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BACTERIOLOGICAL QUALITY OF SOME FARM WATER SUPPLIES IN QUEENSLAND

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SUMMARY

Sixty water supplies from 44 dairy farms were examined bacteriologically to determine the total bacterial count, coliform, lipolytic, proteolytic and psychrophilic counts, numbers of yeasts and moulds and the production of changes in litmus milk. Many of the samples were from rain-water storage tanks, but samples from bores, dams, creeks, springs and a well were also examined.

Many waters had very high counts of organisms which could cause deterioration of dairy products and only five did not contain biochemically active bacteria in 1 ml. In many samples, including most of the samples of rain water, coliform organisms were not detected in 1 ml.

It is concluded that all farm water supplies should be suspected of containing appreciable contamination which can lower the quality of milk or cream, and so should be heat-treated or chemically sterilized before being used for dairy purposes.

I. INTRODUCTION

Early investigations of the importance of organisms found in water with regard to the keeping quality of butter were reviewed by Corley, Long, and Hammer (1943), who suggested standards for water supplies to butter manufacturing plants.

Various workers (e.g. Thomas and Thomas 1947; Cuthbert 1955; Stiles, Royse, and Abbott 1962) have noted that a water supply with a very low coliform count which may be acceptable from a public health point of view may still contain a considerable number of organisms which are undesirable in

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dairy products. For this reason, Harmon (1957) suggested that tests for specific types of spoilage organisms should be made on water supplies for dairy purposes and suggested a standard of not more than 5 proteolytic and/or lipolytic organisms per ml. Thomas and Thomas (1947) suggested the use of a milk-souring organisms test to detect undesirable types of bacteria in milk supplies.

Workers who have discussed the bacteriological quality of farm water supplies include Thomas and Thomas (1947), Franklin and George (1949) Cuthbert, Scarlett, and Westwater (1956) and Stiles, Royse, and Abbott (1962), but with the exception of one sample examined by Stiles and his co-workers, none of the samples was of a rain-water supply. As many dairy farms in Queensland rely on rain water stored in tanks for dairy purposes, it was considered advisable to examine the bacterial flora in such waters in some detail. These samples were obtained during a study of the farm ripening of cream, and attention was therefore paid to the numbers of those types of organisms which could cause spoilage in cream.

II. METHODS

Samples of water were packed in ice immediately after sampling, and examined at the laboratory on the afternoon of the same day.

Examinations for total bacterial count were made on plate count agar (Difco) with incubation for 3 days at 30°C. Coliform organisms were counted on desoxycholate agar (Difco) after 24 hr at 30°C. Psychrophilic organisms were determined after incubation on plate count agar for 14 days at 5°C. Lipolytic organisms were counted using nutrient agar with 0·01% tributyrin added to the plate. Proteolytic organisms and acid-producing organisms were estimated on BCP chalk agar with 10% sterile skim-milk added, and yeasts and moulds were determined using yeast-salt agar (British Standard Methods No. 895, 1940).

One-millilitre quantities of the samples were inoculated into 10 ml litmus milk and changes in the litmus milk noted after 2 days at 30° and 37°C, 5 days at 20°C and 7 days at 10°C, respectively.

III. RESULTS

The results of analyses of 60 samples of untreated farm waters are shown in Table 1. The waters have been grouped according to source, and the numbers of samples with bacterial counts in various ranges have been shown.

Most of the tank-water supplies had high bacterial counts, contained considerable numbers of lipolytic and/or proteolytic organisms, and showed changes in litmus milk in 2 days at 30° or 37°C. However, only 3 of the rain-water samples contained coliform organisms in 1 ml, and these 3 samples had less than 10 coliforms per ml.

