International Journal of Research in Chemistry and Environment
Vol. 2 Issue 1 January 2012(44-53)
ISSN 2248-9649

Research Paper

Assessment of Physico-Chemical and Bacteriological Parameters of Drinking Water in Mysore City, India

Shivaraju H. P.
Guest Faculty, Department of Environmental Science, Yuvaraja Collage,
University of Mysore, Manasagangothri, Mysore 570 005, INDIA

Available online at: www.ijrce.org

(Received 16th May 2011, Accepted 10th October 2011)

Abstract *- The physico-chemical and bacteriological analysis was carried out for the assessment of drinking water quality in the Mysore city. All the water samples were collected from overhead tanks, which are located in different areas of city and as collected water samples were analyzed for the physico-chemical and bacteriological characteristics. In the present study results obtained are reported and importance of drinking water quality parameters obtained are discussed by compared with permissible limits set by bureau of Indian standards. As per physico-chemical parameters are concerned, few drinking water samples supplied in the city crossed their permissible limits. Moreover, the microbial examination was carried out by MPN method and it was suggested that drinking water in the city was seriously polluted by harmful bacteria and unfit for drinking purposes. The main sources and reasons for the contamination of drinking water in the city are reported and possible alternative techniques for the control of drinking water contamination are suggested.*

Keywords: Physico-chemical parameters, Indian standard, overhead tanks, Harmful bacteria, Bacteriological.

Introduction

The modern civilization, industrialization, urbanization and increased population have led to fast pollution of our environment. Water, food and fresh air are the basic necessities for the survival of all living beings and no life can exist without water. Water is an essential nutrient that is involved in every function of the human body and two-thirds of the human body is made of water. It helps to transport nutrients and waste products in and out of the cells. Water dissolves the carbon, oxygen and salts present in the body and distributes to the different parts through the process of blood circulation. It is also needed for the maintenance of proper body temperature [1-5]. Water is indispensable and one of the precious natural resources of this planet. Since, it is not only essential for the survival of human beings but also for the animals, plants and all other living beings. Therefore, drinking water should not be containing unwanted impurities, harmful chemical compounds or harmful bacteria and it should be always remain pure. But, unfortunately water gets polluted through various sources. It has been reported that the world water pollution is posing a threat to human life both in rural and urban areas [6]. In some countries lakes and rivers have been polluted with an assortment of waste, including untreated or partially treated municipal sewage, industrial effluents, harmful chemicals, and agricultural wastes [7-9]. The degradation of both surface and ground water resources had adverse impact on the quality of drinking water for the human use, as well as harmful effects on aquatic life [10-11]. The World Health Organization (WHO) estimated in 1996 that every eight seconds a child dies from a water-related disease and that each year more than five million people died from illnesses linked to unsafe drinking water or inadequate sanitation [12-13]. WHO also suggest that if sustainable safe drinking water and sanitation services were provided to all, each year there would be 200 million fewer diarrhoeal episodes, 2.1 million fewer deaths caused by diarrhoea, 76,000 fewer dracunculiasis cases, 150 million fewer schistosomiasis cases and 75 million fewer trachoma cases [12-13].

Material and Methods

Study area

Mysore is a unique city and it was the capital of former princely state of Karnataka, India. It has kept alive the royal tradition and splendor of the city. Maharajas have departed and new generation of industrialist is emerging. Mysore city is situated between 12^{O} and 11^{O} 06′ latitude and

75^{O} 09′ and 77^{O} 07′ longitudes and it is the second largest city in the Karnataka state, located 140 km south of the Bangalore metropolitan city, India. The population of the city is 6.53 lakhs as per the 1991 census (at present above 20 lakhs). Mysore city is a divisional headquarters and it is also called as the garden city of India.

Brief history of municipal water supply system in the Mysore city

Vani Vilas Water Work (VVWW) is exists in the Mysore city to supply domestic water to the people of the Mysore city. The water source is mainly dependent on the Cauvery river and also local ground water for domestic purposes. VVWW is supplied domestic water to the Mysore city from Krishna Raja Sagara (KRS) dam through four different pumping stations. Total 160 -200 million liter of water is supplying to the city each day. Pumped water from different pumping stations was stored in the sub storage water tanks, which are located in outskirt of the city and later stored water is supplied to the people for their domestic usage through the overhead tanks. These over heads tanks are the main storage tanks for drinking water in the city and later water was directly supplied to the houses for domestic purposes. The water pumped by local bore wells, which are located all over the city is also directly pumped to the overhead tanks and mixed with Cauvery river water in the same overhead tanks for domestic supply.

Sampling and Analysis Technique

Drinking water samples were collected from the overhead tanks, which are located in all over the city and Figure 1 shows the sampling sites in the city. Total 16 samples were collected from different areas of the city in two series of 45 days time intervals for the duration of 3 month (October to December). Water samples were collected using one liter plastic canes, before collection of samples canes were washed with dilute nitric acid and rinsed with water to be analyzed. The samples were collected early morning 5:30 – 6:00 A.M by using available tapes under the overhead tanks in each area. Temperature and *pH* of water were determined during sample collection at sampling sites. As collected water samples were brought to the laboratories for determination of physico-chemical and microbial parameters. The determination of water quality parameters were carried out by standard techniques [14-16] and important parameters (Table 1), which are playing main role in the human health, were considered. For comparative study, water samples (treated) were collected from all the four pumping stations and analyzed. The results obtained were compared with drinking water quality standards set by bureau of Indian standards and techniques used for the analysis is shown in Table 1.

