ASSESSMENT OF BACTERIAL QUALITY IN GROUND WATER SAMPLES OF GORAKHPUR CITY

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ABSTRACT: This paper includes the output of the study, which was carried out in Gorakhpur city to account for the number of total coliforms by MPN method and test the presence or absence of Faecal Coliforms (*E.coli*) in ground water samples using H_2S bottles. The samples were collected from the shallow depth hand-pumps, located in the vicinity of water logged areas from different locations of Gorakhpur city. The study was carried out from January to June, 2013 and a total of 21 samples were collected from the different areas of Gorakhpur city. On analysis of the samples, it was found that the ground water samples were contaminated by total and Faecal Coliforms. Total coliforms were found in almost all the samples in all the three seasons, while Faecal Coliforms (*E.coli*) were confirmed in some of the samples. Various measures have been suggested along with the precautions to be taken during the installation and operation of shallow depth hand-pumps. Creation of awareness among the people and the surveillance of water quality by government agencies with the participation of entire community have been suggested.

Keywords: Total Coliforms, Faecal Coliforms, *E.coli*, Gorakhpur, MPN Count

1. INTRODUCTION

Groundwater is defined as the water which is found underground in the various saturated zones of rocks that can be extracted by means of wells, bore wells and tube wells. The depth of ground water may vary up to 500 m from place to place, depending on the geological make up of soil [**1**]. Groundwater is one of the widely distributed, renewable and most important resource which is present on the earth. It is usually considered as the least polluted water source compared to the other water resources. But, various recent studies show that groundwater is also not free from different pollutants, which may be chemical or biological in nature. The quality of groundwater is a matter of great concern because once it gets polluted/ contaminated it is very difficult to restore its quality [**2**]. The water which is used for the purpose of drinking, should be free of any pathogenic bacteria/ virus and shall be potable in nature, so that it may not cause adverse effects on the health of human beings consuming it.

"Groundwater pollution can be defined as an undesirable change in the quality of groundwater which may result as a consequence of human activities". Water contains small amount of dissolved minerals, suspended matter as well as some microbes in it. But when the concentration of such substances increases to greater levels, then they may act as water pollutants and make it unfit for human consumption. The factors like seasonal variations and depth of the source can influence the microbial characters of groundwater [**3**].

2. MATERIALS AND METHODS

2.1. Site Description

The study was carried out from January to June, 2013. The study area included different locations of Gorakhpur city, namely Rustampur Dhala, Gorakhpur city, Shivpur, Fatehpur, Nanda nagar, Kunraghat and Mohhadipur.

Groundwater samples were collected from shallow depth hand-pumps around which water logging was present, from the selected areas. The samples were collected in sterilized 300 ml Borosil glass bottles for Most Probable Number (MPN) test and in bottles containing a H_2S strip up to the marking given on the bottle. The analysis of the samples was carried out in accordance with the standard procedures.

2.2. SAMPLING METHODOLOGY

A total no. of 21 ground water samples were collected from the shallow depth hand-pumps, located in water logged areas from the selected locations of Gorakhpur city. The samples were collected from hand-pumps, installed by the local residents for getting drinking water. From each location, the samples were collected three

times i.e. during the winter, summer and rainy seasons.

In order to reduce any contamination from microbes during sample collection, the containers were washed thoroughly with Hypo solution and dried prior to collection of samples. Before collection of samples from the hand pumps, about 2 to 4 litres of water was pumped and then the mouth of the hand-pump was flame-sterilized with a portable burner and then the sample collection was done in 300 ml sterile glass bottles for bacterial testing.

2.3 LABORATORY EVALUATION

The Most Probable Number (MPN) test, which is based on gas detection which is produced by bacteria after lactose is fermented, was particularly used to enumerate the no. of total coliforms in ground water samples [5]. The tubes, showing gas production, were used to enumerate the MPN count of the bacteria. McConkey broth was used in the test-tubes for enumeration and determination of MPN count. The H_2S strip bottles were used to detect the presence/ absence of Faecal Coliforms (*E.coli*) in the water samples [6]. The bottles in which water samples turned yellow to black on incubation at 37°C after 24 to 48 hours, confirmed the presence of Faecal Coliforms *(E.coli)* in the samples. The bottles in which no change in colour was observed were free from Faecal Coliforms (*E.coli*).

3. RESULTS AND DISCUSSION

The results obtained after the testing of ground water samples for the MPN count and presence of Faecal Coliforms from different hand-pumps of Gorakhpur city are given in Table-1 and Table-2 respectively.

TABLE-1 TOTAL COLIFORM COUNT IN SAMPLES

Location	Coliform Count (MPN/ 100 ml)		
	Winter	Summer	Monsoon
Rustampur	2	5	11
Gorakhpur city	6	20	30
Shivpur	14	35	40
Fatehpur	3	9	18
Nanda Nagar	20	11	30
Kunraghat	6	13	18
Mohhadipur	4	17	30

It is revealed from Table-1 that all the 21 samples contain total coliforms. The maximum no. of total coliforms is found in the sample collected from Nanda Nagar during the winter season, while the maximum coliform count during the summer and monsoon season is found in the sample collected from Shivpur. The

no. of total coliforms found in the 21 samples during the 3 seasons is represented in Fig. 1.
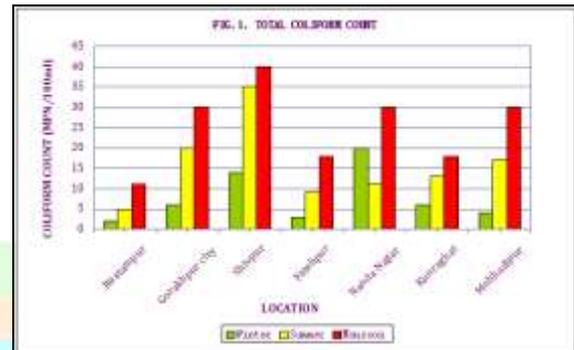

