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Study of Physico-Chemical Total and Feacal Coliform Parameters of Water in the Borewell at Tiruchendur

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Abstract: ***In this study, we evaluated the physicochemical and microbial qualities of bore well water at Tiruchendur. The mean values of some physicochemical constituents are pH (7.0±0.20 to 7.5±0.20), Dissolved oxygen (1.12±0.52 mg/l to 1.80±0.52 mg/l),Total Dissolved Solids (0.2± 0.24 mg/l to 0.6±0.24mg/l),Total Coliform (300±0.17 MPN /100 ml to 300.2±0.17 MPN /100ml) and Faecal Coliform (8.0±0.25 MPN/100ml to 8.2±0.25 MPN/100ml). Physico-chemical characteristics of borewater were assessed through the standard protocol suggested by APHA (2005). Statistical analysis such as single factor ANOVA is performed to the data set to know the relationship among the studied parameters. Results were compared with World Health Organisation (WHO).The water supply sources in the present study have good physicochemical and microbial (Total and Faecal coliform) attributes for human consumption. The study recommends mobilization of onsite treatment interventions to protect the households from further possible consequences of using the water.***

Keywords: Bore water; Physico-chemical parameters and microbial qualities

1. Introduction

People can survive days, weeks or months without food, but only about four day without water. Two major source of water whose quality are assessed by chemists are the surface (stream, river, ponds and lakes) and ground water (well, bore and holes) (Okeola, 2010). The physico-chemical and microbiological quality that adversely affected the quality of water is likely to arise from a variety of sources including land application of agricultural chemicals and organic wastes, infiltration of irrigation water septic tanks, land infiltration of effluents from sewage treatment plants, pits, lagoons and ponds used for storage (Aydin, 2007; Biradar et al., 2014). Coliform will not likely cause illness. Drinking water can become contaminated with foreign matter such as pathogenic bacteria (Salmonella typhi, Shigella dysentariao, Escherichia coli, Klebsiella pneumonia etc.), chemical substances (fertilizer, pesticides, metals etc.) and industrial effluents or other wastes, which deteriorates its quality; rendering it unfit for its intended use (Sunil Kumar Tank and Chippa, 2013) and (Mbah and Muhammed , 2015). It is necessary that the quality of water should be checked at regular time interval, because due to use of contaminated water, human population suffers from varied of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life.

Objectives

The bore well water monitoring is performed with following objectives.

- To analyse the physic-chemical parameters in the bore well water.
- To determine the MPN (Most Probable Number) count of total coliform and feacal coliform in the bore well water.
- To evaluate the analysis of variance.

2. Study Area

The water sample was collected randomly from bore well in Tiruchendur town .The bore well was situated in a house which is owned by Mr. P. Chermadurai. The house was situated in Subramaniyapuram street at Tiruchendur (Figure-1). The bore well site in the house was about near the Subramaniya swami Temple Bus stop of Tiruchendur. The bore well size is about 4 inches and depth is 50 feet (Figure-2). The house lies within longitude 8°49 and latitude 78° 12 N.

Figure 1: Satellite map showing the study area

Figure 2: Sampling site of Bore well

Sample Collection
The water sample was collected from January 2018 to March 2018 from bore well water at Tiruchendur. The sample were collected in 1L plastic container which had been thoroughly washed and filled with distilled water then taken to the sampling site. The bottle was emptied and rinsed several times with the water to be collected. Also the sample bottle was tightly covered immediately after collection. It was then kept in water containing ice blocks and transported to the laboratory for preservation in a refrigerator before analysis was carried out on them. These were analyzed as per the procedures given in standard method (APHA 2005).

Statistical Analysis
Statistical analysis was conducted using the Microsoft Excel version 2007. The single factor ANOVA was carried out to determine significant differences between parameters/ variables in hydrology and water quality.