Results and Discussion

The results obtained for physico-chemical parameters of all the water samples in different areas of the Mysore city are tabulated in Tables 2(a) and 2(b) and microbial parameters obtained show in Table 3. The results obtained are showing that there is a wide variation in the quality of drinking water in the Mysore city. Based on the physico-chemical and bacteriological parameters obtained, the drinking water varies from moderate contamination to large extent of contamination. All water samples were observed and found to be colorless and odorless. The temperature of all water samples was ranged between 18^{O} C to 21^{O} C and *pH* was within permissible limit (6 to 7.8) in both first and second series of water quality analysis (Figure 2).

Electric conductivity (EC): The EC of all water samples ranged between 750 m-mho to 1462 m-mho. The EC of water sample reveals that levels of dissolved ionic substance in drinking water and EC was high in few water samples, which collected from the sampling sites **D**, **J**, **K**, **N** and **M** in both series of water quality analysis (Figure. 3). Few water samples showed high value of EC in some areas due to direct mixing of untreated ground water drawn from local bore wells, which contained high amount of dissolved ionic substances. It was one of the important possible reasons for the higher EC of drinking water in those areas.

Total dissolved solid (TDS): The amount of TDS in water indicates the general nature of salinity of water. The water contains more than 500mg/L TDS is not considered to be desirable for drinking water supply [14-16]. In the present investigation all drinking water contains acceptable value of TDS and they were ranged from 65mg/L to 200mg/L in both series of water quality analysis (Figure 4). TDS contents of water samples were within permissible limits which will not cause any harmful effect to the consumers.

Total hardness (TH): TH of water mainly depends upon the amount of calcium and magnesium salts or both. The permissible limits of TH in potable water ranged within 500 mg/L. In the present study the obtained TH ranged between 75 mg/L to 180 mg/L in both series of water quality analysis (Figure 5). The water quality analysis showed that all most all drinking water samples were within permissible limit in TH and indicating drinking water supplied by VVWW in the Mysore city has less and acceptable range of TD.

Calcium and magnesium: Calcium and magnesium content in drinking water should be within permissible limit. The permissible limit of calcium and magnesium content in drinking water is 75 mg/L and 30 mg/L respectively [14-16]. According to the results obtained in the present study calcium (28 to 56.0 mg/L) and magnesium content were within permissible limit (Figure 6). Calcium content was high in comprison to magnesium contents in all drinking water samples. Few water samples, which were collected from the areas **F**, **G**, **M**, **N** and **B**, **E**, **H**, **I**, **M** showed slightly high amount of magnesium contents (Figure 7).

Chloride: Chloride imparts salty taste to the water. The permissible limit of chloride in drinking water is 250 mg/L [14-16]. The results obtained from the present study show the chloride contents were ranged between 70 to 150 mg/L. The high amount of chloride was found in water sample collected from the area **N** during first series of water quality analysis.

All most all drinking water samples supplied by VVWW were showed within permissible limit amount of chloride contents (Figure 8).

Nitrite and Nitrate: The maximum permissible limit of nitrite and nitrate in drinking water is 0.9 mg/L and 10 to 45 mg/L respectively [14-16]. The nitrite contents in all drinking were ranged between 0.2 to 1.2 mg/L and it was nearest to permissible limit (Figure 9). The amount of nitrate in water indicates the biological contamination of water. According to the obtained results of the present study the occurrence of high amount of nitrate was found in drinking water supplied by VVWW in the Mysore city. Especially the water samples collected from few areas **I**, **G**, **H**, **J** and **K** showed high amount of nitrate contents than others areas of the city (Figure 10).

Sulphate: Sodium sulphate and magnesium sulfate exert a cathartic action in the human being and also sulfate is associated with respiratory illness. Therefore the recommended limit of sulphate content in the drinking water is 200 to 250 mg/L. The results obtained in the present study showed that sulphate content in all water samples were ranged between 50 to 120 mg/L and is within permissible limit (Figure 11).

Alkalinity: Alkalinity measures a water sample's ability to neutralize hydrogen ions (its acid-neutralizing ability). Alkalinity may be caused by dissolved strong bases such as sodium hydroxide or potassium hydroxide (and other hydroxide-containing compounds) and also it may be caused by dissolved carbonates, bicarbonates, borates, and phosphates. The measured alkalinity is the total of all of these species found in a water sample. For the sake of simplicity, it is expressed in terms of mg $CaCO_3$/L although many species other than dissolved calcium carbonate may actually contribute to the alkalinity [14-16]. In the present study all drinking water samples showed that the range of alkalinity was within the permissible limit in both first and second series of water quality analysis (Figure 12). In all areas the alkalinity of drinking water supplied by VVWW was very less and acceptable range for safe drinking purposes.

Zinc: The permissible limit of zinc contents in drinking water is 0.1 mg/L and it should not exceed its limit. High amount of zinc contents in drinking water cause harmful effects to the human body [14-16]. The results obtained from the present study indicate slight contamination of zinc in drinking water supply (Figure 13). Regarding zinc contamination except few areas **D**, **G** and **N**, remaining drinking water samples were within permissible limit in both series of water quality analysis. Also few water samples were showed free from zinc contents and showed safe for drinking purposes regarding to zinc contents in drinking water. Few drinking water samples, which were collected from the sample sites **D**, **G** and **N** showed high range contamination of Zinc due to direct mixing of local bore wells water, which are highly contaminated by sewage water. Few research works also reported regarding physico-chemical and bacteriological contamination of the underground water in few area of the Mysore city [17-21] and mixing of such contaminated water with drinking water leads to zinc contamination.

