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SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS

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PASTEURIZATION OF MARKET MILK IN THE GLASS ENAMELED TANK AND IN-THE-BOTTLE

By T. H. Wright, Jr.*

The glass enameled tank has been used to a considerable extent in the dairy industry for various steps in the manufacture and handling of market milk, condensed milk, butter and ice cream.

It seemed to offer certain advantages as a pasteurizer for market milk which other types did not possess, so an experiment was planned to determine the effect of pasteurization in the glass enameled tank upon cream line, bacteria, flavor and odor.

PLAN AND METHODS

In studying the glass enameled tank as a pasteurizer for market milk, it was decided to compare it with the "in-the-bottle" method.

The milk used was that purchased from farmers and from the college dairy herd for pasteurization and distribution upon the milk routes operated by the college creamery.

It was all run through a clarifier into the glass enameled tank. From here part of it was pumped into the bottle filler and into the milk bottles for pasteurization in-the-bottle. The remainder was pasteurized in the glass enameled tank.

The work of pasteurization was all done under practical working conditions in the college creamery by the regular men. The aim of pasteurization was to heat the milk to and hold at a temperature of 142-145 degrees F. for 30 minutes.

The work was done in two series or sets of experiments with some differences in procedure as will be noted later on. The first series was run in the spring of 1922, and the second in the spring of 1923.

Pasteurization

For pasteurization in-the-bottle there were used oversize bottles of the so-called crown finish type using metal caps with bonded parchment discs. The bottles were placed in a tank of water and the water heated by means of steam. It was aimed not to let the temperature of the water exceed 150 degrees F. and the milk was to be held as stated previously. The milk was cooled by allowing cold water to run in at the bottom of the tank, replacing the hot water and causing it to overflow.

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In the first series, up until May 27, the in-the-bottle milk was cooled to 50 degrees F. before taking samples for bacterial count and cream line. For the remainder of this series it was only cooled to 60 degrees F. The milk was then placed in the refrigerator surrounded by cracked ice.

The milk pasteurized in the glass enameled tank was heated to and held at the same temperature as that in-the-bottle. It was heated by turning live steam into the jacket with the blow-off valve set at 10 pounds. Cooling was accomplished by means of running water and by brine.

In the first series the milk was cooled in the tank itself, being cooled to 50 degrees F. before taking the samples. After May 26, it was only cooled to 60 degrees F. before taking the samples.

In series two the milk pasteurized in the tank was cooled by running over a surface coil cooler, coming off the cooler at a temperature of 50 degrees F. or lower.

Bacterial Count

In the first series the samples for the bacterial count of the pasteurized milks were taken after the milk had been cooled to the temperatures mentioned previously. These samples were packed in ice and plated as soon as possible.

It should be noted that the counts of the milk pasteurized in the glass tank in this series represent samples taken directly from the tank. If this milk had been bottled before sampling the counts would have been higher.

In the second series the milk pasteurized in the glass tank ran from the cooler into the bottle filler and from there into the bottles. The bottles were then placed in the refrigerator surrounded by cracked ice and were held till the following morning before sampling. This method was followed so as to give an idea of the count at the time of delivery to the consumer. The in-the-bottle milk was placed in the refrigerator after it had been cooled to 70 degrees F. or lower. It was also surrounded with cracked ice and held until the following morning before sampling.

Two samples were taken of the milk pasteurized in the glass tank. One of these was from the first milk to run over the cooler and is referred to in the tables as Tank (1). The other was from the last milk over the cooler and is referred to as Tank (2).

The samples for the raw milk counts were taken just before pasteurization and packed in ice until plated.

All counts were made on agar prepared from 1 per cent dehydrated nutrient agar and were incubated at 37 degrees C. for 48 hours.

Cream Line

In the first series the cream line was determined by means of 100 cc. graduates being filled with milk at the time of taking the bacterial samples. These graduates were placed in ice water and held till the following morning when the percent of cream which had risen was noted.

In the second series the percent of cream which had risen was determined from quart bottles of milk which had been held over-night surrounded with cracked ice. The percent of cream was determined by means of a scale which could be placed beside the milk bottle and the percent read directly.