3. Methodology

Test for Total Coliform:
The coliform group includes the entire aerobic and facultative anaerobic gram negative, non - spore forming rod shaped bacteria which ferment lactose with gas formation within 48 hours at 37^0 c. The standard test for the estimation of number of the coliform groups may be carried out either by the multiple tube dilution tests (presumptive test, confirmed test, or completed test) or by the membrane filter technique.

Test for Feacal Coliform:

General
This procedure is used to differentiate coliform of faecal origin from those of non-faecal origin. Faecal coliform are those coliform which can ferment lactose at 44.5^0C within 24±2 hours with the production of gas. Use brilliant green bile lactose broth medium for this test.

Subculture all presumptive positive tubes of the coliform test, at the end of 24 and 48 hours into BGB medium and incubate at 44.5^0C for 24 hours in a water bath. Gas formation within 24 hours is considered to be positive reaction for faecal coliform.

4. Results & Discussions

pH
In the investigation the pH value of water sample varied from 7.0±0.20 to 7.5±0.20 indicated that the nature of water is neutral. Maximum value was recorded as 7.5±0.20 during the study period January whereas the minimum pH value was recorded as 7.0±0.20 during the month of February to March (Figure- 3).

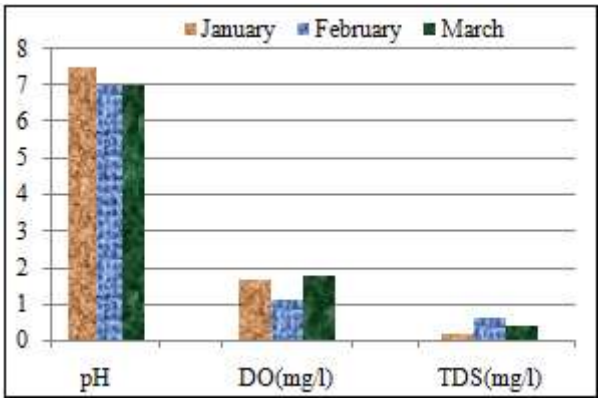

Figure 3: Physico-chemical parameters of bore well water at Tiruchendur

Table 1: Comparison of bore well water with the WHO drinking water standards

Parameters	WHO
pH	6.9-9.2
DO(mg/l)	4.0-5.0
TDS(mg/l)	500-1500
Total coliform(MPN/100ml)	<500MPN/100ml
Faecal coliform(MPN/100ml)	<500MPN/100ml

Table 2: ANOVA Results of microbiological and physic-chemical parameters pH between the groups

Parameters	JANUARY				FEBRUARY					MARCH		
	F Value	P Value			F Value	P Value			F Value	P Value		
DO	605	2.96	P > 0.05	NS	1354	3.26	P > 0.05	NS	950	7.74	P > 0.05	NS
TDS	2523	4.18	P > 0.05	NS	1344	3.36	P > 0.05	NS	2060	7.66	P > 0.05	NS
Total coliform	41.2	0	P < 0.05	S	901	1.65	P > 0.05	NS	257	3.74	P > 0.05	NS
Feacal coliform	8.81	0.02	P < 0.05	S	18.3	0	P < 0.05	S	41.5	0	P < 0.05	S

From the result it can be seen that concentrations of the respective parameter pH was within the WHO standards as shown in table1. There were no significant differences between pH with DO and TDS in the month of January. While in the month of February and March there were no significant differences with DO, TDS, and Total coliform. There was a significant differences between pH with Total coliform and Faecal coliform ($P < 0.05$; $F = 4.16$) ($P = 0.00061$) during January. During February there was a significant differences between pH with Total coliform and Faecal coliform ($P = <0.05$; $F = 18.304$) ($P= 0.0026$). During the month of March there was a significant differences with Faecal coliform ($P = < 0.05$; $F = 41.47$); ($P = 0.0002$) (Table 2).

These values showed slightly alkaline trend, because the pH of water is generally influenced by the catchment of water. Similar literature was available by Musaddiq (2002).

