Studies on Some Physico-Chemical and Microbiological Characteristic of Potable Water Used in Some Different Area of Ahmedabad in Gujarat

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ABSTRACT

A physico chemical and microbiological study of the ground water of some different area of Ahmedabad of Gujarat state has been made. Physico chemical parameter such as colour, odour, taste, temperature, PH, electrical conductivity, TS, TDS, total hardness, total alkalinity, calcium, magnesium, iron, sodium, potassium, chloride, sulphate, nitrate, fluoride, and silica were determine. In microbiological study, Coli forms, E.Coli, sulphate reducing anaerobic bacteria, Pseudomonas aeruginosa, Yeast and Mould were investigated. Samples were taken from different ten area of Ahmedabad viz. Chharodi(S-1), Naroda(S-2), Maninagar(S-3), Ranip(S-4), Shahibaug(S-5), Vatva(S-6), Vasna(S-7), Navrangpura(S-8), Bopal(S-9) and Vastrapur(S-10) . Samples were taken four time in year in month of January, April, and July and august to check the seasonal effects.Here study reported is for samples taken in January-2005 and April 2005. For colour, iron, sulphate, nitrate, fluoride and silica, instrumental methods like Spectrophotometry were used. "Hach- odyssey spectrophotometer" which has facility to store calibration curves and which can display the value for that parameter directly was used

Key words: Physico-chemical, Characteristics, Potable water, Ahmedabad.
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INTRODUCTION

In continuation of earlier studies on ground water[1], here we report the physico-chemical as well as microbiological studies of potable water used in some rural areas of Surat district, Gujarat. Because of the geographical isolation and remoteness, people residing in the rural area, mostly do not have access to safe drinking water. In the absence of fresh water supply, the people are forced to take water from any source that lies near village. In most of the interior rural area, the borewell water is used forced drinking and other domestic purposes. Borewell water is the underground water that has come mainly from the seepage of the surface water and is held in subsoil and pervious rocks. Borewell water is generally of good quality and is difficult to pollute. The use of fertilizers, pesticides and insecticides in rural area, manure, lime, septic tank, refuse dumps, etc. are the main sources of bore well water pollution[2], The water used may be unsafe chemically as well as microbiologically. Chemically unsafe water shows long term and slow effect while microbiologically unsafe water creats short term problem such as dysentery, diarrhea, jaundice, gastrointestinal disorders, fever and amoeboisis which may assume epidemic proportion[3] the work on microbiological pollution is still lacking. Kaushik and Prasad [4],Thapliya et al[5], Shrivastav et al[6], Riccharia and Mishra [7], Garoda et al [8], And J.hussain et al [9], are among the few workers who have worked on microbiological quality of water.

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MATERIALS AND METHODS

Water samples were collected in the first week of January-2005 and first week of april-2005. the different areas of Ahmedabad were selected Chharodi(S-1), Naroda(S-2), Maninagar(S-3), Ranip(S-4), Shahibaug(S-5), Vatva(S-6), Vasna(S-7), Navrangpura(S-8), Bopal(S-9) and Vastrapur(S-10) . for physico-chemical analysis water samples were collected in properly washed polyethylene bottles while for microbiological analysis srerile glass bottles were used standard procedures were adapted for the determination fot the both physico-chemical and microbiological analysis [10].

For spectrophotometric determination of colour, fluoride, iron, nitrate, sulphate and silica, "Hach-odyssey spectrophotometer (USA)" was used. This instrument has facility to store calibration curves and which can display the value for that parameter directly was used. In present study, program of "Hach" with their reagents were used while some programs were prepared by us using our reagents. This is an excellent instrument and results of this instrument are validated by USEPA. Sodium and potassium were determined with the help of microprocessor based flame photometer. Calcium, magnesium, total hardness, chloride, total alkalinity were estimated by titrimetric methods.

For microbiological study, the modern, membrane filter Technique (MFT) was used. All the culture was of "Hi-Media Product".

