,000	6.85	3,725,000	6.55
	Sr		0.08		0.064		0.06		0.17
	RSDr, %		1.45		1.18		0.88		2.60
	P-Value (vs CMMEF)		0.01		0.05				
	P-Value (vs ISO)		0.00		0.00				
P-Value (vs 37°C incubation)		0.10							
High	1	3,300,000	6.52	2,700,000	6.43	<1,000,000	<6.00	100,000,000	8.00
	2	4,900,000	6.69	4,900,000	6.69	<1,000,000	<6.00	47,000,000	7.67
	3	2,800,000	6.45	2,300,000	6.36	26,000,000	7.41	<1,000,000	<6.00
	4	2,900,000	6.46	3,100,000	6.49	110,000,000	8.04	<1,000,000	<6.00
	5	2,700,000	6.43	2,300,000	6.36	24,000,000	7.38	76,000,000	7.88
	Mean	3,320,000	6.51	3,060,000	6.47	53,333,333	7.61	74,333,333	7.85
	Sr		0.11				0.37		0.17
	RSDr, %		1.69		0.00		4.86		2.17
	P-Value (vs CMMEF)		0.03		0.02				
	P-Value (vs ISO)		0.01		0.02				
P-Value (vs 37°C incubation)		0.15							

The low contamination level of mayonnaise had a mean level of lactic acid bacteria of 2.52–2.58 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 10). There was no statistical difference in the level of lactic acid bacteria for all methods for the low contamination level (P=0.44–0.94). The medium contamination level of mayonnaise had a mean level of lactic acid bacteria of 3.58–3.65 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was significantly higher with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C than the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C (P=0.01) and the CMMEF Chapter 19 reference method for the medium contamination level (P=0.01). The high contamination level of mayonnaise had a mean level of lactic acid bacteria of 4.82–4.99 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at the high contamination level (P>0.05) except between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C and the CMMEF Chapter 19 reference method (P=0.00). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.21–5.98, Table 20).

Table 10. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Mayonnaise.

Level		3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method	
		CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g
Low	1	500	2.70	410	2.61	570	2.76	400	2.60
	2	220	2.34	210	2.32	240	2.38	400	2.60
	3	480	2.68	490	2.69	570	2.76	480	2.68
	4	360	2.56	320	2.51	270	2.43	320	2.51
	5	200	2.30	310	2.49	210	2.32	310	2.49
	Mean	352	2.52	348	2.52	372	2.53	382	2.58
	Sr		0.19		0.14		0.21		0.08
	RSDr, %		7.55		5.55		8.30		3.11
	P-Value (vs CMMEF)		0.73		0.94				
	P-Value (vs ISO)		0.44		0.41				
	P-Value (vs 37°C incubation)		0.73						
Medium	1	6,000	3.78	3,900	3.59	4,500	3.65	4,400	3.64
	2	4,300	3.63	3,600	3.56	3,100	3.49	3,500	3.54
	3	5,500	3.74	4,900	3.69	4,600	3.66	5,200	3.72
	4	2,600	3.41	2,600	3.41	2,400	3.38	4,400	3.64
	5	4,900	3.69	4,300	3.63	3,400	3.53	4,500	3.65
	Mean	4,660	3.65	3,860	3.58	3,600	3.54	4,400	3.64
	Sr		0.14		0.10		0.12		0.06
	RSDr, %		3.83		2.80		3.39		1.65
	P-Value (vs CMMEF)		0.01		0.29				
	P-Value (vs ISO)		0.87		0.21				
	P-Value (vs 37°C incubation)		0.01						
High	1	85,000	4.93	80,000	4.90	95,000	4.98	110,000	5.04
	2	80,000	4.90	70,000	4.85	85,000	4.93	90,000	4.95
	3	100,000	5.00	120,000	5.08	140,000	5.15	130,000	5.11
	4	45,000	4.65	30,000	4.48	40,000	4.60	80,000	4.90
	5	90,000	4.95	65,000	4.81	90,000	4.95	85,000	4.93
	Mean	80,000	4.89	73,000	4.82	90,000	4.92	99,000	4.99
	Sr		0.14		0.22		0.20		0.09
	RSDr, %		2.86		4.56		4.06		1.80
	P-Value (vs CMMEF)		0.36		0.00				
	P-Value (vs ISO)		0.09		0.07				
	P-Value (vs 37°C incubation)		0.36						

The mustard potato salad was not naturally contaminated with lactic acid bacteria and was inoculated. The low contamination level of mustard potato salad had a mean level of lactic acid bacteria of 3.2 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 11). The medium contamination level of mustard potato salad had a mean level of lactic acid bacteria of 4.2 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of mustard potato salad had a mean level of lactic acid bacteria of 5.25–5.40 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods at low ($P=0.12-0.94$), medium ($P=0.30-0.69$) and high levels ($P=0.15-0.90$) except the level of lactic acid bacteria on the ISO 15214 reference method was significantly different than that of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C ($P=0.02$) for the high contamination level. The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods ($CV=1.00-3.52$, Table 20).

