Int.J.Curr.Microbiol.App.Sci (2019) *8*(8): 2314-2326

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 8 Number 08 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.808.268

Physico-Chemical Assessment of Drinking Water in Urban and Peri-Urban Areas of Udaipur, India

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Keywords

Drinking water, Physico-chemical, Urban and peri-urban areas, Bureau of Indian Standards

Article Info

Accepted:
20 July 2019
Available Online:
10 August 2019

A B S T R A C T

The quality of drinking water is an important environmental determinant of health. In present study, carried out of physico-chemical analysis of drinking water like public drinking water, surface water, ground water and animal drinking water were collected from different parts of urban and peri-urban areas of Udaipur. Parameters such as pH, electrical conductivity, turbidity, total dissolved solids (TDS), total hardness, nitrate, fluoride, iron, chloride and residual free chlorine were analyzed and range were founded 6.80 to 8.62, 82µs/cm to 5430µs/cm,0 NTU to 25 NTU, 41 mg/l to 2715 mg/l, 25 mg/l to1925 mg/l, 0 mg/l to 100 mg/l, 0 mg/l to 2.5 mg/l, 0mg/l to 1.0mg/l, 10mg/l to 1100mg/l and 0mg/l, respectively. Results showed that the most of the parameters were exceeded the recommended drinking water quality levels of Bureau of Indian Standards (BIS, 2012). Results indicated most of drinking water is not to be suitable for consumptions and recommended to treated before consumptions.

Introduction

Clean and safe drinking water are essential for health, survival, growth and development. But, in developing country like India, still there are some regions where the basic necessities of drinking water are not available. Provision of clean and safe water to the population will not only reduce the expenditure incurred on the health services but will also spur economic growth. Improved water supply and sanitation, and better management of water resources, can boost countries' economic growth and can contribute greatly to poverty reduction (WHO, 2017). Water within the distribution system (such as leaky pipe or outdated infrastructure) or of stored domestic water as a result of unhygienic handling (WHO, 2010).

These physico-chemical parameters indicates the deterioration of water quality which is the result of various anthropogenic disturbances like industrialization, construction activities, utilization of agricultural and forest land for other developmental purposes. The pollution of these water bodies primarily affects the chemical quality and then systematically destroys the community disturbing the delicate balance of food chain. Physico-chemical qualities of these water bodies as source of drinking water is necessitated by the presence of dead vegetation, heavy metal leachates from solid waste dump, domestic and industrial sewages, surface runoffs from agricultural farms etc. (Ademola, 2008).

The inappropriate supervision of water systems leads to severe problems in accessibility and quality of water. The world is growing at a very fast pace with its technologies and the population on earth is increasing tremendously. So, the dependence as well as exploitation of water resources is also increasing rapidly. It is not just the population increase alone but also the technology-aided excessive uses, abuses and misuses of water resources that break the natural water cycle. The water quality description is denoted by assessing the physical parameters like pH, TDS (total dissolved solids), TSS (total suspended solids) and chemical parameters like total alkalinity, free CO_2, DO (dissolved oxygen), total hardness, Ca, Mg, salinity and bacterial parameters like SPC (standard plate count), TCC (total coliform count), etc.

Groundwater forms a vital supply of drinking water supply for urban and rural people of India. There are several states in India where more than 90% population are dependent directly on ground water for drinking and other purposes (Ramachandraiah, 2004). In India, almost 70% of water has become polluted due to the discharge of household sewage and industrial effluents into the natural water sources, like rivers, streams and lakes (Sangu and Sharma 1987).

Materials and Methods

In the present study, attempts were made to assess the physico-chemical quality of drinking water in urban and peri-urban areas of Udaipur (Rajasthan) over a period of June 2018 to January 2019. Udaipur is located in the southern part of Rajasthan. It is actually lying in the center of a bowl-shaped basin surrounded by the Aravali hills and is drained by the Ayad river.

Collection of samples

Four different category of 85 water samples (public drinking water n=23, surface water n=22, ground water n=20 and animal drinking water n=20) were collected in 1000 ml caped glass bottle and brought to the Laboratory of Environmental Hygiene in chilled condition, Department of Veterinary Public Health & Epidemiology, CVAS, Navania, Vallabhnagar, Udaipur and processed within 4-6 hrs of collection.

pH determination

pH is determined by digital pH meter (Chino),

Total dissolved solid determination

TDS of water samples were analysed by digital meter (Divinext digital meter, Balram enterprises, Ludhiana).

