Paper ID E53

A preliminary bacteriological assessment of ground water with reference to coliforms at Jalpaiguri district town of West Bengal, India

Moushree Pal Roy[1], Ishani Sen Gupta[2] and Amal Kumar Patra[3]

[1]Department of Biotechnology, University of North Bengal, West Bengal
[2]Department of Microbiology, A.C.College, Jalpaiguri, West Bengal
[3]Department of Zoology, A.C. College, Jalpaiguri, West Bengal
Corresponding *e*-mail: moushree.palroy@gmail.com

Abstract

A preliminary investigation was conducted to assess the drinking water quality on the basis of coliform bacterial load in Jalpaiguri District of West Bengal for a period of 6 months from May to October, 2013. A total of 56 ground water samples were collected from tube wells, mud and concrete wells from various localities (tea gardens, slum areas, rural and urban areas) where people use these water resources for drinking and all others domestic purposes. The water samples were then screened for contamination by coliform bacteria using lauryl sulphate broth. Positive samples were further cultured in lauryl sulphate media. The culture reports showed positive results except in tube well water. Morphological and biochemical properties revealed different strains of bacteria belonging to the genus *Escherichia, Enterobacter, Salmonella* etc. Of them *Escherichia coli* was more dominated than others and mud well was found to be more diversified than concrete well.

INTRODUCTION

We live on the water planet, with a precious film of water, most of which is salt water, covering about 71% of the earth surface. Water, one of the natural resources, is extremely essential for survival of all living things (a tree is about 60% water by weight and most animals are about 50-65% water). On the entire earth, 97.4% of water by volume is found in the oceans and is too salty for drinking, irrigation or industry. The remaining 2.6% is fresh water and is locked up in ice caps or glaciers or in ground water too deep or salty to be used. Of this 2.6% fresh water, ground water contributes only 0.592% [8]. In India, most of the population is dependent on ground water as the sole source of drinking water supply. The quality of water is vital for mankind since it is directly linked with human wellbeing. It is believed that the ground water is comparatively cleaner and free from pollution than surface water. But prolonged discharge of industrial effluents, agricultural runoff, domestic sewage and solid waste dump causes the ground water to become polluted and create health problems due to water-borne diseases. World Health Organization (WHO) reported that upto 80% of illnesses in developing countries is water and sanitation related [13]. Atlas and Bertha, 1997 [15] reported that approximately 15 million people are died worldwide due to the water borne diseases. During the past two decades, the drinking water quality has undergone radical changes [12, 19]. Environmental biologists and other globally accepted organizations always suggest checking the water quality before using it for drinking purposes. For this purpose they propose testing few water parameters, one of which is coliform load. Scientific research on coliform bacteria in drinking water has been carried out in different parts of West Bengal only by few researchers during 21st century [9, 17]. However, this type of investigation has not been carried out so far in Jalpaiguri district of West Bengal. The goals of this study were to screen the drinking water quality on the basis of coliform bacterial load and to study the diversity of coliform bacterial flora in the water samples.

MATERIALS AND METHODS

Ground water samples were collected from tube well, mud and concrete wells from various localities (tea gardens, slum areas, rural and urban areas) where the people use these water resources for drinking and all others domestic purposes. A total of 56 water samples were collected directly from wells in sterile screw cap glass test tubes of 30 ml capacity each. The collected samples were transported to the laboratory in ice within an insulated container and analyzed within 24 hours of collection. As recommended by APHA, 2005 [1, 7, 16], screening of coliform bacteria was tested by inoculation of sampling water in lauryl sulphate broth (HiMedia) containing tryptose 20 gm, lactose 5 gm, NaCl 5 gm, dipotassium phosphate 2.75 gm, monopotassium phosphate 2.75 gm, sodium lauryl sulphate 0.1gm in 1000 ml of glass distilled water, final pH (at 25°C) 6.8±0.2. Media inoculated with pure cultures of *E. coli* and uninoculated broth served as positive and negative controls respectively. The inoculums were incubated at 37°C for 18 hours. Positive samples were cultured in lauryl sulphate media containing above ingredients and 2% agar (HiMedia) using membrane filtration technique. The samples were passed through the sterile, white, 47 mm diameter cellulose-based filter papers of 0.45µm normal pore size to enumerate the coliform bacterial diversity by incubating the filter papers at 37°C on the lauryl sulphate agar plates. Identification of the isolates was done by the reference of M. Cheesbrough, 2002 [13]. Diversity of coliform bacterial flora was calculated by the references of Shannon and Wiener index [5]. The experiment was conducted for a period of 6 months from May to October, 2013. Mainly the monsoon and early post monsoon period was chosen for sampling, because during the rainy season the ground water level rises considerably and so does the probability of contamination.