Table 11. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Mustard Potato Salad.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Uninoculated	1	<10	<1	<10	<1	<10	<10	<10	<1
	2	<10	<1	<10	<1	<10	<10	<10	<1
	3	<10	<1	<10	<1	<10	<10	<10	<1
	4	<10	<1	<10	<1	<10	<10	<10	<1
	5	<10	<1	<10	<1	<10	<10	<10	<1
	Mean	<10	<1	<10	<1	<10	<1	<10	<1
Low	1	1,700	3.23	1,700	3.23	1,800	3.26	1,900	3.28
	2	1,900	3.28	1,900	3.28	2,200	3.34	1,500	3.18
	3	1,200	3.08	1,200	3.08	1,200	3.08	1,600	3.20
	4	1,500	3.18	1,400	3.15	1,600	3.20	1,600	3.20
	5	1,600	3.20	1,700	3.23	1,600	3.20	1,900	3.28
	Mean	1,580	3.19	1,580	3.19	1,680	3.22	1,700	3.23
	Sr		0.07		0.08		0.10		0.05
	RSDr, %		2.19		2.51		3.11		1.55
	P-Value (vs CMMEF)		0.12		0.23				
	P-Value (vs ISO)		0.41		0.40				
P-Value (vs 37°C incubation)		0.94							
Medium	1	14,000	4.15	14,000	4.15	15,000	4.18	14,000	4.15
	2	15,000	4.18	15,000	4.18	16,000	4.20	18,000	4.26
	3	19,000	4.28	19,000	4.28	29,000	4.46	14,000	4.15
	4	18,000	4.26	18,000	4.26	17,000	4.23	20,000	4.30
	5	11,000	4.04	12,000	4.08	11,000	4.04	15,000	4.18
	Mean	15,400	4.18	15,600	4.19	17,600	4.22	16,200	4.20
	Sr		0.09		0.08		0.15		0.07
	RSDr, %		2.15		1.91		3.55		1.66
	P-Value (vs CMMEF)		0.30		0.41				
	P-Value (vs ISO)		0.60		0.69				
P-Value (vs 37°C incubation)		0.37							
High	1	200,000	5.30	200,000	5.30	210,000	5.32	240,000	5.38
	2	300,000	5.48	310,000	5.49	310,000	5.49	150,000	5.18
	3	230,000	5.36	210,000	5.32	250,000	5.40	190,000	5.28
	4	170,000	5.23	190,000	5.28	190,000	5.28	150,000	5.18
	5	330,000	5.52	320,000	5.51	340,000	5.53	170,000	5.23
	Mean	246,000	5.38	246,000	5.38	260,000	5.40	180,000	5.25
	Sr		0.12		0.11		0.11		0.09
	RSDr, %		2.23		2.04		2.04		1.71
	P-Value (vs CMMEF)		0.02		0.15				
	P-Value (vs ISO)		0.15		0.15				
P-Value (vs 37°C incubation)		0.90							

The low contamination level of deli ham had a mean level of lactic acid bacteria of 4.28–4.37 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 12). The medium contamination level of deli ham had a mean level of lactic acid bacteria of 5.34–5.44 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of deli ham had a mean level of lactic acid bacteria of 7.25–8.05 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods for all three contamination levels (P=0.05–0.72). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.0–5.06, Table 20) except the repeatability of the ISO 15214 reference method was significantly better than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at 28°C (CV=18.06) and 37°C (CV=8.03) for the high contamination level.

Table 12. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Deli Ham.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	22,000	4.34	25,000	4.40	28,000	4.45	15,000	4.18
	2	21,000	4.32	21,000	4.32	17,000	4.23	33,000	4.52
	3	18,000	4.26	18,000	4.26	21,000	4.32	14,000	4.15
	4	20,000	4.30	21,000	4.32	28,000	4.45	26,000	4.41
	5	23,000	4.36	24,000	4.38	25,000	4.40	14,000	4.15
	Mean	20,800	4.32	21,800	4.34	23,800	4.37	20,400	4.28
	Sr		0.04		0.06		0.09		0.17
	RSDr, %		0.93		1.38		2.06		3.97
	P-Value (vs CMMEF)		0.26		0.40				
	P-Value (vs ISO)		0.68		0.56				
P-Value (vs 37°C incubation)		0.13							
Medium	1	170,000	5.23	170,000	5.23	220,000	5.34	340,000	5.53
	2	250,000	5.40	190,000	5.28	270,000	5.43	230,000	5.36
	3	330,000	5.52	210,000	5.32	260,000	5.41	210,000	5.32
	4	320,000	5.51	240,000	5.38	220,000	5.34	200,000	5.30
	5	350,000	5.54	320,000	5.51	370,000	5.57	280,000	5.45
	Mean	284,000	5.44	226,000	5.34	268,000	5.42	252,000	5.39
	Sr		0.13		0.11		0.09		0.10
	RSDr, %		2.39		2.06		1.66		1.85
	P-Value (vs CMMEF)		0.72		0.08				
	P-Value (vs ISO)		0.64		0.51				
P-Value (vs 37°C incubation)		0.05							
High	1	14,000,000	7.15	14,000,000	7.15	16,000,000	7.20	11,000,000	7.04
	2	10,000,000	7.00	9,800,000	6.96	14,000,000	7.15	16,000,000	7.20
	3	14,000,000	7.15	13,000,000	7.11	16,000,000	7.20	16,000,000	7.20
	4	15,000,000	7.18	10,000,000	7.00	20,000,000	7.30	14,000,000	7.15
	5	15,000,000	7.18	13,000,000	7.11	14,000,000	7.15	18,000,000	7.26
	Mean	13,600,000	7.13	11,840,000	7.07	16,000,000	7.20	15,000,000	7.17
	Sr		0.07		0.08		0.06		0.08
	RSDr, %		0.98		1.13		0.83		1.12
	P-Value (vs CMMEF)		0.08		0.05				
	P-Value (vs ISO)		0.47		0.15				
P-Value (vs 37°C incubation)		0.11							