DO:

Table 3: ANOVA Results of microbiological and physic-chemical parameters DO between the groups

Parameters	January				February				March			
	F Value	P Value			F Value	P Value			F Value	P Value		
pH	605.45	2.96	P > 0.05	NS	998.39	1.1	P > 0.05	NS	1354.05	3.26	P > 0.05	NS
TDS	47.20	0.0004	P < 0.05	S	30.04	0.0005	P < 0.05	S	88.09	1.36	P > 0.05	NS
Total coliform	42.45	0.00051	P < 0.05	S	357.84	6.31	P > 0.05	NS	932.81	1.43	P > 0.05	NS
Feacal coliform	8.81	2.96	P > 0.05	NS	866.60	1.92	P > 0.05	NS	678.96	5.05	P > 0.05	NS

Higher dissolved oxygen concentration observed during the month of March as 1.80±0.52 mg/l. The lower DO concentration was obtained during as February 1.12±0.52 mg/l. The dissolved oxygen concentration was within the permissible limits of WHO standards.

The DO levels did not show statistically significant variations between pH and faecal coliform during January (Table 3). While during February no significant variations was revealed between pH, Total coliform and Faecal coliform. Consequently during March there were no significant variations between DO among the parameters. There were significant differences between DO with TDS, Total coliform during January. There were significant differences between DO with TDS during February.
The maximum concentration of DO might be due to on the basis of the capacity of water to hold oxygen. This finding was closely confirmed with Parihar et al (2009).

TDS:
TDS was recorded maximum during February as 0.6±0.24 mg/l while minimum was recorded as 0.2± 0.24 mg/l during January. TDS were within the permissible limits of WHO during this investigation. During the study period January the TDS revealed there were no statistically significant variations between pH and Feacal coliform. While there was a significant differences occurred between DO and total coliform. During the study period February there were no statistically significant variations between the parameters such as pH, Total coliform and Faecal coliform. Consequently during the study period March the TDS levels did not show statistically significant variations among the parameters (Table 4).

The highest level of TDS might be the concentration of dissolved ions may cause the water to be corrosive, salty or brackish taste, result in scale formation. Similar literature was available in Shivaprasad et al (2014).

Table 4: ANOVA Results of microbiological and physic-chemical parameters TDS between the groups

Parameters	January				February				March			
	F Value	P Value			F Value	P Value			F Value	P Value		
pH	2522.18	4.184	P> 0.05	NS	2088.15	5.81	P >0.05	NS	1344.05	3.26	P > 0.05	NS
DO	47.20	0.0004	P < 0.05	S	30.04	0.0005	P < 0.05	S	88.09	1.36	P > 0.05	NS
Total coliform	43.09	0.0009	P < 0.05	S	360.09	6.15	P > 0.05	NS	932.81	1.43	P > 0.05	NS
Feacal coliform	142.53	2.09	P > 0.05	NS	1391.11	2.93	P > 0.05	NS	678.96	5.05	P > 0.05	NS

Total coliform
The maximum total coliform was observed as 300.2±0.17 MPN /100ml during January while the minimum count was observed during March 300±0.17 MPN/100 ml (Figure -4). The Total coliform counts were within the desirable limits of WHO.

Total coliform counts did not show any statistically significant variations between pH during January, February and March. There is a single factor ANOVA indicated there was a significant differences between Total coliform with DO, TDS and Faecal Coliform during January. The one way analysis of variance represented there was no significant variance between Total coliform with DO, TDS, and Faecal coliform during February and March (Table 5).