RESULTS AND DISCUSSIONS

Water samples collected from mud and concrete wells showed confirmatory consequence by changing red to yellow color in lauryl sulphate broth whereas no coliform was detected in tube well water (Fig, 1).

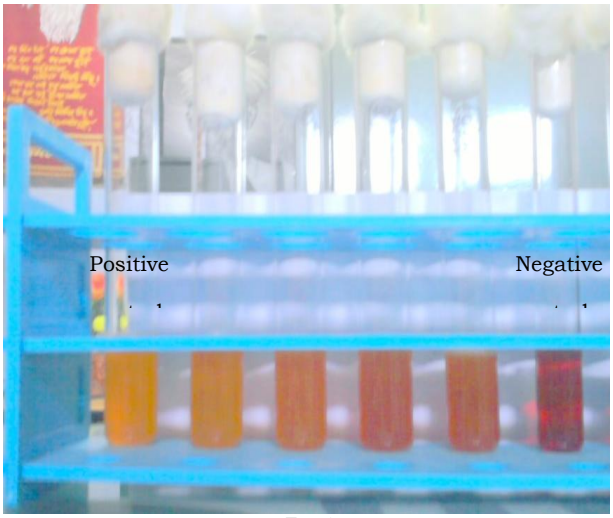

Fig. 1

Yellow colonies appeared on membrane filters (by incubation at 37 °C for 18 hours) in lauryl sulphate media were further identified upto the genus level. Morphological, Gram staining and biochemical properties revealed three strains of bacteria belonging to the genus *Escherichia*, *Enterobacter*, and *Salmonella* (Table. 1).

Table 1. Morphological and biochemical characterisation of the isolates

Characterization tests	***W1***	***W2***	***W3***	***W4***
Gram reaction	-	-	-	-
Shapes & Arrangement of cells	rods; singly or in chains	short rods	rods	rods
Catalase	+	+	+	+
Casein hydrolysis	+	-	-	+
Starch hydrolysis	+	+	-	+
Gelatin liquefaction	+	-	+	+
Indole	+	-	-	-
Methyl red	+	+	-	+
Voges-proskauer	-	-	+	-
Citrate utilisation	-	-	+	+
Oxidase	-	-	-	-
Nitrate reduction	+	+	+	+
Lipolytic activity	+	-	-	+
KCN	+	-	+	+
H2S production	-	-	-	-
Oxygen relationship	FA	ND	ND	FA
Oxidative fermentation	O	ND	O/F	O
Anaerobic growth	-	-	-	+
Sugar fermentation:				
Glucose	A	A/G	A/G	A
Lactose	A	A/G	A	A
Fructose	A	A/G	A	A
Galactose	A	-	-	-
Maltose	A	A/G	A	A
Mannitol	A	A/G	A	A
Sucrose	A	A/G	A	A
Xylose	A	-	A	A
Motility	+	+	+	+
Endospore formation	+	-	-	+

Keys: +=Positive; - = Negative; A= Acid production; A/G= acid & gas production; F/A= Facultatively anaerobe; A*=Aerobe; O=Oxidative reaction; O/F= Oxidative & fermentative reaction; ND= Not determined

Of these three species, *Escherichia coli* was more dominated than others. Shannon & Wiener species diversity index specified that mud well was more diversified than concrete well (Table 2).

Table 2: Diversity of the isolated strains in different water samples

Strains	G1	G2	G3	G4
W1	14	10	6	5
W2	17	5	7	2
W3	12	2	9	5
W4	11	2	15	9

Coliforms are members of *Enterobacteriaceae*, which grow in the presence of bile salts and produce acid and gas from lactose within 48 hours at 37°C [6]. These bacteria can also be defined as, members of family *Enterobacteriaceae* capable of growing at 37°C, that normally possess galactosidase [11]. Lauryl Sulphate Broth [20] is used for the detection of coliforms in water as recommended by APHA [1, 7, 16]. It not only acts as a presumptive test but also as a confirmatory test for the presence of coliforms, in the routine testing of water and is also recommended by the ISO Committee for the detection of coliforms [10]. Tests for coliform bacteria are the most important routine microbiological examinations carried out on drinking water. These tests provide a sensitive means for detecting faecal contamination, for assessing raw water quality, the effectiveness of water treatment and disinfection, and for monitoring water quality in distribution.