The low contamination level of stainless steel had a mean level of lactic acid bacteria of 2.08–2.23 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 13). The medium contamination level of stainless steel had a mean level of lactic acid bacteria of 4.09–4.11 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of stainless steel had a mean level of lactic acid bacteria of 5.06–5.29 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods for all three contamination levels (P=0.07–0.86) except ISO 15214 reference method was significantly different than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at both incubation temperatures for the high contamination level (P=0.04 [28°C] and 0.00 [37°C]). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.00–4.84, Table 20) except the repeatability of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C was significantly better than the 3M Petrifilm Lactic Acid Bacteria Count Plate method at 28°C for the high contamination level (CV=7.84).

Table 13. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Stainless Steel.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Uninoculated	1	<10	<1	<10	<1	<10	<1	<10	<1
	2	<10	<1	<10	<1	<10	<1	<10	<1
	3	<10	<1	<10	<1	<10	<1	<10	<1
	4	<10	<1	<10	<1	<10	<1	<10	<1
	5	<10	<1	<10	<1	<10	<1	<10	<1
	Mean	<10	<1	<10	<1	<10	<1	<10	<1
Low	1	110	2.04	80	1.90	140	2.15	55	1.74
	2	200	2.30	90	1.95	140	2.15	380	2.58
	3	140	2.15	120	2.08	110	2.04	90	1.95
	4	140	2.15	90	1.95	90	1.95	80	1.90
	5	310	2.49	320	2.51	280	2.45	240	2.38
	Mean	180	2.23	140	2.08	152	2.15	169	2.11
	Sr		0.18		0.25		0.18		0.35
	RSDr, %		8.09		9.98		7.36		16.58
	P-Value (vs CMMEF)		0.19		0.36				
	P-Value (vs ISO)		0.33		0.84				
P-Value (vs 37°C incubation)		0.07							
Medium	1	11,000	4.04	12,000	4.08	11,000	4.04	13,000	4.11
	2	12,000	4.08	11,000	4.04	12,000	4.08	15,000	4.18
	3	14,000	4.15	13,000	4.11	14,000	4.15	9,700	3.99
	4	18,000	4.26	16,000	4.20	16,000	4.20	14,000	4.15
	5	11,000	4.04	10,000	4.00	12,000	4.08	12,000	4.08
	Mean	13,200	4.11	12,400	4.09	13,000	4.11	12,740	4.10
	Sr		0.09		0.08		0.06		0.07
	RSDr, %		2.19		2.00		1.47		1.71
	P-Value (vs CMMEF)		0.86		0.32				
	P-Value (vs ISO)		0.82		0.80				
P-Value (vs 37°C incubation)		0.19							
High	1	190,000	5.28	210,000	5.32	120,000	5.08	130,000	5.11
	2	110,000	5.04	210,000	5.32	120,000	5.08	120,000	5.08
	3	180,000	5.26	180,000	5.26	120,000	5.08	110,000	5.04
	4	160,000	5.20	160,000	5.20	160,000	5.20	85,000	4.93
	5	260,000	5.41	210,000	5.32	210,000	5.32	140,000	5.15
	Mean	180,000	5.24	194,000	5.29	146,000	5.15	117,000	5.06
	Sr		0.14		0.05		0.11		0.08
	RSDr, %		2.67		0.95		2.13		1.58
	P-Value (vs CMMEF)		0.14		0.08				
	P-Value (vs ISO)		0.04		0.00				
P-Value (vs 37°C incubation)		0.50							

The low contamination level of terrine had a mean level of lactic acid bacteria of 3.85–3.94 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 14). The medium contamination level of terrine had a mean level of lactic acid bacteria of 5.22–5.29 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of terrine had a mean level of lactic acid bacteria of 6.75–7.01 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C and the reference methods. The level of lactic acid bacteria was not significantly different between the methods for the low (P=0.13–0.97) and medium contamination level (P=0.34–0.94). The 3M Petrifilm Lactic Acid Bacteria Count Plate method at both incubation temperatures was significantly different than both reference methods for the high contamination level (P=0.00–0.01) but not each other (P=0.98). The repeatability of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C was significantly better than the reference methods for the low (CV=30.25 [CMMEF Chapter 19] and 72.25 [ISO 15214]) and medium contamination level (CV=9.0 [CMMEF Chapter 19] and 22.56 [ISO 15214]) and the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C for the low contamination level (CV=12.25). The repeatability of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C was significantly better than the ISO 15214 reference method for the medium contamination level (CV=10.03).