Flavor and Odor

In all instances the comparisons on these items were made after the milk had been held overnight. At time of comparison the samples were warmed so that off flavors and odors would be more pronounced. Usually more than one person made the comparison. The raw milks were not taken into consideration in ranking on flavor and odor.

RESULTS

SERIES I.

Bacterial Count

On 11 days the count of the milk pasteurized in the glass tank was lower than that pasteurized in-the-bottle and on 10 days it was higher but we find that the in-the-bottle method had a slightly lower average count and a higher average efficiency as shown by the following figures:

Milk	Average Count	Average Efficiency
Raw	1,622,841	
Glass Tank	60,807	95.7%
In-The-Bottle	48,334	96.3%

Note:— In figuring the average count and the average efficiency, only those days were considered on which data were available for each of the three samples of milk. The average efficiency was determined by dividing the total for the series by the number of days and was not determined from the average counts of the raw and pasteurized milks.

The average count of the pasteurized milks is affected

more by occasional exceptionally high or low counts than is the bacterial efficiency. If we use the figures obtained for the average efficiency and apply them to the average count of the raw milk we get a count of 69,782 for the milk pasteurized in the glass tank and a count of 60,045 for that pasteurized in-the-bottle.

Cream Line.

On 17 days the in-the-bottle pasteurized milk showed more cream than that pasteurized in the glass tank and on five days it showed less.

The average percents of cream and average creaming efficiencies were as follows:

Milk	Average Percent Cream	Average Efficiency
Raw	11.5	
Glass Tank	8.2	70%
In-The-Bottle	10.0	87%

Note:— These averages were obtained in the same way as the averages under bacterial count.

If we use the above figures for average efficiency and apply them to the average percent of cream on the raw milk we get 8.1 percent as the volume of cream on the milk pasteurized in the glass tank and 9.6 percent for that pasteurized in-the-bottle.

Flavor and Odor

On 10 days preference was given to the milk pasteurized in the glass tank and on seven days the in-the-bottle was preferred. On seven occasions half of those comparing the milks preferred that pasteurized in the glass tank and the other half preferred that pasteurized in-the-bottle.

SERIES II.

Bacterial Count

If we compare the bacterial count of the milk pasteurized in-the-bottle with that first over the cooler after pasteurization in the glass tank, we find that on eight days that pasteurized in-the-bottle had a lower count and on five days it had a higher count.

When compared with the last over the cooler we find that the in-the-bottle had a lower count on nine days and a higher one on four days.

When we take the average count of both samples from the milk pasteurized in the glass tank and compare this with the count of that pasteurized in-the-bottle we get a lower count on eight days for that pasteurized in-the-bottle and a higher count on five days.

The average bacterial count and average bacterial efficiency were as follows:

Milk	Average Count	Average Efficiency
Raw	1,298,958	
Glass Tank (1)	26,625	93.9%
Glass Tank (2)	41,058	91.6%
In-The-Bottle	62,483	93.3%
Glass Tank (Ave.)	33,842	92.8%

Note:—These averages were obtained as in Series I.

If we use the above figures for average efficiency and apply them to the average count of the raw milk we get the following counts:— Glass Tank (1) 79,236; Glass Tank (2) 109,112; In-The-Bottle, 87,030 and Glass Tank (Ave), 93,524.

Cream Line

Out of 18 days the milk pasteurized in-the-bottle showed less cream than either the first or last over the cooler from the glass tank. On two days it was higher than either of the other samples and on one day it was lower than one of the other samples and tied with the second.

The average percents of cream and the average creaming efficiencies were as follows:

Milk	Average Percent Cream	Average Efficiency
Raw	15.0	
Tank (1)	13.1	90%
Tank (2)	11.6	80%
In-The-Bottle	9.9	69%
Tank (Ave)	12.4	85%

Using the above figures for average creaming efficiency and applying them to the average volume of cream found on the raw milk we get the following figures for the volume of cream:—Tank (1), 13.5; Tank (2), 12.0; In-The-Bottle, 10.4 and Tank (Ave), 12.8.

It should be mentioned that in most cases the line of demarcation was much more distinct in the case of the milks pasteurized in the glass tank than in that pasteurized in-the-bottle.

Flavor and Odor

The data on these items is not very complete for this series. Where comparisons were made the glass tank pasteurized milks were preferred in three cases out of five and the in-the-bottle milk in two cases.

