



Physico-chemical and bacteriological investigations of tuikhur water, Saiha town, Mizoram, India

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ABSTRACT

The main source of potable water in the township of Saiha is through the supply maintained by the Public Health Engineering (PHE) Department, Govt. of Mizoram. This supply is done without any proper treatment and is more or less limited especially during the non-monsoon seasons. For domestic use, the people have to depend on alternate resource systems viz. tuikhur (i.e. water seepages accumulated in artificially fabricated small pits), hand pumps and rainwater harvesting (on local level into large tanks). The water samples from different tuikhur were analyzed in the year 2007 (post monsoon) for various physico-chemical parameters such as pH, electrical conductivity (EC), total dissolved solid (TDS), turbidity, phenolphthalein alkalinity, total alkalinity, total hardness, total chloride, iron and fluoride and total coliform (MPN) for bacteriological characteristics in order to obtain the current status of potable water quality in the city. The results are suggestive of the fact that the quality of tuikhur water used for domestic purposes is by and large within the acceptable limit.

Key words: Alkalinity; electrical conductivity; pH; total dissolved solid; turbidity; water.

INTRODUCTION

Water, called elixir of life, is a prime natural resource, a basic human need as well as for all forms of life. Requirement of water for drinking and domestic purposes depends on physical as well as socio-economic development of the area. Almost all water situations and problems are local or regional in nature. Long distance inter-regional transportation of water in large quantities is impracticable be-

cause of the unaffordable costs involved in it. Therefore, the demand of fresh water has to be fulfilled from its indigenous resources. Due to rapid growth in population and industries, water requirement increases and exerts additional pressure on water resource in terms of both quantity and quality. Therefore, the maintenance of good quality water supply should be a major component of any urban planning.¹

Saiha is the headquarters of the southernmost district of Mizoram, India and is facing problems of water supply for domestic purposes. Natural resources are the only sources

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of water due to the poor infrastructural development in the state. The population of the district is >60000 as per 2001 census. Mizoram is under the direct influence of monsoon and so is Saiha. The main source of potable water in the township of Saiha is through the supply maintained by the Public Health Engineering Department, Govt. of Mizoram. The Govt. supply system procures water mainly from the natural springs located at (1) Bualpui Ng—Saiha road (Zotlang) natural source; and (2) Tuisumpui road—Saihatlanglui and PHE lui.

The supply of water through PHE is very limited not only during the non-monsoon seasons but also during the rainy season. The frequency of water supply varies from once in a week to once in a fortnight or even a month depending on the availability of water to the supply sources which are fed by rain. Therefore, majority of population uses rain/stream (tuikhur) water as drinking water. The quality of tuikhur water is expected to be similar to that of PHE supply water as the source of the later also lies with the springs only.

The present paper discusses water quality assessment of one of the important towns of the North- Eastern state of Mizoram in India.

MATERIALS AND METHODS

There are several tuikhurs spread over a large area of the Saiha town. Most of them get dried during the non- monsoon seasons specially pre- monsoon and only a few of them remain productive throughout the year.

The following seven perennial water sources which include six streams and a hand pump were selected for the study.

- Station I – New Saiha hand pump
- Station II – UPC Tuikhur, New Colony
- Station III – Chhochhopa Tuikhur, New Colony
- Station IV – Medical Veng Tuikhur
- Station V – College Veng Tuikhur
- Station VI – Pi Lali Tuikhur, New Saiha
- Station VII – New Colony Vengpui

Tuikhur (Khurpui)

The samples were collected by grab sampling method² in polythene bags, which were thoroughly washed with acid water and rinsed twice with distilled water. The polythene bags were closed tightly to avoid any spillage during transportation.

pH values of all the samples were determined on the digital pH meter-335 whereas electrical conductivity (EC) and total dissolved solids (TDS) were measured with the help of Systronics Conductivity/TDS meter-307. Turbidity of the samples was measured by using digital Nephelo Turbidity meter-132 using formazin as standard. The most probable number (MPN) of coliforms was estimated by multiple tube dilution method. The multiple tube dilution technique was used to enumerate positive presumption and confirmed coliform test.

Presumptive Test

Dilution above 1:1000 was prepared; five fermentation tubes previously filled with 9 ml of Mac Conkey broth were prepared for each dilution. Now one Durham's vial was put in an inverted condition inside each fermentation tube. The tubes were plugged with cotton and sterilized in an autoclave. Now sample was added to each test tube with the help of a sterilized pipette. The tubes were vigorously shaken and incubated at 35-37°C for 48 hours. Each test tube was examined for gas production. The tubes showing gas in the Durham's vial were recorded as positive. The tubes showing positive results were now subjected to the confirmatory test.

