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Chemical Analysis of Drinking Water of Villages of Mahad Tahsil Raigad Distract

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Abstract: *The water quality is determined in different villages of Mahd Tahsil & water samples taken from different locations like Savitri river water, Bore well water, open well water; where from each water samples are under studied for Physico- chemical status of water samples. The present research work has been carried out to estimate the various physico-chemical parameters of drinking water at eight different villages around Mahad town Raigad Maharashtra. All the drinking water samples were subjected to analysis of physico-chemical parameters such as pH, electrical conductivity, total dissolved solids, chloride, sodium, potassium, calcium, magnesium, nitrate, sulphate, phosphate and fluorid . The obtained results are compared with WHO standard values. The results revealed that most of the physicochemical parameters such as fluoride were in high concentration at most of the drinking water sampling stations*

Keywords: drinking water, physico-chemical, total dissolved solids, water quality

I. INTRODUCTION

Water is vital elements in each of our lives. Without water there is no life on our planet. Not only is it to our health, but also use in for numerous household tasks. Water is an essential ingredient of animal and plant life. In a nature water is distributed in different form, such as rain water, river water, spring water and mineral water etc. rain water is consider as purest form of water. Drinking water is used for domestic and industrial water supply and also for irrigation purposes in all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization.

Although statistics, the WHO reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water [1]. Fresh water is one of the most important resources crucial for the survival of all the living beings. It is even more important for the human being as they depend upon it for food production, industrial and waste disposal, as well as cultural requirement [2]. Human and ecological use of ground water depends upon ambient water quality. Human alteration of the landscape has an extensive influence on watershed hydrology Gurunathan, 2006 [3].

Water is one of the most important compound of the ecosystem, but due to increases human population, industrialization, use of fertilizers and pesticides in the agriculture & man made activity. India several places now suffer from non availability of water for domestic and industrial use due to it's over exploitation & improper waste disposal, especially in urban areas [3]. Therefore it is necessary that the quality of drinking water should be cheeked at regular time interval. Because due to the use of contaminated water,not only human population but also aquatic organism, wildlife health suffers from varied water born diseases. The present study involved the analysis of drinking water described by its physical water quality in terms of physio- chemical parameters such as pH, conductivity, hardness, alkalinity, chlorides, fluorides etc. of different places around Mahad.

II. MATERIAL AND METHODS

Experimental, Study area: Mahad is located 8.0 kilometer from Mahad MIDC, Raigad district of Maharashtra, India. Raigad district is located at latitude 17.98N and longitude 73.47E . In the villages the majority of the people depend on under drinking water as a source for their day to day life.

Water Sampling: Water samples were collected from various sourses located in and around Mahad town (Table-1). The samples were collected in 1000 ml plastic bottles with necessary precaution. They were then carefully sealed, labeled and taken for analysis of physico-chemical parameters such as pH, EC, TDS, Cl^- , Na, K, Ca, Mg, NO_3^-, SO_4^{2-} , PO_4^{2-}

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and Cl^{-}. The drinking water samples were subjected to physicochemical analysis using standard procedure by APHA [4].

Table-1: Areas of sample collection in Mahad

Sample No.	Sample Location	Source
S_1	*Birwadi*	Open wall Water
S_2	*Shirgaon*	Bore Water
S_3	*Nate*	Bore Water
S_4	*Rajewadi*	Open wall Water
S_5	*Pachad*	Open wall Water
S_6	*Isane Kamble*	Open wall Water
S_7	*Sundarwadi*	Bore Water
S_8	*Chambharkhind*	River Water

Instruments: The following instruments are used to analyze drinking water samples.
Atomic Absorption Spectrometer (AAS) (PerkinElmer), Digital pH meter (Orion 3 Star, Thermo Scientific), UV-visible spectrophotometer (Model 117, Scientific), Digital Conduct meter with fluoride sensitive electrode, Flame photometer along with compressor