CONCLUSIONS

The glass enameled tank when used as a complete pasteurizer and cooler for market milk had two objections. The first of these was the length of time required for cooling, which delayed the bottling of the milk. While it is true that with the in-the-bottle method used it required a still longer time for cooling yet this was not so serious because the milk was already bottled ready for delivery. The second objection was the reduction of the volume of cream due probably to the excessive length of time required for cooling during which the milk was subjected to agitation.

The glass enameled tank when used with a surface coil cooler gave very satisfactory results as compared with the in-the-bottle method. The rapid cooling gave a larger volume of cream and the line of demarcation was very distinct. The last milk over the cooler gave a less volume than the first over the cooler. It took about 30 or 40 minutes to finish the cooling and bottling and this meant that the last milk over the cooler was under agitation for a longer period of time. It is probably true that with other methods of in-the-bottle pasteurization cooling may be accomplished more quickly than in these experiments. If this is possible better results could no doubt be obtained as to volume of cream and distinctness of cream line.

As far as bacterial count is concerned it is the usual impression that the in-the-bottle method gives the better results and this is the case unless special care is taken in sterilizing the cooler, bottler, etc., to which the milk is exposed after pasteurization in bulk. In our work a commercial sterilizer was used in addition to hot water and steam and the counts of the milk pasteurized in the glass tank compared very favorably with those of the milk pasteurized in-the-bottle.

The flavor and odor was usually cleaner in the case of the milk pasteurized in the glass tank. If there are any objectionable flavors or odors present in the raw milk they have a better chance to escape when the milk is pasteurized in bulk. There was a slight heated taste in some of the milk pasteurized in the glass tank but it was not serious.

Under the conditions of these experiments the glass enameled tank combined with a surface coil cooler is to be preferred to the in-the-bottle method for pasteurization of market milk.

TABLE I.
Series I.

Date	Milk	Initial temperature degrees F.	Minutes Required to heat to 142 F.	Maximum temperature	Minutes required to cool to 50 F.	Total minutes to heat, hold and cool	Percent butterfat in milk	Percent cream in 24 hours	Creaming efficiency percent	Bacteria count per c.c.	Percent efficiency of bacterial reduction	Rank on flavor
1922	Raw	.....	.....	.....	.....	.....	3.4	×	.....	3,445,000	.....	.....
May 11	Tank	63	32	145	90	152	3.4	9	×	352,000	89.8	1
	Bottle	61	45	146	165	240	3.4	9	×	14,200	99.6	2
	Raw	.....	.....	.....	.....	.....	3.5	13	.....	1,725,000	.....	.....
May 12	Tank	70	21	145	94	145	3.5	10	77	21,000	98.8	1
	Bottle	58	65	143	135	230	3.5	13	100	207,800	88.0	2
	Raw	.....	.....	.....	.....	.....	3.65	12	.....	1,000,000	.....	.....
May 13	Tank	60	27	146	83	140	3.65	12	100	23,850	97.6	1
	Bottle	57	60	145	140	230	3.65	11	92	55,500	94.4	2
	Raw	.....	.....	.....	.....	.....	3.6	13	.....	356,500	.....	.....
May 15	Tank	66	28	144	92	150	3.6	10	77	17,700	95.0	1
	Bottle	60	49	145	171	250	3.6	11	85	19,600	94.5	2
	Raw	.....	.....	.....	.....	.....	3.5	11	.....	4,425,000	.....	.....
May 25	Tank	69	37	143	×	×	3.5	×	×	103,500	97.7	2
	Bottle	70	50	143	×	×	3.5	×	×	52,250	98.8	1
	Raw	.....	.....	.....	.....	.....	3.4	9	.....	1,555,000	.....	.....
May 26	Tank	×	24	148	×	×	3.4	4	44	3,100	99.8	Tie
	Bottle	×	56	144	×	×	3.4	8	89	3,400	99.8	Tie
	Raw	.....	.....	.....	.....	.....	3.5	13	.....	2,070,000	.....	.....
May 27	Tank	77	36	144	111	177	3.5	10½	81	58,000	97.2	2
	Bottle	77	44	145	100	174	3.5	9½	73	11,900	99.4	1
	Raw	.....	.....	.....	.....	.....	×	13½	.....	2,735,000	.....	.....
May 29	Tank	74	70	143	87	187	×	9	67	116,500	95.7	2
	Bottle	74	51	144	120	201	×	11	81	130,500	95.2	1