Table 14. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Terrine.

Level		3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method	
		CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g
Low	1	8,600	3.93	6,800	3.83	6,800	3.83	5,100	3.71
	2	7,600	3.88	8,000	3.90	4,800	3.68	9,100	3.96
	3	8,300	3.92	9,300	3.97	9,500	3.98	6,700	3.83
	4	7,800	3.89	9,500	3.98	7,600	3.88	11,000	4.04
	5	7,700	3.89	9,700	3.99	7,800	3.89	14,000	4.15
	Mean	8,000	3.90	8,660	3.93	7,300	3.85	9,180	3.94
	Sr		0.02		0.07		0.11		0.17
	RSDr, %		0.51		1.78		2.86		4.32
	P-Value (vs CMMEF)		0.34		0.13				
	P-Value (vs ISO)		0.72		0.97				
	P-Value (vs 37°C incubation)		0.44						
Medium	1	190,000	5.28	170,000	5.23	140,000	5.15	160,000	5.20
	2	200,000	5.30	170,000	5.23	130,000	5.11	100,000	5.00
	3	180,000	5.26	220,000	5.34	220,000	5.34	190,000	5.28
	4	180,000	5.26	220,000	5.34	220,000	5.34	310,000	5.49
	5	220,000	5.34	200,000	5.30	230,000	5.36	130,000	5.11
	Mean	194,000	5.29	196,000	5.29	188,000	5.26	178,000	5.22
	Sr		0.04		0.06		0.12		0.19
	RSDr, %		0.76		1.13		2.28		3.64
	P-Value (vs CMMEF)		0.68		0.43				
	P-Value (vs ISO)		0.51		0.34				
	P-Value (vs 37°C incubation)		0.94						
High	1	13,000,000	7.11	14,000,000	7.15	11,000,000	7.04	6,900,000	6.84
	2	14,000,000	7.15	13,000,000	7.11	11,000,000	7.04	10,000,000	7.00
	3	8,700,000	6.94	8,700,000	6.94	6,500,000	6.81	3,800,000	6.58
	4	9,200,000	6.96	8,700,000	6.94	7,500,000	6.88	5,300,000	6.72
	5	7,500,000	6.88	7,900,000	6.90	7,000,000	6.85	4,200,000	6.62
	Mean	10,480,000	7.01	10,460,000	7.07	8,600,000	6.92	6,040,000	6.75
	Sr		0.12		0.11		0.11		0.17
	RSDr, %		1.71		1.57		1.59		2.52
	P-Value (vs CMMEF)		0.01		0.00				
	P-Value (vs ISO)		0.00		0.00				
	P-Value (vs 37°C incubation)		0.98						

The low contamination level of yogurt had a mean level of lactic acid bacteria of 3.85–3.94 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 15). The medium contamination level of yogurt had a mean level of lactic acid bacteria of 5.22–5.29 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of yogurt had a mean level of lactic acid bacteria of 6.75–7.01 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods for the low (P=0.07–0.94), medium contamination level (P=0.10–0.95) and high contamination level (P=0.32–0.94) except between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and the ISO 15214 reference method on the low contamination level (P=0.02). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=0.16–5.22, Table 20) except the repeatability of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C was significantly better than the ISO 15214 reference method for the high contamination level (CV=7.11).

Table 15. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Yogurt.

Level		3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method	
		CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g
Low	1	780,000	5.89	810,000	5.91	810,000	5.91	760,000	5.88
	2	660,000	5.82	660,000	5.82	670,000	5.83	590,000	5.77
	3	850,000	5.93	790,000	5.90	790,000	5.90	800,000	5.90
	4	920,000	5.96	920,000	5.96	920,000	5.96	890,000	5.95
	5	680,000	5.83	690,000	5.84	700,000	5.85	650,000	5.81
	Mean	778,000	5.89	774,000	5.89	778,000	5.89	738,000	5.86
	Sr		0.06		0.06		0.05		0.07
	RSDr, %		1.02		1.02		0.85		1.19
	P-Value (vs CMMEF)		0.94		0.18				
	P-Value (vs ISO)		0.02		0.07				
P-Value (vs 37°C incubation)		0.83							
Medium	1	8,400,000	6.92	9,100,000	6.96	8,700,000	6.94	8,700,000	6.94
	2	6,600,000	6.82	6,300,000	6.80	8,300,000	6.92	6,400,000	6.81
	3	9,200,000	6.96	9,500,000	6.98	8,400,000	6.92	8,600,000	6.93
	4	7,300,000	6.86	6,900,000	6.84	6,900,000	6.84	6,600,000	6.82
	5	8,000,000	6.90	8,000,000	6.90	8,000,000	6.90	7,800,000	6.89
	Mean	7,900,000	6.89	7,960,000	6.90	8,060,000	6.90	7,620,000	6.88
	Sr		0.06		0.08		0.04		0.06
	RSDr, %		0.87		1.16		0.58		0.87
	P-Value (vs CMMEF)		0.70		0.77				
	P-Value (vs ISO)		0.17		0.10				
P-Value (vs 37°C incubation)		0.95							
High	1	76,000,000	7.88	96,000,000	7.98	83,000,000	7.92	77,000,000	7.89
	2	97,000,000	7.99	93,000,000	7.97	85,000,000	7.93	84,000,000	7.92
	3	84,000,000	7.92	97,000,000	7.99	89,000,000	7.95	89,000,000	7.95
	4	82,000,000	7.91	73,000,000	7.86	82,000,000	7.91	100,000,000	8.00
	5	65,000,000	7.81	68,000,000	7.83	65,000,000	7.81	40,000,000	7.60
	Mean	80,800,000	7.90	85,400,000	7.93	80,800,000	7.90	78,000,000	7.87
	Sr		0.06		0.05		0.05		0.16
	RSDr, %		0.76		0.63		0.63		2.03
	P-Value (vs CMMEF)		0.94		0.32				
	P-Value (vs ISO)		0.57		0.41				
P-Value (vs 37°C incubation)		0.45							

