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Physico-Chemical Characteristics of Spring Water of Lunglei, Mizoram

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ABSTRACT

In developing countries, availability of potable water to common masses is one of the main problems and thus, the majority population is dependent on the unsafe drinking water. The main objectives of the present work were to collect water samples from open springs (Tuikhur) and piped waters from the Lunglei, Mizoram and analyzed these samples for their physico-chemical quality in order to identify the problems of contamination and suggest appropriate measures for their cleanliness. Results of the present study indicated several parameters which are important for health and aesthetic values. For example, detection of elevated levels of chloride (25 to 100 mg/l) suggests further investigations of the occurrence of chloride contamination in the samples of the Lunglei city which needs to be maintained within the safety standard for drinking water. The pH values of the tested samples were between the values of 6.5 to 7.5. Total Hardness ranged from 30 mg/l to 105 mg/l. TDS values ranged from 40 mg/l to 380 mg/l Iron and Nitrate contents were present only in trace quantities in all the samples. The use of alternative sources, improvement of water supply structures and water treatment are possible solutions to improve the quality of drinking water in Lunglei.

Keywords Drinking water, Physico-chemical, Lunglei, Iron, Nitrate.

INTRODUCTION

In India today, biological pollutants of potable water supplies are still common and prevalent in rural areas, because of unhygienic and insanitary situations. But in the past few years, such cases of water-based diseases have decreased markedly by introduction of new government schemes and program that resolve sanitary related conditions for the reduction of water borne diseases such as typhoid, diarrhoea. The findings in Mizoram indicate that the Public Health Engineering Department (PHED) water is better than the tuikhurs water supply; however, the tolerance limits were shown to be more or less of the same for the water quality of both sources, which is used both for drinking and domestic purposes (Kumar *et al* 2010).

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Everyone requires drinking water, the water used to feed humans and animals. We all have to safeguard the availability of quality water and guarantee its sustainable supply to every household. The rising population has greatly increased the demand for water. The key suppliers of potable water are sub-surface waters, land and rainwater, which ensures and preserves consistency and adequacy, posing major challenges to governments and communities in rural hilly areas like Lunglei. It is exceedingly difficult to eliminate and avoid structures that damage water supplies in rural areas where water needs outweigh mechanisms and protections for protecting their water sources. It is not only the government that is in charge of safe drinking water, but also the communities and every household in rural environments to legislate and enforce the more stringent laws may not be the solution for the people.

Studies were collected and analyzed on the water samples from the rural areas of north and south Lunglei under the physico-chemical parameters of different areas and the results show that the current water quality of potable water falls within the safety standards defined by the BIS and is below the allowable limits at those locations. Mizoram water is very clean with respect to Nitrate (Lalchhingpuii *et al.* 2011). The reports available show that most of the arsenic affected in Asia's flood plains lie next to the Himalayan or Tibetan plateau rivers (Nickson *et al.* 2005, Das *et al*. 2008). In the south of Mizoram, tuikhurs and hand pumps are typically readily suited for domestic use as water sources (Blick *et al.* 2016).

Lunglei is one of northeastern India's districts of Mizoram. The territory of the district covers a surface of 4, 538 km^2 and the city of Lunglei is located on a ridge, at an altitude of 722 m amsl and is the district's administrative center. According to the 2011 census, the population of district is 1,54,094 and the main agricultural system of the district consists of cultivation, locally known as "jhuming, practiced on steep slopes. This study is being carried out in Lunglei's main city district. In this study, a total of 10 samples were collected. PHED, the Govt of Mizoram and the traditional Tuikhurs primarily provide new and drinking water. As Lunglei is however a smaller area, the majority of households rely on the PHED water line rather than on tuikhurs to cook and drink. The research region is geologically mainly rocks of clay and arena. They are part of the Middle Bhuban rocks from the Surma group represented by the Neogenic period. The laminated shells are typical and vary from grey to brown in color. The sandstones are also mostly buff sandstones and are often also grey in color, and water carriers. The N-S rocks strand is quite common in general between 30-45° west. Vertical relation of the rocks is very common.