	Raw	.....	.....	.....	.....	.....	3.7	13½	.....	1,125,000	.....	.....
May 30	Tank	60	32	147	105	137	3.7	7	52	19,000	98.3	1
	Bottle	60	64	142	111	175	3.7	13	96	63,000	94.4	2
	Raw	.....	.....	.....	.....	.....	3.5	13½	.....	930,000	.....	.....
May 31	Tank	68	42	148	70	142	3.5	7½	56	14,200	98.5	2
	Bottle	68	62	142	112	204	3.5	11½	85	10,800	98.8	1
	Raw	.....	.....	.....	.....	.....	3.4	13	.....	1,370,000	.....	.....
June 2	Tank	71	32	146	73	135	3.4	7	54	29,300	97.9	1
	Bottle	71	52	145	145	227	3.4	9	69	21,600	98.4	2
	Raw	.....	.....	.....	.....	.....	3.6	13	.....	171,000	.....	.....
June 3	Tank	×	×	143	×	×	3.6	11½	88	48,400	71.7	2
	Bottle	×	×	145	×	×	3.6	11	85	17,100	90.0	1
	Raw	.....	.....	.....	.....	.....	3.3	11	.....	×	.....	.....
June 5	Tank	74	51	147	95	176	3.3	4	36	×	×	1
	Bottle	74	57	143	90	177	3.3	10	91	×	×	2
	Raw	.....	.....	.....	.....	.....	3.4	10	.....	1,080,000	.....	.....
June 7	Tank	73	36	147	69	135	3.4	6	60	53,000	95.1	1
	Bottle	73	56	144	120	206	3.4	9	90	10,000	99.1	2
	Raw	.....	.....	.....	.....	.....	3.7	9½	.....	700,000	.....	.....
June 8	Tank	66	27	145	85	142	3.7	7	74	36,600	94.7	1
	Bottle	67	50	144	110	190	3.7	9½	100	15,900	97.7	2
	Raw	.....	.....	.....	.....	.....	3.9	11	.....	2,110,000	.....	.....
June 9	Tank	70	35	147	72	137	3.9	6	55	×	×	1
	Bottle	70	59	143	110	199	3.9	9½	86	55,050	97.4	2
	Raw	.....	.....	.....	.....	.....	3.5	10	.....	2,320,000	.....	.....
June 10	Tank	70	28	149	67	125	3.5	7	70	174,500	92.5	1
	Bottle	70	52	144	110	192	3.5	7½	75	98,500	95.8	2
	Raw	.....	.....	.....	.....	.....	3.5	9	.....	980,500	.....	.....
June 12	Tank	68	20	146	75	125	3.5	5	56	7,700	99.2	2
	Bottle	68	56	144	157	243	3.5	8½	94	23,100	97.6	1
	Raw	.....	.....	.....	.....	.....	×	12	.....	1,410,000	.....	.....
June 13	Tank	60	30	144	60	120	×	10½	87	106,000	92.5	2
	Bottle	60	51	142	×	×	×	10	83	106,000	92.5	1

TABLE I. (Continued)
Series I

Date	Milk	Initial temperature degrees F.	Minutes Required to heat to 142 F.	Maximum temperature	Minutes required to cool to 50 F.	Total minutes to heat, hold and cool	Percent butterfat in milk	Percent cream in 24 hours	Creaming efficiency percent	Bacteria count per c.c.	Percent efficiency of bacterial reduction	Rank on flavor
	Raw	.....	.....	.....	.....	.....	3.5	10½	.....	350,000	.....	.....
June 14	Tank	70	18	146	75	123	3.5	7½	71	1,800	99.5	Tie
	Bottle	70	61	144	95	186	3.5	9½	90	6,100	98.3	Tie
	Raw	.....	.....	.....	.....	.....	3.6	13	.....	4,695,000	.....	.....
June 16	Tank	50	27	144	56	113	3.6	12	92	111,000	97.6	1
	Bottle	50	54	143	95	179	3.6	10	77	74,500	98.4	2
	Raw	.....	.....	.....	.....	.....	3.5	10½	.....	500,000	.....	.....
June 17	Tank	68	32	146	50	112	3.5	9	86	13,900	97.2	1
	Bottle	68	50	143	155	235	3.5	10	95	27,300	94.5	2
	Raw	.....	.....	.....	.....	.....	3.5	10	.....	1,500,000	.....	.....
June 19	Tank	72	27	145	66	123	3.5	8	80	24,400	98.4	2
	Bottle	72	58	144	172	260	3.5	9	90	51,300	96.6	1
	Raw	.....	.....	.....	.....	.....	3.6	11	.....	1,260,000	.....	.....
June 20	Tank	70	49	143	59	138	3.6	9	82	2,300	99.8	1
	Bottle	70	58	144	100	188	3.6	10½	95	54,000	95.7	2