Chemicals Required:
All Chemicals used are of Analytical Reagent grade and all the solutions are prepared by using distilled water and wherever water without carbon dioxide is used when required .Established methods 15 are used to prepare for standardized solutions. Potassium hydrogen phthalate, Potassium hydrogen phosphate and borax buffer are used for pH meter calibration. Every time the instrument is calibrated, by using known pH buffer solutions and then the pH values of samples are measured. pH maintenance is one of the most important attributes of any aquatic system since all the biochemical activities depend on pH of the surrounding water. After calibration of the conductivity meter, conductivity of the samples is measured. Standard Calcium Carbonate, standard EDTA, Buffer solution (NH_4Cl +NH_4OH), EBT indicator and Muroxide indicator are used for measuring the Total, Calcium and Magnesium hard nesses in the samples. In the estimation of p-alkalinity and m alkalinity, standard Na_2CO_3, HCl and indicators of phenolphthalein and methyl orange are used. The Standard NaCl, $AgNO_3$ solutions and K_2CrO_4 indicator are used for analysis of Chloride in the samples. Through gravimetric analysis, the sulphates in the samples are analyzed using the solutions of $BaCl_2$, HCl, $AgNO_3$ – Nitric acid reagent and methyl orange indicator. In the analysis of estimation of nitrites, the chemicals used are of standard nitrite solution, standard sodium oxalate, Potassium permanganate, Ferrous Ammonium sulphate and Sulphanalamide reagent, N-(1-Napthyl) – ethylenediamine dihydrochloride and 1:1 H_2SO_4. For estimation of fluoride in the samples the required solutions are stock fluoride and Total Ionic Strength Adjustment Buffer (TISAB).
Procedure: For estimation of following various components in the water samples are estimated by follow the standard methods [5-11].
Estimation of pH and Electrical conductivity: The pH and electrical conductivity of all water samples are measured by using digital pH meter and conductivity meter.
Estimation of total dissolved solids: 100 ml of sample water is taken into a clean porcelain dish and heated at 180 ± 20C up to dryness and it is cooled to room temperature and finally placed in desiccators for complete removal of any moisture present in it. After that from the obtained weight, the amounts of total dissolved solids in the samples are determined by using appropriate formula.
Determination of Total hardness, Calcium and Magnesium: The known quantity of water samples are titrated in presence of Ammonia Buffer solution against with 9.3 × 10-3 N concentration of EDTA. The Calcium in the water samples are estimated by using with same EDTA in presence of KOH buffer solution. Finally the Magnesium content in the samples is estimated by using the consumed volumes of EDTA in the estimation of total hardness and Calcium hardness.

Estimation of Chlorides:
Known quantity of water samples are titrated in presence of Potassium Chromate indicator against with 1.94 ×10-2 N Silver Nitrate solution.

Estimation of Sulphates: Known quantity of water samples are taken and these are adjusted to a pH value of 4.5 to 5.0 by dilute HCl and these samples are heated up to desired conditions, while in hot, 10% BaCl2 solution is added till a white precipitate is obtained and the precipitate is separated by Whatman no. 42 filter paper and is dried and weighed.

Estimation of fluoride: With the help of the standard fluoride solution (from Sodium Fluoride) the ion analyzer instrument is calibrated. Now known quantity of water samples are added with 5 ml of TISAB buffer in a polythene container and then the concentrations of fluoride in the samples are estimated by ion analyzer.

Estimation of Sodium and Potassium: The flame photometer is calibrated separately with 4, 8, 12, 16 and 20 ppm of solutions of KCl and NaCl respectively at each time and immediately directly measured the concentrations of Sodium and Potassium in ppm units.

III. RESULTS AND DISCUSSION

The drinking water samples were collected in and around the Dindigul town. The obtained results are tabulated in table-1. The experimental results are compared with the limits recommended by WHO[4] and discussed.

pH: pH is used to determine whether a solution is acidic or alkaline. The pH values of all drinking water samples are found to be in the range of 7.09 - 7.53 (table 2). The highest value of 7.53 is observed at station S8 whereas the lowest value of 7.02 is observed at station S6. The permissible limit of pH for drinking water is 7.0 - 8.5 (WHO). The drinking water sample is found to be within the acceptable limit of WHO. There is no abnormal change of pH in the drinking water samples. If the pH is found beyond the permissible limit, it affects the mucous membrane of cells [5].

Electrical conductivity (EC):
The electrical conductivity values for all the drinking water samples are recorded within the range of 101-338 mmhos/cm. The electrical conductance is a good indication of total dissolved solids which is a measure of salinity that affects the taste of potable water [6]. Several factors like temperature, ionic mobility and ionic valences also influence the conducivity. The electrical conductivity value for all the drinking water samples are found within the permissible limit (1.8 dsm-1).