Electrical conductivity determination

EC were assessed by digital conductivity meter 304 systronics UVSAR, India.

Total Hardness of water (as $CaCO_3$)

Total hardness of water samples were determined by ethylene diamine tetra acetic acid (EDTA) titration method.50 ml of water sample was taken without dilution in the porcelain dish or conical flask and 1ml of buffer solution and 1ml of inhibitor solution. (for monitoring interference from aluminum and manganese) were added then indicator erichrome black-T was added and titrated it against the standard EDTA solution till the color of solution changed from red to blue, showing the end-point of titration. The volume of EDTA consumed was recorded during the titrations as V_1 (ml).Same amount (50ml) of deionized distilled water was taken and 1ml buffer solution, 1ml of inhibitor solution and indicator erichrome black-T were added and titrated against the standard EDTA solution in the same manner the volume of titrated EDTA consumed was recorded as V_2 (ml).

Net volume of EDTA solution required by water sample was $\mathbf{V=V_1-V_2}$ **(ml)**

The hardness was calculated by the formula given below:

Calculation

Total Hardness (as $CaCO_3$ mg/l) =

$$\frac{V(ml)\ X1000}{\text{Volume of water sample before dilution (in ml)}}$$

Nitrate, fluoride, iron and chloride

Estimated according to the procedure prescribed by American Public Health Association (APHA, 2005).

Turbidity and residual free chlorine

Estimated by Himedia WT023 Octo aqua test kit.

Results and Discussion

Water is considered as potable, if it meets the recommended criteria for physical, chemical and microbiological quality set by regulatory agencies. Potable water is required for good health and socio-economic development of man and animal.The acceptability and use of potable water for recreational and other domestic needs are influenced by physicochemical parameters such as pH, total dissolved solids and conductivity etc. Inorganic minerals however constitute the greatest source of raw water contaminants, of which mineral salts are introduced as water moves over the soil structure. A major factor affecting water quality is anthropogenic activities arising from rapid industrialization and urbanization (Ubalua and Ezeronye 2005).

pH of water is an important environmental factor, the fluctuation of pH is linked with chemical changes, species composition and life processes. It is generally considered as an index for suitability of the environment (Rani *et al.,* 2012).In current study pH values found in the range between 6.80 to 8.62. In which urban areas ranged found in between 6.80 to 8.62 while, in peri-urban areas ranged found in between 6.80 to 8.62.Most of the samples comes in the acceptable range given by (BIS, 2012). Similar to our result finding of pH range were also reported by Pathak *et al.*, 2016, Rai and Chouhan 2017and Ghosh, 2018.While higher pH range was reported by Dixit *et al.*,2015. Also, slightly lower pH value for water samples was reported by Samuel *et al.*, 2017and Sunday *et al.*, 2014.Variation in pH affects aquatic life and mainly occurs due to the different physico-chemical nature of the soil. Acidic water also leads to corrosion of water pipes while the alkaline waters are less corrosive but may have bitter or soda like taste. High values of pH may occur due to the discharge of waste and microbial decomposition of organic matter present in water (Table 1 to 8; Fig. 1 and 2).

Total dissolved solids are a measure of total inorganic substances dissolved in water (ANZECC, 2000). TDS indicates the general nature of water quality or salinity. The TDS concentration was found to be above the permissible limit may be due to the leaching of various pollutants into the ground water which can decrease the portability and may cause gastrointestinal irritation in human and may also have laxative effect particularly upon transits (WHO, 1997). It affects the taste of water. The WHO has recommended the TDS value of 500mg/l as acceptable for consumption. High levels of the TDS in drinking water may have adverse effect on human health due to the presence of excessive salts. While, extremely low TDS leads to the development of flat insipid taste in water. TDS values found in the range between 41 mg/l to 2715 mg/l in different categories of water. In which urban areas ranged found in between 41 mg/l to 1639 mg/l while, in peri-urban areas ranged found between 237 mg/l to 2715 mg/l(Table 1 to 8; Fig. 1 and 2).All surface water and public drinking water comes in acceptable for consumption suggested by (BIS, 2012) but ground water and animal drinking water show higher value of TDS which is not consumable according to (BIS, 2012). Similar results were also reported by Shukla *et al.,* 2013 and Buridi and Gedala 2014. While, lower TDS values were observed by Rahmania *et al.,* 2015 and Sunitha *et al.,* 2013.TDS recommendation for drinking water is 200 mg/l to 2000 mg/l. (BIS, 2012).