In the entire exploration, the presence of coliforms in certain drinking water samples might be attributed to inadequate water treatment, agricultural runoff, effluent from septic systems or sewage discharges and infiltration of domestic or wild animal's fecal matter. The presence of coliforms does not mean that pathogens are present, but it does make fecal contamination and, thus, contamination by pathogens much more likely. The consumption of drinking water contaminated with pathogenic microbes of faecal origin is a significant risk to human health in the developing world [14], especially in remote rural areas and peri-urban `shanty' communities. More than 3 million deaths per year is attributed to water-borne diseases, especially among infants and young children in poor communities in Africa, Asia and South America [2]. So, the bacteriological examination of water samples collected from different sources of Jalpaiguri district suggests that the water of mud and concrete wells is not potable while the tube well water may be secure for drinking.

REFERENCES

[1] AD Eaton, LS Clesceri, EW Rice and AW Greenberg. 2005. *Standard Methods for the Examination of Water and Wastewater*. 21st Ed. APHA, Washington, D.C.

[2] Anon. 1997. World Health Report. World Health Forum 97: 181-188

[3] Anon. 2000. Waterborne outbreak of gastroenteritis associated with a contaminated municipal water supply, Walkerton, Ontario, May–June 2000. Canada Communicable Disease Report. 26:170–173.

[4] Central Pollution Control Board Ministry of Environment and Forests. 2009.

[5] CE Shannon and W Wiener. 1949. *The Mathematical Theory of Communication Urban*. University of Illinois Press. 125.

[6] Department of Environment, Department of Health and Social Security, Public Health Laboratory Service. 1982. Methods for the Examination of Water and Associated Materials, The Bacteriological Examination of Drinking Water Supplies. 1982. Her Majesty's Stationary Office. London.

[7] FP Downes and K Ito. 2001. Compendium of Methods for the Microbiological Examination of Foods, 4th Ed., APHA, Washington, D.C

[8] GT Miller. 2004. *Sustaining the Earth*. 6th edition. California: Thompson Learning, Inc. Pacific Grove. 9:211-216.

[9] HS Mandal, A Das and S Bose. 2012. Scholars Research Library. 4(1):605-610.

[10] International Organization for Standardization (ISO), 1991, Draft ISO/DIS 4831.

[11] JG Collee, AG Fraser, BP Marmion, A Simmons. 1996. *Practical Medical Microbiology*. 14th Edition. Churchill, Livingstone: Mackie and McCartney.

[12] Katayal, TM Satake, Rajkumer. 1991. *Environmental pollution*. New Delhi: Anmol Publications. pp. 54-63.

[13] M Cheesbrough. 2002. *District Laboratory Practice in Tropical Comtries Part 2*. Cambridge University Press. Cambridge Low Price reprinted edition.

[14] RJ Davies-Colley, JW Nagels, AM Donnison and RW Muirhead. 2001. *Faecal contamination of rural streams – implications for water quality monitoring and riparian management.* 43rd annual conference of the New Zealand Water and Wastes Association, 19th-21st September, 2001. Wellington, New Zealand.

[15] RM Atlas and R Bertha. 1997. *Microbial Ecology-Fundamentals and applications*. Benjamin/Commings Science Publishing. pp. 01-694.

[16] RT Marshall. 1992. *Standard Methods for the Examination of Dairy Products*. APHA, Washington, D.C.

[17] SN Chatterjee, D Das, M Roy, S Banerjee, P Dey and T Bhattacharya. 2007. Bacteriological examination of drinking water in Burdwan India with reference to coliforms. *African J Biotechnol*. 6:2601—2602.

[18] VK Tyagi, AK Chopra, AA Kazmi and A Kumar. 2006. Alternative microbial indicators of faecal pollution:current perspective. *Iranian J Environ. Health Sc. Engg.* 3(3):205-216.

[19] VP Kudesia. 1990. *Water pollution*. 3rd revised edn. Meerut: Pragati parkashan. pp. 84-102.

[20] WC Mallmann and CW Darby. 1941. Uses of a lauryl sulfate typtose broth. *Am. J. Public Health*. 31:127-134.