
Estimation of Hardness in Municipal Tap Water of Some Selected Areas of Tiptur Town, Tumkur District

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Abstract: *Water is one of the abundantly available substances in nature and also called 'elixir of life'. Quality of water is an important criterion for evaluating the suitability of water for drinking and domestic purpose. Physico-Chemical analysis such as Temperature, P^H, Total dissolved solids, Electrical Conductance, Total alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Nitrate, Phosphate, Sulphate and Iron of tap water samples for drinking purpose have been carried out from fifteen sampling locations of Tiptur town during winter and summer seasons in order to assess water quality. The results were compared with standards prescribed by BIS. In the present investigation, 98% of the samples were found to be very hard and Chloride levels of some sampling locations were approaching maximum limits except all other parameters.*

Keywords: *Physico-Chemical parameters, Municipal tap water, Tiptur town, domestic purpose and elixir of life.*

1. INTRODUCTION

Water is indispensable and one of the precious natural resources of our planet. It is used in irrigation, industries and household. Water resources include rivers, ground water, lakes and reservoirs etc. The geology of a particular area has greater influence on the occurrence and quality of water. The water quality varies due to change in chemical composition (Raj Mohan, 2003). The pollution of water may be due to heavy metals (Sharma and Dubey, 2005). Poor quality of water affects badly the plant growth and human health (Subba Rao, 2005, WHO 1992, Karanth 1997). Further water quality studies with respect to drinking and irrigation purposes have been carried out in different parts of the world (Majumdar and Gupta, 2000).

The quality of water is a vital concern for mankind since it is directly linked with human welfare. The present investigations involve the analysis of Physico-Chemical parameters of drinking water supply to the residents of Tiptur town and evaluate its suitability for drinking with respect to BIS guidelines. Supply of safe water is univocally a basic requirement for human consumption. It is one of the most important compounds that profoundly influence life. Unsafe drinking water contributes to numerous health problems associated mainly with water borne diseases. According to WHO, 80% of all the diseases in human beings are caused by contaminated water. It is therefore important to check the water quality at regular intervals of time. Quality and quantity of water at a place play a vital role in health, wealth and prosperity of the region. So, the present study deals with Physico-Chemical parameters of municipal tap water of Tiptur town for drinking and domestic purpose.

2. STUDY AREA

Tiptur town is about 75 km from Tumkur district. It covers an area of 785 sq km having 13° 16' north latitude 76° 29' east longitude and an altitude of 850.30 meter above sea level. The average temperature ranges 11° in winter and 38° during summer. The average rain fall of Tiptur town is 503 mm (Basavaraddi *et al.*, 2012).

3. MATERIALS AND METHODS

Water samples from fifteen sampling locations in Tiptur town were collected in two litre cleaned and dried polythene bottles with necessary precautions. All the chemicals used were of AR Grade. Double distilled water was used for the preparation of reagents and solutions. The water quality parameters like Temperature, P^H, TDS, EC, TA, TH, Calcium, Magnesium, Chloride, Nitrate, Phosphate, Sulphate and Iron were studied. Physical parameters were measured by using water analyser kit at the spot. Chemical parameters were analysed within 24hrs using standard methods of APHA. Some parameters like Phosphate, Sulphate, Nitrate and Iron were analysed by using Spectrophotometer (EI Make). The present study was carried out during NOV 2014 to MAY 2015 for seasonal studies.

4. RESULTS AND DISCUSSION

Water quality data of municipal tap water samples collected during winter and summer season are tabulated in table 1 and 2.

Temperature

Temperature is an important factor which controls the chemical reactions and also plays an important role in the metabolic activities of the organism. In the present study, temperature ranged from a minimum of 22.8°C to a maximum of 28.5°C.

P^H

The P^H is an important index of acidity or alkalinity and the concentration of hydrogen ion in water sample. In the present study, the water samples are slightly acidic. The P^H values of water samples were varied from a minimum of 6.24 to a maximum of 7.87 and were found within the prescribed limits of BIS.

Total Dissolved Solids

The drinking water quality especially taste depends on the dissolved minerals and also inorganic substances (Trivedy and Goel; 2006). In the present study, Total dissolved solids ranged from a minimum of 385mg/L to a maximum of 1525mg/L. According to BIS Standards, the values must be less than 500mg/L for drinking water, but in unavoidable cases 1500mg/L are permissible. The TDS concentration is found to be above the permissible limit, this may be due to leaching of rock minerals and also excess inorganic compounds into the water which causes decrease in the potability. Excess TDS may cause gastro-intestinal irritation in human.