Fluoride: Fluoride is an important nutrient in drinking water for the development of normal bone and teeth, but it should be within permissible limit (0.5 to 1 mg/L) [14-16]. The excess fluoride in drinking water cause dental Flurosis, skeletal Flurosis and crippling Flurosis. The results obtained showed that the fluoride contents in drinking water were ranged between 0.2 to 2.5 mg/L (Figure. 14). The high amount of fluoride contents was found in water samples areas **A, F, G, H, L, N** and **O** during first series of water quality analysis and water samples areas **B, G** and **O** during second series of water quality analysis. The possible reasons and source for fluoride contamination may be the mixing of fluoride rich bore well water with Cauvery water in the overhead tanks.

Iron: Permissible limit of iron content in drinking water is 0.3 mg/L [14-16] and it present in different forms such as; in solution or complex with other minerals or organic substances. It is commonly found in water in the ferric form and cause harmful effects to the human body if it exceeds its permissible limit in drinking water. In the present investigation the iron content ranged between 0.1 – 1.2 mg/L (Figure 15). Few water samples collected from **L, N** (First series) and **F, G, I** (Second series) showed high amount of iron contents in drinking water. The possible source of iron contamination of drinking water in the Mysore city was mainly corroded metal pipes, which were used for drinking water supply and iron pipe linings of bore wells, which were all most corroded.

The water quality analysis of drinking water in the Mysore city showed that absence and within permission limits of other trace metals like copper, chromium, mercury, manganese and aluminium etc,

Bacteriological quantity

The acceptable limit of MPN/mL prescribed for drinking purposes by Indian standard limit should be less than 10 total numbers of coliform bacteria and zero for fecal coliform bacteria per 100 mL [14-16]. The microbial analytical results obtained are shown in Table 3. Only few water samples, which were collected from **C, D, F** and **J** showed satisfactory values with respect to total coliform bacteria in drinking water and other water samples were highly contaminated by total coliform bacteria in both the series of water quality analysis. Water samples collected from **H** and **L** showed high level contamination of total coliform bacteria (40 to 50/100 mL). Presence of fecal coliform bacteria in drinking water serves as a potential indicator of harmful bacteriological contamination. In the present study drinking water quality analysis indicated that out of 16 collected drinking water samples only 3 to 4 water samples were found free from fecal coliform bacteria. The water samples collected from **B, C, F, I, O** (First series) and **D, I, M, O** (Second series) were showed acceptable results of fecal coliform bacterial contamination in drinking water. Other

than above mentioned areas, all drinking water samples were highly contaminated by fecal coliform bacteria and they are bacteriologically not safe for drinking purposes.

In the present investigation results obtained indicate that all water samples were free from chemical and microbial contamination at their pumping stations (source) and within permissible limits (Table 1). But all drinking water samples collected at different areas of the city (except few areas) are highly contaminated by harmful bacteria and other pollutants. It clearly indicating that drinking water contamination is taking place during its transportation, storage and distribution level in the Mysore city.

The possible sources and reasons for the drinking water contamination in the Mysore city are listed below

- The water supply pipes are close located to sewage drains and septic tanks which lead to the drinking water contamination trough joints and cracks. The pipes used for drinking water supply and bore well liners are almost corroded and lost their strength to carry good quality water. Motors and pumps used in boreholes were also frequently increasing the iron concentrations in the water.
- Direct pumping and mixing of bore well water with Cauvery water in the overhead tanks is the major source of drinking water contamination in the Mysore city. All most 80% of bore wells water in some areas of the city has been chemically and biologically contaminated by sewage water, it has been proved by many research works carried out by local agencies and KPCB projects. Some bore wells are located nearest to the sewage drainage and direct entry of sewage water in to the bore well also leads to high level contamination of the underground water, which is mixed with Cauvery water.
- Direct exposing of large water storage tanks, open water supply pipe valves and stop wall fits to the ambient environment leads to microbial contamination of water by activities of birds, insects and some animals.
- Poor maintenance, lack of inspection and information, improper and unscientific storage and water distribution system in the Mysore city play important role in drinking water contamination.

Conclusion

Regarding to potability of drinking water supply of VVWW in the Mysore city with respect to analyzed parameters consideration we can conclude that; the water was physically and chemically satisfied except excess of iron, nitrate and nitrite content of over permissible limit in some areas (**I**, **G**, **H**, **J, K, F, G, I**). The drinking water in some areas has been highly contaminated by microorganisms and they were bacteriologically unsafe for drinking purposes. Generally water samples contain slightly high value of fluoride, iron, nitrate and EC contents in some areas of the city. Based on our qualitative study of drinking water in the Mysore city confirmed that drinking water supplied by VVWW has been completely polluted by harmful bacteria and it is unsafe for drinking purposes.

The results of this study would greatly facilitate the health and sanitary authorities to monitor and to control drinking water contamination in the Mysore city. It needs more detailed study on chemical contamination including sewage contamination. It needs the continuous disinfection of drinking water at the site of each overhead tank and storage tanks during water supply system. Periodic drinking water quality monitoring is necessary in drinking water supply and storage system. Old and corroded pipes are not able to carry good quality of drinking water to the public as an alternative technique for this problem is suggesting here for the usage of microbial growth resistant material coated metal or ceramic pipes for the safe drinking water supply system.

