Examination of Bacteriological Contamination of Household Water bodies in Meenambalam, Kollam District, Kerala, India

Mahath.C.S and K.MophinKani

Abstract— A safe, consistent, and reliable water supply for drinking is a need for all living organisms. However, a large number of the world's human population lives in areas that are suffering from water quality problems and water shortages. Many areas have contaminated water with fecal coliform bacteria as the primary contaminant is the most common health risk. As a result, there are many aid groups that are actively working to develop and improve the water supply in the developing world. An important first step in such work is an accurate appraisal of the existing water supply. This appraisal often requires a rapid, onsite field assessment of possible fecal coliform contamination with minimal equipment. The coliform bacteria are often referred to as "indicator organisms" because they indicate the potential presence of disease-causing bacteria. Not all microorganisms are harmful. Main harmful species of coliform bacteria that present in the sewage water are E.Coli. Even though not all species of E.coli are harmful, only certain strains of E.coli are harmful. The present work is conducted to study the presence of coliforms (that may be pathogenic) of groundwater of Meenambalam area, Kollam district, Kerala is selected and to evaluate the suitability of groundwater for drinking purposes. Groundwater from the wells as well as surface water bodies located at different parts of the study area were be analysed for the presence of total as well as fecal coliforms and estimation is done through multiple tube fermentation (MPN) technique.

Index Terms— Coliform bacteria, E.Coli, Fecal coliforms, Ground water, Indicator organisms, MPN Technique, Total coliforms.

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1. Introduction

Water is one of the most important elements for all forms of life. It is indispensable in the maintenance of life on earth. It is also essential for the composition and renewal of cells. Despite of this, human beings are continuing to pollute water sources resulting in provoking water related illnesses [1].

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Diseases related to contamination of drinking-water constitute a major burden on human health. The most common and widespread health risk associated with drinking-water is microbial contamination. Up to 80% of all sicknesses and diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. As to 2006 report of world health organisation (WHO) approximately [2] three out of five persons in developing countries do not have access to safe drinking water and only about one in four has any kind of sanitary facilities. Water may also play a role in the transmission of pathogens which are not faecal excreted. Contamination of drinking water with a type of Escherichia coli known as O157:H7 can be fatal. Many microorganisms are found naturally in fresh and

Salt water [3]. The microbiological quality of drinking water has attracted great attention worldwide because of implied public health impacts [3]. Total and fecal coliform have been used extensively for many years as indicators for determining the sanitary quality of water sources. The purpose of the routine bacteriological examination of water samples is usually to estimate the hazard due to fecal pollution and the probability of the presence of pathogenic organisms.

Normally occurring bacteria in the intestines of warm-blooded animals have been used as indicators of fecal pollution. Total coliforms, fecal coliforms, and fecal streptococci have all been used as pollution indicators at various times**.** [4] Total coliform densities have been used to measure the occurrence and degree of fecal pollution in streams for over 60 years. As defined in *Standard Methods* the coliform group comprises all of the aerobic and facultative anaerobic, gram-negative, non spore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hr at 35°C.

The TC group has been adopted as an indicator of fecal pollution suggestive of a hazard to health because these bacteria are associated with the gut of warm-blooded animals. Thus, the absence of TC is generally evidence of a bacteriologically safe water [5]. If the hypothesis that the coliform bacteria of fecal origin represent greater danger to health than those native to other environments is accepted, the separation of the fecal and non fecal groups is necessary. Enumerating methods for FC by the elevated temperature tests have been developed by [6] for the MPN procedure.

The most common fecal coliform species is *Escherichia coli.* The FC organisms generally do not multiply outside the intestines of warm-blooded animals, except in certain high-carbohydrate wastewaters such as that from sugar beet refineries [7]. Populations and types vary from host species to host species, and even according to the individual [8].In domestic sewage, the FC density may constitute 30 to 40 percent of the TC density. In aged sewage and in polluted waters, the FC fraction tends to decrease progressively with elapsed time. In heavily polluted surface waters, the FC component usually falls between 10 and 35 percent of the TC count [9]. Water born outbreaks are the most obvious manifestation of waterborne disease. The tape water system is not here and most of the people depend on wells for drinking water. Some of the wells are hand-Dug while others use pumps to take water from wells [10].