TABLE II.

Milk Pasteurized in Glass Tank. Series I.

Date	Percent Cream	Creaming Efficiency	Bacteria Count	Bacterial Efficiency
May 11, 1922	9	×	352,000	89.8
12	10	77	21,000	98.8
13	12	100	23,850	97.6
15	10	77	17,700	95.0
25	×	×	103,500	97.7
26	4	44	3,100	99.8
27	10.5	81	58,000	97.2
29	9	67	116,500	95.7
30	7	52	19,000	98.3
31	7.5	56	14,200	98.5
June 2	7	54	29,300	97.9
3	11.5	88	48,400	71.7
5	4	36	×	×
7	6	60	53,000	95.1
8	7	74	36,600	94.7
9	6	55	×	×
10	7	70	174,500	92.5
12	5	56	7,700	99.2
13	10.5	87	106,000	92.5
14	7.5	71	1,800	99.5
16	12	92	111,000	97.6
17	9	86	13,900	97.2
19	8	80	24,400	98.4
20	9	82	2,300	99.8
Average	8.2	70	60,807	95.7

Note: The average bacteria count of the raw milk was 1,622,841 and the average percent of cream on the raw milk was 11.5

TABLE III.

Milk Pasteurized In-The-Bottle. Series I.

Date	Percent Cream	Creaming Efficiency	Bacteria Count	Bacterial Efficiency
May 11, 1922	9	×	14,200	99.6
12	13	100	207,800	88.0
13	11	92	55,500	94.4
15	11	85	19,600	94.5
25	×	×	52,250	98.8
26	8	89	3,400	99.8
27	9.5	73	11,900	99.4
29	11	81	130,500	95.2
30	13	96	63,000	94.4
31	11.5	85	10,800	98.8
June 2	9	69	21,600	98.4
3	11	85	17,100	90.0
5	10	91	×	×
7	9	90	10,000	99.1
8	9.5	100	15,900	97.7
9	9.5	86	55,050	97.4
10	7.5	75	98,500	95.8
12	8.5	94	23,100	97.6
13	10	83	106,000	92.5
14	9.5	90	6,100	98.3
16	10	77	74,500	98.4
17	10	95	27,300	94.5
19	9	90	51,300	96.6
20	10.5	95	54,000	95.7
Average	10.0	87	48,334	96.3

Note: The average bacteria count of the raw milk was 1,622,841 and the average percent of cream on the raw milk was 11.5

TABLE IV.
Series II.

Date	Milk	Initial temperature degrees	Minutes required to heat to 142 F.	Maximum temperature	Percent cream in 24 hours	Creaming Efficiency percent	Bacteria count per c. c.	Percent Efficiency of bacterial reduction	Rank on Flavor
1923	Raw	.....	.....	.....	15	.....	247,000	.....	.....
April 11	Tank (1)	56	30	144	12	80	22,000	91.1	×
	Tank (2)	56	30	144	11	73	7,300	97.0	×
	Bottle	56	46	142	14	93	73,500	70.2	×
	Raw	.....	.....	.....	12	.....	253,500	.....	.....
April 12	Tank (1)	52	26	142	12	100	28,500	88.8	×
	Tank (2)	52	26	142	10½	87	15,200	94.0	×
	Bottle	53	27	148	7	58	3,600	98.6	×
	Raw	.....	.....	.....	14	.....	72,000	.....	.....
April 16	Tank (1)	58	34	142	14	100	14,600	79.7	×
	Tank (2)	58	34	142	14	100	×	×	×
	Bottle	52	39	×	8	57	×	×	×
	Raw	.....	.....	.....	13	.....	260,000	.....	.....
April 18	Tank (1)	56	28	142	13	100	15,300	94.1	×
	Tank (2)	56	28	142	11	85	14,300	94.5	×
	Bottle	62	38	144	8	62	6,000	97.7	×
	Raw	.....	.....	.....	13	.....	1,555,000	.....	.....
April 19	Tank (1)	63	27	×	12½	96	45,000	97.1	×
	Tank (2)	63	27	×	12	92	146,000	90.6	×
	Bottle	59	36	×	10	77	37,000	97.6	×
	Raw	.....	.....	.....	14½	.....	510,000	.....	.....
April 23	Tank (1)	54	32	142	15½	107	45,000	91.2	×
	Tank (2)	54	32	142	13½	93	54,000	89.4	×
	Bottle	57	32	145	10	69	×	×	×