Total hardness of water is expressed in $CaCO_3$ (mg/l) which includes calcium as well as magnesium hardness. Total hardness values found in the range between 25 mg/l to 1925 mg/l in different categories of water. In which urban areas ranged found in between 25 mg/l to 800 mg/l while, in peri-urban areas ranged found between 125 mg/l to 1925 mg/l (Table 1 to 8 ; Fig. 1 and 2).High levels of hardness in the study area in ground water and animal drinking water might be contributed due to the lime stone, zinc and magnesium rich soil. Increased values of hardness leads to scale formation in pipes which leads to their damage and leads to increased expenditure on their maintenance. It is also a hazard for human health, especially for persons suffering from kidney stones. In urban public drinking water show consumable hard water as per BIS, 2012 because of good water supply system and in other hand peri-urban public drinking water show more than 600 mg/l which exceed limit cause of poor public drinking water supply.Some researchers show contrasting findings were reported by Chindo *et al.,* 2013, Mostafa *et al.,* 2013, Buridi and Gedala 2014 and Ehiowemwenguan *et al.,* 2014. Similar findings were also reported by Chidinma *et al.,* 2016, Olatayo, 2014, Sebiawu *et al.,* 2014, Chaubey and Patil 2015, Hassan *et al.,* 2016 and Reda, 2016.Total hardness recommendation for drinking water is 200 mg/l to 600 mg/l. (BIS, 2012).

Electrical conductivity (EC) is the ability of an aqueous solution to conduct the electric current. Electrical Conductivity is a useful tool to evaluate the purity of water (Acharya *et al.,* 2008).Electrical conductivity (EC) is the ability of a solution to conduct an electrical current which is dependent on the quantity and charge of the ions in the solution. ECvalues found in the range between 82 µs/cm to 5430 µs/cm in different categories of water. In which urban areas ranged found in between 82 µs/cm to 3278 µs/cm while, in peri-urban areas ranged found between 474 µs/cm to 5430 µs/cm. As compared with our study, lower EC were observed by Chindo *et al.,* 2013, Buridi and Gedala 2014, Vyas *et al.,* 2015, Adegboyega *et al.,* 2015 and Samuel *et al.,* 2017. While higher EC values were reported by Saha *et al.,* 2018. Higher EC values give an indication towards the higher concentration of mineral salts in the water. It is also due to increased corrosion of metals (Table 1 to 8; Fig. 1 and 2).

Table.1 Physico-chemical analysis of public drinking water in urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	PW 1	7.52	473	947	80	275	1.5	0	45	0	0
2.	PW 2	8.37	288	577	70	150	1.0	0	10	0	0
3.	PW 3	7.50	614	1229	100	325	1.5	0	10	0	0
4.	PW 4	7.20	98	197	20	30	0.0	0	0	0	0
5.	PW 5	7.61	607	1215	110	300	1.5	0	10	0	0
6.	PW 6	7.20	110	220	10	25	0	0	0	0	0
7.	PW 7	6.82	282	565	60	125	0.5	0	10	0	0
8.	PW 8	7.20	95	191	50	25	0.5	0	10	0	0
9.	PW 9	6.90	671	1342	130	225	0	0	0	0	0
10.	PW 10	7.20	563	1126	80	225	0.5	0	10	0	0
11.	PW 11	6.80	41	82	20	25	0	0	0	0	0
12.	PW 12	7.10	447	895	20	226	1.5	0.5	10	0	0
13.	PW 13	7.20	352	704	30	194	1.5	0.3	10	0	0
14.	Mean	7.278	357	714.615	60	165.384	0.769	0.615	9.615	0	0

PW= public water supply, TDS= total dissolved solid, EC= electrical conductivity, TH= total hardness, RC= residual chlorine