FIG. 1. TOTAL COLIFORM COUNT

TABLE-2 PRESENCE/ ABSENCE OF FAECAL COLIFORM

Location	Faecal Coliform (Presence or Absence)		
	Winter	Summer	Monsoon
Rustampur	Absent	Absent	Absent
Gorakhpur city	Absent	Present	Present
Shivpur	Present	Present	Present
Fatehpur	Absent	Absent	Absent
Nanda Nagar	Present	Absent	Present
Kunraghat	Absent	Present	Present
Mohhadipur	Absent	Present	Present

Table-2 shows that the Faecal Coliforms are present in 11 of the 21 samples and absent in the other 10 samples. The percentage of samples in which Faecal Coliforms are present or absent is represented in Fig. 2.

FIG.2. PERCENTAGE OF SAMPLES SHOWING PRESENCE OR ABSENCE OF FAECAL COLIFORMS
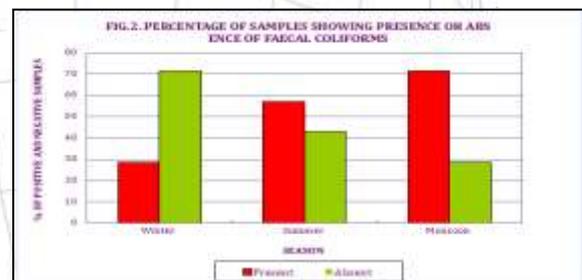
The H_2S bottles showing presence and absence of Faecal Coliforms (*E.coli*) are given in Fig. 3 below. The bottle in which colour of sample has turned black confirms the presence of Faecal Coliforms (*E.coli*), while the bottle in which colour of sample is yellowish determines that the sample is free of Faecal Coliforms (*E.coli*).

FIG.3. H_2S BOTTLES SHOWING *E.COLI* PRESENCE/ ABSENCE

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CONCLUSION

It is revealed from the study that the monitoring of the microbiological parameters is strictly needed in order to know about the potability of drinking water, when the installation of the hand-pumps is done as well as during their use. As a common belief, hand-pumps installed by the local people are supposed to yield contamination free water, so that the users are not affected by water borne diseases. However, the outcome of this study raises a question on this aspect. It is visible that the lack of provision of adequate depth and concrete platforms around the local shallow depth hand-pumps installed by the local population, could be the main reasons for contamination of drinking water.

It is quite obvious that, if the local hand-pumps are installed at shallow depth (as water table in Gorakhpur area is quite high) in the vicinity of contamination sources like septic tanks and soak pits, animal i.e. pig and cow sheds, sites where excreta is disposed or areas with water logging and absence of concrete platform, it is likely that the contaminated water could seep along the pipe casing of the hand-pump which would lead to contamination of the ground water which, in turn, could get lifted up at the time of use of hand-pumps. The condition of hand-pumps from which water samples were collected is shown in Fig. 4.

FIG.4. WATER LOGGING NEAR HAND-PUMPS

This is a very important issue, which relates to the reliability of water quality which is being yielded by the local hand-pumps and it necessitates 100% percent quality assurance in all the existing local shallow depth hand-pumps, including provision of concrete platform around the hand-pump. Also, strict quality assurance measures need to be followed during the installation of such shallow depth hand-pumps in future. The contamination of 28.6% of the samples in winter, 57.1% of the samples in summer and 71.4% of the samples by Faecal Coliforms (*E.coli*) also indicates a very poor water quality scenario and indicates the need of well-defined water quality surveillance in the city.

Recommendations:

Taking into account, that samples collected from the hand-pumps located near the waterlogged areas are mostly found to be contaminated with coliform bacteria, a local community awareness campaign should be taken up by local bodies in the areas with a view to educate the people to avoid installation of the hand-pumps in areas where there is prominent water logging, near septic tanks & soak pits, animal i.e. pig and cow sheds and excreta disposal sites. In addition, people who install such local hand-pumps should also be made aware to avoid installation of such hand-pumps at very shallow depths. The local body and government agencies in the areas should conduct regular water quality testing from such hand-pumps. Wherever it is felt necessary, the local people should be advised to do reboring and/or provide concrete platform around the hand-pumps.

The presence of Coliforms and Faecal Coliforms (*E.coli*), also raises questions about the presence of various other bacteria (*Vibrio*) and virus of Faecal origin. These bacteria and virus may lead to many water borne diseases. For this proper testing of water samples, collected from the shallow depth hand-pumps located near the water logged areas needs to be done, in order to check the presence of bacteria other than coliforms.

At present, the major problem in and around Gorakhpur district is of **"Acute Encephalitis Syndrome"** (AES) which has taken many lives in the area. The major bacteria/ virus responsible for AES, is still a matter of discussion and it may be possible that it is water borne. Proper research in this field is required to identify the cause and source of AES.

Thus, it can be seen that in order to maintain the potable nature of drinking water from shallow depth hand-pumps, proper and suitable arrangements need to be made so that, contamination through percolation and seeping through does not take place.

ACKNOWLEDGMENT

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