TABLE IV. (Continued)
Series II.

Date	Milk	Initial temperature degrees	Minutes required to heat to 142 F.	Maximum temperature	Percent cream in 24 hours	Creaming Efficiency percent	Bacteria count per c. c.	Percent Efficiency of bacterial reduction	Rank on Flavor
	Raw	.....	.....	.....	17	.....	2,310,000	.....	.....
April 24	Tank (1)	54	23	142	15½	91	74,000	96.8	2
	Tank (2)	54	23	142	13	76	109,000	95.3	1
	Bottle	58	25	145	12½	74	27,000	98.8	3
	Raw	.....	.....	.....	15	.....	6,800,000	.....	.....
April 25	Tank (1)	54	23	142	14½	97	12,300	99.8	×
	Tank (2)	54	23	142	12	80	21,100	99.7	×
	Bottle	52	39	146	8½	57	440,000	93.5	×
	Raw	.....	.....	.....	16	.....	670,000	.....	.....
April 26	Tank (1)	58	24	142	14	88	68,000	89.9	2
	Tank (2)	58	24	142	13	81	69,000	89.7	3
	Bottle	60	36	142	11½	72	25,000	96.3	1
	Raw	.....	.....	.....	13	.....	330,000	.....	.....
April 27	Tank (1)	54	20	143	11½	88	4,400	98.7	×
	Tank (2)	54	20	143	10½	81	5,000	98.5	×
	Bottle	64	31	147	10	77	2,500	99.2	×
	Raw	.....	.....	.....	×	.....	×	.....	.....
April 30	Tank (1)	63	25	144	14½	×	134,000	×	1
	Tank (2)	63	25	144	11½	×	50,000	×	1
	Bottle	60	27	145	8	×	456,000	×	3
	Raw	.....	.....	.....	13½	.....	455,000	.....	.....
May 1	Tank (1)	×	×	142	12½	93	33,000	92.7	×
	Tank (2)	×	×	142	11½	85	×	×	×
	Bottle	×	×	150	9½	70	107,000	76.5	×

	Raw	.....	.....	.....	14	.....	2,720,000	.....	.....
May 2	Tank (1)	64	22	145	9	64	14,500	99.5	×
	Tank (2)	64	22	145	8	57	29,200	98.9	×
	Bottle	64	34	146	10½	75	106,000	96.1	×
	Raw	.....	.....	.....	13½	.....	910,000	.....	.....
May 3	Tank (1)	60	18	143	12½	92	2,200	99.8	×
	Tank (2)	60	18	143	×	×	×	×	×
	Bottle	60	26	145	×	×	×	×	×
	Raw	.....	.....	.....	14	.....	100,000	.....	.....
May 4	Tank (1)	54	22	142	13	93	13,000	87.0	×
	Tank (2)	54	22	142	11½	82	34,400	65.6	×
	Bottle	60	37	144	11½	82	24,300	75.7	×
	Raw	.....	.....	.....	17½	.....	1,230,000	.....	.....
May 7	Tank (1)	57	25	143	14	80	31,000	97.5	3
	Tank (2)	57	25	143	12½	71	20,000	98.4	2
	Bottle	60	28	145	×	×	×	×	1
	Raw	.....	.....	.....	16½	.....	240,000	.....	.....
May 8	Tank (1)	48	22	144	13½	82	11,300	95.3	2
	Tank (2)	48	22	144	12	73	30,000	87.5	1
	Bottle	50	44	145	10	67	1,700	99.3	3
	Raw	.....	.....	.....	17	.....	130,000	.....	.....
May 9	Tank (1)	52	19	144	13½	79	×	×	×
	Tank (2)	52	19	144	11	65	5,900	95.5	×
	Bottle	58	36	144	9	53	1,900	98.5	×
	Raw	.....	.....	.....	×	.....	102,000	.....	.....
May 10	Tank (1)	56	20	143	13½	×	11,200	89.0	×
	Tank (2)	56	20	143	11	×	12,200	88.0	×
	Bottle	58	38	143	9½	×	3,200	96.9	×
	Raw	.....	.....	.....	16½	.....	×	.....	.....
May 11	Tank (1)	52	22	144	14	85	×	×	×
	Tank (2)	52	22	144	10½	64	×	×	×
	Bottle	52	42	146	9	55	×	×	×

