Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 08, pp.19368-19372, August, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

PHYSICOCHEMICAL AND MICROBIOLOGICAL ANALYSIS OF MUNICIPALITY DRINKING WATER

[1]Sailaja, V., [2]Umamaheswari, P., [*,3]Dileep Kumar Kanderi, [3]Praveen Kumar Reddy, G., and [4]Girinath Rajoji

[1]Department of Botany, VSU P.G Centre, Kavali, A.P., India
[2]Department of Zoology, VSU P.G Centre, Kavali, A.P., India
[3]Department of Microbiology, Sri Krishnadevaraya University, Anantapuramu, A.P., India
[4]Department of Biotechnology, Sri Srinivasa Degree College, Madanapalle, A.P., India

ARTICLE INFO

Article History:
Received 05th May, 2015
Received in revised form
05th June, 2015
Accepted 29th July, 2015
Published online 31st August, 2015

Key words:
Drinking water,
Kavali,
Microbial pollution,
Physcio-chemical parameters.

ABSTRACT

A study was conducted to evaluate the quality of drinking water samples from the four different drinking water sources namely open wells, Bore wells, can water and tap water from 37 wards of Kavali Municipality, SPSR Nellore district, A.P. The microbiological parameters such as total viable count of bacteria, total conidial spores were carried out. The physico chemical parameters are using standard method. It was found that the open well water was contaminated in almost all the wards of the municipality. The microbiological contamination of drinking water is in this order. Open well water > Municipal tap water > Bore water > Can water. The results shows that the total viable count of the Open well water is highest (95×10^4 bacteria / mL) and lowest in can water. The total conidial spores are also high in open well waters (10.75×10^4 spores / cm). Total plate and coliform count revealed that 82.6 % and 92.4 % of drinking water samples found to cross the WHO guideline value for drinking water. Total viable count was by pour plate technique while Most Probable Number (MPN) counts were by the multiple tube fermentation technique. The pH (at 25°C) ranged from 6.1 to 8.33 for the untreated raw water samples while temperature ranged from 28 to 30°C while the turbidity of the water and waste water samples ranges from 0.08 to 1.00. The total viable counts for all the water samples were generally high exceeding the limit of 1.0×10^2 cfu/mL for water. The MPN count ranges from 9.3 to 44 MPN/100 mL. The fecal coliform counts on EMB agar plate ranged between 5 and 48 cells, also exceeding the standard limit for water. The Isolated organisms were identified to be organisms namely *Escheichia coli, Pseudomonas aerugixnosa and* Proteus *vulgaris* species.

Copyright © 2015 Sailaja et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

***Citation*:** Sailaja, V., Umamaheswari, P., Kanderi Dileep Kumar, G., Praveen Kumar Reddy and Girinath Rajoji, 2015 " Physicochemical and Microbiological analysis of Municipality Drinking Water", *International Journal of Current Research*, 7, (8), 19368-19372.

INTRODUCTION

Water of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability (Lamikanra, 1999). The provision of portable water to the public by the municipality is necessary to prevent health hazards (Nikoladze and Akastal, 1989). A good knowledge of microbial and chemical qualities of raw water is necessary so as to guide its suitability for use. Thus, regular physico-chemical analysis of water at source must be carried out to determine or check the effectiveness of treatment process. This work is therefore, in an attempt to examine the different sources of drinking water in Kavali Municipality and compared with standard table water for conformity to microbiological and physico-chemical standards for drinking water samples as well as examines the different domestic and industrial effluents.

Corresponding author: Kanderi Dileep Kumar,
Department of Microbiology, Sri Krishnadevaraya University, Anantapuramu, A.P., India.

MATERIALS AND METHODS

Drinking water samples from different sources such as open wells, bore wells, can water and tap water from 37 wards of Kavali Municipality, SPSR Nellore district were collected and transported by standard methods as mentioned in APHA, 1998. Random sampling was adopted for the study. Microbiological analysis of water samples was conducted in the Department of Biotechnology, Jawahar Bharati Degree and P.G. College, Kavali, SPSR Nellore district, A.P.