The guidelines of water quality differs from country to country, but most of the countries and organisations will recommend the WHO [11] standards. The standards for drinking water are more stringent than those for recreational water quality.

2. OBJECTIVES

The objectives of this study were

1. To analyze the water sample and find out its suitability for drinking purpose as per WHO standards.

2. To detect the presence of total and fecal coliforms in the water sample.

3. MATERIALS AND METHODS

3.1 Study design and period

A cross sectional study was conducted on drinking water sources (wells) to assess the extent of bacterial contamination from January to March (Summer season) Meenambalam area, Kollam district, Kerala.

3.2 Study area

The study was conducted in Meenambalam area, Kollam district, Kerala,India.Total area: 1.27 km² (13,653,230.05 ft²) ,Total distance: 4.16 km (2.59 mi), which is situated 1.27 km west of ESIC Hospital paripally, Kollam, Kerala, India.

ISSN 2229-5518

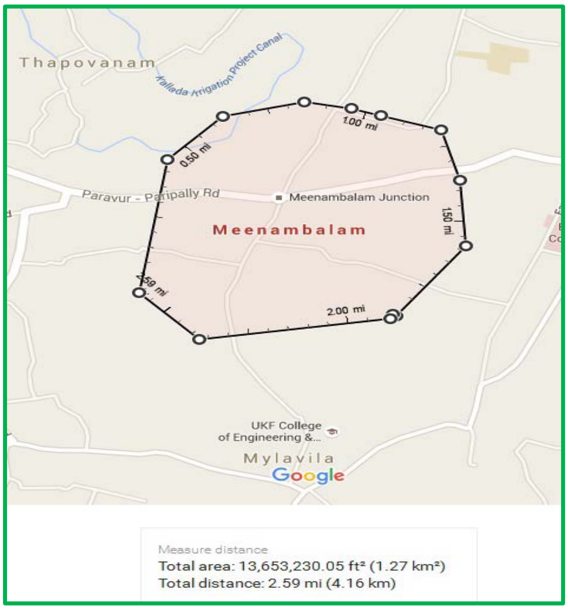

Fig.1. Location map

3.3 Data collection and processing

From individual water sources,50 ml sample of water was collected in sterile bottles and transported immediately to the Environmental Lab by ice cold containers within 1 hr. of collection .The samples are randomly collected from the private owned wells (both hand dug and pump) of the Meenambalam area.

3.4 Determination of Total Coliform and Faecal Coliform Count

Coliform count was obtained using the three tube assay of the Most Probable Number (MPN) technique [12]. Presumptive coliform test was performed using Brilliant Green Lactose Bile (BGLB) broth. The set of tubes was filled with 9 ml single strength broth. All the tubes contained Durham tubes before sterilization. The three sets of tubes received 0.1 ml, 0.01 ml and 0.001 ml quantities of water samples using sterile pipettes. The tubes were incubated at 37^{0}C for 24-48hrs for estimation of total coliforms and at 44.5^{0}C for faecal coliforms for 24-48hrs; and examined for acid and gas production. Gas production was checked for by entrapment of gas in the Durham tube. The MPN was then estimated from table for three tube test.

3.5 Ethical consideration

Prior to work design permissions from each householders was obtained to collect water samples for the present work.

Fig.2. EC Broth & BGLB Broth

Fig.3. Test tubes filled with corresponding serial dilution samples in BGLB AND EC-Broth.

ISSN 2229-5518

Table 1:- STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, TWELTH EDITION (NEW YORK,THE AMERICAN PUBLIC HEALTH ASSOCIATION INC.P.729)

Table 1. For 3 tubes each at 0.1, 0.01, and 0.001 g inocula, the MPNs per gram and 95 percent confidence intervals.

