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Chemical studies on Faecal Coliforms (E. Coli) present in ground water samples of Sidhi City (M.P.) India

Vinod Dubey[1], Suvir Dubey[2], Shalini Singh[3]
Professor, S.G.S. Govt. P.G. College, Sidhi (M.P.) India
Doctor, S.N. Medical College and Research Institute Bagalkot, Bangalore, Karnataka, India
Research Scholar, S.G.S. Govt. P.G. College, Sidhi (M.P.) India

Abstract: *The present study carried out in Sidhi city of Madhya Pradesh to test the presence of Faecal Coliforms (E. Coli) in ground water samples using H_2S bottles. The study was carried out in May 2014 and 40 samples were collected from various locations within city. The testing of the samples indicated the contaminations of ground water by Faecal Coliforms in high depth and shallow depth hand-pumps. It was found that most of the samples taken form hand pumps located near the water logged area showed the present of Faecal Coliforms (E. Coli). The measure for strict quality assurance in the installation and operation of hand-pumps and water quality surveillance by local body and government agencies with the involvement of community participation has been suggested.*
Key words: *High depth hand-pump, Faecal Coliform (E. Coli), Shallow depth hand-pump, contamination.*

I. Introduction

Water quality plays a very important role for all living beings whether humans or animals. The protection of public and environmental health requires safe water for drinking that is it must be free from any pathogenic bacteria.

Ground water may be defined as the water present in underground aquifers which may be drawn by means of hand-pumps or tube-wells. Ground water is an important source of water supply for agriculture, municipalities and industry.

In most Indian villages, peoples rely heavily on ground water as a source of drinking water. The contamination of ground water by Faecal Coliforms has emerged as a major concern worldwide.

Many micro-organisms may be present in drinking water that may deteriorate its quality and make it unsuitable for human consumption. So the concept of microbiological testing of water was introduced in the 19^{th} century, so as to assess the quality of water used for human consumption. Many indicator organisms like the coliform group of bacteria are used as an indicator for determining the contamination of water by Faecal matter or by other sources.

The microbial analysis of water determines its portability and sanitary quality. But the inability to access laboratories and good field test kits is a major obstacle towards the quality assurance in the provision of drinking water which is microbiologically safe to many communities and people all over the world. To overcome this problem, a number of alternative tests have been developed to detect faecal contamination of drinking water. Some of these tests are low cost. Simple and do not require a microbiology laboratory. The most commonly used method is the hydrogen sulphide (H_2S) test which detect hydrogen sulphide producing bacteria which are considered to be associated with faecal contamination.

The advantage of this test is it has a low cost; it is simple to be conducted and its ability to be performed even in those areas where no microbiology labs and other test kits are available. Its major drawback is that, as it measures the presence of H_2S by its reaction with iron (Fe) to form insoluble iron sulphide, the presence of H_2S by any source in the sample can lead to a positive result. Many bacteria originating from the intestine can release H_2S from proteins, amino acids and other compounds by their reduction that may lead to a positive test through this method. In this study the presence of Faecal Caliform in hand-pumps being used as source of drinking water in Sidhi city has been tested by using H_2S method.

II. Study Area

The city of Sidhi is located in the north east part of M. P., India. The city is situated along the bank bothside of Sukha nallah, the sample water collected from different areas of city namely, Karaundiya, Old Bus Stop, Near Collectorate, Hospital Chauk, Lalta Chauk, Near Kotwali, Madariya, Old Sidhi City, Civil Line, Gopaldas Colony and Police Line area, from each area water samples were collected from high depth hand-pumps, shallow depth hand-pumps and from the hand-pumps located near water logged areas.

III. Material And Methods

A total of 40 ground water samples were collected from different part of Sidhi city in May 2014. The samples were collected from high depth hand-pumps, shallow depth hand-pumps and also form the hand-pumps located near the water logged areas in H_2S bottles containing H_2S strip up to the marking given on the bottles. Then the samples were brought to the laboratory of public health Engineering Department of the M.P. Govt. in opaque boxes and were tested for the presence of Faecal Coliform (E. Coli.). After incubation for 24 to 48 hours at 24 to 37 ^{0}C the change in colour of the samples was noted. The samples which become black after incubation, showed the presence of Faecal Coliform.

IV. Result And Discussion

The result obtained after the testing of water samples for the presence of Faecal Coliforms using H_2S bottles from different hand-pumps of Sidhi city are given in table 1.

Table 1
Type and number of samples tested for the presence of (E. Coli) using H_2S bottles in Sidhi City

Type of Samples	Number of Samples	Sample showing positive result	Sample showing negative result	Percentage (%) of Contaminated samples
High depth hand-pumps	10	3	7	30 %
Shallow depth hand-pumps	16	9	7	53 %
Hand-pumps of water logging areas	14	11	3	75 %
Total	**40**	**23**	**17**	**55 %**

Table 2
Number of samples collected from hand-pumps located near water logged areas and no of Faecal Coliforms (E.coli)

Area	Number of samples collected from Source near water logged area		Number of Faecal Coliforms Positive Sample	
	High depth hand-pumps	*Shallow depth hand-pumps*	*high depth hand-pumps*	*shallow depth hand-pumps*
Karaundiya	1	1	1	1
Old bus stop	0	1	0	1
Hospital Chauk	1	1	1	1
Near collectorate	0	2	0	1
Lalta Chauk	0	1	0	0
Near Kotwali	0	1	0	1
Madariya	0	1	0	0
Old city area	1	1	1	1
civil line	0	0	0	0
Gopaldas Colony	0	1	0	1
Police Line area	0	1	0	1
Total	3	11	3	8

It is revealed from the table-1 that out of 40 samples subjected to the test 23 samples gave positive result for the presence of Faecal Coliforms whereas 17 samples were found to be negative. Out of 14 samples taken from the hand-pumps located near water logged areas 11 gives positive result for the presence of Faecal Coliforms (E. Coli). It is seen that 3 of the 10 high depth hand-pumps also gave positive result for the presence of Faecal Coliforms (E. Coli), while 9 of the 16 shallow depth hand-pumps samples showed the presence of E. Coli.