Electrical Conductivity

Electrical conductivity is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts. EC values were ranged from a minimum of 650 to a maximum of 2320µs/cm. High EC values were observed for five sampling points S₃, S₄, S₅, S₆ and S₉ indicating the presence of high amount of dissolved substances. The tolerance EC limit is 1500µs/cm.

Total Alkalinity

Alkalinity of water is its capacity to neutralise a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of Calcium, Sodium and Potassium. In the present study, the total alkalinity content ranged between a minimum of 90mg/L to a maximum of 480mg/L. Alkalinity in itself is not harmful to human being, but imparts an unpleasant taste.

Total Hardness

Hardness of water is mainly depends upon the amount of Calcium or Magnesium salts or both. The hardness values ranged between a minimum of 232mg/L to a maximum of 872mg/L. The samples S₅, S₆, S₉, S₁₁, S₁₄ and S₁₅ were exceeded the prescribed limit (600mg/L) .BIS (1998). Water having hardness below 300mg/L is considered potable, but beyond this limits cause gastro-intestinal irritation. Normal water hardness does not pose any direct health problems, but higher concentration of hardness (above 600mg/L) may cause kidney problems.

Calcium and Magnesium

Calcium and Magnesium are directly related to hardness. Calcium plays a significant role in blood clotting, muscular contraction and in enzymes assisting in metabolic processes. Excess Calcium contributes to the formation of kidney and bladder stones. Excessive Magnesium may give water a

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bitter taste, but is normally not a health hazard. Calcium and Magnesium are both essential minerals for living organisms. Magnesium concentration is generally lower than the Calcium concentration. In the present study, Calcium concentration is ranged from a minimum of 24.8mg/L to a maximum of 101mg/L. The tolerance range for Calcium hardness is 200mg/L. The values were below the permissible limit. The Magnesium concentration is ranged from a minimum of 13mg/L to a maximum of 56.4mg/L. The tolerance range for Magnesium hardness is 100mg/L and the values were below the permissible limit.

Chloride

In the present study, Chloride concentration is ranged from a minimum of 72mg/L to a maximum of 494mg/L. While the tolerance range is 250 to 1000mg/L. High Chloride content can cause high B.P in people. Chloride in excess imparts a salty taste to water and people who are not accustomed to high Chloride may be subjected to laxative effect. The samples S₅, S₆, S₉ and S₁₄ have high Chloride content. High Chloride concentration is also an indicator of large amount of organic matter.

Nitrate

The concentration of nitrate in water samples depends on the nitrification activities of micro-organisms. Nitrate-Nitrogen is one of the major constituents of organism along with carbon and hydrogen as amino acids, proteins and organic compounds in water samples. The nitrate content in water samples is ranged from a minimum of 13mg/L to a maximum of 40mg/L. The tolerance range for nitrate is 45mg/L (APHA, 2006) and the values were found well within the prescribed limit.

Phosphate

Phosphate content in the study area is ranged from a minimum of 0.02mg/L to a maximum of 0.10mg/L. The tolerance range for Phosphate is 0.50mg/L and the values were found within the prescribed limit.

Sulphate

The sulphate content is ranged from a minimum of 28mg/L to a maximum of 115mg/L. The tolerance range for sulphate is 200mg/L to 400mg/L and the values were found within the prescribed limit. High concentration of sulphate has laxative effect and carthartic effects.

Iron

Iron is one of the most abundant elements in nature. All kinds of water, including ground water have appreciable quantities of Iron. The shortage of iron causes a disease called anaemia and continues consumption of drinking water with high concentration of iron for a long time can lead to liver disease called as haemosiderosis. The Iron content in the study area is ranged from a minimum of 0.08mg/L to a maximum of 0.30mg/L and the values were found within the prescribed limit (1mg/L)

