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Physico-Chemical and Microbial Analysis of Drinking Water from Gadhinglaj Tahsil, Maharashtra, India

SHOBHA D. JADHAV
Department of Chemistry
Dr. Ghali College, Gadhinglaj, M. S., India
RAJARAM S. SAWANT[1]
Department of Botany
Dr. Ghali College, Gadhinglaj, M. S., India
RAHUL SHIVAJI PATIL
Department of Microbiology
Dr. Ghali College, Gadhinglaj, M. S., India
ASHVIN G. GODGHATE
Department of Chemistry
Dr. Ghali College, Gadhinglaj, M. S., India

Abstract:

The present investigation deals with physico-chemical and microbial analysis of drinking water from Gadhinglaj Tahsil, Maharashtra, India. The work is carried out during the year 2013-2014. The physico-chemical parameters such as Total hardness, Ca, Mg, Chloride, Total alkalinity, pH and EC were analyzed for collected drinking water samples from 29 villages of Gadhinglaj Tahsil and found to be suitable for human contact. From the microbial aspects all the water samples were found unsafe for drinking as all samples contains the fecal coliform in significant number. The research suggests the use of well hygiene during handling and supplying the water after its well purification as it could pose serious health problems due to the potential risk of water-borne diseases.

Key words: Potability, Gadhinglaj Tahsil, Physico-chemical parameters, Microbial parameters.

[1] Corresponding author: rss.botany@gmail.com

Introduction:

The life is first arisen in aquatic environment (Patil, *et al.*, 2013). The world has vast freshwater resources like lentic and lotic ecosystems. The lentic ecosystems such as lakes, ponds, tanks and reservoirs while lotic include streams and rivers. The increased attention should be given to physico-chemical factors since these are directly or indirectly affects on the life. The regular supply of clean water is very essential for the survival of all living things (Sawant and Telave, 2009).

Fecal coliforms are the indicator microorganisms used in measuring the sanitary condition and quality of drinking water (Michigan water science center, 2007; EPA, 2007). Presence of heterotrophic bacteria and fecal coliform in water raise a concern on its safety for consumption (Oram, 2011). Gadhinglaj tahsil is dependent on various water sources for drinking so it is necessary to assess the water quality.

The present research work was undertaken to evaluate water quality of drinking water supplied by the Grampanchayat and Municipality.

Materials and Methods:

Study area:

Gadhinglaj is located at 16^{o} 13' 26" N and 74^{o} 26' 9" E having a population about 2,16,257 which is distributed into 90 small as well as large villages occupying about 48,094 ha of area (Patil *et al.* 2015). There are number of drinking water sources present in the tahsil like small and large water bodies. Gadhinglaj have the Hiranyakeshi River, which is lifeline of the Tahsil, along with this people also uses dug well and bore well water for drinking.

Collection of samples:

Drinking water samples of 29 villages from Gadhinglaj tahsil (Fig. 1) were collected in the month of August 2013; collected in an ice packed plastic container. The Physico-chemical and Microbial parameters were analyzed immediately at the respective laboratory.

Analysis of physico-chemical parameters:

Standard methods were used for analyzing physico-chemical parameters as per recommendation of APHA, AWWA and WPCF (2005) and Trivedi and Goel (1984).

Analysis of Microbial Parameters:

Standard Plate Count (SPC) and Most Probable Number (MPN) were estimated as per the method recommended by Greenberg *et al*. (1992). Bacterial colony count was enumerated by using colony counter. Fecal coliforms were enumerated by using Membrane filtration technique on MacConkeys agar in sterile petri plates. Pour plate technique and serial dilution technique were used to enumerate the total coliforms, on a Nutrient Molten agar as a medium.

Results and Discussion:

The Physico-chemical and microbial parameters are presented in Table 1 and 2.