Microbiological Analysis

Microbiological quality of water was determined using Most Probable Number (MPN) methods (IOSWQ 2000).

The test was performed within 24 h of sample collection. The MPN method was used to determine the presence of gas producing lactose fermenters and most probable number of coliform present in 100 ml of water. The standard MPN method (nine multiple tube dilution technique) was used for detection of total coliform by inoculation of samples into tubes of lactose broth (LB) and incubation at 37°C for 48 h. The positive tubes were sub-cultured into Brilliant Green Lactose Broth (BGLB) and were incubated at 44.2°C for 48 h and checked for total count.

Physico-chemical Analysis

The physico chemical parameters such as p^H, electrical conductivity (EC), total dissolved solids (TDS), turbidity, dissolved oxygen (DO), Chemical Oxygen Demand (COD), total alkalinity (TA), total hardness (TH), calcium (Ca^{2+}) magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), chloride (Cl^-), nitrate (NO^{3-}), sulphate (SO_4^{2-}), phosphate (PO_4^{3-}) using standard methods (APHA. 1989, Trivedi and Goel 1986**,** Manivaskam 2005).

RESULTS AND DISCUSSION

The main objective of this study was evaluation of quality of water from different sources in Kavali Municipality. The microbiological analysis of the water from different sources is presented in Tables 1- 4. The data on Total viable count (TVC) present in various drinking water sources of Kavali Municipality are presented in Table -1. The data shows that the well water has the highest microbial load after 24 and 48 h of incubation having a value of 18×10^5 cfu/mL, which was higher than the recommended value. The TVCs for all the water samples were generally high, exceeding the limit of 1.0×10^2 cfu/mL for water (Table 1).

The most probable number (MPN) for the presumptive total coliform count of the water samples ranges from 2 to 140 MPN/100 mL (Table 3). The data shows that water from 11 and 26th ward had the highest total coliform counts of 140 MPN/100 mL followed by the 27th ward having 75 MPN/100 mL. The data on the biochemical identification of bacteria is presented in Table-4. The isolated organisms were identified to *Escheichia coli, Pseudomonas aerugixnosa and* Proteus *vulgaris* species. The physicochemical parameters of different water sample are represented in the Table 5.

p^H

p^H is a term used universally to express the intensity of the acid or alkaline condition of a solution. Most of the waters are slightly alkaline due to presence of carbonates and bicarbonates. The pH values of water samples varied between 6.3 to 8.1 and only minor fluctuation in pH was recorded and was found within the limit prescribed by WHO. The p^H levels were within the limits set for domestic use as prescribed by APHA 1985.

TDS

TDS values varied from 327mg/L to 1270 mg/L. The bore water showed higher TDS values than the prescribed limit given by ISI 10500-91. However in can water it is less (327 mg/L) is about to reach the maximum permissible while TDS value for Tap water is also high (874 mg/L) which is beyond the prescribed limit. Total dissolved solids indicate the salinity behavior of groundwater. Water containing more than 500 mg/L of TDS is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg/L is also allowed (Aulicino and Pastoni, 2004). The TDS concentration is considered a secondary drinking water standard, which means that it is not a health hazard.

Table 1. Total viable count of bacteria in various drinking water sources of Kavali Municipality

S.No	Source of water	Dilution (d)	Volume (v)	Number of colonies (n)	Average no of colonies	Total viable count (bacteria/ml) Vc=n/dv
1	Bore water	10^{-4}	1 mL	95	47.5	95×10^4
2	Can Water	10^{-4}	1 mL	25	12.5	25×10^4
3	Tap Water	10^{-4}	1 mL	120	60	12×10^5
4	Well Water	10^{-4}	1 mL	180	90	18×10^5

Table 2. Total Conidial spores present in various drinking water sources of Kavali Municipality

S.No	Source of water	Total Conidial spores present (spores/cm)
1	Bore water	3.5×10^4
2	Can Water	2.5×10^4
3	Tap Water	8.25×10^4
4	Well Water	10.75×10^4

Illegal dumping of domestic wastes, livestock management, fecal deposit and waste dumps are the probable reasons for such high bacterial concentration in well waters. The data on total conidial spores in various drinking water sources of Kavali Municipality is presented in Table 2. The microbiological contamination of conidial spores of drinking water is in this order. Open well water > Municipal tap water > Bore water > Can water. The data on most probable number (MPN) index of the different water samples of different wards of Kavali Municipality are presented in Table 3.