TABLE 1

SUMMARY OF BACTERIOLOGICAL ANALYSES OF WATER SUPPLIES

Observation*	Source of Water				Total
	Tank	Dam	Creek or Spring	Bore or Well	
Total bacterial count/ml					
$<10^2$	1	..	..	..	1
$10^2-<10^3$	10	1	..	..	11
$10^3-<10^4$	10	1	2	4	17
$10^4-<10^5$	13	5	3	2	23
10^5 and over	5	2	1	..	8
Coliform organisms/ml					
<1	36	3	3	4	46
1 –10	3	1	..	..	4
10 –$<10^2$	..	3	2	2	7
10^2 and over	..	2	1	..	3
Psychrophiles/ml					
<1	13	1	..	1	15
1 –<10	12	3	..	..	15
10 –$<10^2$	7	..	..	2	9
$10^2-<10^3$	4	2	5	1	12
10^3 and over	3	3	1	2	9
Lipolytic organisms/ml					
<1	5	..	..	..	5
1 –<10	4	..	..	1	5
10 –$<10^2$	7	..	..	1	8
10^2 and over	11	5	2	3	21
Proteolytic organisms/ml					
<1	8	..	..	1	9
1 –<10	4	..	..	..	4
10 –$<10^2$	7	1	..	..	8
$10^2-<10^3$	10	1	2	2	15
10^3 and over	8	6	3	3	20
Yeast and moulds/ml					
<10	6	3	2	5	16
10 –$<10^2$	28	5	4	1	38
10^2 and over	5	1	..	..	6
Litmus milk					
Change in 2 days	35	9	6	5	55
No change	4	..	..	1	5
No. examined	39	9	6	6	60

* Only 56 samples were examined for proteolytic organisms and 39 for lipolytic organisms.

Relatively small numbers of waters from other sources were examined. Most of these waters had high bacterial counts and all except one bore water showed deterioration of litmus milk in 2 days. There was a much greater incidence of coliform contamination in these waters than in the samples of rain water.

The five samples (4 tank and 1 bore) which did not change litmus milk in 2 days all had coliform and psychrophyilic counts less than 1 per ml, and proteolytic and lipolytic counts less than 10 per ml. The total counts of 3 of these samples were between 1,000 and 10,000 per ml, but comprised biochemically inert types of organisms.

Only 13 samples contained acid-producing organisms in 1 ml. These comprised 4 samples of tank water, 4 of bore water and the one well-water sample, 2 samples of dam water and 2 of creek water. The numbers of acid-producing organisms in most of these samples were low (less than 100 per ml) but 1 tank water, 1 creek water and 1 bore water had counts of 1300, 700 and 600 per ml, respectively.

Four samples of water from dairy boilers were also examined. Three of these samples were of good bacteriological quality but the other contained large numbers of proteolytic and lipolytic organisms which were apparently sporing rods belonging to the genus *Bacillus*.

IV. DISCUSSION

Most of the water supplies examined contained organisms which could cause undesirable changes in dairy products. This result for rain-water supplies is similar to that found in overseas countries for untreated waters from other sources. The results obtained here suggest that the use of the coliform test, as an indication of the bacteriological quality of a water supply for dairy use, without some other test for spoilage organisms, would be even less reliable in the case of rain water than in the case of underground, creek or dam waters.

In Queensland, the reactions in litmus milk over a range of temperatures have been determined on routine water samples for bacteriological analysis for many years. The tests reported here showed that litmus milk reactions adequately indicate the biochemical activity of the bacteria in the sample, as even small numbers of lipolytic, proteolytic or psychrophilic organisms caused rapid changes of the litmus milk. Counts of acid-producing organisms were generally low, and the types of colonies on the BCP agar plates indicated that streptococci occurred only rarely in 1-ml quantities of water. This finding is in agreement with that of Thomas (1949).

As over 90% of the farm waters examined contained undesirable organisms, it would seem that routine examinations of such supplies are unnecessary. The considerable variation in the bacteriological quality of farm waters depending on seasonal conditions also makes the results of isolated tests unreliable. All supplies should therefore be sterilized by boiling or by chemical methods before being used for rinsing equipment. If chlorination is being used, a sediment-free water should be treated to give 10-20 p.p.m. available chlorine.

Examination of dairy boiler waters showed that periodical cleaning may be necessary to prevent the occurrence of considerable numbers of sporing organisms. These organisms produce very objectionable defects in dairy products. The effectiveness of heat treatment or chemical sterilization of a water supply could easily be checked in the field by the inoculation of sterile litmus milk with a small amount of the treated water.

Some of the tank-water supplies contained very high bacterial counts. Regular cleaning of tanks containing water to be used for dairy purposes should maintain the bacterial count at a much lower level.

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