RESULTS AND DISCUSSION

All metabolic and physiological activities and life processes of aquatic organisms are generally influences by water temperature. In the present study temperature ranged from 27^0C-31^0C, The pH of the water body indicates the degree of deterioration of water quality. In the present study pH range from 7.79-8.49 which lies within the range prescribed by ISI [11], which is 6.5-8.5. The specific conductivity (SC), which is a measure of the dissolved ion concentration, was much higher then the permissible limits. In the present study it ranged from 1220-3922 s/cm. maximum SC was observed at Bopal(S-9) during the study period. According to WHO [12] and ISI, total dissolved solid (TDS) value should be less then 500 mg/L for drinking water. In the present study it ranged from 836-1785 mg/L. most of the samples have higher values of TDS the prescribed value.

Total hardness in water is mainly due to the salts of calcium and magnesium. In the present study in ranged from 84-460 mg/L. some samples have higher values then the prescribed by ISI, which are 300 mg/L the limit of calcium and magnesium have been prescribed in the ranged 75-200 mg /L and 50-100 mg/L respectively. In the present study calcium and magnesium ranged from 20.84-60.12 mg/L and 7.77-80.19 mg/L respectively.

Total alkalinity of all samples ranged from 346-634 mg/L. all the samples have higher value then the prescribed limits, 200 m/L.

The chloride content in the samples ranged from 19-566 mg/L. the highest chloride observed in the sample of Bopal(S-9). The concentration of sulphate in all sample observed prescribed for sulphate content, 200 mg/L and it varies from 55-295 mg/L during the study period.

Nitrate is one of the major constituent of organism along with carbon and hydrogen as amino acid, proteins and organic compounds in ground water. In the present study nitrate ranged from 10-35 mg/L which is lies under the prescribed limits. Fluoride limits in drinking water from 1.0-1.5 mg/L. In the present study it ranged from 0.09-1.61 mg/L which lies within the range except the highest observed in the sample of Bopal(S-9). Iron is one of the most abundant elements in the earth's crust. Iron deficiency in the human body causes anemia. In the present study it ranged from 0 27-0.34 mg/L, which lies under the limits prescribed by WHO and ISI.

Sodium and potassium ranged from 69-256 mg/L and 11-22 mg/L respectively. Sodium contents more then 50 mg/L makes the water unsuitable for drinking purpose. The ground water of.S-3 and S-4 respectively were found to have higher concentration of sodium and potassium. Sodium is he most important element, which influence the soil quality and plant growth either by affecting the permeability of soil by clogging or replacing other cations. The extant replacement of other cation by sodium is denoted by sodium adsorption ratio (SAR) calculated by the following equation as described by Richards[13],

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SAR= Na$^+$/ (Ca$^+$ + Mg^{2+}/2)$^{0.5}$ where Na$^+$ and Mg^{2+} are in meq/L

SAR in present study ranged from 3.022-7.938 meq/L. salinity Laboratory of Agriculture recommended the water classification according to the value of SAR was found below the prescribed limit.

Table-1 Physico-chemical analysis report of Potable waters in JANUARY-2005

Sr.No.	Parameter	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1	Colour	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Temperature (°C)	27	27	28	28	27	27	28	28	29	29
5	Ph	7.79	8.13	8.49	8.26	8.44	7.96	8.21	7.92	7.98	7.94
6	SC (µS)	2510	2200	2940	3590	1220	3250	1950	2400	3920	1930
7	TDS	1234	966	1308	1783	1170	1332	832	1052	1682	1748
8	TS	1240	970	1320	1799	1185	1340	840	1060	1685	1752
9	TH	226	140	202	154	84	275	222	127	457	308
10	Ca Hardness	112	60	80	64	52	130	124	63	128	150
11	Mg Hardness	114	80	122	90	32	144	98	64	329	158
12	TA	524	558	548	631	520	466	346	480	612	630
13	Carbonate	24	31	48	42	34	48	33	24	33	24
14	Bicarbonate	602	649	570	654	561	468	353	536	678	417
15	Sodium	155	157	255	159	69	160	138	135	150	183
16	Potassium	18	10	11	20	10	12	12	11	15	10
17	Calcium	44.88	24.04	32.06	25.65	20.84	52.10	49.69	24.85	51.30	60.12
18	Magnesium	27.70	19.44	29.64	15.55	7.77	34.99	23.81	15.55	79.94	55.67
19	Iron	0.28	0.28	0.29	0.34	0.32	0.30	0.29	0.29	0.29	0.28
20	Silica	31.1	31.9	53.9	30.1	18.2	32.7	39.0	24.8	28.0	29.2
21	Chloride	343	169	270	513	19	525	268	278	564	551
22	Sulphate	55	70	145	135	170	125	150	60	295	150
23	Nitrate	22	32	26	35	22	27	35	21	11	10
24	Fluoride	1.0	1.07	0.72	1.28	0.22	1.03	0.81	1.23	1.61	0.44