TABLE V.

Milk Pasteurized in Glass Tank. Series II.

(First over the Cooler)

Date	Percent Cream	Creaming Efficiency	Bacteria Count	Bacterial Efficiency
April 11, 1923	12	80	22,000	91.1
12	12	100	28,500	88.8
16	14	100	14,600	79.7
18	13	100	15,300	94.1
19	12.5	96	45,000	97.1
23	15.5	107	45,000	91.2
24	15.5	91	74,000	96.8
25	14.5	97	12,300	99.8
26	14	88	68,000	89.9
27	11.5	88	4,400	98.7
30	14.5	×	134,000	×
May 1	12.5	93	33,000	92.7
2	9	64	14,500	99.5
3	12.5	92	2,200	99.8
4	13	93	13,000	87.0
7	14	80	31,000	97.5
8	13.5	82	11,300	95.3
9	13.5	79	×	×
10	13.5	×	11,200	89.0
11	14	85	×	×
Average	13.1	90	26,625	93.9

Note: The average bacteria count of the raw milk was 1,298,958 and the average percent of cream on the raw milk was 15.0

TABLE VI.

Milk Pasteurized in Glass Tank. Series II.

(Last over the Cooler)

Date	Percent Cream	Creaming Efficiency	Bacteria Count	Bacterial Efficiency
April 11, 1923	11	73	7,300	97.0
12	10.5	87	15,200	94.0
16	14	100	×	×
18	11	85	14,300	94.5
19	12	92	146,000	90.6
23	13.5	93	54,000	89.4
24	13	76	109,000	95.3
25	12	80	21,100	99.7
26	13	81	69,000	89 7
27	10.5	81	5,000	98.5
30	11.5	×	60,000	×
May 1	11.5	85	×	×
2	8	57	29,200	98.9
3	×	×	×	×
4	11.5	82	34,400	65.6
7	12.5	71	20,000	98.4
8	12	73	30,000	87.5
9	11	65	5,900	95.5
10	11	×	12,200	88.0
11	10.5	64	×	×
Average	11.6	80	41,058	91.6

Note: The average bacteria count of the raw milk was 1,298,958 and the average percent of cream on the raw milk was 15.0

TABLE VII.

Milk Pasteurized In-The-Bottle. Series II.

Date	Percent Cream	Creaming Efficiency	Bacteria Count	Bacterial Efficiency
April 11, 1923	14	93	73,500	70.2
12	7	58	3,600	98.6
16	8	57	×	×
18	8	62	6,000	97.7
19	10	77	37,000	97.6
23	10	69	×	×
24	12.5	74	27,000	98.8
25	8.5	57	440,000	93.5
26	11.5	72	25,000	96.3
27	10	77	2,500	99.2
30	8	×	456,000	×
May 1	9.5	70	107,000	76.5
2	10.5	75	106,000	96.1
3	×	×	×	×
4	11.5	82	24,300	75.7
7	×	×	×	×
8	10	67	1,700	99.3
9	9	53	1,900	98.5
10	9.5	×	3,200	96.9
11	9	55	×	×
Average	9.9	69	62,483	93.3

Note: The average bacteria count of the raw milk was 1,298,958 and the average percent of cream on the raw milk was 15.0

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