References

1. Prajapati J.R. and Rao B.V., Studies on the ground water quality of Kalol city, Gujarat, India, *J. Environ. Poll. Technol*., **6**(2), 197-201 (**2007**).
2. Harish Babu K., Puttaiah E.T., Vijaya K. and Thirumala S., Status of drinking water quality in Tarikere taluk with special reference to fluoride concentration, *J. Environ. Poll. Technol*., **5**(1), 71-78 (**2006**).
3. Kumar P.V. and King P., Assessment of ground water quality in Visakhapatnam area of Andra Pradesh, *J. Environ. Eng. Poll*., **8**(2), 327-330 (**2004**).
4. Fatima Rani S. A. and Beita Sherine H., A study on measure of pollution load of well waters in Tiruchy area, *J. Environ. Poll*., **27**(8), 721-723 (**2007**).
5. Pandey S., Water pollution and health, *Kathm. Univer. Medi. J*., **4**(13), 128-134 (**2006**).
6. Kumar A.R. and Riyazuddin P., Application of chemometric techniques in the assessment of groundwater pollution in a suburban area of Chennai city, India, Curr. Scie., 94(8), 1012-1022 (2008)
7. Aftab Begum S.Y., Noorjahan C.M. and Dawood Sharif S., Physico-chemical and fungal analysis of a fertilizer factory effluent, *J. Environ. Poll. Technol*., **4**(4), 529-530 (**2005**).
8. Chetna A., Pratima A. and Rina C., Bacteriological water quality status of river Yamuna in Delhi, *J. Environ. Biol*., 27, 97-101 (**2006**).
9. Dutta R.K., Saikia G., Das B., Bezbaruah., Das H.B. and Dube S.N., Fluoride contamination in groundwater of Central Assam, India, *Asi. J.Wat. Environ. Poll*., **3**(2), 93-100 (**2006**).
10. Jaiprakash N., Vijaya K. and Puttaiah E.T., Assessment of ground water quality of Magadi Taluk, Bangalore Rural District, *J. Environ. Poll*., **27**(8), 717-720 (**2000**).
11. Kaushik A., Water quality index and suitability assessment of urban ground water of Hisar and Panipat in Haryana, *J. Environ. Biol*., **23**(3), 325-333 (**2002**).
12. WHO., Guidelines for Drinking Water Quality, 2nd ed, Geneva, 1, 56 **(1996).**

13. WHO., World Health Report – Fighting Disease, Fostering Development, World Health Organization, Geneva, (**1996**).
14. APHA., AWWA., WEF (21st ed.), Standard methods for the examination of water and wastewater, American Public Health Association, Washington, DC (**2005**).
15. BIS., Indian standards for drinking water, Bureau of Indian Standards, New Delhi, IS: 10500, (**1991**).
16. KSPCBOA., Handbook of environmental laws and guidelines, Bangalore, India (**2000**).
17. Prasanna Raj P., Sadashivamurthy B.M. and Vijay Kumar G.S., Study of water distribution system during investigation of typhoid epidemic in Mysore city, *International Conference on Water and Health*, Mysore, India, 86-89 (**2005**).
18. Ramalingam A., A successful investigation with epidemic of gastro-enteric diseases in Bogadi, Mysore city, *International Conference on Water and Health*, Mysore, India, 124-126 (**2005**).
19. Raju N.S. and Sriragava T.J., Physico chemical and biological quality of drinking water in Mysore city, *International Conference on Water and Health*, Mysore, India, 183-184 (**2005**).
20. Vijay Kumar G.S., Keerthi A.M., Fathima S.N., Swomya G.S., Rao R. and Kiran T.S., Bacteriological analysis of drinking water samples at Mysore, *International Conference on Water and Health*, Mysore, India, 129-130 (**2005**).
21. Srikantaswamy S., Byrappa K. and Dayananda A.S., Environmental impact assessment study of ground water status in parts of industrial areas of Mysore city, *International Conference on Water and Health*, Mysore, India, 157-158 (**2005**).