The low contamination level of chicken sausage had a mean level of lactic acid bacteria of 3.57–3.63 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 16). The medium contamination level of chicken sausage had a mean level of lactic acid bacteria of 4.65–4.70 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of chicken sausage had a mean level of lactic acid bacteria of 5.28–5.45 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods for the low ($P=0.07$ – 0.89) and medium contamination level ($P=0.07$ – 0.97). For the high contamination level, the 3M Petrifilm Lactic Acid Bacteria Count Plate method counts were significantly different from each other ($P=0.03$) and the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C was significantly different than the CMMEF Chapter 19 reference method ($P=0.04$). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different ($CV=0.40$ – 3.06 , Table 20) except the repeatability of the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C was significantly better than the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C for the high contamination level ($CV=7.56$).

Table 16. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Chicken Sausage.

Level		3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method	
		CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g
Low	1	4,100	3.61	2,800	3.45	4,600	3.66	4,100	3.61
	2	3,200	3.51	3,600	3.56	2,600	3.41	5,000	3.70
	3	5,300	3.72	5,100	3.71	4,000	3.60	5,000	3.70
	4	5,300	3.72	5,000	3.70	3,500	3.54	5,300	3.72
	5	4,000	3.60	5,300	3.72	4,300	3.63	6,500	3.81
	Mean	4,380	3.63	4,360	3.63	3,800	3.57	5,180	3.71
	Sr		0.09		0.12		0.10		0.07
	RSDr, %		2.48		3.31		2.80		1.89
	P-Value (vs CMMEF)		0.23		0.47				
	P-Value (vs ISO)		0.22		0.07				
P-Value (vs 37°C incubation)		0.89							
Medium	1	48,000	4.68	40,000	4.60	37,000	4.57	44,000	4.64
	2	65,000	4.81	57,000	4.76	55,000	4.74	39,000	4.59
	3	34,000	4.53	34,000	4.53	31,000	4.49	56,000	4.75
	4	54,000	4.73	42,000	4.62	57,000	4.76	51,000	4.71
	5	53,000	4.72	52,000	4.72	49,000	4.69	60,000	4.78
	Mean	50,800	4.70	45,000	4.65	45,800	4.65	50,000	4.69
	Sr		0.10		0.09		0.11		0.08
	RSDr, %		2.13		1.94		2.37		1.70
	P-Value (vs CMMEF)		0.10		0.92				
	P-Value (vs ISO)		0.97		0.48				
P-Value (vs 37°C incubation)		0.07							
High	1	160,000	5.20	250,000	5.40	310,000	5.49	220,000	5.34
	2	200,000	5.30	240,000	5.38	310,000	5.49	300,000	5.48
	3	190,000	5.28	230,000	5.36	210,000	5.32	260,000	5.41
	4	280,000	5.45	300,000	5.48	300,000	5.48	220,000	5.34
	5	150,000	5.18	260,000	5.41	280,000	5.45	200,000	5.30
	Mean	196,000	5.28	256,000	5.41	282,000	5.45	240,000	5.38
	Sr		0.11		0.04		0.07		0.07
	RSDr, %		2.08		0.74		1.29		1.30
	P-Value (vs CMMEF)		0.04		0.23				
	P-Value (vs ISO)		0.14		0.54				
P-Value (vs 37°C incubation)		0.03							

The low contamination level of cottage cheese had a mean level of lactic acid bacteria of 5.22–5.47 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 17). The medium contamination level of cottage cheese had a mean level of lactic acid bacteria of 6.36–6.67 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of cottage cheese had a mean level of lactic acid bacteria of 6.98–7.51 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was significantly different between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C and the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C (P=0.01–0.02), the CMMEF Chapter 19 (0.00) and the ISO 15214 reference methods (P=0.00–0.02) for all three contamination levels. The 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C was significantly different from the CMMEF Chapter 19 reference method for the medium contamination level (P=0.00) and both the CMMEF Chapter 19 (P=0.00) and ISO 15214 reference methods (P=0.00) for the high contamination level (P<0.05). For the high contamination level, the 3M Petrifilm Lactic Acid Bacteria Count Plate method samples were significantly different than each other P=0.02) and the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C was significantly different than the CMMEF Chapter 19 reference method (P=0.00). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.00–5.06, Table 20).