Total Hardness:

The total hardness is due to presence of Ca and Mg ions in ground water (Jadhav *et al.,* 2012). The other cations like strontium, iron and manganese also contribute to hardness. In the present study, the content of total hardness for bore well ranges from 52 mg L^{-1} (Sambre) to 264 mg L^{-1} (Hasurwadi), for river 46 mg L^{-1} (Kanadewadi) to 122 mg L^{-1} (Tawarewadi), for

reservoir 100 mg L^{-1} (Mahagaon) to 260 mg L^{-1} (Vairagwadi) and for dug well 52 mg L^{-1} (Hebbal) to 200 mg L^{-1} (Dugunwadi).

Calcium hardness:

Calcium hardness is an important component in buffering lake water and it is the main skeletal component of some living system. Calcium is the element which influences the floral components of the ecosystem, which play central role in metabolism and growth. The level of calcium for bore well ranges from 20.05 mg L^{-1} (Sambre) to 56.00 mg L^{-1} (Waghrali), for river 11.43 mg L^{-1} (Gadhinglaj) to 29.67 mg L^{-1} (Tawarewadi), for reservoir 24.86 mg L^{-1} (Yemehatti) to 48.17 mg L^{-1} (Vairagwadi) and for dug well 12.03 mg L^{-1} (Hebbal) to 60.95 mg L^{-1} (Masewadi).

Magnesium:

Magnesium is main cation present in natural water. It comes from natural processes and some other sources like, Industrial and agricultural wastes. High amount of magnesium in water reduces its use for domestic purposes. The magnesium values for bore well ranges from 7.76 mg L^{-1} (Sambre) to 58.11 mg L^{-1} (Hasurwadi), for river 5.33 mg L^{-1} (Kanadewadi) to 22.63 mg L^{-1} (Arjunwadi), for reservoir 14.55 mg L^{-1} (Mahagaon) to 53.05 mg L^{-1} (Vairagwadi) and for dug well 8.71 mg L^{-1} (Edarguchchi) to 33.79 mg L^{-1} (Dugunwadi).

Chloride:

Chloride is a common inorganic anion present in water. It usually occurs in the form of chelates. Generally major amount of chlorides comes from use of chemical fertilizers, human urine and feces and animal excretory material. The chloride values for bore well ranges from 39.76 mg L^{-1} (Lingnur) to 76.68 mg L^{-1} (Hadalage), for river 17.08 mg L^{-1} (Gadhinglaj) to 56.80 mg L^{-1} (Tawarewadi), for reservoir 36.92 mg L^{-1} (Vairagwadi) to 51.12 mg L^{-1} (Yemehatti) and for dug well 34.08 mg L^{-1} (Kadamwadi)

to 56.80 mg L^{-1} (Jambhulwadi). Desirable limit of chloride in drinking water is 250 mg/l (WHO, 1984).

Total alkalinity:

The alkalinity in water is imparted by the salts of weak acids. In water carbonates and bicarbonates are present in proper amount which gives alkalinity. The total alkalinity value for bore well fluctuates from 36 mg L^{-1} (Bidrewadi) to 72 mg L^{-1} (Sawatwadi), for river 12 mg L^{-1} (Gadhinglaj) to 80 mg L^{-1} (Kanadewadi), for reservoir 46 mg L^{-1} (Vairagwadi) to 66 mg L^{-1} (Mahagaon) and for dug well 38 mg L^{-1} (Hebbal) to 64 mg L^{-1} (Masewadi).

pH:

pH plays an important role in acid-base neutralization, precipitation, water softening, coagulation and acid disinfections. The pH value for bore well fluctuates from 6.87 (Sawatwadi) to 7.78 (Saroli), for river 6.30 (Arjunwadi) to 7.78 (Harali Budruk), for reservoir 7.13 (Vairagwadi) to 7.25 (Mahagaon) and for dug well 6.99 (Jambhulwadi) to 7.71 (Dugunwadi).

Electric conductivity:

Electrical conductivity is a numerical value of the ability of an aqueous solution to carry electricity. It is an important tool to access the water purity. The variation in electrical conductance, ranges for bore well from 0.19 mho cm^{-1} (Hadalage) to 0.59 mho cm^{-1} (Hasurwadi), for river 0.08 mho cm^{-1} (Tawarewadi) to 0.42 mho cm^{-1} (Harali Budruk), for reservoir 0.25 mho cm^{-1} (Yemehatti) to 0.39 mho cm^{-1} (Vairagwadi) and for dug well 0.25 mho cm^{-1} (Edarguchchi) to 0.47 mho cm^{-1} (Masewadi).

