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TOTAL VIABLE COUNT OF TREATED WATER IN THE KANDY MUNICIPAL DISTRIBUTION SYSTEM

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Abstract : The general bacterial population of treated water in the Kandy distribution system was studied. The mean total viable counts at 35°C and 20°C were found to be 80/ml and 129/ml respectively. The mean total viable counts at 35°C and 20°C were not significantly different. The frequency of detection of coliforms was increased to levels up to a total viable count of 500/ml but decreased thereafter.

1. Introduction

Potable water of good bacteriological quality is generally associated with attainment of less than one total coliform/100 ml of water. Yet there are many other micro-organisms common to the flora of finished water whose numbers far exceed those of the coliform group. Some of these organisms may be a factor in creating health problems in very young and the debilitated persons in a community.[4,7] In addition high non-coliform population in finished water have been implicated in suppressing coliform growth in test media.[1,3,5] Even though water treatment is adequate and Cl_2 disinfection is provided, quality could deteriorate in the distribution system as a result of growth of organisms other than detectable coliforms.

Unless there is considerable collection of data within a country the total microbial count is difficult to use as a water quality standard. This study provides data with regard to the levels of non-fastidious heterotrophic bacteria in treated water in one of the main water distribution networks in Sri Lanka.

2. Experimental

Eighty-four samples of water from the Kandy water distribution system was examined for the total viable count and the total coliforms. The samples were collected from street standposts which are directly connected to the main and transported in accordance with the methods recommended by the WHO.[10]

2.1 Total viable count

One ml quantities of the sample and of the 10^{-1} dilution were added to petridishes and 5 ml of glucose extract agar was poured over and mixed well. Duplicate plates for each dilution was used. After the plates were set, one set of plates were incubated at 35°C for 24 hours and the other set at 20°C for 48 hours. All colonies on selected plates (plates having colony numbers between 30 and 300) were counted after the incubation time.

2.2 Total coliforms

Most probable number technique using MacConkey broth was used in the estimation of total coliforms according to the WHO recommendations.[10]

3. Results

3.1 Mean total viable count in the Kandy Water Distribution System

The mean total viable counts, the standard deviation and the range of counts at the two incubation temperatures 35°C and 20°C are shown in Table 1. The mean total viable counts at 35°C and 20°C are 80 and 129 respectively. A significant difference of viable counts was not observed by the "t" test for paired observations.

Table 1. Mean total viable count and the Density by range in the Kandy water distribution system

	No. of Samples	Mean and Standard Deviation	Range
Total viable count at 35°C	72	80 ± 9	1 – 1600/ml
Total viable count at 20°C	73	129 ± 11	1 – 2200/ml

The percentage of samples in the different density ranges of the total viable count at 35°C and 20°C are shown in Tables 2 and 3. 23 and 25% of the samples have total viable counts $\leq$ 10 at 35°C and 20°C respectively.

Table 2. Bacterial Plate Counts at 35°C Versus Coliform detection in water in the Kandy water distribution system

Total plate count Density range/ml	Pour plate method 35°C		Total coliforms	
	No. of samples	Percentage	Occurrence	Percentage
1 – 10	23	27.4	3	13
11 – 30	12	14.3	1	8.3
31 – 100	11	13.1	4	36.3
101 – 300	11	13.1	5	45.4
301 – 500	9	10.7	5	55.5
501 – 1000	2	2.4	1	50
> 1000	4	4.8	2	50
Covered with proteus	12	14.2	10	83.3

Table 3. Bacterial Plate Count at 20°C Versus Coliform detection in water in the Kandy water distribution system

Total plate count Density range/ml	Pour plate method 20°C		Total coliforms	
	No. of samples	Percentage	Occurrence	Percentage
1 – 10	25	29.7	4	16
11 – 30	4	4.8	0	0
31 – 100	11	13.1	4	36.3
101 – 300	12	14.3	8	66.6
301 – 500	13	15.5	8	61.5
501 – 1000	2	2.4	0	0
> 1000	6	7.1	1	16.6
Covered with proteus	11	13.1	6	54.5

3.2 Total viable count versus coliform detection

The data presented in Tables 2 and 3 show the relationship between the total viable count and the detection of coliforms at the two temperatures 35°C and 25°C. At 35°C, the frequency of detecting coliforms does not show a significant increase after a total viable count of 500/ml (Table 2) and at 20°C the frequency of detecting coliforms increases upto a total viable count of 500/ml and decreases thereafter (Table 3).

3.3 Percentage of samples of water below a total viable count of 500/ml

Of the samples of the Kandy distribution system 77 to 78% were below 500/ml at 20°C and 35°C respectively. In 13–14% of the total samples analysed it was unable to estimate an accurate count due to the plates being covered with proteus.

4. Discussion

The total viable count for drinking water as described in standard methods of American Public Health Association 1975, is the plating of small quantities (usually 1.0 ml or 0.1 ml) of a properly collected water sample in a nutrient agar medium and incubating aerobically for a fixed period at a prescribed temperature (35°C for 24 hours in 20°C for 48 hours).

Although no constant relationship appears to exist between standard plate count and the number of potentially pathogenic invaders that might be present, it is logical to assume that change occurences are proportionally greater as the general bacterial population increases. In addition high non coliform populations in finished water have been implicated in suppressing coliform growth in test media.[1,3,5] Therefore water having a high non-coliform population would indicate a negative coliform test giving the consumer a false sense of security. The initial level of suppression of coliforms has been shown to be a general bacterial population exceeding 1000/ml.[8] Therefore an establishment of a standard plate count limit of 500/ml in the distribution water has been considered as a useful measure.[6]

The results of the present study shows that the mean total viable count of Kandy distribution water is below 500/ml and therefore the adverse influence of excessive bacterial population interfering on routine monitoring procedures of the Kandy water distribution system could be considered very low. The present study too shows that the frequency of detection of coliforms increasing as the standard plate count increased to levels upto 500/ml but decreasing thereafter (Table 3).

The total viable count could be considered as a quality control of water treatment processes and the efficacy of sanitation measures used on distribution lines. Fischer[5] indicates that a total viable count below 500/ml could be maintained in the distribution lines by maintaining a residual Cl_2 level of approximately 0.3 mg/l throughout the distribution lines. Of the samples of the Kandy distribution water 77 to 78% showed counts below 500/ml at 20°C and 35°C respectively, indicating that the deterioration of water quality in the distribution system is very low.

Water used in food, beverage cosmetic and drug industries should be of a higher standard with regard to the total viable count because these organisms create taste, odor and spoilage problems in the finished products.[2] It has been suggested that the water used in food processing should have a plate count of less than 50 bacteria/ml.[2] With regard to the water in the Kandy distribution system supplemental treatment procedures are required if the water is used for food, beverage, cosmetic or drug industries to maintain good keeping properties of the products.

The importance of using two temperatures of incubation namely 20°C and 35°C in determining the total viable count is that 20°C covers the growth requirements of most natural soil and water bacteria and 35°C the organisms of animal human reservoir. In the present study the total viable counts at 20°C and 35°C were not significantly different. Theoretically, an increased count at 35°C is more critical from a hygienic point of view than an increased count at 20°C.

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