Table 17. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Cottage Cheese.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	300,000	5.48	220,000	5.34	270,000	5.43	220,000	5.34
	2	230,000	5.36	170,000	5.23	310,000	5.49	340,000	5.53
	3	150,000	5.18	150,000	5.18	260,000	5.41	270,000	5.43
	4	160,000	5.20	120,000	5.08	210,000	5.32	320,000	5.51
	5	250,000	5.40	180,000	5.26	310,000	5.49	360,000	5.56
	Mean	218,000	5.32	168,000	5.22	272,000	5.43	302,000	5.47
	Sr		0.13		0.10		0.07		0.09
	RSDr, %		2.44		1.92		1.29		1.64
	P-Value (vs CMMEF)		0.08		0.00				
	P-Value (vs ISO)		0.12		0.02				
P-Value (vs 37°C incubation)		0.02							
Medium	1	2,800,000	6.45	1,500,000	6.18	3,500,000	6.54	2,500,000	6.40
	2	4,000,000	6.60	2,700,000	6.43	5,000,000	6.70	3,600,000	6.56
	3	3,300,000	6.52	2,900,000	6.46	4,900,000	6.69	4,300,000	6.63
	4	3,200,000	6.51	2,000,000	6.30	5,000,000	6.70	3,900,000	6.59
	5	4,100,000	6.61	2,800,000	6.45	5,000,000	6.70	3,900,000	6.59
	Mean	3,480,000	6.54	2,380,000	6.36	4,680,000	6.67	3,640,000	6.55
	Sr		0.07		0.12		0.07		0.09
	RSDr, %		1.07		1.89		1.05		1.37
	P-Value (vs CMMEF)		0.00		0.00				
	P-Value (vs ISO)		0.65		0.00				
P-Value (vs 37°C incubation)		0.01							
High	1	11,000,000	7.04	16,000,000	7.20	25,000,000	7.40	31,000,000	7.49
	2	8,900,000	6.95	9,500,000	6.98	35,000,000	7.54	35,000,000	7.54
	3	9,600,000	6.98	12,000,000	7.08	27,000,000	7.43	30,000,000	7.48
	4	8,500,000	6.93	11,000,000	7.04	33,000,000	7.52	38,000,000	7.58
	5	9,400,000	6.97	15,000,000	7.18	35,000,000	7.54	29,000,000	7.46
	Mean	9,480,000	6.98	12,700,000	7.10	31,000,000	7.49	32,600,000	7.51
	Sr		0.04		0.09		0.07		0.05
	RSDr, %		0.57		1.27		0.93		0.67
	P-Value (vs CMMEF)		0.00		0.00				
	P-Value (vs ISO)		0.00		0.00				
P-Value (vs 37°C incubation)		0.02							

The low contamination level of pepperoni had a mean level of lactic acid bacteria of 5.87–6.72 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 18). The medium contamination level of pepperoni had a mean level of lactic acid bacteria of 6.37–7.18 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of pepperoni had a mean level of lactic acid bacteria of 7.36–8.17 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was significantly different between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and the reference methods for all three contamination levels (P=0.00–0.03) and the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C for the medium and high contamination levels (P=0.00). The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.33–1.49, Table 20).

Table 18. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and ISO 15214 Reference Methods for Pepperoni.

Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method		
	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	
Low	1	720,000	5.86	920,000	5.96	1,300,000	6.11	1,500,000	6.18
	2	930,000	5.97	1,300,000	6.11	13,000,000	7.11	1,400,000	6.15
	3	650,000	5.81	11,000,000	7.04	15,000,000	7.18	1,200,000	6.08
	4	760,000	5.88	1,400,000	6.15	14,000,000	7.15	1,400,000	6.15
	5	700,000	5.85	1,300,000	6.11	1,100,000	6.04	1,100,000	6.04
	Mean	752,000	5.87	3,184,000	6.28	8,880,000	6.72	1,320,000	6.12
	Sr		0.06		0.59		0.59		0.06
	RSDr, %		1.02		9.40		8.78		0.98
	P-Value (vs CMMEF)		0.03		0.13				
	P-Value (vs ISO)		0.00		0.49				
P-Value (vs 37°C incubation)		0.13							
Medium	1	1,500,000	6.18	16,000,000	7.20	12,000,000	7.08	19,000,000	7.28
	2	2,200,000	6.34	18,000,000	7.26	12,000,000	7.08	15,000,000	7.18
	3	2,200,000	6.34	14,000,000	7.15	16,000,000	7.20	11,000,000	7.04
	4	3,400,000	6.53	12,000,000	7.08	12,000,000	7.08	16,000,000	7.20
	5	3,000,000	6.48	12,000,000	7.08	16,000,000	7.20	15,000,000	7.18
	Mean	2,640,000	6.37	14,400,000	7.15	13,600,000	7.13	15,200,000	7.18
	Sr		0.14		0.07		0.07		0.09
	RSDr, %		2.20		0.98		0.98		1.25
	P-Value (vs CMMEF)		0.00		0.70				
	P-Value (vs ISO)		0.00		0.66				
P-Value (vs 37°C incubation)		0.00							
High	1	28,000,000	7.45	120,000,000	8.08	100,000,000	8.00	87,000,000	7.94
	2	18,000,000	7.26	130,000,000	8.11	150,000,000	8.18	130,000,000	8.11
	3	29,000,000	7.46	180,000,000	8.26	110,000,000	8.04	150,000,000	8.18
	4	15,000,000	7.18	190,000,000	8.28	110,000,000	8.04	120,000,000	8.08
	5	28,000,000	7.45	140,000,000	8.15	130,000,000	8.11	120,000,000	8.08
	Mean	23,600,000	7.36	152,000,000	8.17	120,000,000	8.07	121,400,000	8.08
	Sr		0.13		0.07		0.07		0.09
	RSDr, %		1.77		0.86		0.87		1.11
	P-Value (vs CMMEF)		0.00		0.15				
	P-Value (vs ISO)		0.00		0.05				
P-Value (vs 37°C incubation)		0.00							

The low contamination level of ready-to-bake pizza had a mean level of lactic acid bacteria of 5.32–5.54 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods (Table 19). The medium contamination level of ready-to-bake pizza had a mean level of lactic acid bacteria of 6.43–6.53 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The high contamination level of ready-to-bake pizza had a mean level of lactic acid bacteria of 7.80–8.13 Log CFU/g with the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C and 37°C, and the reference methods. The level of lactic acid bacteria was not significantly different between the methods for all three contamination levels (P=0.12–0.85) except between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 37°C and 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at 28°C (P=0.03) and the CMMEF Chapter 19 reference method (P=0.01) on the high contamination level. The repeatability of the methods when compared between the 3M Petrifilm Lactic Acid Bacteria Count Plate method incubated at both temperatures and the reference methods was not different between methods (CV=1.00–2.78, Table 20).

Table 19. Method Comparison Results for the 3M Petrifilm Lactic Acid Bacteria Count Plate Method Compared to the CMMEF Chapter 19 and the ISO 15214 Reference Methods for Ready-to-Bake-Pizza.

Level		3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		CMMEF Method		ISO Method	
		CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g	CFU/g	Log CFU/g
Low	1	370,000	5.57	120,000	5.08	490,000	5.69	350,000	5.54
	2	270,000	5.43	240,000	5.38	370,000	5.57	190,000	5.28
	3	320,000	5.51	220,000	5.34	320,000	5.51	310,000	5.49
	4	390,000	5.59	300,000	5.48	310,000	5.49	380,000	5.58
	5	190,000	5.28	200,000	5.30	190,000	5.28	670,000	5.83
	Mean	308,000	5.47	216,000	5.32	336,000	5.51	380,000	5.54
	Sr		0.13		0.15		0.15		0.20
	RSDr, %		2.37		2.82		2.72		3.61
	P-Value (vs CMMEF)		0.51		0.17				
	P-Value (vs ISO)		0.60		0.12				
	P-Value (vs 37°C incubation)		0.15						
Medium	1	4,800,000	6.68	2,200,000	6.34	3,400,000	6.53	2,700,000	6.43
	2	3,000,000	6.48	3,000,000	6.48	2,700,000	6.43	2,900,000	6.46
	3	4,100,000	6.61	2,700,000	6.43	3,500,000	6.54	7,300,000	6.86
	4	3,000,000	6.48	2,000,000	6.30	2,500,000	6.40	2,800,000	6.45
	5	2,600,000	6.41	4,000,000	6.60	4,200,000	6.62	2,400,000	6.38
	Mean	3,500,000	6.53	2,780,000	6.43	3,260,000	6.51	3,620,000	6.52
	Sr		0.11		0.12		0.09		0.20
	RSDr, %		1.68		1.87		1.38		3.07
	P-Value (vs CMMEF)		0.68		0.14				
	P-Value (vs ISO)		0.85		0.47				
	P-Value (vs 37°C incubation)		0.32						
High	1	290,000,000	8.46	250,000,000	8.40	270,000,000	8.43	370,000,000	8.57
	2	54,000,000	7.73	51,000,000	7.71	58,000,000	7.76	460,000,000	8.66
	3	38,000,000	7.58	34,000,000	7.53	48,000,000	7.68	60,000,000	7.78
	4	50,000,000	7.70	50,000,000	7.70	60,000,000	7.78	76,000,000	7.88
	5	50,000,000	7.70	45,000,000	7.65	55,000,000	7.74	57,000,000	7.76
	Mean	96,400,000	7.86	86,000,000	7.80	98,200,000	7.88	204,600,000	8.13
	Sr		0.36		0.34		0.31		0.45
	RSDr, %		4.60		4.36		3.93		5.54
	P-Value (vs CMMEF)		0.12		0.01				
	P-Value (vs ISO)		0.14		0.10				
	P-Value (vs 37°C incubation)		0.03						

Table 20. Comparison of Repeatability: The 3M Petrifilm Lactic Acid Bacteria Count Plate Method vs the CMMEF Chapter 19 and ISO 15214 Reference Methods.

