

THE BACTERIOLOGICAL CONDITION AND KEEPING QUALITIES OF GRADE "A" (CERTIFIED) MILK DURING THE YEAR 1921.

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THE year 1921 was characterised by prolonged high temperatures and was one of great difficulty for the milk industry. It is, therefore, of interest to study the results of the bacteriological examination, and the keeping qualities of samples of Grade "A" (certified) milk which were examined during the period January 1st to December 30th, 1921.

The following paper has, therefore, been prepared and shows the condition of the milk from four farms which are described, as in previous papers, as Farms I, II, III and IV.

The milk travelled in pint bottles by rail to the laboratory and no special precautions were taken in order to keep it cool on the journey.

Sixty-four samples from Farm I, at an average age of 32 hours, and 144 samples from Farm III, at an average age of 30 hours, were examined. The results have been classified, according to the temperature of the samples on arrival at the laboratory and the bacteriological counts, and are found in Table I.

Table I.

*Farm I.*

No. of colonies per 1 c.c.	Temp. on arrival at laboratory 41-50° F.	Temp. on arrival at laboratory 51-60° F.	Temp. on arrival at laboratory 61-70° F.	Temp. on arrival at laboratory 71-75° F.	Temp. on arrival at laboratory over 75° F.
0- 1,000	7	13	7	—	—
1,000- 5,000	4	7	4	—	—
5,000- 10,000	—	—	1	—	—
10,000- 30,000	—	—	1	—	—
30,000-100,000	—	—	1	1	—
100,000-200,000	—	—	—	2	—
Over 200,000	—	1	6	9	—

*Farm III.*

0- 1,000	10	26	8	—	—
1,000- 5,000	5	9	10	—	1
5,000- 10,000	—	3	1	—	—
10,000- 30,000	1	4	6	—	—
30,000-100,000	2	1	6	—	—
100,000-200,000	—	2	3	—	—
Over 200,000	—	4	32	8	2

*Results of the examination of 208 samples of milk when 30-32 hours old.*

On combining the results of both farms it is found that 29 samples arrived at temperatures between 41 and 50° F. and that two of them showed counts exceeding 30,000 colonies per 1 c.c.

Seventy samples, eight of which exceeded the standard of 30,000 per 1 c.c., arrived at the laboratory at temperatures between 51 and 60° F. Of the 86 samples which were delivered at temperatures between 61 and 70° F. 48 showed counts which were above the standard. When the temperature on arrival lay between 71 and 75° F. the counts of all the 20 samples examined exceeded the standard. Two out of three of those samples which reached the laboratory at temperatures over 75° F. also gave counts in excess of 30,000 per 1 c.c. Therefore, of the 99 samples, which arrived at the laboratory at temperatures of 60° F. or less, only ten failed to conform to the standard, as compared with 70 out of 109 when the temperatures on arrival were over 60° F.

*Results of the examination of 90 samples of milk when 22-24 hours old.*

In the case of Farm II 42 samples at an average age of 22 hours, and in that of Farm IV 48 samples at an average age of 24 hours, were examined. Table II shows the results obtained with the samples from both farms.

Table II.

*Farm II.*

No. of colonies per 1 c.c.	Temp. on arrival at laboratory 41-50° F.	Temp. on arrival at laboratory 51-60° F.	Temp. on arrival at laboratory 61-70° F.	Temp. on arrival at laboratory 71-75° F.
0- 1,000	6	6	2	—
1,000- 5,000	4	6	2	2
5,000- 10,000	—	—	1	—
10,000- 30,000	—	2	1	—
30,000-100,000	—	—	2	1
100,000-200,000	—	—	1	—
Over 200,000	—	1	4	1

*Farm IV.*

0- 1,000	8	13	9	—
1,000- 5,000	—	6	6	—
5,000- 10,000	1	1	—	—
10,000- 30,000	—	1	1	—
30,000-100,000	—	—	—	—
100,000-200,000	—	—	—	—
Over 200,000	—	—	1	1

If these results be combined it appears that 19 samples reached the laboratory at temperatures between 41 and 50° F. and none gave counts which exceeded the standard of 30,000 per 1 c.c. Thirty-six samples arrived at temperatures between 51 and 60° F. and one only was found to have exceeded the standard. On the other hand, of 30 samples which reached the laboratory at temperatures varying from 61 to 70° F., eight showed counts in excess of 30,000 per 1 c.c., and of five samples arriving at temperatures between 71 and 75° F., three failed to conform to the standard.

A study of Table I demonstrates that Farm I shows a certain superiority over Farm III and similarly in Table II Farm IV shows more consistent results than Farm II.

It seems, therefore, that even on farms of good type the bacteriological quality of the milk is not constant from farm to farm, but the excellence or otherwise of the labour is reflected in the results. This effect of labour on resulting quality is further emphasized when the keeping qualities of the milk are considered later on in the paper.

Table III.

*The influence of Age and Temperature upon the Bacteriological Counts of Grade "A" (Certified) Milk.*

Age (hours)	No. of samples	Temp. on arrival at laboratory 41-50° F.		Temp. on arrival at laboratory 51-60° F.		Temp. on arrival at laboratory 61-70° F.		Temp. on arrival at laboratory 71-75° F.		Temp. on arrival at laboratory over 75° F.	
		Counts under 30,000 per c.c.	Counts over 30,000 per c.c.	Counts under 30,000 per c.c.	Counts over 30,000 per c.c.	Counts under 30,000 per c.c.	Counts over 30,000 per c.c.	Counts under 30,000 per c.c.	Counts over 30,000 per c.c.	Counts under 30,000 per c.c.	Counts over 30,000 per c.c.
24	90	19	0	35	1	22	8	2	3	—	—
30	208	27	2	62	8	38	48	0	20	1	2

The results found in Tables I and II have been combined in Table III and confirm the observation made in a previous paper—that properly produced milk delivered to the consumer at an age not greater than 24 hours and at a temperature of not more than 60° F. may be expected to conform to the bacteriological standard of 30,000 per 1 c.c., as laid down in the regulations for Grade "A" (Certified) milk, and also that if the age of the milk exceeds 24 hours and the temperature is over 60° F. success is by no means certain.