Table-1. Result of analysis of samples collected in winter season 2014-15

No.	Sample station	Tempr. °c	PH	TDS mg/l	EC µs/cm	TA mg/l	TH mg/l	Ca++ mg/l	Mg++ mg/l	Cl- mg/l	NO3 mg/l	PO4 mg/l	SO4 mg/l	Fe mg/l
S1	Gandhinagara	23.6	7.55	430	650	90	248	27.2	13.6	85.2	18.0	0.02	28.0	0.12
S2	Marketyard	23.3	6.52	880	1340	350	512	47.2	33.5	210.0	18.8	0.10	55.0	0.12
S3	Kote	23.4	6.38	1060	1620	370	496	40.0	35.9	261.3	22.0	0.03	56.0	0.16
S4	Doddapeti	23.2	6.36	1040	1590	360	324	29.6	21.4	207.0	13.0	0.05	50.0	0.15
S5	Halepalya	23.3	7.61	1490	2310	220	716	66.4	46.7	494.0	15.5	0.07	94.0	0.15
S6	Annapura	24.9	7.60	1030	1570	180	672	72.0	37.9	298.0	22.5	0.04	76.0	0.17
S7	Manjunathanagara	25.5	7.87	620	980	170	384	40.8	21.9	144.8	20.6	0.03	42.0	0.23
S8	K.R.Extention	23.0	6.26	730	1120	280	408	41.6	24.3	187.4	12.5	0.03	26.0	0.16
S9	Shankarappa layout	23.2	6.28	1030	1580	410	656	38.4	56.4	278.3	20.0	0.05	26.0	0.17
S10	Govinapura	25.5	7.29	940	1420	200	576	61.6	32.6	252.8	28.0	0.02	62.0	0.18
S11	Shadaksharibadavane	25.4	6.24	910	1400	430	644	40.0	53.9	204.5	18.5	0.06	32.0	0.18
S12	Kenchagatta	25.0	6.90	680	1000	300	450	42.5	30.5	133.5	30.8	0.02	30.0	0.08
S13	Vidyanagara	23.6	6.88	720	1120	180	572	65.6	29.7	173.0	23.8	0.02	16.0	0.18
S14	Maranagere	22.8	6.65	970	1480	340	716	60.8	50.0	289.7	11.3	0.02	50.0	0.20
S15	Vinayakanagara	23.4	6.31	920	1400	420	672	44.0	54.9	247.0	17.5	0.03	64.0	0.17

Table-2. Result of analysis of samples collected in Summer season 2015

No.	Sample station	Tempr. °c	PH	TDS mg/l	EC µs/cm	TA mg/l	TH mg/l	Ca ⁺⁺ mg/l	Mg ⁺⁺ mg/l	Cl ⁻ mg/l	NO ₃ mg/l	PO ₄ mg/l	SO ₄ mg/l	Fe mg/l
S1	Gandhinagara	26.5	7.58	385	590	205	232	24.8	13.0	72.4	17.5	0.033	28.6	0.23
S2	Marketyard	26.5	7.60	790	1210	320	448	54.0	21.6	200.0	23.3	0.074	56.2	0.24
S3	Kote	26.4	6.99	990	1530	360	470	50.0	28.3	255.6	34.2	0.036	76.0	0.24
S4	Doddapeti	26.5	6.86	975	1490	345	488	55.6	25.5	264.0	23.2	0.033	76.0	0.30
S5	Halepalya	27.5	7.06	1525	2320	480	790	86.8	43.3	488.5	19.4	0.046	115	0.16
S6	Annapura	27.5	7.02	1445	2235	400	864	101	43.5	467.0	40.0	0.042	83.5	0.14
S7	Manjunathanagara	27.8	7.86	740	1120	340	478	42.8	32.0	194.4	19.3	0.048	36.8	0.11
S8	K.R.Extention	26.3	7.01	800	1240	360	710	46.4	41.3	271.3	29.7	0.040	39.5	0.26
S9	Shankarappa layout	28.2	6.62	1020	1560	355	712	54.8	43.7	282.5	18.9	0.058	36.8	0.13
S10	Govinapura	26.8	6.95	950	1440	415	620	60.4	38.7	254.2	34.9	0.036	53.5	0.26
S11	Shadaksharibadavane	26.7	6.78	890	1370	430	614	52.8	42.5	204.3	22.2	0.059	29.8	0.15
S12	Kenchagatta	28.5	6.75	670	1010	300	468	54.0	29.9	139.2	21.5	0.048	49.0	0.13
S13	Vidyanagara	27.6	6.51	720	1115	355	538	52.0	33.8	183.2	21.1	0.048	40.5	0.16
S14	Maranagere	26.6	7.14	1300	2000	395	872	92.4	49.8	401.9	31.1	0.042	115	0.29
S15	Vinayakanagara	27.8	7.07	915	1400	360	632	76.0	40.1	247.0	24.0	0.074	59.0	0.26