Electrical Conductivity (EC)

Electrical conductivity is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts (Rao and Venkateswaralu, 2000). The range for EC values was 380 mho/cm to 2440 mho/cm. High EC values were observed for bore and open well waters indicating the presence of high amount of dissolved inorganic substances in ionized form.

Table 3. Most probable number (MPN) index of the different water samples of different wards of Kavali Municipality

Ward Number	Source	Number of Durham tubes positive for gas production with			
		10 mL inoculums	1 mL inoculums	0.1 mL inoculums	MPN Index/ 100mL
1	Bore Water	4	2	1	25
2	Well Water	1	1	0	4
3	Well Water	3	2	1	16
4	Bore Water	1	2	0	5
5	Well Water	4	1	1	20
6	Bore Water	3	2	1	16
7	Bore Water	2	3	0	11
8	Bore Water	2	1	0	5
9	Tap Water	4	1	0	16
10	Tap Water	3	1	1	13
11	Tap Water	5	3	2	140
12	Well Water	5	1	0	31
13	Tap Water	3	3	0	16
14	Bore Water	2	0	1	5
15	Well Water	4	1	1	20
16	Tap Water	2	1	0	5
17	Well Water	4	1	0	16
18	Tap Water	1	2	0	5
19	Tap Water	4	3	1	31
20	Bore Water	2	2	0	7
21	Bore Water	2	1	1	7
22	Bore Water	4	1	0	16
23	Well Water	3	3	0	16
24	Bore Water	3	0	1	19
25	Well Water	4	3	1	31
26	Bore Water	5	3	2	140
27	Well Water	5	3	0	75
28	Well Water	0	1	0	2
29	Well Water	4	1	1	20
30	Bore Water	4	3	1	31
31	Well Water	2	2	0	7
32	Well Water	1	1	0	16
33	Tap Water	3	0	0	7
34	Bore Water	2	1	0	5
35	Tap Water	1	0	0	2
36	Well Water	3	2	0	13
37	Tap Water	2	1	0	7

Table 4. Results of the biochemical tests for confirmation of coliform from the different water samples of Kavali Municipality

Sl. No.	Name of the Test	Positive/ Negative	Organism
1	Starch hydrolysis	-	*E.Coli*
2	H_2S production test	+	Proteus Vulgaris
3 a)	MR test	+	*E.Coli*
b)	VP test	-	*E.Coli*
4	Citrate utilization test	-	*E.Coli*
5	Urease test	-	Pseudomonas
6	Indole production test	+	*E.Coli*
7	Fermentation of carbohydrates	+	*E.Coli*

Table 5. The physicochemical parameters of the different sources water from Kavali Municipality

S.No.	Parameter	Bore well	Can water	Tap water	Open well Water
1	Temperature	32ºC	33ºC	34ºC	33ºC
2	p^H	6.2	7.7	6.9	8.1
3	TDS	1270	327	874	524
4	EC (mch/cm)	2440	380	1321	1870
5	Turbidity NTU	0.2	0.1	0.1	0.2
6	DO mg/L	1.1	1.0	2.5	1.8
7	COD mg/L	12	8.5	13.4	18.6
8	Total alkalinity mg/L	320	150	180	240
9	Calcium (Ca^{2+}) mg/L	180	100	140	175
10	Magnesium (Mg^{2+}) mg/L	58	40	46	60
11	Total hardness (TH)	195	76	125	225
12	Sodium(Na^{+}) mg/L	78	43	67	68
13	Potassium mg/L	0.540	0.348	0.432	0.675
14	Chloride mg/L	57	23	45	87
15	Nitrates mg/L	1.231	0.453	1.876	2.45
16	Sulphates($SO4^{2-}$) mg/L	78.44	12.55	67.35	109.66
17	Phosphate ($PO4^{3-}$) mg/L	0.234	0.145	0.355	0.456

Turbidity

The turbidity values ranged from 0.1 to 0.2 NYU for various samples and all are within the admissible limits. In most waters, turbidity is due to colloidal and extremely fine dispersions.