All the values except pH are in mg/L,
BDL= Below Detection Limit

Table-2 Physico-chemical analysis report of Potable waters in APRIL-2005

Sr.No.	Parameter	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1	Colour	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Temperature (°C)	29	29	28	28	28	28	28	29	29	30
5	pH	7.80	8.10	8.40	8.31	8.52	8.10	8.25	8.00	8.10	8.12
6	SC (µS)	2521	2216	2945	3596	1300	3248	1956	2419	3922	1935
7	TDS	1235	965	1310	1785	1175	1335	836	1064	1685	1752
8	TS	1243	976	1321	1779	1184	1342	845	1066	1688	1750
9	TH	228	146	202	161	100	280	225	130	460	304
10	Ca Hardness	113	63	82	67	55	135	127	65	130	149
11	Mg Hardness	115	83	120	94	45	145	98	65	330	155
12	TA	520	559	550	632	423	470	348	482	621	634
13	Carbonate	25	35	50	44	36	49	33	25	35	25
14	Bicarbonate	600	650	573	650	563	470	350	538	680	419
15	Sodium	157	158	256	162	76	159	140	136	149	180
16	Potassium	17	12	13	22	13	11	15	12	11	12
17	Calcium	45.29	25.25	32.86	26.85	22.04	54.10	50.90	26.05	52.10	59.71
18	Magnesium	27.94	20.16	29.16	22.84	10.93	35.23	23.81	15.79	80.19	37.66
19	Iron	0.27	0.28	0.29	0.29	0.30	0.30	0.29	0.31	0.29	0.28
20	Silica	32	33	54	31	19	33	41	26	28	30
21	Chloride	342	170	275	510	132	530	270	280	566	550
22	Sulphate	56	75	140	135	172	136	148	62	287	158
23	Nitrate	29	35	32	34	23	29	32	24	12	14
24	Fluoride	1.05	0.09	1.10	1.12	0.23	1.04	0.98	1.13	1.52	0.52

All the values except pH are in mg/L
BDL= Below Detection Limit

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Table-3 Microbiological analysis report of Potable waters JANUARY-2005

Sr.No.	Parameter	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1	Sodium	6.739	6.826	11.086	6.913	3.0	6.956	6.00	5.869	6.521	7.956
2	Potassium	0.460	0.255	0.281	0.511	0.255	0.306	0.306	0.281	0.383	0.255
3	Calcium	2.234	1.197	1.596	1.277	1.037	2.594	2.474	1.237	2.554	2.993
4	Magnesium	2.277	1.598	2.437	1.278	0.638	2.877	1.958	1.278	6.574	4.578
5	Carbonate	0.8	1.033	1.6	1.4	1.133	1.6	1.1	0.8	1.1	0.8
6	Bicarbonate	9.868	10.639	9.344	10.721	9.196	7.672	5.786	8.786	11.114	6.836
7	SAR	4.489	5.774	7.807	6.117	3.278	4.208	4.032	5.235	3.052	4.090
8	PS	61.47	71.69	73.81	74.39	66.02	57.03	58.72	70.97	43.06	52.02
9	RSC	6.157	8.877	6.911	9.566	8.654	3.801	2.454	7.071	3.086	0.065