Table.2 Physico-chemical analysis of public drinking water in peri-urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	PW 14	7.50	946	1886	250	425	1.5	0.5	45	0	0
2.	PW 15	7.68	1374	2748	410	475	1.5	1.0	10	0	5
3.	PW 16	8.01	651	1303	60	150	1.5	0.3	10	0	0
4.	PW 17	7.14	1787	3574	750	1000	1	0.3	10	0	0
5.	PW 18	6.83	537	1074	60	216	1.0	0.3	10	0	0
6.	PW 19	6.89	742	1448	110	300	0.5	0.3	10	0	0
7.	PW 20	7.49	998	1997	230	700	2.0	0	10	0	0
8.	PW21	6.90	1258	2516	450	500	2.0	0	0	0	0
9.	PW22	7.26	500	1000	90	205	1.0	0.3	10	0	0
10.	PW23	7.92	237	474	50	125	0.5	0	10	0	0
11.	Mean	7.362	903	1802	246	409.6	1.25	0.3	12.5	0	0.5

PW= public water supply, TDS= total dissolved solid, EC= electrical conductivity, TH= total hardness, RC= residual chlorine

Table.3 Physico-chemical analysis of surface water in urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	SW 1	8.67	283	566	70	150	1.0	0.3	10	0	5
2.	SW 2	8.70	304	608	60	175	0.5	0.3	10	0	0
3.	SW 3	7.80	204	408	50	100	1.0	0.0	45	0	0
4.	SW 4	8.00	299	599	60	126	1.0	0.3	45	0	5
5.	SW 5	8.20	270	541	50	124	0.5	0.3	45	0	0
6.	SW 6	7.20	590	1181	120	200	1.5	0.3	10	0	5
7.	SW 7	7.80	617	1235	130	208	1.0	0.3	10	0	5
8.	SW 8	7.40	593	1186	70	276	1.0	0.3	10	0	5
9.	SW 9	7.10	190	380	40	75	1.0	0.0	10	0	0
10.	SW 10	7.20	203	406	40	106	0.5	0.0	10	0	5
11.	SW 11	7.80	350	700	160	200	0.5	0.0	10	0	5
12.	SW 12	8.90	980	1960	200	620	1.0	0.5	45	0	20
13.	Mean	7.897	406.916	814.166	87.5	196.667	0.875	0.216	21.666	0	4.583

SW= surface water, TDS= total dissolved solid, EC= electrical conductivity, TH= total hardness, RC= residual chlorine

Table.4 Physico-chemical analysis of surface water in peri-urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	SW 13	8.38	957	1914	220	375	1.5	0.3	100	0	25
2.	SW 14	8.62	1167	2334	210	375	1.0	0.5	10	0	25
3.	SW 15	7.86	710	1420	190	325	0.5	0.3	45	0	0
4.	SW 16	8.58	437	844	80	175	1.0	0.3	10	0	0
5.	SW 17	7.18	431	862	70	206	0.5	0.3	10	0	0
6.	SW 18	7.10	298	596	60	126	0.5	1.0	10	0	5
7.	SW 19	7.71	640	1280	240	500	1.5	0.5	45	0	5
8.	SW 20	7.20	370	740	110	325	0.5	0.3	10	0	5
9.	SW 21	8.15	270	540	160	300	1.5	0.3	45	0	0
10.	SW 22	7.80	250	500	130	250	1.5	1.0	10	0	0
11.	Mean	7.858	533	1103	147	295.7	1	0.48	29.5	0	6.5

Table.5 Physico-chemical analysis of ground water in urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	GW 1	7.10	827	1665	180	375	1.5	0	10	0	0
2.	GW 2	7.20	1310	2620	450	600	1.0	0	45	0	15
3.	GW 3	7.30	1217	2434	330	275	2.0	0	10	0	0
4.	GW 4	7.10	1622	3244	750	750	2.5	0.5	10	0	0
5.	GW 5	7.42	721	1443	130	350	1.0	0.3	10	0	0
6.	GW 6	8.10	335	670	70	150	0.5	0.5	10	0	0
7.	GW 7	7.90	301	602	70	150	0.5	0	10	0	0
8.	GW 8	7.80	1477	2954	300	625	1.5	0.3	45	0	0
9.	GW 9	7.00	1130	2261	300	534	1.5	0.3	0	0	0
10.	GW 10	7.10	1422	2844	330	424	1.5	0.3	10	0	0
13.	Mean	7.402	1036.2	2073.7	291	423.3	1.35	0.22	16	0	1.5