Graphs of some important parameters

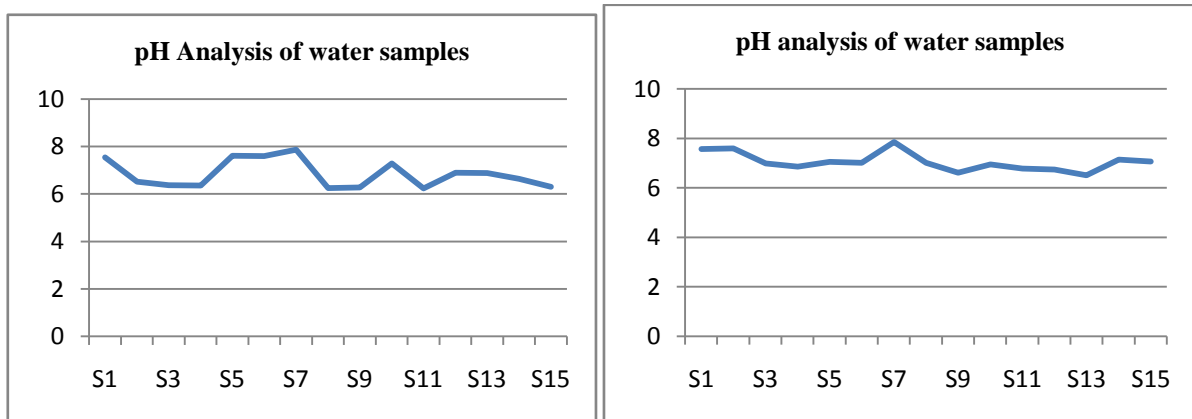


Fig 1. pH(6.5-8.5)Analysis of Drinking water samples

TDS of water samples in winter and summer season 2015

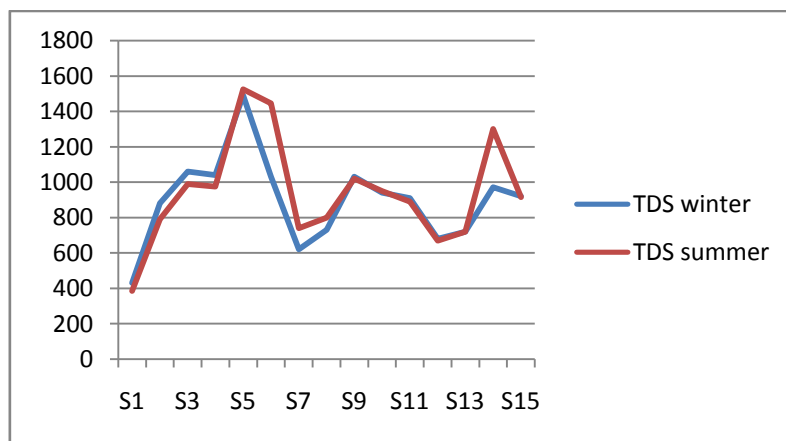


Fig 2. TDS(500-1500 mg/L)Analysis of Drinking water samples

Electrical Conductivity of water samples

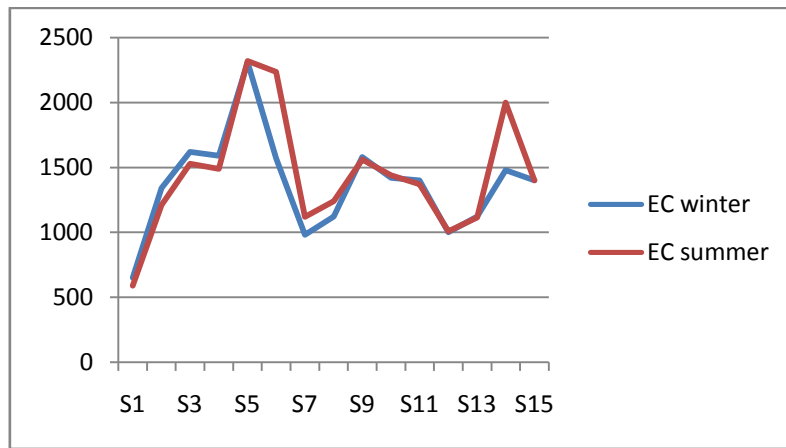


Fig 3. EC Analysis of Drinking water samples

Total Hardness of water samples

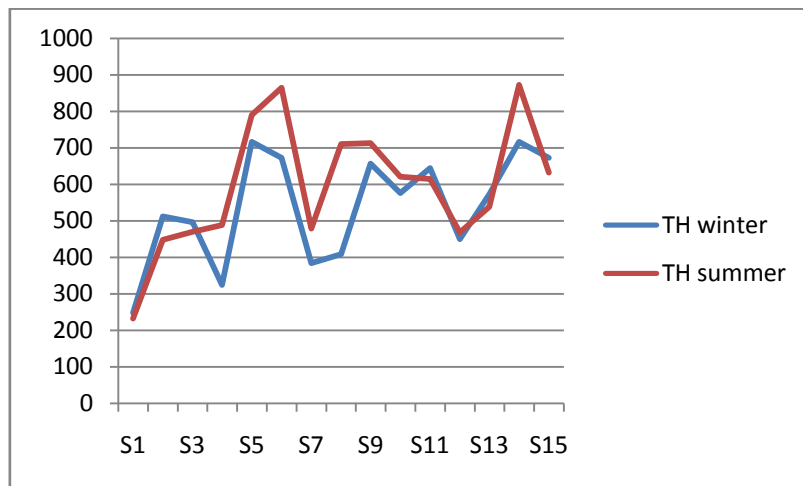


Fig 4. TH(300-600 mg/L) Analysis of Drinking water samples

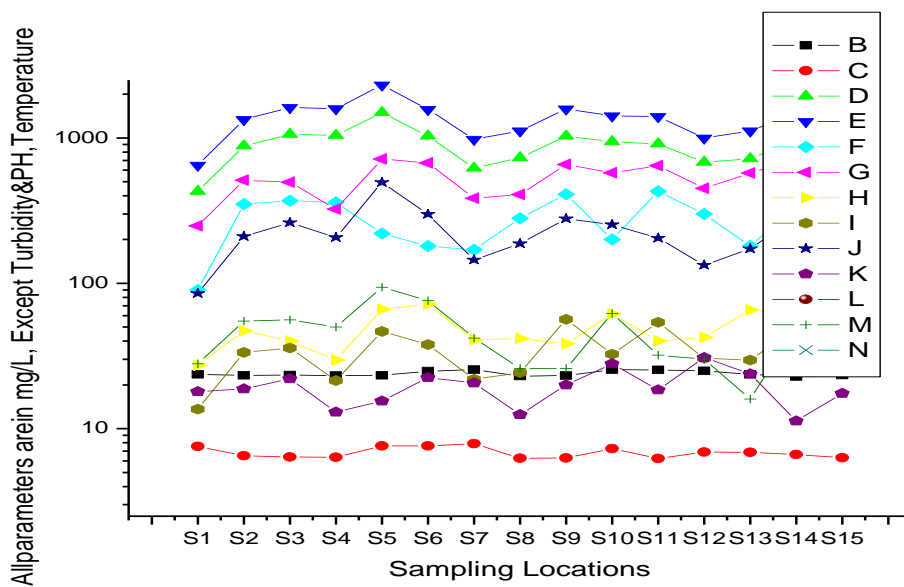