SPC; MPN; Total coliforms and Fecal coliforms:

The standard Plate count, Total coliform, fecal coliform and Most Probable Number were analyzed for drinking water

samples are presented in Table 2. The SPC ranged from 30,200 to 12,53,700 (x 10^5) cfu/ml. Total coliforms count ranged from 11 to 134 cfu/100 ml of water sample. The fecal coliforms ranged from 06 to 48 /100 ml while MPN ranged from 17 to 170 /100 ml of water sample.

The significant numbers of fecal coliforms were found in all the water samples and it found significantly higher than the WHO limit (0). All the water samples may raise concern on the safety of the consumer.

Conclusion

The present study has shown that the water samples are significantly contaminated with fecal coliforms while the physico-chemistry of the water reveals that the water is suitable for drinking. As per microbial aspect proper purification technique should be adopted.

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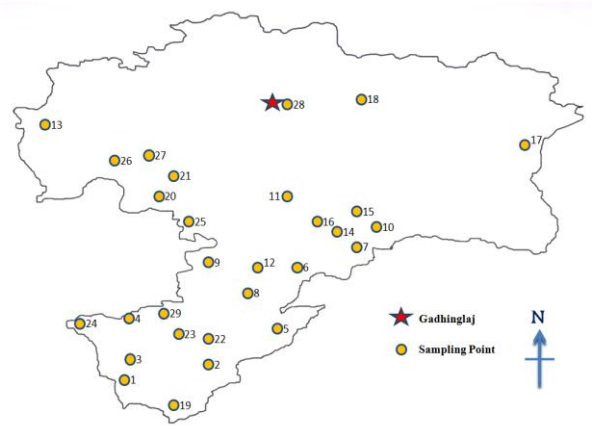

Fig: Study area

Table 1: Physico-chemical analysis

Sr. No.	Villages	Sources	Chloride	Total Alkalinity	Mg Hardness	Ca Hardness	Total Hardness	EC	pH
1	Kumari	Bore well	51.12	52	26.81	33.68	144	0.41	7.68
2	Sambre	Bore well	45.44	52	07.76	20.05	052	0.35	7.73
3	Saroli	Bore well	53.96	64	48.68	25.66	226	0.58	7.78
4	Talewadi	Bore well	68.16	54	28.85	27.26	146	0.44	7.07
5	Hadalage	Bore well	76.68	52	16.22	23.25	090	0.19	7.11
6	Bidrewadi	Bore well	62.48	36	32.06	20.05	152	0.40	7.48
7	Lingnur	Bore well	39.76	40	28.18	24.04	140	0.30	7.19
8	Waghrali	Bore well	68.16	50	34.96	56.14	200	0.43	7.32
9	Batkangle	Bore well	56.80	36	25.16	26.46	130	0.30	7.42
10	Mungurwadi	Bore well	68.16	70	43.42	51.32	230	0.58	7.34
11	Hasurwadi	Bore well	48.28	62	58.11	24.86	264	0.59	7.33
12	Sawatwadi	Bore well	51.12	72	22.73	34.48	128	0.40	6.87
13	Kadamwadi	Dug well	34.08	66	30.70	33.68	160	0.30	7.20
14	Jambhulwadi	Dug well	56.80	54	26.21	52.13	160	0.40	6.99
15	Dugunwadi	Dug well	39.76	60	33.79	60.95	200	0.44	7.71
16	Masewadi	Dug well	45.44	64	31.36	60.95	190	0.47	7.55
17	Edarguchchi	Dug well	46.43	62	08.71	13.03	054	0.25	7.10
18	Hebbal	Dug well	56.80	38	09.71	12.03	052	0.29	7.20
19	Yemehatti	Reservoir	51.12	52	22.63	24.86	118	0.25	7.14
20	Mahagoan	Reservoir	42.06	66	14.55	40.01	100	0.34	7.25
21	Vairagwadi	Reservoir	36.92	46	53.05	41.70	260	0.39	7.13