Table-4 Microbiological analysis report of Potable waters in APRIL-2005

Sr.No.	Parameter	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1	Sodium	6.826	6.869	11.130	7.043	3.304	6.913	6.086	5.913	6.478	7.826
2	Potassium	0.434	0.306	0.332	0.562	0.332	0.281	0.383	0.306	0.281	0.306
3	Calcium	2.255	1.257	1.636	1.336	1.097	2.693	2.534	1.297	2.594	2.973
4	Magnesium	2.297	1.657	2.298	1.878	0.898	2.897	1.958	1.298	6.594	3.0978
5	Carbonate	0.833	1.166	1.66	1.466	1.20	1.633	1.1	0.833	1.166	0.833
6	Bicarbonate	9.836	10.655	9.393	10.655	9.299	7.704	5.737	8.819	11.147	6.868
7	SAR	4.526	5.690	7.938	5.558	3.310	4.137	4.062	5.191	3.022	4.4920
8	PS	61.46	71.11	74.44	70.29	64.57	56.27	59.01	70.55	42.38	52.25
9	RSC	6.117	8.907	7.125	8.907	8.434	3.747	2.345	7.057	3.125	1.631

All the values except pH are in meq/L
SAR = Sodium Adsorption Ratio
RSC = Residual Sodium Carbonate
PS = Percentage Sodium

Table -5 Microbiological analysis report of Potable waters JANUARY-2005

Sr.No.	Parameter	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1	E.Coli	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
2	Coli forms	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
3	SRAB	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
4	Pseudomonas aeruginosa	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
5	AMC										
(a)	At 20 °c	44	50	45	42	55	59	52	51	16	52
(b)	At 37 °c	11	9	9	11	9	10	11	13	9	13
6	Yeast and Mould	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Table-6 Microbiological analysis report of Potable waters in APRIL-2005

Sr.No.	Parameter	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1	E.Coli	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
2	Coliforms	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
3	SRAB	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
4	Pseudomonas aeruginosa	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
5	AMC										
(a)	At 20 °c	46	52	50	49	60	61	50	49	17	53
(b)	At 37 °c	12	10	9	10	9	11	12	9	12	10
6	Yeast and Mould	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

SRAB=Sulfite Reducing Anaerobic Bacteria, AMC=Aerobic Microbial Counts.

The concentration of bicarbonate and carbonate also influence influence the suitability of water for irrigation purpose [13, 14] .considering this hypothesis, Ealtron [14] purposed the concept of residual sodium carbonate (RSC) for the assessment of high carbonate waters. RSC is calculated by the following formula.

$$RSC = (CO_3^{2-} + HCO_3^{--}) - (Ca^{2+} + Mg^{2+})$$

The water with high RSC will have high pH and makes soil infertile by depositing black alkali on the surface. According to a classification made by united state Salinity Laboratory water sample are safe for irrigation purpose

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with RSC value below 1.25meq/L while water samples with RSC value above 2.5meq/L are unsuitable for irrigation purpose. In our study area RSC ranged from 0.065-9.566 meq/L.

Percentage sodium (PS) is another important factor to study sodium hazard. It is calculated as the percentage of sodium and potassium against all cationic concentrations. It is also used for adjusting the quality of ground water for the use of agriculture purpose. The use of high PS waters for irrigation purpose stunts the plant growth. It is calculated by the following formula.

$$PS = [(Na^+ + K^+)/ (Ca^{2+} + Mg^{2+} + Na^+ + K^+)] \times 100$$

In the present study PS ranged from 42.384-74.447meq/L. all the samples were found good to permissible limit except S-3 .

Coli forms generally occur in drinking water due to contamination of sewage water or unhygienic practice. Coli forms in drinking water can cause amoebic dysentery and various other pathogenic complexities. In our present study it was not observed.

E.Coli occurs in drinking water due to contamination of sewage water or unhygienic practice. E.Coli was also absent in the present study.

Fungi are present; the organism often occurs in fasces   of humans, but in lower numbers then coli forms. It indicates faecal contamination. It helps in detecting the reconstitution of dehydration mixture, baby food and pharmaceutical preparation as surveillance of bottled water. In the present study it was absent.

Aerobic microbial counts are used to assess the general bacterial content of water. Sudden increase in colony count from a ground water source may be an early sign of pollution of the aquifer, useful in evaluating the efficiency of water treatment processes – coagulation, filtration, and disinfection. In the present study it was determined at two temperature, 20^0C and 37^0C. They were found within the limits.

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