#### KEEPING QUALITIES.

A number of the samples from Farms I and III were kept and the keeping qualities determined by the following method. Each sample was divided into two, one part was kept in a cool cellar and one in the laboratory. Each portion was tested twice daily, the length of time during which the milk remained sweet being calculated in the following way. If the milk was sweet when tested at 36 hours old but sour or tainted at 48 hours, the duration of sweetness was taken as 36 hours. In many cases, therefore, the actual duration of sweetness of the milk was some hours longer than is shown by the figures. In this way 37 samples from Farm I and 89 from Farm III were examined between the middle of July and December 31st, 1921. In all, therefore, 126 samples were examined from both farms and are classified in Table IV according to the length of time they remained sweet, and the temperature on arrival.

If the samples kept in the laboratory be considered it is found that of 12 samples which arrived at temperatures between 41 and 50° F. none remained sweet for less than three days. Of the 28 samples arriving at temperatures varying from 51 to 60° F. only one was sweet for less than two

and a half days and none for less than two days. Sixty-six samples arrived at temperatures between 61 and 70° F. and of these, 11 were sweet for one and a half and 55 for two days or more.

Table IV.

*The keeping qualities of Grade "A" (Certified) Milk at Room Temperatures and in a cool cellar.*

		No. of days sweet from time of milking	Temperatures on arrival at the laboratory							
			41-50° F.		51-60° F.		61-70° F.		Over 70° F.	
			Lab.	Cellar	Lab.	Cellar	Lab.	Cellar	Lab.	Cellar
Farm I 14 vii. 21 to 5 i. 22	{	1 day	—	—	—	—	—	—	—	—
		1½ days	—	—	—	—	—	—	—	—
		2 "	—	—	—	—	2	—	3	2
		2½ "	—	—	—	—	2	—	6	2
		3 "	1	—	1	—	6	5	1	5
		More than 3 days	3	4	8	9	4	9	—	1
Farm III 14 vii. 21 to 29 xii. 21	{	1 day	—	—	—	—	—	—	—	—
		1½ days	—	—	—	—	11	2	5	1
		2 "	—	—	1	—	8	4	4	4
		2½ "	—	—	4	2	22	11	1	3
		3 "	4	—	6	2	8	17	—	2
		More than 3 days	4	8	8	14	3	17	—	—
Farms I and III combined	{	1 day	—	—	—	—	—	—	—	—
		1½ days	—	—	—	—	11	2	5	1
		2 "	—	—	1	—	10	4	7	6
		2½ "	—	—	4	2	24	11	7	5
		3 "	5	—	7	2	14	22	1	7
		More than 3 days	7	12	16	23	7	26	—	1

NOTE. Two days' sweetness indicates that the sample was not tainted at the end of two days, but was sour when tasted at two and a half days.

Two samples from Farm III were not examined in the cellar.

Twenty samples reached the laboratory at temperatures of over 70° F., and of these five were sweet for one and a half days and 15 for two days or more. When these figures are compared with those for the samples kept in the cellar it is seen that the average duration of sweetness of the milk is noticeably longer than in the laboratory.

In the cellar no sample arriving at temperatures between 41 and 50° F. was sweet for less than three and a half days. When the temperature on arrival lay between 51 and 60° F. no sample was sweet for less than two and a half days, and 25 out of 27 were sweet for three days or more. Even when the temperature on arrival was between 61 and 70° F. only two samples out of 65 were sweet for less than two days and 48 were sweet for three days or more. Twenty samples arrived at temperatures above 70° F. and of these only one was sweet for less than two days. It is a notable fact that despite the very high temperatures encountered by many of the samples, none remained sweet for less than one and a half days from the time of milking even when kept in the laboratory where the average maximum temperature throughout the summer period was 72° F.

In the case of Farm I, the bacteriological tests of which show a certain superiority over Farm III, no sample was sweet for less than two days. This

fact is of great importance to the milk industry, since at no time during the summer period was the farmer in a position to cool his milk below 57° F., and on many occasions the temperature could not be reduced below 64° F.

A study of the figures for 1921, therefore, warrants the following conclusions:

1. No milk should be delivered to the consumer at an age greater than 24 hours and a temperature of over 60° F. if the bacteriological standard of 30,000 per 1 c.c. is to be maintained.

2. The keeping qualities of well produced Grade "A" (certified) milk are such that provided (1) is adhered to there should be no difficulty in keeping milk in a consumer's house from one delivery to the next.

3. Taking all factors into consideration the keeping qualities of Grade "A" (certified) milk under very adverse temperature conditions are so vastly superior to those of ordinary market milk that the universal adoption of better methods of milk and handling milk would materially reduce the losses through souring which in the year under consideration were colossal.

4. The figures also show that if the milk after delivery to the consumer be stored in a cool place, even though it may have encountered very high temperatures *en route* it will keep sweet an appreciably longer time than when stored at ordinary room temperatures.