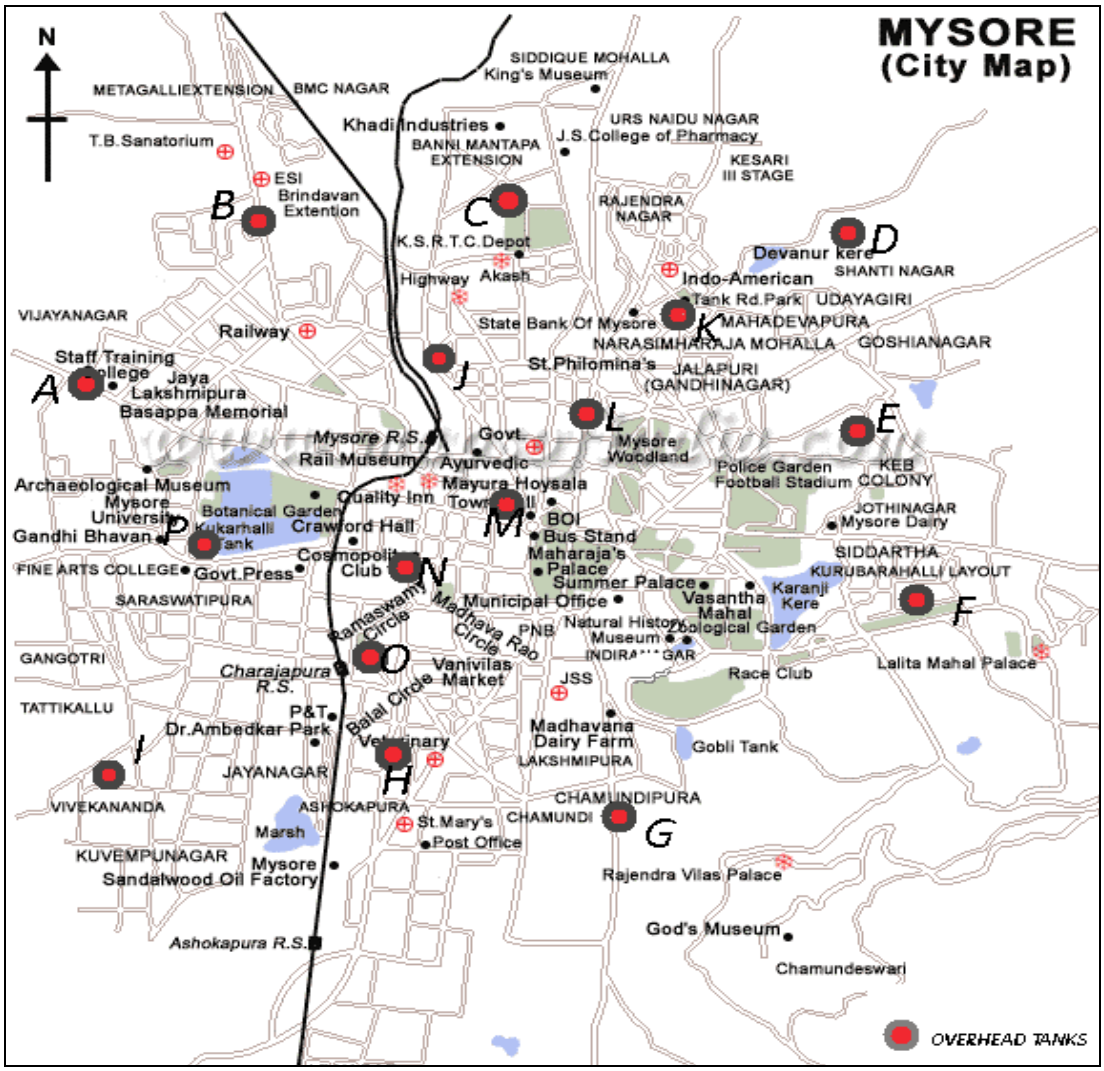

Figure1: Samples site's locations in the Mysore city (*A-Jayalakshmipurum; B-Kumbarakoppalu, C-Shivaratreeshwaranagara, D-Shanthinagar, E-Siddarthalayout, F-Siddartha Layout, G-Vishweshwaranagara, H-Ashokpuram, I-Kuvempunagar, J-Tilaknagar, K-N.R Mohalla, L-Veeranagere, M-Kumbarageri, N-Sunnadhakeri, O-Vidhyranyapurum, P-Saraswatipurum*)