GW= ground water, TDS= total dissolved solid, EC= electrical conductivity, TH= total hardness, RC= residual chlorine

Table.6 Physico-chemical analysis of ground water in peri-urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	GW 11	7.86	2180	4360	910	1025	1.0	0.3	10	0	0
2.	GW 12	7.55	2715	5430	1100	1925	1.0	0.3	45	0	0
3.	GW 13	6.92	1858	3317	850	1250	1.0	0.3	10	0	0
4.	GW 14	6.80	1195	2390	450	625	1.0	0	10	0	0
5.	GW 15	6.81	1643	3286	550	708	1.0	0.3	10	0	0
6.	GW 16	7.00	1300	2600	350	530	1.5	0.3	10	0	0
7.	GW 17	8.70	1032	2064	220	625	2.5	0.3	10	0	0
8.	GW 18	6.90	1109	2218	250	725	1.5	0.3	10	0	0
9.	GW 19	7.45	1620	3240	650	700	1.5	0.3	10	0	0
10.	GW 20	7.28	1814	3629	800	625	1.0	0	10	0	0
11.	Mean	7.297	1646.6	3253.4	613	873.8	1.3	0.24	13.5	0	0

Table.7 Physico-chemical analysis of animal drinking water in urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	AW 1	7.20	827	1665	180	350	1.5	0	10	0	0
2.	AW 2	6.82	1321	2642	550	675	2.5	0.3	45	0	0
3.	AW 3	7.20	1212	2424	330	275	2.0	0	10	0	15
4.	AW 4	6.91	1639	3279	800	800	2.5	0.5	10	0	25
5.	AW 5	7.30	710	1420	140	350	1.0	0.3	10	0	5
6.	AW 6	7.89	700	1401	130	375	1.0	0.3	10	0	0
7.	AW 7	8.16	378	757	80	175	0.5	0	10	0	0
8.	AW 8	7.80	1408	2816	290	575	1.0	0	45	0	5
9.	AW 9	7.20	1335	2670	420	584	1.0	0	10	0	5
10.	AW 10	6.80	1167	2234	420	425	1.5	0.3	45	0	5
11.	Mean	7.328	1069.7	2130.8	334	458.4	1.45	0.17	20.5	0	6

AW= animal drinking water, TDS= total dissolved solid, EC= electrical conductivity, TH= total hardness, RC= residual chlorine

Table.8 Physico-chemical analysis of animal drinking water in peri-urban areas of Udaipur

S. No.	Sample No.	pH (mg/L)	TDS (mg/L)	EC (µs/cm)	Chloride (mg/L)	TH (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Nitrate (mg/L)	RC (mg/L)	Turbidity (NTU)
1.	AW 11	7.91	2229	4459	950	1125	1.5	0.3	45	0	5
2.	AW 12	7.92	833	1667	70	525	1.5	0.3	10	0	0
3.	AW 13	7.76	1819	3639	850	1250	1.0	0.3	10	0	5
4.	AW 14	6.90	1260	2520	450	700	1.0	0.3	10	0	10
5.	AW 15	7.14	1711	3422	550	762	1.0	0.3	10	0	5
6.	AW 16	6.90	1350	2700	350	560	1.0	0.3	10	0	10
7.	AW 17	7.58	903	1806	130	500	2.5	0.3	10	0	0
8.	AW 18	7.10	1132	2264	250	700	1.0	0.3	10	0	10
9.	AW 19	7.65	1580	3160	600	675	1.0	0.3	10	0	10
10.	AW 20	8.15	1340	2680	550	500	2.0	0.3	45	0	0
11.	Mean	7.501	1415.7	2831.7	475	729.7	1.35	0.3	17	0	5.5

Fig.1 Variation of TDS, chloride content and total hardness of different types of water

