Quality Evaluation of Drinking Water Samples from Bore Wells In Edanji Using Physico-Chemical Parameters

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Abstract

We discussed the physicochemical analysis of drinking water samples collected from various bore wells in Edanji, Thiruvananthapuram, Kerala. We have analyzed the physical (Odor, taste, colour, temperature, turbidity, and electrical conductance) and chemical (amount of total alkalinity, total hardness, Calcium, Magnesium, Chloride, Fluoride) parameters of the water samples. The water samples are found as odorless, colors, and tasteless. The temperature of the samples is found as within 30.00 and is useful for drinking purposes. The turbidity measurement of the water samples was carried out. The analysis of the samples implies that the samples are slightly basic. The high electrical conductance values imply the presence of charged particles. The alkalinity of water samples is mainly due to the presence of ions. Hardness determination points out that most of the water samples are very hard. The presence of Ca^{2+} and Mg^{2+} ions in the water samples are within acceptable limits. Cl^- and F^- ions are also within the tolerable limit and may be beneficial for health. Overall, the analyzed water samples are not fit for drinking purposes.

Keywords: *Physico-Chemical analysis; Turbidity; pH; Alkalinity; Hardness*

I. INTRODUCTION

Water is plentiful and is a central part of the earthly environment covering about 75 % of the earth's surface. It ensues as surface water (in lakes, ponds, rivers, streams, seas, oceans, glaciers, etc.) and groundwater [1, 2]. Freshwater has to turn out to be a scarce product owing to the increasing industrialization, the demand for water supply has been increasing enormously [3, 4]. The borewell water is regarded as groundwater because it is obtained from underground layers of water-bearing rocks (aquifers) [5]. Groundwater is a foremost source for drinking, domestic, and irrigation purposes. It is considered one of the untainted forms of water accessible in nature and encounters most of the requirements of both normal and urban inhabitants [6]. Groundwater quality in an area is mainly subject to natural processes like dissociation and precipitation of minerals, groundwater velocity, the eminence of recharge water, interaction with other types of water aquifers, and human-caused actions [7].

As said above, groundwater is an important resource that affects the health and welfare of people worldwide [8]. So periodical assessment of drinking water quality is recommended. Because of the above facts, in this study, we describe the quality assessment of drinking water samples collected from bore wells of Edanji near Manchavilakom in Thiruvananthapuram District, Kerala, India using some physicochemical parameters.

II. MATERIALS AND METHODS

Drinking water samples were collected from ten different Open. The samples were collected after washing and rinsing plastic containers of two-liter capacity. The temperature of the samples was measured directly using a thermometer, which was placed in the water sample taken in a 100 mL beaker. The digital pH meter was allowed to warm up for 5 minutes, then placed in the water sample taken in a 100 ml beaker, and the pH was read directly. Turbidity was spectrophotometrically determined at 450 nm using a Napheloturbidimetric meter. The electrical conductivity was measured using a digital Electrical Conductivity meter. The unit is presented ppm at 25 ^{0}C. EDTA titration was performed to measure the hardness of the water. Volumetric method was used to determine the total alkalinity of the drinking water sample. Chloride content was

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determined by argentometry. Fluoride concentration in the water samples was determined spectrophotometrically by the SPADNS method.

III. RESULTS AND DISCUSSION

The physical and chemical water quality parameters will give vital information about the quality of water. In this study, the water quality parameters were evaluated as per the instructions of the edition of 'standard methods for the examinations of water and waste water' published jointly by the American public health association and American water works association and federation in 2005. The quality standards followed as per the chart of IS 0500: 2012 published by the Bureau of Indian standards about water quality. The different water quality parameters evaluated were utilized to determine the quality of water for drinking purposes.

In the present investigation, ten water samples were collected from the bore wells in Santhom Malankara Arts and Science College, Edanji, Thiruvananthapuram District.

1.1. Physical parameters

The different physical parameters calculated for the water samples are presented here. The results obtained are tabulated in Table 1.

Odor: The presence of odor in water samples is an indication of pollution/contamination. In the present study, all the ten well water samples collected are odorless.

Taste: The present water samples are found as tasteless.

Colour: According to the guidelines of WHO, the colour of a water sample should not exceed 5 TCU. In the study, the water samples collected from bore wells are found as colorless.

Temperature: Temperature is an important physical parameter that influences the chemical, bio-chemical characteristics of the water body. The temperature of the water samples collected from the bore walls of Edanji ranges between 29.50-30.00, and the found values are in the acceptable range.

Turbidity: The measurement of turbidity of water is related to its optical property/transparency. Turbidity is influenced by the components present in the water sample. According to WHO guidelines, a water sample with turbidity less than 5 NTU is more favorable to drinking. Here the turbidity values are under 5 NTU and range between 0.00 to 3.20 NTU. The low turbidity value indicates the absence of iron contamination and the absence of suspended organic contaminants [9, 10].

pH: The measurement provides vital information about the strength as acidity, and alkalinity of a sample. In the present study, all the water samples exhibit values closer to neutrality (5.06-7.77). The samples 4 – 10 show pH values lower than 7.

