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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 July-2005 and October- 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 borewell 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.

EXPERIMENTAL

Water samples were collected in the first week of July-2005 and first week of October-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 sterile glass bottles were used standard procedures were adapted for the determination for 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”.

RESULT 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-30^0C,

The pH of the water body indicates the degree of deterioration of water quality. In the present study pH range from 7.81-8.73 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 1290-3910 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 834-1788 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 98-456 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 21.64-59.71 mg/L and 10.69-79.70 mg/L respectively.

Total alkalinity of all samples ranged from 350-642 mg/L. all the samples have higher value then the prescribed limits, 200 m/L

The chloride content in the samples ranged from 133-567 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 53-288 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 12-35 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 0.09-1.45 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 0.20-0.37 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 the 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 3.076-7.978 meq/L. salinity Laboratory of Agriculture recommended the water classification according to the value of SAR was found below the prescribed limit.

The concentration of bicarbonate and carbonate also 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 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 1.185-8.367 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 43.00-74.60meq/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.

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Table-4.3 Physico-chemical analysis report of Potable waters in JULY-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)**	30	29	28	29	29	28	29	29	29	30
5	**pH**	8.73	8.12	8.20	8.2	8.44	8.20	7.98	7.89	8.02	7.93
6	**SC (µS)**	2523	2218	2943	3590	1290	3245	1950	2410	3910	1930
7	**TDS**	1234	967	1315	1788	1178	1333	837	1065	1686	1750
8	**TS**	1237	970	1322	1790	1183	1344	841	1063	1687	1755
9	**TH**	231	148	206	164	100	279	225	133	456	302
10	**Ca Hardness**	114	64	81	68	54	135	126	66	128	147
11	**Mg Hardness**	117	84	125	96	46	144	99	67	328	155
12	**TA**	516	557	552	640	425	475	350	480	624	631
13	**Carbonate**	26	37	51	45	37	47	32	26	33	26
14	**Bicarbonate**	590	651	580	652	562	472	354	546	683	424
15	**Sodium**	150	155	253	158	78	161	135	135	151	180
16	**Potassium**	18	11	14	26	12	10	16	14	12	13
17	**Calcium**	45.69	25.69	32.46	27.25	21.64	54.10	50.50	26.45	51.30	58.91
18	**Magnesium**	28.08	20.41	30.37	23.33	11.17	34.99	24.06	16.28	79.70	37.66
19	**Iron**	0.21	0.27	0.20	0.28	0.29	0.27	0.25	0.29	0.25	0.29
20	**Silica**	31	32	55	32	20	34	41	27	27	31
21	**Chloride**	340	175	271	511	155	525	279	281	567	547
22	**Sulphate**	55	76	135	137	170	136	145	63	280	160
23	**Nitrate**	28	33	31	35	24	28	31	21	13	15
24	**Fluoride**	1.00	0.09	1.10	1.13	0.23	1.05	1.10	1.10	1.45	0.68

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

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Table-4.4 Physico-chemical analysis report of Potable waters in OCTOBER-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)**	28	28	27	28	28	29	29	30	29	30
5	**pH**	7.81	8.10	8.40	8.31	8.55	8.10	8.25	8.01	8.10	8.12
6	**SC (µS)**	2524	2216	2939	3596	1295	3241	1956	1412	3910	1934
7	**TDS**	1230	960	1309	1784	1187	1337	834	1064	1680	1754
8	**TS**	1233	972	1323	1799	1188	1341	843	1068	1683	1754
9	**TH**	235	147	195	153	98	281	217	126	454	303
10	**Ca Hardness**	115	65	80	66	54	137	120	60	134	149
11	**Mg Hardness**	120	82	115	87	44	144	97	66	320	154
12	**TA**	513	552	543	642	433	467	352	485	618	632
13	**Carbonate**	25	40	45	45	36	49	33	37	52	21
14	**Bicarbonate**	589	645	575	651	560	465	352	537	573	420
15	**Sodium**	153	156	256	161	76	161	145	130	151	181
16	**Potassium**	15	11	12	27	18	13	15	14	11	10
17	**Calcium**	46.09	26.05	32.06	26.45	21.64	54.91	48.09	24.05	53.71	59.71
18	**Magnesium**	29.16	19.92	27.95	21.14	10.69	34.99	23.57	16.03	77.76	37.42
19	**Iron**	0.29	0.24	0.29	0.30	0.32	0.30	0.29	0.37	0.30	0.27
20	**Silica**	35	36	52	32	20	33	43	26	24	28
21	**Chloride**	341	167	280	524	133	527	265	270	562	522
22	**Sulphate**	53	71	135	134	119	176	150	73	288	160
23	**Nitrate**	30	33	31	32	24	28	31	30	14	12
24	**Fluoride**	0.99	0.90	1.01	1.02	0.51	1.06	0.96	1.01	1.08	0.70

*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 JULY-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**	6.522	6.739	11.00	6.869	3.391	7.00	5.869	5.869	6.565	7.826
2	**Potassium**	0.460	0.281	0.358	0.664	0.306	0.255	0.409	0.358	0.306	0.332
3	**Calcium**	2.275	1.279	1.616	1.356	1.077	2.693	2.514	1.317	2.554	2.933
4	**Magnesium**	2.309	1.678	2.497	1.918	0.918	2.877	1.973	1.338	6.554	3.097
5	**Carbonate**	0.433	0.616	0.85	0.75	0.616	0.783	0.533	0.433	0.55	0.433
6	**Bicarbonate**	9.672	10.672	9.508	10.688	9.213	7.737	5.803	8.950	11.196	6.950
7	**SAR**	4.310	5.546	7.670	5.370	3.397	4.196	3.920	5.094	3.076	4.508
8	**PS**	60.36	70.36	73.41	69.70	64.95	56.56	58.31	70.10	43.00	57.49
9	**RSC**	5.521	8.331	6.245	8.164	7.834	2.950	1.849	6.728	2.638	1.353

Table-4 Microbiological analysis report of Potable waters in OCTOBER-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**	6.652	6.782	11.130	7.00	3.304	7.00	6.304	5.652	6.565	7.869
2	**Potassium**	0.383	0.281	0.307	0.690	0.460	0.332	0.383	0.358	0.281	0.255
3	**Calcium**	2.295	1.297	1.596	1.317	1.077	2.734	2.394	1.197	2.674	2.973
4	**Magnesium**	2.398	1.638	2.298	1.738	0.879	2.877	1.938	1.318	6.394	3.0778
5	**Carbonate**	0.416	0.666	0.75	0.75	0.60	0.816	0.55	0.616	0.866	0.350
6	**Bicarbonate**	9.655	10.573	9.426	10.672	9.180	7.622	5.770	8.803	9.393	6.885
7	**SAR**	4.344	6.199	7.978	5.668	3.344	4.181	4.285	5.041	3.083	4.525
8	**PS**	59.98	70.64	74.60	71.56	65.80	56.64	60.68	70.49	43.01	57.31
9	**RSC**	5.378	8.304	6.282	8.367	7.824	2.827	1.988	6.904	1.191	1.185

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

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Table 4.15 Microbiological analysis report of Potable waters in JULY-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**	65	55	80	70	64	66	65	55	10	62
(b)	**At 37 °c**	10	12	16	18	10	9	11	12	8	10
6	**Yeast and Mould**	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Table-4.16 Microbiological analysis report of Potable waters in OCTOBER 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**	53	51	72	67	56	55	60	47	14	53
(b)	**At 37 °c**	15	9	8	14	12	10	13	10	9	11
6	**Yeast and Mould**	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

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

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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