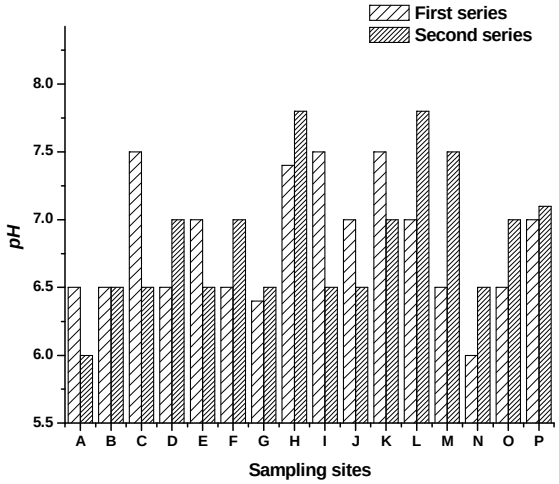

Figure 2: The *pH* of the water samples in Mysore city

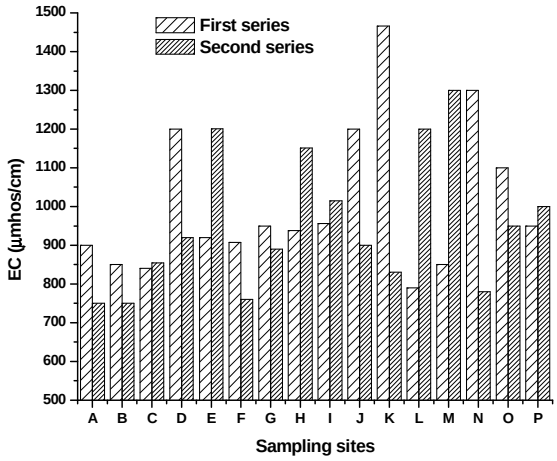

Figure 3: Conductivity of the water samples in Mysore city

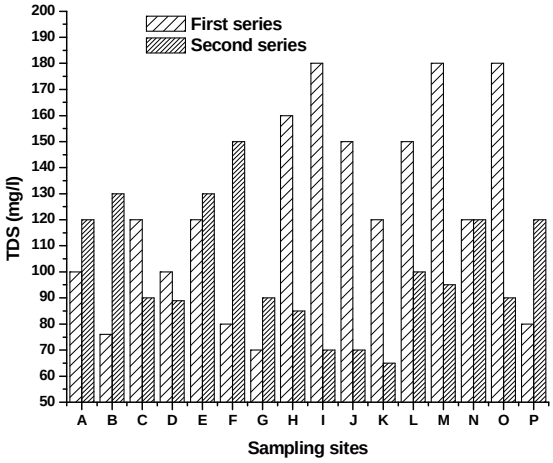

Figure 4: Total dissolved solids of the water samples in Mysore city

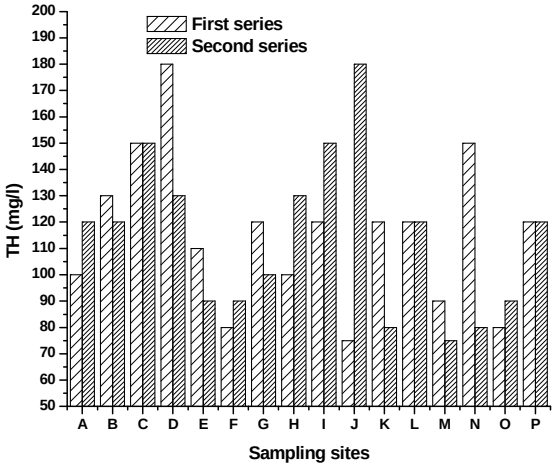

Figure 5: Total hardness in the water samples in Mysore city

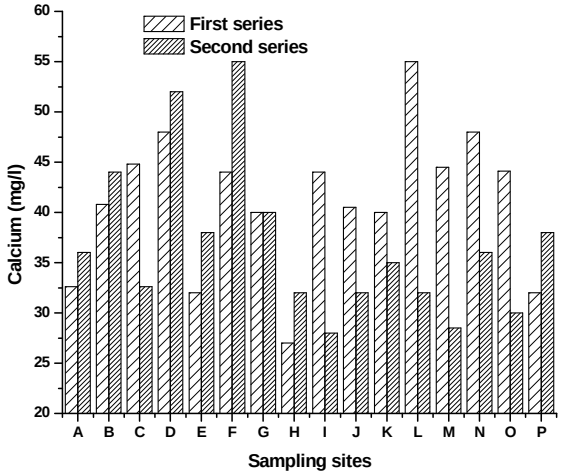

Figure 6: Calcium contents in the water samples in Mysore city

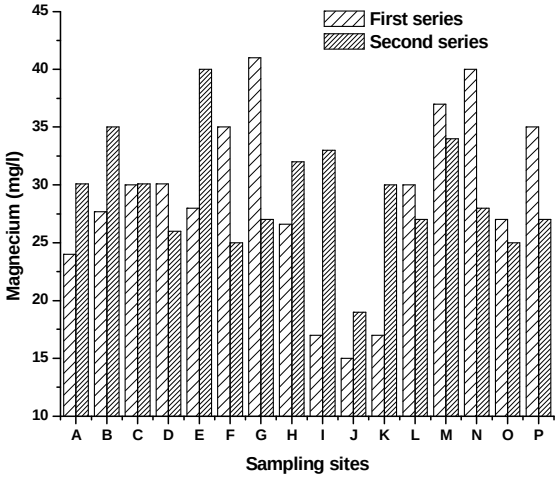

Figure 7: Magnecium contents in the water samples in Mysore city

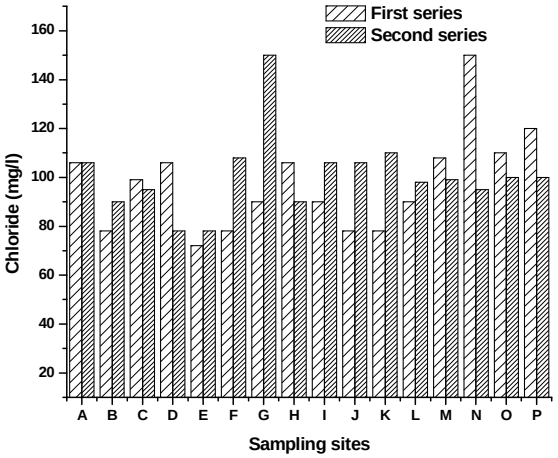

Figure 8: Chloride contents in the water samples in Mysore city

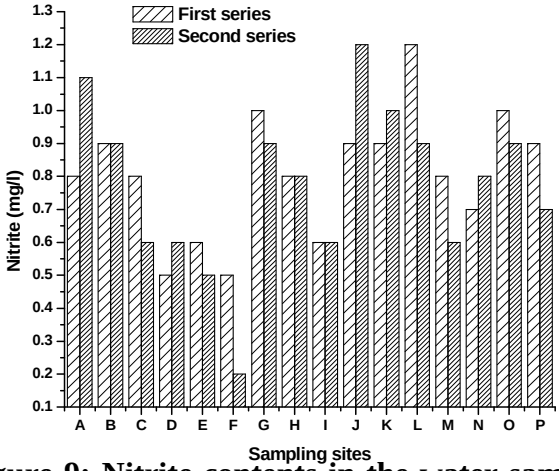

Figure 9: Nitrite contents in the water samples in Mysore city

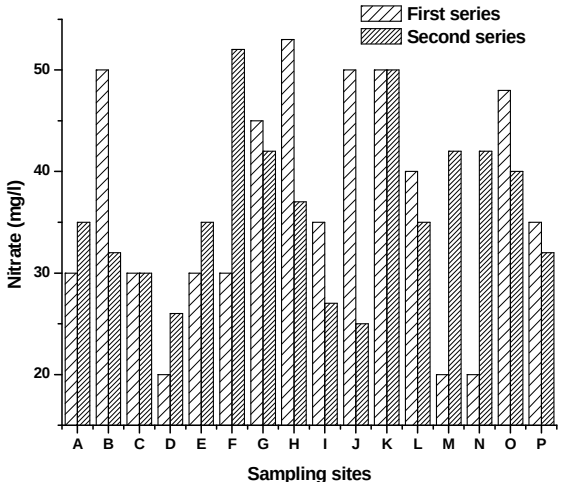

Figure 10: Nitrate contents in the water samples in Mysore city

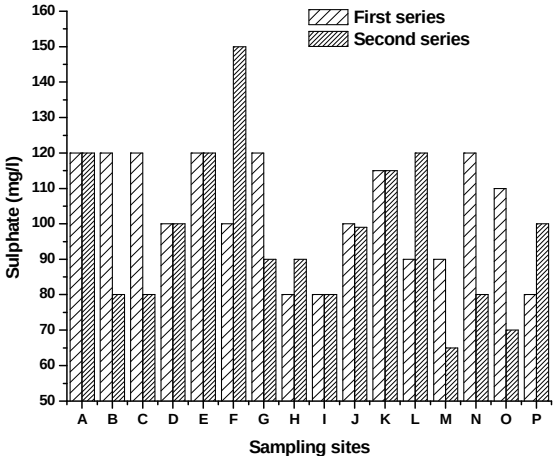

Figure 11: Sulfate contents in the water samples in Mysore city

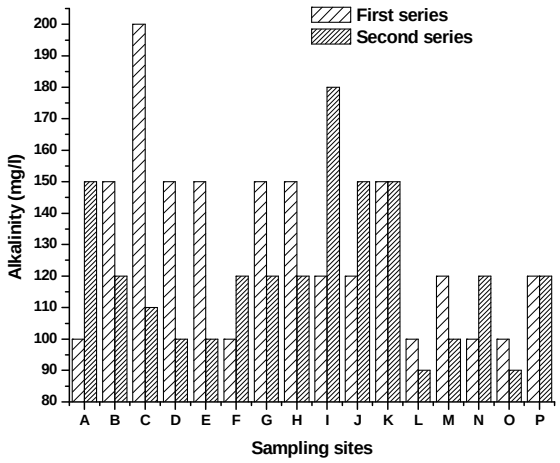

Figure 12: Alkalinity of the water samples in Mysore city

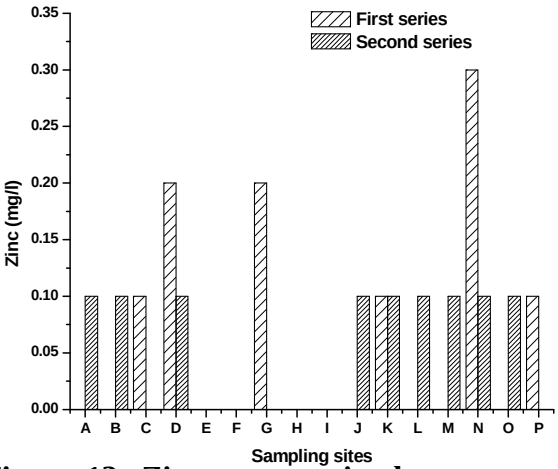

Figure 13: Zinc contents in the water samples in Mysore city