Table 1. Physical parameters of water samples collected from bore wells

Sample ID	Odor	Taste	Colour	Temperature (^{o}C)	Turbidity (NTU)	pH	Electrical conductance (ppm)
1	--	--	--	30.00	3.20	7.39	226.92
2	--	--	--	29.70	--	7.77	240.38
3	--	--	--	29.80	0.40	7.16	373.08
4	--	--	--	29.50	--	5.56	78.08
5	--	--	--	29.50	1.50	6.75	197.44
6	--	--	--	29.80	--	6.35	189.74
7	--	--	--	29.90	1.90	6.62	103.08
8	--	--	--	29.70	1.20	5.06	44.17
9	--	--	--	29.80	0.30	6.64	230.13
10	--	--	--	29.90	0.10	6.56	108.65

Electrical Conductivity: Electrical conductivity measurements will provide an idea about the capability of water to conduct electric currents. It is also used as a fool to assess the purity of water, and this parameter depends on the type of substance present in water. Here, the electrical conductivity values range between 44.7 to 373.08 *ppm*. Most of the bore well samples, except 4 and 8, show comparatively higher electrical conductivity, which may be due to the presence of dissolved ions in high concentrations.

1.2. Chemical parameters

The different chemical parameters calculated for the water samples collected from bore wells are provided below and summarized in Table 2.

Total alkalinity: The total alkalinity in water is due to carbonates, bicarbonates, and salts of weak acids. The maximum to the tolerable limit of alkalinity of a water sample is 120 ppm. Here the total alkalinity of the water samples is in the range of 1-5 *ppm*, which is highly desirable for drinking water. The analysis revealed that the alkalinity is due to the presence of
OH-, CO_3^{2-} ions.

Table 2. Chemical parameters of water samples collected from bore wells

Sample ID	Alkalinity (ppm)			Total hardness (ppm)	Ca^{2+} (ppm)	Mg^{2+} (ppm)	Cl^- (ppm)	F^- (ppm)
	OH^-	CO_3^{2-}	HCO_3^-					
1	--	--	3.00	409.00	80.00	51.00	19.88	0.0014
2	--	2.00	1.00	189.00	51.00	15.00	21.30	0.0015
3	--	--	4.00	581.00	152.00	49.00	57.51	0.0014
4	--	--	2.00	69.40	13.00	9.00	22.01	0.0014
5	--	--	3.00	317.60	81.00	28.00	14.91	0.0013
6	1.00	--	--	225.00	44.00	28.00	39.76	0.0014
7	5.00	--	--	80.00	32.00	--	17.04	0.0015
8	--	--	2.00	43.00	49.40	5.00	17.04	0.0014
9	--	--	2.00	406.00	115.00	29.00	23.43	0.0016
10	1.00	--	--	175.00	20.00	17.00	30.53	0.0016

Total hardness: The hardness of water is a variable that depends on the quantity mixture of cations and anions. Mainly, calcium and magnesium salts of carbonates, sulfates, and chlorides are responsible for the total hardness. According to WHO, the permissible limit of total hardness for drinking purposes is 200 *ppm*. Hardness beyond 300 ppm many leads to serious health issues and affects the heart and kindly functions [9, 10]. In this study, the total hardness of most water samples is very high and is not safe for drinking purposes. The hardness values range between 49.40 – 581.00 *ppm*. Among the 10 samples, six samples are very hard, one sample is hard, two samples are moderately hard, and one sample is soft.

Calcium: According to WHO, the maximum favorable limit in drinking water is 75 *ppm*. Here, the Calcium level ranges between 20.0-152.0 *ppm*. Among the ten samples, four samples (1, 3, 5, and 9) are not good for drinking purposes due to the high quantity of calcium.

Magnesium: The amount of Magnesium will influence the quality of drinking water. The allowed limit of drinking water is 30 *ppm*. In this study, the amount of *Magnesium* ranges from 0-51.00 *ppm*. The values are within the allowed limit for eight samples, and two samples (1 and 3) are not useful for drinking.

Chloride: In general, the presence of excess amount Chloride ions in the drinking water will cause a salty taste. Chloride ions in water bodies are animal waste, industrial wastes, sediments from igneous rocks and pit latrines, etc. The permissible limit of Chloride ions in drinking water is 200 *ppm*. In the present investigation, the amount of Chloride ions in the water samples ranges from 14.91-57.51 *ppm* and are under for tolerance limit.

Fluoride: Fluoride ion is present in almost all water bodies. The presence of Fluoride ions up to 1*ppm* is considered beneficial, which improves dental health. If the amount surpasses above 1.5 *ppm*, it is dangerous to health. Excessive fluoride in drinking water may lead to 'dental fluorosis' and other adverse health effects [9, 10]. In this investigation, we found that Fluoride ion is present in trace amounts (0.0013-0.0016 *ppm*) and is beneficial for health in all water samples.

III. CONCLUSION

In this study, we analyzed the quality of drinking water samples collected from various bore wells in Edanji, Thiruvananthapuram, Kerala via the evaluation of various physical (Odor, taste, colour, temperature, turbidity, and electrical conductance) and chemical (amount of total alkalinity, total hardness, Calcium, Magnesium, Chloride, Fluoride) parameters. Following are the concluding remarks of the present investigation. The water samples are found as odorless, colors, and tasteless. The temperature of the samples is in the range of 29.50-30.00 and is useful for drinking purposes. The turbidity of the water samples indicates that *iron* and other suspended organic contaminants are absent. The analysis of the samples says that the samples are slightly basic. The high electrical conductance values suggest that the presence of charged particles. Alkalinity determination says that the alkalinity of water samplers is mainly due to the presence of ions. The alkalinity due to OH^- and CO_3^{2-} ions are also observed. Hardness determination indicates, most of the water samples are very hard. Among the 10 samples, six samples are very hard, one sample is hard, two samples are moderately hard, and one sample is soft. The presence of Ca^{2+} and Mg^{2+} ions in most of the water samples are within acceptable limits. Cl^- and F^- ions are also within the tolerable limit and may be beneficial for health. Overall, the analyzed water samples are not safe for drinking purposes.

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