Pos. tubes			MPN/g	Conf. lim.		Pos. tubes			MPN/g	Conf. lim.	
0.1	0.01	0.001		Low	High	0.1	0.01	0.001		Low	High
0	0	0	<3.0	--	9.5	2	2	0	21	4.5	42
0	0	1	3	0.15	9.6	2	2	1	28	8.7	94
0	1	0	3	0.15	11	2	2	2	35	8.7	94
0	1	1	6.1	1.2	18	2	3	0	29	8.7	94
0	2	0	6.2	1.2	18	2	3	1	36	8.7	94
0	3	0	9.4	3.6	38	3	0	0	23	4.6	94
1	0	0	3.6	0.17	18	3	0	1	38	8.7	110
1	0	1	7.2	1.3	18	3	0	2	64	17	180
1	0	2	11	3.6	38	3	1	0	43	9	180
1	1	0	7.4	1.3	20	3	1	1	75	17	200
1	1	1	11	3.6	38	3	1	2	120	37	420
1	2	0	11	3.6	42	3	1	3	160	40	420
1	2	1	15	4.5	42	3	2	0	93	18	420
1	3	0	16	4.5	42	3	2	1	150	37	420
2	0	0	9.2	1.4	38	3	2	2	210	40	430
2	0	1	14	3.6	42	3	2	3	290	90	1,000
2	0	2	20	4.5	42	3	3	0	240	42	1,000
2	1	0	15	3.7	42	3	3	1	460	90	2,000
2	1	1	20	4.5	42	3	3	2	1100	180	4,100
2	1	2	27	8.7	94	3	3	3	>1100	420	--

Table 2:- Raw Water (Abstraction) Standards.*__1962 WHO (Omitted 1973 and 1984)__*

Coliform/100ml	Class	Classification
0-50	I	Needs Disinfection only
50-5,000	II	Needs Conventional treatment
5,000-50,000	III	Needs Extensive treatment
>50,000	IV	Unacceptable - only use if nothing else.

4. RESULTS AND DISCUSSION

Ten water samples were collected from the study area. Three were from protected wells and three from unprotected wells. Samples (A,B,C) are from protected wells, Samples (D,E,F) are from unprotected wells, Samples (G,H) are from the samples from wells whose distance is from latrine (<30 m) and Samples (H,I) are from the samples from wells whose distance is from latrine (>30).

ISSN 2229-5518

Fig.2. BGLB Result

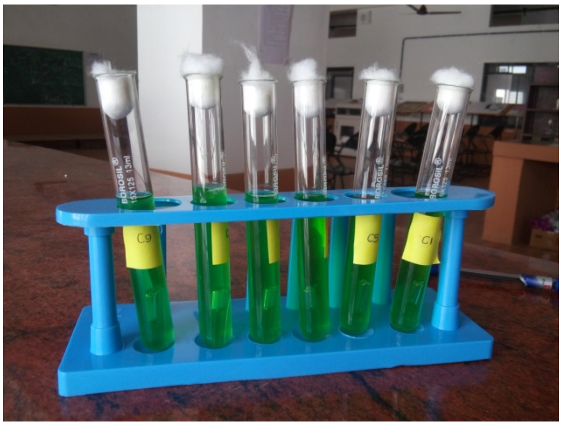

Figure.3. EC medium Result

TOTAL COLIFORMS (BGLB)

SAMPLES	POSITIVE TUBES			MPN/100ML	SUITABLE/NON-SUITABLE FOR DRINKING*#	REMARKS
	0.1	0.01	0.001			
SAMPLE A	0	0	0	<3	SUITABLE FOR DRINKING	NIL
SAMPLE B	0	0	1	3	NON-SUITABLE FOR DRINKING	Needs Disinfection only**
SAMPLE C	0	0	0	<3	SUITABLE FOR DRINKING	NIL
SAMPLE D	2	3	1	36	NON-SUITABLE FOR DRINKING	Needs Disinfection only**
SAMPLE E	2	2	0	21	NON-SUITABLE FOR DRINKING	Needs Disinfection only**
SAMPLE F	1	3	0	16	NON-SUITABLE FOR DRINKING	Needs Disinfection only**
SAMPLE G	2	3	0	29	NON-SUITABLE FOR DRINKING	Needs Disinfection only**
SAMPLE H	2	3	1	36	NON-SUITABLE FOR DRINKING	Needs Disinfection only**
SAMPLE I	0	0	0	<3	SUITABLE FOR DRINKING	NIL
SAMPLE J	0	0	0	<3	SUITABLE FOR DRINKING	NIL

**As per 1962 WHO (Omitted 1973 and 1984).

FECAL COLIFORMS (EC MEDIUM)