Total dissolved solids (TDS):
The total dissolved solids in water are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chlorides, phosphate, organic matter, and other particles. The values of the total dissolved solids for all the drinking water samples vary between 672 and 947 mg/l. The maximum allowable limit of total dissolved solids in drinking water for domestic purpose is 1500 mg/l (WHO). The maximum value (947 mg/l) is recorded at station S4 and minimum value (672mg/l) is recorded at station S7. According to classification of drinking water on the basis of TDS values, all the drinking water samples are found to be non-saline. In this study, the TDS value for all the drinking water samples are well within the permissible limit of 1500 mg/l.

Chloride (Cl):
The value of chloride for all the drinking water samples is ranged from 113 – 290 mg/l. Most of the drinking water samples show chloride values within the acceptable limit (250 mg/l) of WHO. The drinking water sample at station S3 & S4 has slightly excess chloride (283 & 290 mg/l respectively). Excess chloride (>250 mg/l) imparts a salty taste to water. Excessive chloride in potable water is particularly not harmful but the criteria set for chloride value is based on its potentially high corrosive. Soil porosity and permeability also play an important role in building up the chloride value [7]. Increase of chlorine level in water is injurious to people suffering due to heart and kidney diseases.

Sodium (Na):
Sodium and potassium are naturally occurring elements in drinking water. These two elements are directly added into drinking water from industrial and domestic wastes and contribute salinity of water[8].The value of sodium for the drinking water samples is recorded in the range of 24 - 68 mg/l. The highest value of sodium is recorded at station S1

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and lowest value of sodium is recorded at station S6. From this study, it is confirmed that the value of sodium for the drinking water sample is well within the permissible limit (200 mg/l) suggested by WHO. High concentration of sodium ion in drinking water may cause heart problems and High sodium ion in irrigation water may cause salinity problems [9]

Potassium (K):

Sodium and potassium are the most important minerals occurring naturally. The potassium values for the drinking water samples are observed between 0.12 and 0.21 mg/l. High amount of potassium in the drinking water sample is due to the presence of silicate minerals from igneous and metamorphic rocks [10]. The maximum value (0.21 mg/l) of potassium is observed at station S4 and minimum value (0.12 mg/l) is observed at S1 and S5 (Table 2). On comparison with the WHO standard value, it is found that the potassium values for all the drinking water samples are well within the maximum permissible limit (12 ppm).

Calcium (Ca):

Calcium may dissolve readily from carbonate rocks and lime stones or be leached from soils. But calcium is an essential nutritional element for human being and aids in the maintaining the structure of plant cells and soils [11]. In this investigation, the estimated calcium values are recorded between 90 and 180 mg/l. For most of the drinking water samples, the calcium values are found within the maximum permissible limit (200 mg/l).

Magnesium (Mg):

The magnesium values are recorded between 74 and 89 mg/l for the drinking water samples. The highest value of magnesium is observed at station S8 and the lowest value of magnesium is observed at station S3. On comparison with the WHO standard value of magnesium, in this study it is confirmed that the magnesium value for all the drinking water sample is within the maximum permissible limit (150 mg/l). Magnesium generally occurs in lesser concentration than calcium because of dissolution of magnesium rich minerals is slow process and calcium is more abundant in earth crust [12]

Fluoride (F^-):

The value of fluoride for the drinking water samples is recorded between 2.65 and 4.80 mg/l. The maximum allowed limit of fluoride according to WHO is 1.0 mg/l. The fluoride values for all the drinking water samples are well exceeding the permissible limit. High concentration of fluoride in drinking water may be due to breakdown of rocks and soils or infiltration of chemical fertilizers from agricultural land. The high concentration of fluoride in the study area poses a sign of water quality problem. Skeletal fluorosis is an important disease due to presence of high fluoride content in drinking water [13]

Nitrate (NO_3^-):

The value of nitrate in all the drinking water sampling stations is found between 0.02 and 0.08 mg/l (table 1). The acceptable limit of nitrate is 45 mg/l according to WHO. The presence of nitrate in drinking water may be due to leaching of nitrate with the percolating water. The contamination of drinking water may be due to sewage and other wastes rich in nitrates[19]. Toxicity of nitrates in infants causes methaemoglobiaemia [14].