MATERIALS AND METHODS

The water samples were collected from different parts of Lunglei city for this study. All the samples were taken from the local springs (Tuikhurs) which are regularly used as a potable water source for most of the local population in the area as the water supply from the PHE department is not adequate to cover all the requirements of the city's population (Lalmalsawmzauva 2016). The samples' locations can be seen in the map in Fig.1 and the coordinates can be seen in Table 1. In total, ten samples were taken from Tuikhurs around the city. The samples were

Table 1. Sample location details.

Sl. No.	Station	Name of the Station	GPS coordinates	Elevation (in m)
1.	L1	Zothlang phul Tuikhur	$22^0$54'56"N $92^0$45'13"E	1130
2.	L2	Saptui Tuikhur	$22^0$54'24"N $92^0$45'35"E	1137
3.	L3	Thanghluta Tuikhur	$22^0$54'24"N $92^0$45'41"E	1136
4.	L4	Zohnuai Tuikhur	$22^0$54'19"N $92^0$45'25"E	1121
5.	L5	Venglai Tuikhur	$22^0$54'21"N $92^0$44'30"E	1149
6.	L6	Lunglawn Tuikhur	$22^0$52'17"N $92^0$45'21"E	1095
7.	L7	Three gate Tuikhur	$22^0$52'11"N $92^0$45'30"E	1099
8.	L8	College veng Tuikhur	$22^0$52'9"N $92^0$45'29"E	972
9.	L9	Venghlun Tuikhur	$22^0$52'43"N $92^0$44'42"E	969
10.	L10	Rahsi veng Tuikhur	$22^0$53'34"N $92^0$44'33"E	1008

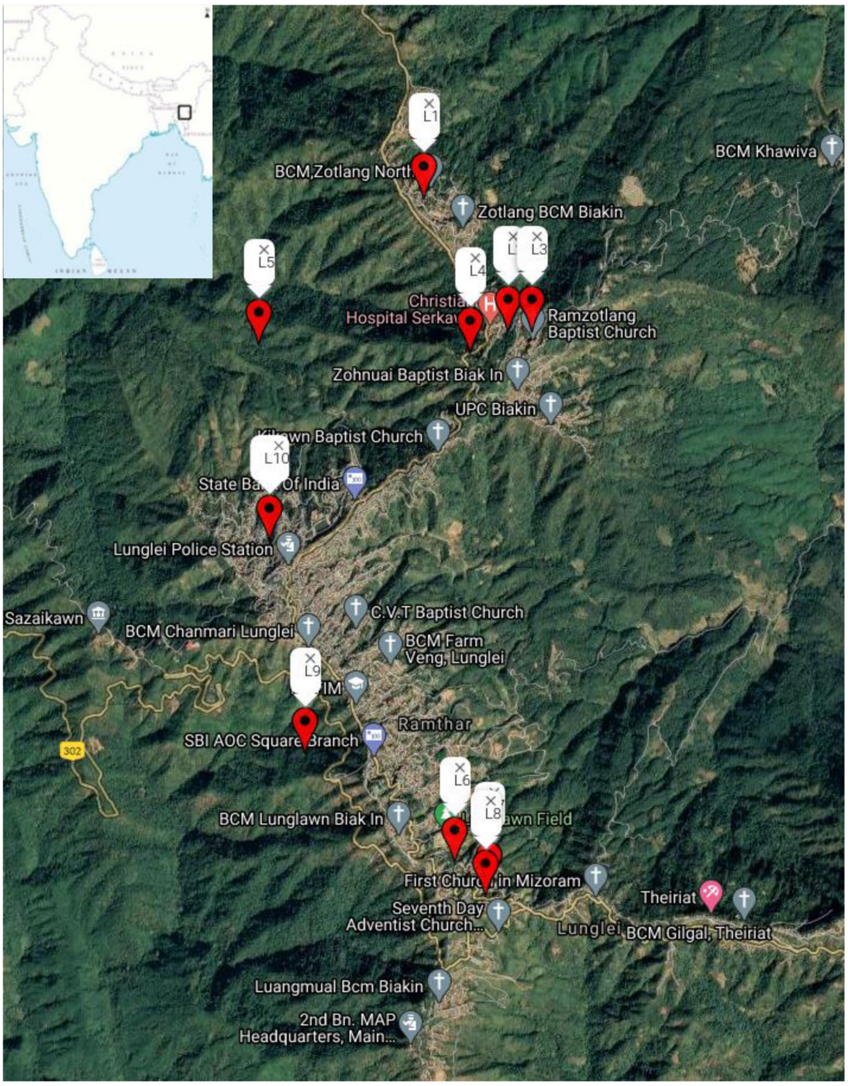

Fig. 1. Sample location map for study area.

collected following the APHA (1998) regulations in polyethylene bottles. The bottles were pre cleaned thoroughly, rinsed with distilled water and were again rinsed with the sample water just before collection of the sample.