SAMPLES	POSITIVE TUBES			MPN/100ML	PRESENCE OF E-C*OLI.**	REMARKS
	0.1	0.01	0.001			
SAMPLE A	0	0	0	<3	NIL	NIL
SAMPLE B	0	0	0	<3	NIL	NIL
SAMPLE C	0	0	0	<3	NIL	NIL
SAMPLE D	2	1	1	20	PRESENCE OF E-C*OLI.*	Needs Disinfection only**
SAMPLE E	1	1	1	14	PRESENCE OF E-C*OLI.*	Needs Disinfection only**
SAMPLE F	1	0	1	7.2	PRESENCE OF E-C*OLI.*	Needs Disinfection only**
SAMPLE G	2	1	1	20	PRESENCE OF E-C*OLI.*	Needs Disinfection only**
SAMPLE H	2	2	0	21	PRESENCE OF E-C*OLI.*	Needs Disinfection only**
SAMPLE I	0	0	0	<3	NIL	NIL
SAMPLE J	0	0	0	<3	NIL	NIL

**As per 1962 WHO (Omitted 1973 and 1984).

The presence of total coliforms and fecal coliforms are found in samples B, D, E, F, G, H and these water samples are not suitable for drinking. Therefore samples **B, D, E, F, G, and H** requires disinfection. Otherwise it may result health problems to people who are living this area.

6. CONCLUSION

This mini project is conducted to study whether there is any chance to cause health problems due to the bacterial contamination of water. The availability of water in this area is less. Moreover the pipe water supply is not available in most of the houses. So most of the house holds depend on wells in this area. The study is carried out in summer season from January to march in order to get the accurate result, due to the lack of water.

The samples were collected on the basis of criteria such as samples from protected and unprotected wells, as well as the samples from wells whose distance is from latrine (<30 m) and the samples from wells whose distance is from latrine (>30).Most of the wells require Disinfection. The most commonly used well water disinfectants are sodium hypochlorite (chlorine bleach) and calcium hypochlorite (chlorinated swimming pool disinfectant).Otherwise it may result health problems to people who are living this area.

Also, there is need to increase awareness among the people in the study area, the danger associated with the use of contaminated water and construction of pit latrine and septic tank near water source. Water from all the hand dug wells should be boiled and filtered before drinking. Regular disinfection of drinking water sources, periodic bacteriological appraisal of drinking water sources and construction and distribution of piped water is necessary in this area.

ACKNOWLEDGMENT

We would like to thank UKF College of Engineering and Technology for opportunity and we would also express our gratitude towards Dr.Anu N for his support.

REFERENCES

[1] WHO (2008). Guidelines for Drinking-water Quality, Third Edition, Volume 1, 2008, Geneva, pp. 2-7.

[2] WHO (World Health Organization), Guidelines for drinking water quality. World Health Organization, 2004, Geneva.

[3] Amira AA, Yassir ME (2011). Bacteriological qualityof drinking water in Nyala, South Darfur, Sudan. Environ. Monit. Assess,175: 37–43

{4}. Kabler, P. W. 1968. Microbial considerations in drinking water. Journal of American Water Works Association v. 60(10):1173-1180.

{5}. American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1971. Standard methods for the examination of water and wastewater. American Public Health Association, Inc., 13th ed., New York, 875p.

[6]Manjula, A.V., Shankar, G.K., Preeti and M. Sharada (2011) Bacteriological Analysis ofDrinking Water Samples. Journal of Bioscience and Technology. 2(1):220-222.

[7]WHO (2012): Guidelines for Standard Operating Procedures for Microbiology: InBacteriological Examination of Water. World Health Organization Regional Office forSouth-EastAsia.

{8}Working Group of Water Quality of the Subcommittee on Water Quality, Interdepartmental Committee on Water. 1972.

{9}Guidelines for water quality objectives and standards, a preliminary report. Department of the Environment, Ottawa, Canada, Inland Water Branch, Technical Bulletin 67, p. 14-25.

{10} Geldreich, E. E., H. F..Clark, P. W. Kabler, C. B. Huff, and R. H. Bordner. 1958. The coliform group, II. Reactions in EC medium at 45 C. Applied Microbiology v. 6(5):347-348.

[11] WHO (World Health Organization), Guidelines for drinkingwater quality. vol 2, Health criteria and other supporting information, WHO Publ, Geneva, 1984, 335.

[12]Speck, M.I. (1976) Compendium of Methods for the Microbiological Examination of Foods.American Public Health Association, Washington, D.C.