22	Tawarewadi	River	56.80	60	22.44	29.67	122	0.08	6.95
23	Kanadewadi	River	45.44	80	05.33	24.06	046	0.11	6.97
24	Arjunwadi	River	51.12	64	22.63	28.87	122	0.36	6.30
25	Umberwadi	River	56.08	48	09.89	27.26	068	0.11	7.40
26	Harali (khurd)	River	36.08	40	17.48	18.04	090	0.09	8.20
27	Harali (Budruk)	River	42.06	40	11.35	27.26	074	0.42	7.78
28	Gadhinglaj	River	17.08	12	19.84	11.43	067	0.30	7.70
29	Nesari	River	52.98	26	20.32	16.65	076	0.29	7.20

Note: All values are in mg L^{-1}, except pH and E.C. (mhos cm^{-1})

Table 2: Microbial analysis

Sr. No.	Villages	Sources	SPC CFU/ml	Total Coliform by MFT cfu/100ml	Fecal Coliform/100ml	MPN/100ml
1	Kumari	Bore well	57,200 X 10^5	018	06	033
2	Sambre	Bore well	59,100 X 10^5	020	07	034
3	Saroli	Bore well	51,300 X 10^5	017	09	022
4	Talewadi	Bore well	56,600 X 10^5	017	07	022
5	Hadalage	Bore well	50,400 X 10^5	011	06	018
6	Bidrewadi	Bore well	53,900 X 10^5	020	09	027
7	Lingnur	Bore well	54,500 X 10^5	014	06	017
8	Waghrali	Bore well	61,000 X 10^5	016	07	020
9	Batkangle	Bore well	51,300 X 10^5	013	06	017
10	Mungurwadi	Bore well	48,100 X 10^5	011	06	032
11	Hasurwadi	Bore well	57,300 X 10^5	018	09	026
12	Sawatwadi	Bore well	55,400 X 10^5	017	08	034
13	Kadamwadi	Dug well	34,500 X 10^5	035	16	042
14	Jambhulwadi	Dug well	38,300 X 10^5	037	19	045
15	Dugunwadi	Dug well	59,900 X 10^5	015	08	033
16	Masewadi	Dug well	30,200 X 10^5	044	12	054
17	Edarguchchi	Dug well	32,400 X 10^5	030	10	039
18	Hebbal	Dug well	32,700 X 10^5	034	11	044
19	Yemehatti	Reservoir	1,20,400 X 10^5	062	21	079
20	Mahagoan	Reservoir	57,000 X 10^5	112	35	170
21	Vairagwadi	Reservoir	1,33,600 X 10^5	066	25	076
22	Tawarewadi	River	68,300 X 10^5	112	35	120
23	Kanadewadi	River	78,600 X 10^5	122	38	130
24	Arjunwadi	River	68,200 X 10^5	102	34	120
25	Umberwadi	River	56,800 X 10^5	106	30	120
26	Harli (khurd)	River	8,12,000 X 10^5	132	52	140
27	Harli (Budruk)	River	8,10,000 X 10^5	128	48	133
28	Gadhinglaj	River	12,53,700 X 10^5	134	42	143
29	Nesari	River	1,38,700 X 10^5	103	35	113

Note: SPC = Standard plate count, cfu = Colony forming unit, MFT = Membrane filtration technique, MPN = Most probable number

Table 3: Drinking water standards of WHO (1963), ICMR (1975) & BIS (1991)

Parameters	WHO	ICMR	BIS
Total Hardness	500	300	500
Calcium	75	75	75
Magnesium	50	50	50
Chloride	200	250-1000	200
Alkalinity	75	----	----
pH	6.5-8.5	7-8.5	7 to 8
E.C.	0.300	0.300	0.300

Note: All values are in mg L^{-1}, except pH and E.C. (mhos cm^{-1})