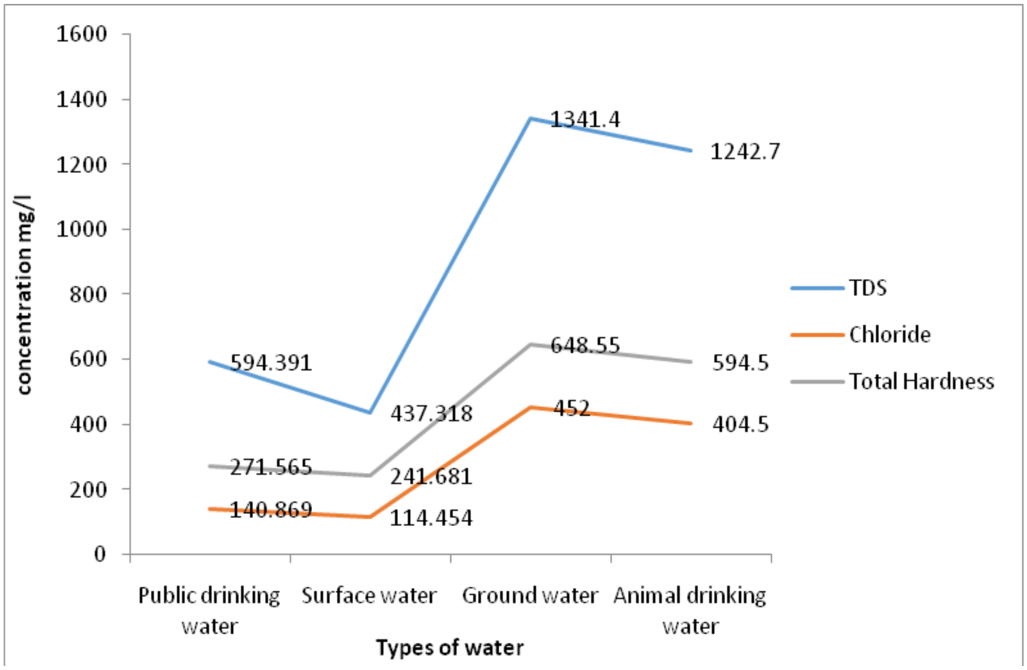
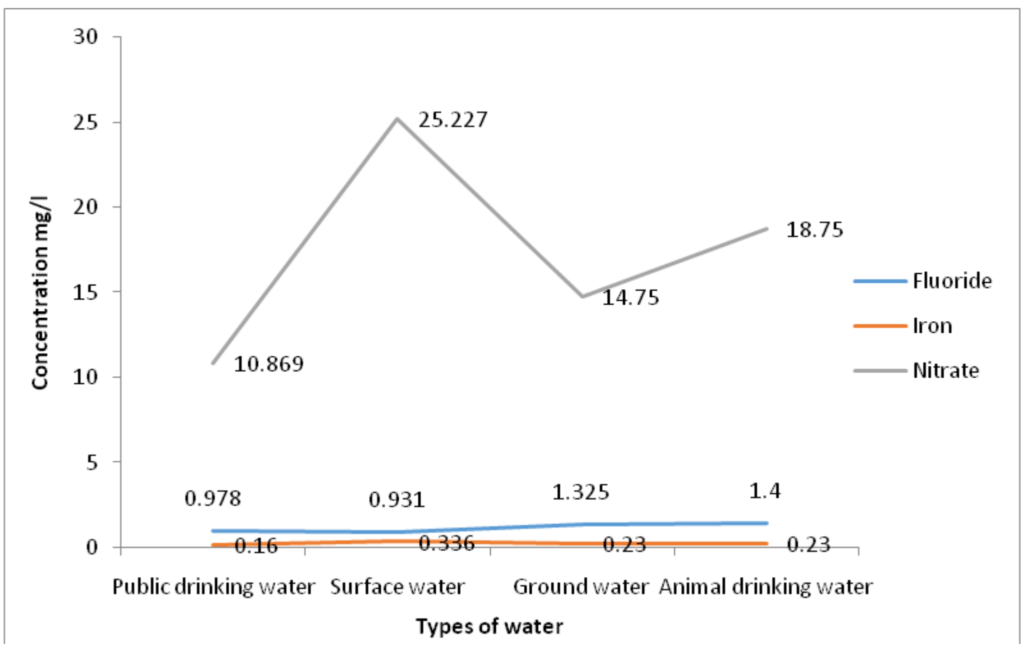


Fig.2 Variation of fluoride, iron and nitrate content in different types of water



One of the most vital inorganic ions in water is chloride. This is found in almost all water bodies as it is highly soluble. It is also regarded as an indicator of sewage pollution(Wetzel, 1966).Chlorides are leached from various rocks into soil and water by weathering (WHO, 1996). Chloride values found in the range between 10 mg/l to 1100 mg/l in different categories of water. In which urban areas ranged found in between 10 mg/l to 800 mg/l while, in peri-urban areas ranged found between 50 mg/l to 1100 mg/l(Table 1 to 8; Fig. 1 and 2). Slightly lower chloride content in drinking water were reported by Sebiawu *et al.,* 2014 and Chaubey and Patil 2015.All category of water chloride comes in acceptable limit for drinking water is 250mg/l to1100mg/l (BIS, 2012).