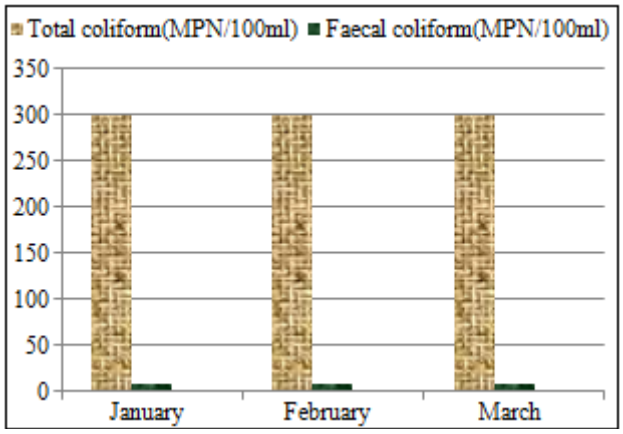

Figure 4: Coliform parameters of bore well water at Tiruchendur

Table 5: ANOVA Results of microbiological and physic-chemical parameters Total coliform between the groups

Parameters	JANUARY				FEBRUARY				MARCH			
	F Value	P Value			F Value	P Value			F Value	P Value		
pH	68.57	3.4	P > 0.05	NS	345.06	7.27	P > 0.05	NS	900.92	1.65	P > 0.05	NS
DO	42.63	0.00016	P <0.05	S	357.84	6.31	P > 0.05	NS	932.81	1.43	P > 0.05	NS
TDS	43.09	0.0005	P < 0.05	S	360.09	6.15	P > 0.05	NS	940.15	1.39	P > 0.05	NS
Feacal coliform	40.53	0.0007	P< 0.05	S	341.94	7.54	P > 0.05	NS	893.55	1.1	P > 0.05	NS

The highest count of Total coliform was influenced through seepage from surface run-off leaky-septic tanks, plant bacteria or natural soil conditions. This study confirms findings by Lobina Palamuleni and Mercy Akoth (2015) who found similar results in borehole Water in Mahikeng, South Africa.

Faecal coliform

The maximum faecal coliform count was found during January 8.2±0.25 (MPN/100ml) and minimum count was observed during March 8.0±0.25 (MPN/100ml). Faecal coliform counts were within the recommendable limits of WHO.

The single factor ANOVA represented there was a significant variation between Faecal coliform with pH and Total coliform during January. There was no statistically significant variation was observed between Faecal coliform with DO and TDS during January. During the study period February there was no statistically significant variation between Faecal coliform with DO, TDS and Total coliform. During this investigation there was no significant differences was observed between Faecal coliform with pH, DO and TDS, in the month of March while there was a significant variation with Total coliform (Table 6).The maximum count might be due to discharge of excreta from human beings and other homeotherms. Similarly reported by Radha Krishnan et al.,(2007).

Table 6: ANOVA Results of microbiological and physic-chemical parameters Faecal coliform between the groups

Parameters	JANUARY				FEBRUARY				MARCH			
	F Value	P Value			F Value	P Value			F Value	P Value		
pH	8.817	0.024	P < 0.05	S	41.47	0.0002	P < 0.05	S	18.30	0.002	P > 0.05	NS
DO	92.113	7.32	P > 0.05	NS	86.60	1.92	P > 0.05	NS	678.96	5.05	P > 0.05	NS
TDS	142.90	2.09	P > 0.05	NS	1391.11	2.93	P > 0.05	NS	816.08	2.440	P > 0.05	NS
Total coliform	40.53	0.0007	P < 0.05	S	341.94	7.54	P > 0.05	NS	893.55	893.55	P < 0.05	S

5. Recommendations

- Rainwater harvesting must be provided and should be made compulsory for each residential unit as it is considered as the economical solution.
- Consideration of schemes to construct artificial recharge structures.
- Provision of government owned treatment units like reverse osmosis, desalination ion-exchange process etc. To prevent the consumption of marginal quality variation.
- The ground water assessment and estimation should be conducted each year for understanding of groundwater quality variation.

6. Conclusion

The borehole well in this area is good and therefore suitable for domestic purposes. Our findings suggested that the physico-chemical characteristics of water from borehole well were within the WHO standards. This implies that the entire groundwater samples are suitable for irrigation purposes, and are suitable as a source of drinking water. In conclusion, there is a need for regular hydrogeochemical studies in the study area in order to detect any future deterioration of groundwater quality.

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