Fig-5. Graph showing variation of parameters during Winter season

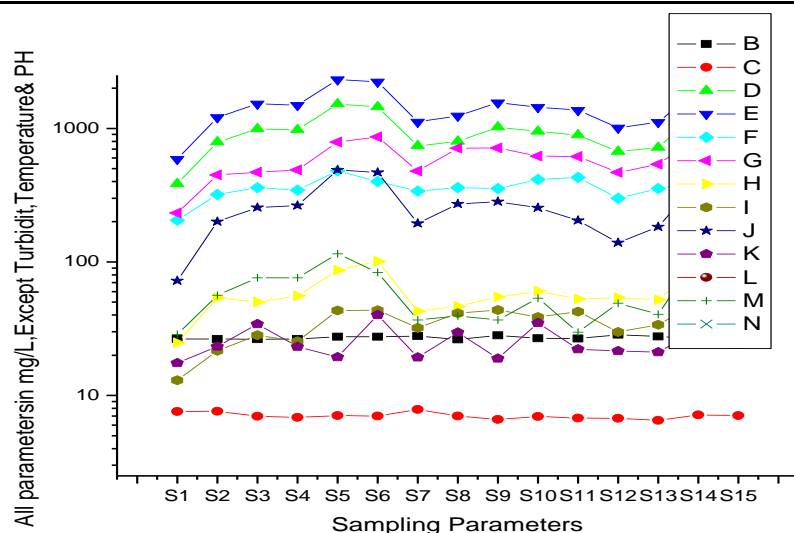


Fig-6. Graph showing variation of parameters during Summer Season

5. CONCLUSION

The water quality analysis reveals that

- The water in the study area is very hard.
- TDS and Chlorides were approaching maximum permissible limits of BIS standards.
- Water must be softening before drinking to avoid chonical diseases.
- The water can be used for domestic and small scale industries.
- Municipal authorities are advised to treat the water by filtration, reverse osmosis and electro-dialysis, before use.

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