Sulphate (SO_4^{2-}):

The sulphate values for the drinking water samples are exhibited between 42 and 112 mg/l. The maximum value (112 mg/l) is noted at station S8 and minimum value sulphate (42 mg/l) is noted at S2. The sulphate values for all the drinking water samples are well within the permissible limit (200 mg/l) of WHO. High concentration of sulphate may cause gastro – intestinal irritation particularly when magnesium and sodium ions are also present in drinking water resources [15]

Phosphate (PO_4^{2-}):

The value of phosphate in the drinking water samples lie between 0.02 to 0.05 mg/l. Highest value (0.05 mg/l) is recorded at station S2, S6 and S8 and minimum value (0.02 mg/l) is recorded at station S4. In this present study, the phosphate values are found within the permissible limit (0.1 mg/l) of WHO. Normally drinking water contains only a minimum phosphorus level because of the low solubility of native phosphate minerals and the ability of soils to retain phosphate [16]. The phosphate values of all the drinking water samples do not pose any water quality problem.

Table-2:Physico-chemical characteristics of drinking water at Mahad Region

$Na^{+}, K^{+}, Ca^{2+}, Mg^{2+}, F^{-}, Cl^{-}, SO_4^{2-}, NO_3^{-}, PO_4^{2-}$,

S. NO.	pH	EC	TDS	Na^{+}	K^{+}	Ca^{2+}	Mg^{2+}	F^{-}	Cl^{-}	SO_4^{2-}	NO_3^{-}	PO_4^{2-}
S_1	7.15	114	810	68	0.12	134	80	2.65	210	84	0.04	0.03
S_2	7.32	103	920	44	0.17	180	83	3.32	220	90	0.07	0.05
S_3	7.19	204	769	54	0.14	122	74	4.22	283	54	0.06	0.03
S_4	7.47	338	947	62	0.21	165	81	3.42	180	67	0.08	0.02
S_5	7.21	202	751	32	0.12	120	79	2.91	113	58	0.05	0.04
S_6	7.09	290	806	24	0.15	090	80	3.04	120	42	0.05	0.05
S_7	7.15	101	672	42	0.12	140	82	4.20	230	60	0.06	0.04
S_8	7.53	226	882	62	0.18	130	89	4.80	290	112	0.07	0.05

All parameters are expressed in mg/l except pH and EC. EC in µmhos/cm

Table. No. 3: Classification of Drinking water based on TDS

TDS Range (mg/ml)	Description	No. of samples
≤ 1,000	Non-Saline	08
1,000 – 3,000	Slightly Saline	00
3,000 - 10,000	Moderately Saline	00
≥ 10,000	Very Saline	00

Table-3: Statistical evaluations of drinking water samples collected in and around Mahad town.

Parameters	Minimum	Maximum	Mean	median	WHO (1992)	
					Acceptable	Allowable
pH	7.15	7.53	7.295	7.265	7.0 – 8.5	6.5-9.2
EC	890	1338	1045.1	1021	------	-----
TDS	672	947	803.22	796	600	1500
Na^{+}	24	68	48	49	175	200
K^{+}	0.12	0.21	0.154	0.145	----	12
Ca^{2+}	90	180	135.1	132	75	200
Mg^{2+}	74	89	81.1	80.5	50	150
F^{-}	2.65	4.8	3.601	3.37	---	0.1
Cl^{-}	113	290	204.9	215	250	1000
SO_4^{2-}	42	112	72.1	63.5	200	400
NO_3^{-}	0.04	0.08	0.059	0.060	4.5	10.0
PO_4^{2-}	0.02	0.05	0.036	0.035	0.1	1.0