Product	Level	3M Petrifilm LAB Method 28°C		3M Petrifilm LAB Method 37°C		3M Petrifilm LAB Method 28°C vs 37°C
		vs CMMEF	vs ISO	vs CMMEF	vs ISO	
Cold Smoked Salmon	Low	2.47	1.36	2.47	1.36	1.00
	Medium	2.89	8.03 (RM ^a)	4.00	11.11 (RM)	1.38
	High	1.99	1.47	1.78	1.65	1.12
Cream-filled Puff Pastry	Low	1.00	1.56	1.00	1.56	1.56
	Medium	1.44	2.25	1.00	1.56	1.56
	High	1.27	1.49	1.27	1.49	1.49
Creamy Dressing	Low	1.47	10.80 (RM)	1.11	8.16 (RM)	1.32
	Medium	1.93	7.72 (RM)	1.23	4.94	1.56
	High	1.28	1.28	1.44	1.44	1.12
Deli Chicken	Low	1.14	1.45	3.10	2.43	3.53
	Medium	1.89	1.56	1.49	1.23	1.27
	High	2.09	2.42	1.16	1.00	2.42
Deli Turkey	Low	5.75	2.25	1.56	4.00	9.00 (37°C)
	Medium	1.33	2.09	3.52	1.27	2.64
	High	5.44	5.90	9.00 (RM)	3.57	1.65
Duck Pâté	Low	1.53	13.80 (RM)	1.20	10.80 (RM)	1.28
	Medium	1.08	11.39 (RM)	1.56	19.14 (RM)	1.68
	High	1.87	1.69	3.20	2.89	1.71
Pickled Herring	Low	1.00	2.56	1.00	2.56	1.00
	Medium	1.49	1.21	1.78	1.44	1.19
	High	1.21	1.49	1.56	1.27	1.89
Kimchi	Low	2.47	13.8 (TM, CV=6.94)	7.56 (TM, CV=6.94)	42.25 (TM, CV=6.94)	3.06
	Medium	1.78 (CV=224.60)	4.52 (CV=6.59)	1.03 (CV=6.59)	8.03 (TM, CV=6.59)	1.78
	High	11.31 (TM, CV=6.59)	2.39 (CV=6.94)	6.98 (TM, CV=6.59)	1.47 (CV=6.94)	1.62
Mayonnaise	Low	1.22	5.04	2.25	3.06	1.22
	Medium	1.36	5.44	1.44	2.78	1.36
	High	2.04	2.42	1.21	5.98	2.04
Mustard Potato Salad	Low	2.04	1.96	1.56	2.56	1.31
	Medium	2.78	1.65	3.52	1.31	1.27
	High	1.19	1.78	1.00	1.49	1.19
Deli Ham	Low	5.06	18.06 (TM)	2.25	8.03 (TM)	2.25
	Medium	2.09	1.69	1.49	1.21	1.40
	High	1.36	1.31	1.78	1.00	1.31
Stainless Steel	Low	1.00	3.78	1.93	1.96	1.93
	Medium	2.25	1.65	1.78	1.31	1.27
	High	1.62	3.06	4.84	2.56	7.84 (TM)
Terrine	Low	30.25 (TM)	72.25 (TM)	2.47	5.90	12.25 (28°C)
	Medium	9.0 (TM)	22.56 (TM)	4.00	10.03 (TM)	2.25
	High	1.19	2.01	1.00	2.39	1.19
Yogurt	Low	0.16	1.36	1.44	1.36	1.00
	Medium	2.25	1.00	4.00	1.78	1.78
	High	1.44	7.11 (TM)	1.96	5.22	1.36
Chicken Sausage	Low	1.23	1.65	1.44	2.94	1.78
	Medium	1.21	1.56	1.49	1.27	1.23
	High	0.40	2.47	3.06	3.06	7.56 (37°C)
Cottage Cheese	Low	3.45	2.09	2.04	1.23	1.69
	Medium	1.00	1.65	2.94	1.78	2.94
	High	3.06	1.56	1.65	3.24	5.06
Pepperoni	Low	1.33	1.33	1.33	1.33	1.33
	Medium	1.49	1.49	1.31	1.27	1.49
	High	1.35	1.35	1.35	1.35	1.35
Ready-To-Bake Pizza	Low	1.33	2.37	1.00	1.78	1.33
	Medium	1.49	3.31	1.78	2.78	1.19
	High	1.35	1.56	1.20	1.75	1.12

CV = Critical Value (6.39 unless noted).

RM^a = Reference method repeatability statistically better.

TM^b = Test method repeatability statistically better.

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