The percentage of microbiologically acceptable and contaminated samples obtained from different types of sources is shown in fig. 1 which revealed that more than 75 % samples taken from hand-pumps located near water logged areas are found to be contaminated whereas more than 50 % of the samples taken from shallow depth hand-pumps are also found to be contaminated. Surprisingly 30 % of the samples taken from high depth hand-pumps are also found to be contaminated.

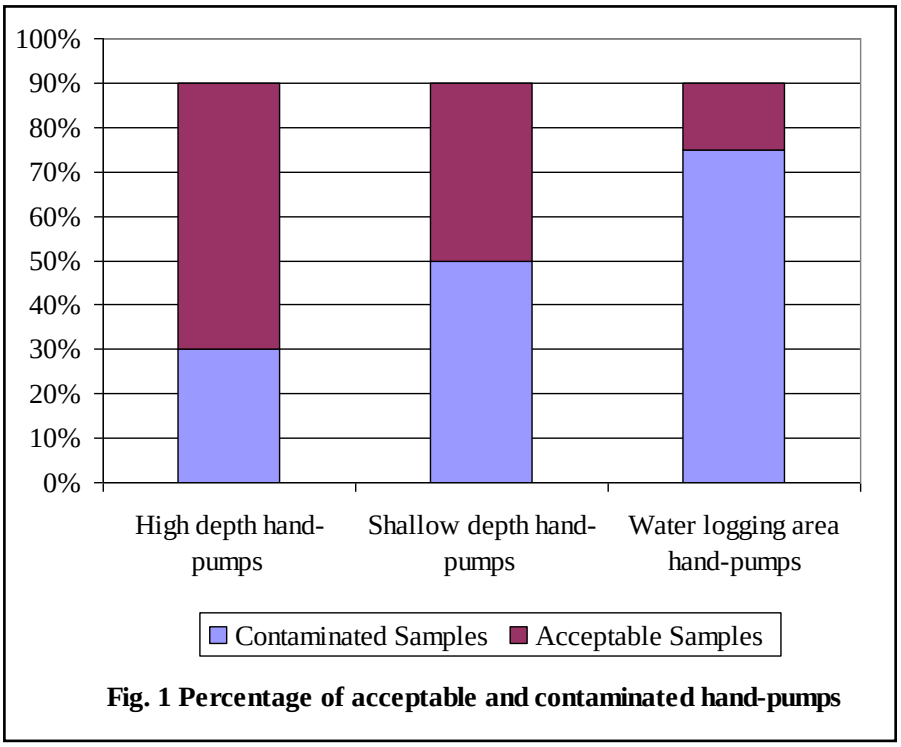

Fig. 1 Percentage of acceptable and contaminated hand-pumps

The detail of the samples collected from sources located near water logged areas and number of samples indicating positive result for the presence of faecal coliform (E. coli) are given in the table-2.

It is revealed from table 2 that 8 out of 11 samples collected from shallow depth hand-pumps located near water logged areas show the presence of Faecal Coliforms (E. Coli) while all the 3 samples collected from high depth hand-pumps located near water logged areas show the presence of Faecal Coliform (E. Coli).

It was also observed during the study that the positive outcome of H_2S method was obtained in the situation where MPN count was found above 17. This reflects a low sensitivity of this method, which is considered to be a limitation while considering the interpretation of the result.

V. Conclusion

As it is commonly belief that high depth hand-pumps are supposed to yield contamination free water, however the outcome of this study raises a caution on this aspect. It appears that the lack of provision of adequate depth and concrete platform around high depth hand-pumps could be the major factor resulted in by poor quality assurance and workmanship in the installation of high depth hand-pumps. It is quite obvious that if high depth hand-pumps are installed at shallow depth in the vicinity of potential sources of contamination like septic tanks and soak pits, animal and cow sheds, excreta deposal sites or water logged areas and concrete platform is also not provided, it is likely that the polluted water could percolate along the casing of the hand-pump which could contaminate the ground water, while in turn could get lifted up. This is an issue which relates to the reliability of water quality yielded by such high depth hand-pumps and necessitates cent percent quality assurance in all the existing high depth hand-pumps, including verification of depth and provision of concrete platform around the hand-pump. Also there is a need to follow strict quality assurance measure in the installation of high depth hand-pumps in future.

The contamination of 55 % of the samples by Faecal Coliforms (E. Coli) also shows a poor water quality scenario and indicates the need of detailed water quality surveillance in the city. It is also revealed in the study that a strict monitoring of the microbiological parameters needs to be done in order to ascertain the portability of drinking water not only at the time of installation of hand-pumps but also during their use.

VI. Recommendation

On the basis of the finding of this study that almost all the sample taken from the hand-pumps located near the water logged area are found to be contaminated, hence a community awareness campaign should be taken up with a view to educate the people to avoid installing the hand-pumps near water logged areas such as septic tanks, soak pits, animal and cow sheds and excreta disposal sites.

In addition people should also be made aware to avoid shallow depth hand pumps for drinking water use. However, the local body and government agencies should ensure strict quality assurance in the installation

of all kind of hand-pumps and wherever felt necessary, reboring and/or provision of concrete platform around the hand-pumps may be resorted to.

Water quality surveillance of all the drinking water sources may be taken up on priority and suitable measures should be adopted towards the use of field testing kits and ensuring community participation.

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