Fluoride values found in the range between 0 mg/l to 2.5 mg/l in different categories of water. In which urban areas ranged found in between 0 mg/l to 2.5 mg/l while, in peri-urban areas ranged found between 0.5 mg/l to 2.5 mg/l(Table 1 to 8; Fig. 1 and 2). Many ground water samples show high contain of fluoride due to the nature of specific structure of the rocks and soil of particular area. Similar to our finding for fluoride content in drinking water were reported by Reda, 2016. Fluoride recommendation for drinking water is 1 mg/l to 1.5 mg/l. (BIS, 2012).

Iron values found in the range between 0 mg/l to 1.0 mg/l in different categories of water. In which urban areas ranged found in between 0 mg/l to 0.5 mg/l while, in peri-urban areas ranged found between 0 mg/l to 1.0 mg/l(Table 1 to 8; Fig. 1 and 2).Sebiawu *et al.,* 2014 and Rahmania *et al.,* 2015 revealed iron content of drinking water which were in agreement with the findings of our study.Iron recommendation for drinking water is 0.3 mg/l. (BIS, 2012).

Nitrate values found in the range between 0 mg/l to 100 mg/l in different categories of water. In which urban areas ranged found in between 0 mg/l to 45 mg/l while, in peri-urban areas ranged found between 0 mg/l to 100 mg/l (Table 1 to 8; Fig. 1 and 2).Singh *et al.,* 2014 and Adegboyega *et al.,* 2015 also found similar to our results for nitrate content in water. Nitrate is produced by the action of microbes on fertilizers. The increased use of fertilizer in agriculture practice may be an important source of nitrate contamination in water. Leaching of fertilizers to the water table through the soil is also an important means of ground water contamination. Nitrate recommendation for drinking water is 45 mg/l. (BIS, 2012)

All these parameters chloride, fluoride, iron and nitrate were in the acceptable range recommended by BIS. High levels of iron occur due to specific structure of the rocks in the study area. Moreover, the salty taste in water occurs due to the high chloride concentration. Increased amount of chloride, fluoride and iron indicates the role of anthropogenic activities and sewage pollution as the cause of their contamination in drinking water.

Turbidity of water is an important parameter which is directly linked with the increased amount of organic matter in the water. It is not only hazardous for human health but also adversely affects the efficacy of disinfectant. Also, turbid water has high concentration of pathogenic microbes like bacteria and other parasites which pose a serious health hazard. In our study, few samples of surface water exceeded the acceptable limit of turbidity. Turbidity values found in the range between 0 NTU to 25 NTU in different categories of water. In which urban areas ranged found in between 0 NTU to 25 NTU while, in peri-urban areas ranged found between 0 NTU to 25 NTU. Turbidity recommendation for drinking water is not more than 1.0 NTU. (BIS, 2012)And all of the water samples were negative for residual chlorine(Table 1 to 8; Fig. 1 and 2).

Acknowledgement

I am thankful to co-others Dr. Abhishek Guarav, Dr. S.S. Shekhawat, Dr. Bincy

Joseph, Dr. Hitesh Kumar and Dr. Devender Choudhary, Department of Veterinary public Health, CVAS, Navania, Vallabhnagar, Udaipur for their gaudiness, co-operation and persistence motivation during entire period of study.

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How to cite this article:

Nirmal Kumar, Abhishek Gaurav, Surendra Singh Shekhawat, Bincy Joseph, Hitesh Kumar and Devender Choudhary. 2019. Physico-Chemical Assessment of Drinking Water in Urban and Peri-Urban Areas of Udaipur, India. *Int.J.Curr.Microbiol.App.Sci.* 8(08): 2314-2326.
doi: https://doi.org/10.20546/ijcmas.2019.808.268