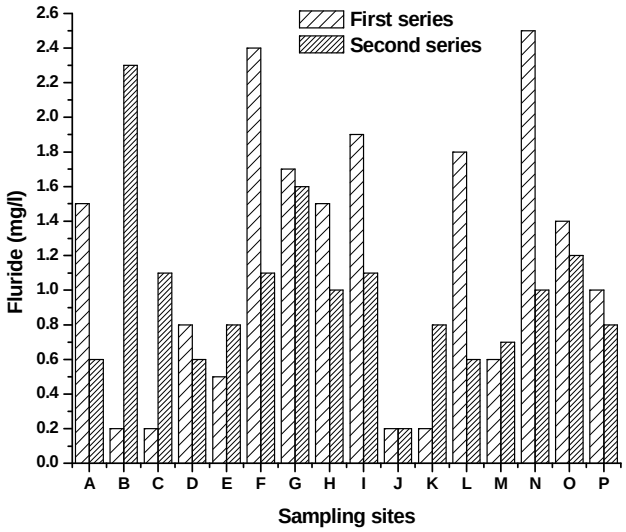

Figure 14: Fluoride contents in the water samples in Mysore city

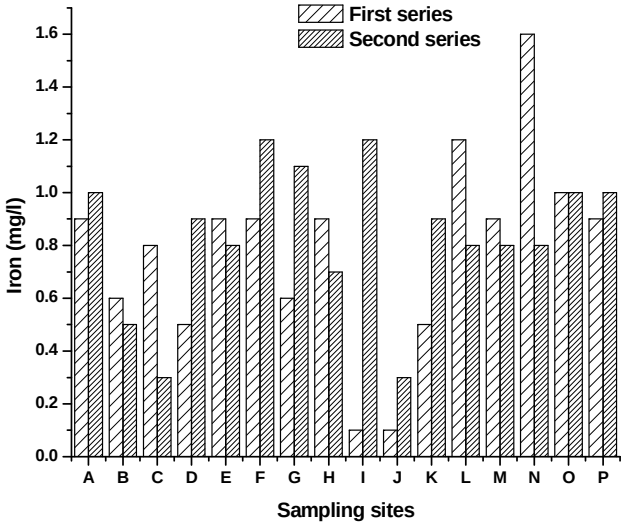

Figure 15: Iron contents in the water samples in Mysore city

Table 1: Details of analytical methodology and drinking water quality standards

S. No.	Parameters	Symbols	Methods	Units	*Desirable limits
01	Temperature	T	-	^{O}C	-
02	Color	Color	-	Hazan unit	5
03	Odour	Odour	-	-	-
04	Electrical Conductivity	EC	Electrolytic	µmhos/cm	-
05	*pH*	*pH*	Potentiometry	*pH*	6.5-8.5
06	Total dissolved solids	TDS	Gravimetry	mg/l	500
07	Total hardness	TH	EDTA titrimetric	mg/l	300
08	Calcium	Ca	EDTA titrimetric	mg/l	75
09	Magnesium	Mg	by difference	mg/l	30
10	Chloride	Cl	Argentometry	mg/l	250
11	Nitrite	NO_2	Spectrophotometry	mg/l	0.9
12	Nitrates	NO_3	Spectrophotometry	mg/l	45
13	Sulfate	SO_4	Nephloturbidimetry	mg/l	200
14	Alkalinity	alkalinity	Titrimetry	mg/l	200
15	Manganese	Mn	ET–AAS	mg/l	0.1
16	Zinc	Zn	ET–AAS	mg/l	5
17	Aluminium	Al	ET–AAS	mg/l	0.03
18	Fluoride	F	ET–AAS	mg/l	1.9
19	Iron	Fe	ET–AAS	mg/l	0.3
20	Copper	Cu	ET–AAS	mg/l	0.05
21	Chromium	Cr	ET–AAS	mg/l	0.05
22	Mercury	Hg	ET–AAS	mg/l	0.001
23	Total Coliform bacteria		MPN	count/100 ml	>10
24	Fecal Coliform bacteria		MPN	count/100 ml	Zero