All parameters are expressed in mg/l except pH and EC. EC in µmhos

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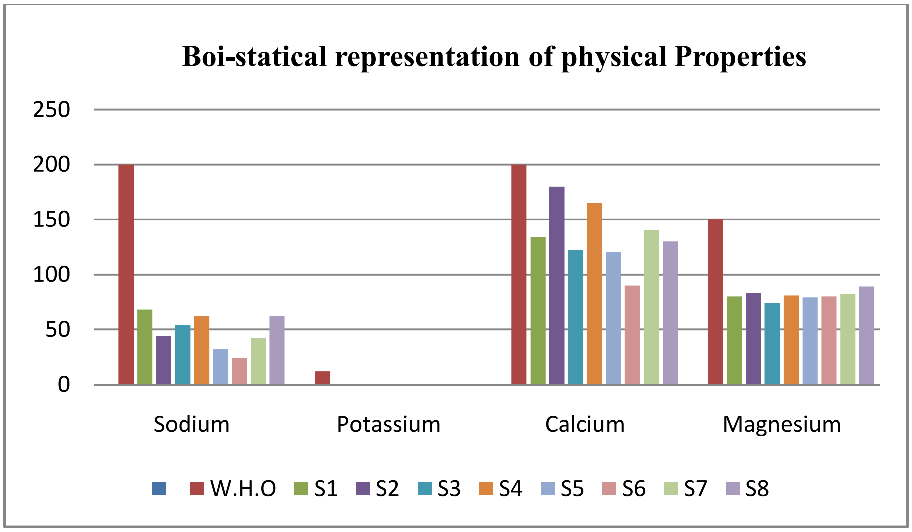

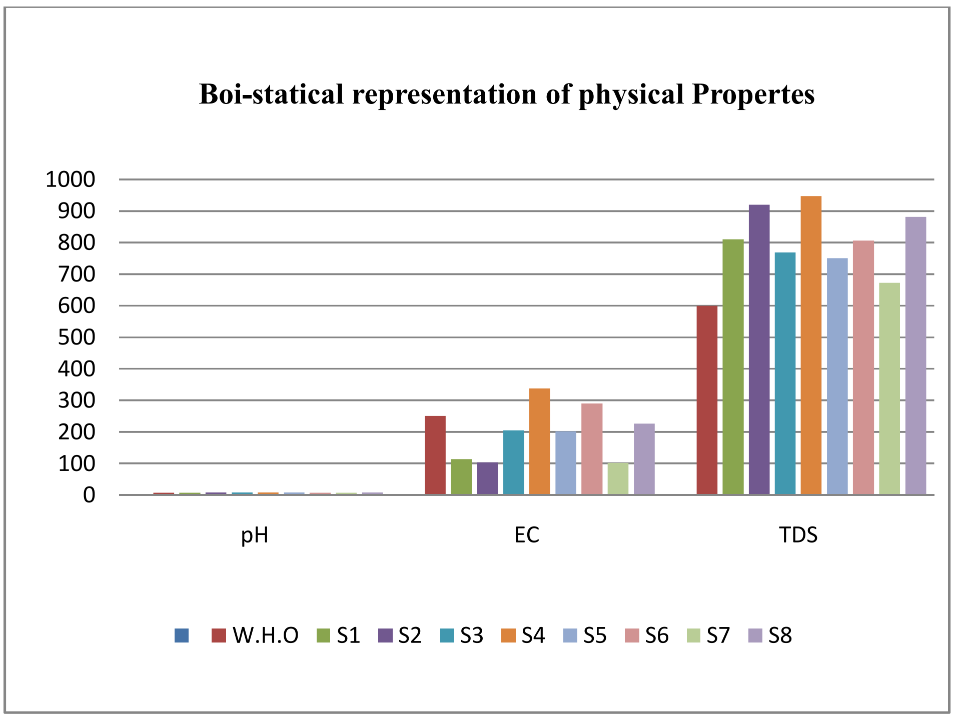

IV. CONCLUSION

Physico-chemical characterization of drinking water samples are taken from eight villages from Mahad tahsil eight drinking water samples were collected from different parts of Mahad tahsil and analyzed for pH, EC, TDS, $\boldsymbol{Na^{+}}$, K^{+},Ca^{2+},Mg^{2+}, F^{-}, Cl^{-}, SO_4^{2-}, NO_3^{-},PO_4^{2-} using standard procedures. The values of all the drinking water samples are compared with the standard permissible value. Fluoride is exceeding the permissible limit in most of the drinking water samples. From the obtained results, it is suggested to monitor the drinking water quality and assess periodically in this study area to prevent the further contamination.

Among the various parameters studies, most of the chemical constituents do not comply with the water quality standards prescribed by BIS. People should be aware about the quality of water they are drinking and this problem will

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be more aggressive when similar water sources are used for drinking purpose for a longer period (Chronic) because of the possible clinical problems associated with these chemicals in the drinking water. There is an urgent need to create public awareness on the sources, causes and prevention of drinking water pollution and also the consequence of impact of pollution on human health, which would be a key factor for sustainable development of the area Treatment.

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