Each sample was collected in two bottles of 250 ml each, one of which was acidified with 2-4 ml of diluted HNO_3 and one was collected kept as it is. *In situ* testing of the samples was also done at the site for the basic physico-chemical properties like pH, electrical conductivity (EC) and total dissolved solids (TDS). These measurements were made using digital instruments form Eutech Oakton. Turbidity was measured on the Digital Nephelo-Turbidity meter-132 (Systronics). P-alakilinity, M-alkalinity, total alkalinity, total hardness and total chloride were measured in the laboratory using titrimetric methods. The iron and fluoride concentration were determined using spectroquant (NOVA 60).

Table 2. Quality Results of the water samples.

Station	pH	EC	Turbidity	TDS	Total hardness	P-alkalinity	M-alkalinity	Total alkalinity	Total chloride	Total iron	Fluoride
L1	7.3	493	<1.0	30	65	Nil	30	30	40	<0.01	<0.01
L2	7.1	243	<1.0	240	75	Nil	35	35	35	<0.01	<0.01
L3	6.6	366	<1.0	240	55	Nil	40	40	45	<0.01	<0.01
L4	6.7	346	<1.0	140	40	Nil	30	30	30	<0.01	<0.01
L5	6.5	407	<1.0	100	50	Nil	30	30	25	<0.01	<0.01
L6	7.3	296	<1.0	70	80	Nil	40	40	45	<0.01	<0.01
L7	6.8	288	<1.0	190	45	Nil	45	45	55	<0.01	<0.01
L8	7.1	305	<1.0	130	35	Nil	30	30	40	<0.01	<0.01
L9	7.0	296	<1.0	290	110	Nil	120	120	100	<0.01	<0.01
L10	6.6	300	<1.0	420	65	Nil	50	50	60	<0.01	<0.01

RESULTS AND DISCUSSION

All the collected samples were colourless, odourless and tasteless at the time of collection. The results of the laboratory analysis are presented in Table 2. The pH values of the samples ranged between 6.5 and 7.5. All samples were within the prescribed limits for potable use (BIS 2012). The EC values ranged between 243 µS/cm and 493 µS/cm. The TDS values ranged between 30 mg/l and 420 mg/l. Total Hardness was between 35 mg/l and 110 mg/l. All the samples were safe and within the ISI prescribed limit of 300 mg/l for water hardness.

None of the samples collected showed any P-alkalinity, whereas, M-alkalinity in the samples ranged from 30 to 120 mg/l. All samples were within the ISI prescribed limit of 200 mg/l, however, the value of sample L9 was a little higher than other samples. Appelo and Postma (1993) has shown in their study that chloride concentration is an indicative parameter for evaluating the atmospheric input to the spring water. In our samples the chloride concentration ranged between 25 mg/l and 100 mg/l. The values quite low and will not have any adverse effects on the taste of the water (Lockhart *et al.* 1955).

Fluoride concentration in all the samples were in trace quantities only and well below the ISI prescribed limits. This indicates non-availability of soluble fluoride bearing minerals in the geology of the area (Das *et al.* 2000, Handa 1975). Iron concentration was similarly only found in trace quantities in all samples in this study. Iron presence can be attributed to sewage effluent and sewage leakage into the subsurface water sources of the area (Handa *et al.* 1981). Another source could be leaching of heavy metals into soil (Mishra *et al.* 2005). The absence of significant quantity of Iron indicates no such leakage is present in the study area.

CONCLUSIONS

The physico-chemical analyses of the Tuikhur water samples collected from various parts of Lunglei city show that the water is safe for potable use because all the parameters tested were within the ISI prescribed limits for potable water supply. Having said that, since tuikhurs are natural resources of water with no treatment done on them, it is advisable to use basic filtration before using this water for drinking purposes. As far as other potable purposes are concerned the water is perfectly safe for all the other kind of human uses. Further, studies would be required to assess the microbiological contamination of this water as it has not been done in the present study.

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