Table 2 (a): Physico-chemical parameters of drinking water samples in first series of water quality analysis

Parameters in mg/L	Water samples collected at different areas of Mysore city during First series														
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**O**	**P**
Temper	20	19	18	19	19	20	19	19	19	18	18	20	19	21	18
Colour	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
Odour	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
pH	6.5	6.5	7.5	6.5	7	6.5	6.4	7.4	7.5	7	7.5	7	6.5	6	6.5
EC	900	850	840	1200	920	908	950	938	956	1200	1466	790	850	1300	1100
TDS	100	76	120	100	120	80	70	160	180	150	120	150	180	120	180
TH	100	130	150	180	110	80	120	100	120	75	120	120	90	150	80
Ca	32	40	44	48	32	44	40	27	44	40	40	55	44	48	44
Mg	24	27	30	30	28	35	41	26	17	15	17	30	37	40	27
Cl	106	78	99	106	72	78	90	106	90	78	78	90	108	150	110
Nitrite	0.8	0.9	0.8	0.5	0.6	0.5	1	0.8	0.6	0.9	0.9	1.2	0.8	0.7	1
NO_3	30	50	30	20	30	30	45	53	35	50	50	40	20	20	48
SO_4	120	120	120	100	120	100	120	80	80	100	115	90	90	120	110
Alkalinity	100	150	200	150	150	100	150	150	120	120	150	100	120	100	100
Mn	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
Zn	NF	NF	0.1	0.2	NF	NF	0.2	NF	NF	NF	0.1	NF	NF	0.3	NF
Al	NF	0.2	NF	0.1	NF	NF	NF	NF	NF	NF	0.1	NF	NF	NF	NF
Fl	1.5	0.2	0.2	0.8	0.5	2.4	1.7	1.5	1.9	0.2	0.2	1.8	0.6	2.5	1.4
Fe	0.9	0.6	0.8	0.5	0.9	0.9	0.6	0.9	0.1	0.1	0.5	1.2	0.9	1.6	1
Cu	NF	NF	0.1	0.2	NF	NF	0.2	NF	NF	NF	0.1	NF	NF	0.3	NF
Cr	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
Hg	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

NF-not found

Table 2 (b): Physico-chemical parameters of drinking water samples in first series of water quality analysis

Parameters in mg/L	Water samples collected at different areas of Mysore city during Second series														
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**O**	**P**
Temper	21	18	21	20	17	22	18	21	22	19	19	20	19	17	21
Colour	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
Odour	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
pH	6	6.5	6.5	7	6.5	7	6.5	7.8	6.5	6.5	7	7.8	7.5	6.5	7
EC	750	750	855	920	1201	760	890	1151	1015	900	830	1200	1300	780	950
TDS	120	130	90	89	130	150	90	85	70	70	65	100	95	120	90
TH	120	120	150	130	90	90	100	130	150	180	80	120	75	80	90
Ca	36	44	32.6	52	38	55	40	32	28	32	35	32	28.5	36	30
Mg	30.1	35	30.1	26	40	25	27	32	33	19	30	27	34	28	25
Cl	106	90	95	78	78	108	150	90	106	106	110	98	99	95	100
Nitrite	1.1	0.9	0.6	0.6	0.5	0.2	0.9	0.8	0.6	1.2	1	0.9	0.6	0.8	0.9
NO_3	35	32	30	26	35	52	42	37	27	25	50	35	42	42	40
SO_4	120	80	80	100	120	150	90	90	80	99	115	120	65	80	70
Alkalinity	150	120	110	100	100	120	120	120	180	150	150	90	100	120	90
Mn	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
Zn	0.1	0.1	NF	0.1	NF	NF	NF	NF	NF	0.1	0.1	0.1	0.1	0.1	0.1
Al	NF	NF	NF	0.1	0.1	NF	NF	NF	NF	NF	NF	NF	0.2	0.1	NF
Fl	0.6	2.3	1.1	0.6	0.8	1.1	1.6	1	1.1	0.2	0.8	0.6	0.7	1	1.2
Fe	1	0.5	0.3	0.9	0.8	1.2	1.1	0.7	1.2	0.3	0.9	0.8	0.8	0.8	1
Cu	0.1	0.1	0.1	NF	0.1	NF	NF	NF	NF	NF	0.1	0.1	0.1	0.1	0.1
Cr	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
Hg	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

NF-not found

Table 3: **Bacteriological analysis of drinking water samples in the Mysore city**

Water samples collected at different areas of Mysore city	MPN test during first series		MPN test during second series	
	Total coliform bacteria/100ml	Fecal coliform bacteria/100ml	Total coliform bacteria/100ml	Fecal coliform bacteria/100ml
A	39	5	24	2
B	45	0	24	2
C	9.4	0	9.3	1
D	7.4	2	9	0
E	25	1	28	4
F	8	0	11	3
G	31	4	36	6
H	51	15	41	13
I	13	0	23	0
J	9	1	8	2
K	32	4	32	3
L	40	6	32	4
M	20	2	37	0
N	25	1	41	1
O	30	0	20	0
P	12	4	20	5