Confirmatory Test

The fermentative tube was filled with 10 ml Brilliant Green Lactose Bile (BGLB) broth and Durham's vial was put in an inverted position in each fermentation tube. The positive tubes were shaken gently and one loopful of sample was transferred to each fermentative

tube having BGLB broth. These tubes were incubated at 35-37°C for 48 hours. The tubes producing gas were recorded as positive and MPN/100 ml was calculated as per following formula:

$$\text{MPN/100 ml} = \frac{[\text{MPN table value} \times 10]}{\text{Starting value}}$$

RESULTS AND DISCUSSION

The results of various physicochemical and bacteriological analyses are summarized in Table 1 and 2. The values are for the post-monsoon season and it seems that these values may increase during the pre-monsoon season as the post-monsoon recharge dilutes the chemical ingredients whereas the pre-monsoon evaporation enhances its concentrations.^{3,4} It can be viewed that the pH varies from 6.9 to 7.8, which are found to be well within the acceptable limit for drinking water

specified as 6.5-8.5. Electrical conductivity varies from a minimum of 138 mS/cm to a maximum 227 mS/cm. The EC values are generally higher for tuikhur water in comparison to the hand pump. The TDS varies from 103 mg/l to 192 mg/l for tuikhur where as for the only hand pump taken for this study it is 156 mg/l, which is intermediate of the two extreme values. The higher values of TDS may be attributed to the presence of various kinds of ions. The desirable limit of TDS in drinking water is 500 mg/l, and therefore, the values are found to be well within the prescribed limit. The desirable limit of turbidity is 5 NTU, and for the samples under study the value ranges between 1.2 NTU to 4.2 NTU for tuikhur waters and is within the desirable limit where as it is beyond the desirable limit (5.6 NTU) for the only hand pump taken under study. However, the value is still within the permissible limit of 10 NTU.

Tabel 1. Analyses of pH, EC, TDS, Turbidity and MPN (*n* = 3)

Location	pH	EC	TDS	Turbidity	MPN (Total Coliform)
New Saiha Hand Pump	6.9	183.9	156	5.6	5
UPC Tuikhur	7.2	170.1	110	2.4	32
Chhochhopa Tuikhur	7.1	204	137	1.4	35
Medical Veng Tuikhur	7.0	137.7	103	3.0	17
College Tuikhur	7.1	227	192	2.1	14
Pi Lali's Tuikhur	7.0	185.1	145	4.2	21
New Colony-Vengpui Tuikhur	7.1	227	170	1.2	42

Table 2. The values of chemical parameters (*n* = 3)

Location	P. Alkalinity ppm	Total Alkalinity ppm	Total Chloride ppm	Total Hardness ppm	Total Iron ppm	Fluoride ppm
New Saiha Hand Pump	Nil	80	10	100	1	Trace
UPC Tuikhur	Nil	20	30	100	Trace	Trace
Chhochhopa Tuikhur	Nil	60	20	80	Trace	Trace
Medical Veng Tuikhur	Nil	40	20	80	Trace	Trace
College Tuikhur	Nil	40	20	120	Trace	Trace
Pi Lali's Tuikhur	Nil	40	30	40	Trace	Trace
New Colony-Vengpui Tuikhur	Nil	40	30	120	Trace	Trace

The total coliform density varies from a minimum (which is for the hand pump) of 5 to a maximum of 42 for station VII. As per ISI drinking water standards,⁵ more than 10 MPN/100 ml should not be present in any sample but the values exceed this limit in all the samples except in that of the hand pump. This high value may be due to the use of pit latrines (dry latrines), piggeries and poultries⁶ which are predominant in the area and poor sanitation facilities as well as unawareness of the masses.

Total hardness varies from 40 to 120 for different tuikhurs and is 100 for hand pump. The minimum and maximum chloride concentration was found to be 20 and 30 for different tuikhurs whereas the value for the hand pump is found to be 10 ppm which is least of all the sources taken. The slight higher concentration of chloride may be attributed to the pollution from sewage wastes leaching. The fluoride concentration for all the samples was found to be only in trace (very low) which may be due to the lack of fluoride bearing minerals in the strata through which the water is assimilating.^{7,8} The dissolved iron is generally low in all samples except the hand pump of New Saiha where it is 1 ppm (i.e. 1 mg/l). The concentration of Fe in hand pump water is higher because under reducing condition, the solubility of Iron bearing minerals increases, enriching dissolved Iron in water.⁹

CONCLUSION

The results obtained from the physico-chemical and bacteriological studies reveal

that water samples of the area selected are free from impurities. However, further investigations of other parameters will strengthen the findings.

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