Dissolved oxygen (DO)

Dissolved oxygen is important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. The DO values indicate the degree of pollution in water bodies. DO values varied from 1 to 2.5 mg/L.

Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water making COD a useful measure of water quality. It is expressed in milligrams per liter (mg/L), which indicates the mass of oxygen consumed per liter of solution. The maximum allowed value of chemical oxygen demand (COD) is 10 mg/L in drinking water. The present samples have registered a range of 8.5 to 18.6 mg/L. These values are little higher than that expected for a good quality potable water. However, the higher values of COD were observed only open well and tap waters. The most probable reason for this slightly higher value of COD may be due to leakage of water supply line and sewage discharge.

Total Alkalinity

Total alkalinity of water is due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium and it is capacity to neutralize a strong acid. The prescribed value for total alkalinity by WHO is 120 mg/L. Total alkalinity values for all the investigated samples were found to be greater than the value prescribed by WHO.

Calcium and magnesium (Ca^{2+}, Mg^{2+})

Calcium and Magnesium are directly related to hardness. Calcium concentration ranged between 120 mg/L to 180 mg/L and found beyond permissible limit, except can water supply sample which was exactly equal to the prescribed limit by WHO (100 mg/L). Magnesium content in the investigated water samples ranging from 40 mg/L to 60 mg/L which were found within WHO limit.

Total hardness (TH)

Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The hardness values showed range from 176 mg/L to 225 mg/L which are within the prescribed limit by WHO.

Sodium (Na^{+})

Sodium concentrations were found in between 43mg/L to 78 mg/L.

Potassium (K^{+})

The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of waste water. Potassium content in the water samples varied from 0.234 mg/L to 3.675 mg/L.

Chloride (Cl^{-})

The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects[23]. In the present analysis, chloride concentration was found in the range of 23 mg/L to 87mg/L. The values are within the limit.

Nitrate (NO_3^{-})

Groundwater can be contaminated by sewage and other wastes rich in nitrates. Groundwater contains nitrate due to leaching of nitrate with the percolating water. The nitrate content in the study area varied in the range 0.453 mg/L to 2.5 mg/L and found within the prescribed limit.

Sulphate ($SO4^{2-}$)

Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals (Manivasakam, 2005). Discharge of industrial wastes and domestic sewage tends to increase its concentration. The sulphate concentration varied between 12.55 mg/L and 109.76 mg/L. and found within the prescribed limit.

Phosphate ($PO4^{3-}$)

Phosphate may occur in groundwater as a result of domestic sewage, detergents, agricultural effluents with fertilizers and industrial waste water. The phosphate content in the study area was found in the range of 0.155 mg/L to 0.473 mg/L.

Conclusion

Water meant for human consumption should be safe and acceptable and must be free from all pathogenic organisms. According to guidelines for drinking water quality, the results of the present study indicated that all the borehole water sources tested were of poor microbiological quality. The physico-chemical properties of the freshly collected water samples are particularly the tap and bore well samples did not comply with the standard limits for drinking water and waste discharges. The present study indicated very high level of contamination of open well water. Deviations were observed by groundwater samples from municipal water and water quality standards indicating groundwater pollution. Municipal water contained fecal coliform mainly due to leakage of pipe line.

Acknowledgement

The authors gratefully acknowledge UGC for the financial support in the form of UGC Major Research project, which made this research study possible.

REFERENCES

APHA, 1985. Standard methods for examination of waters and waste waters, 16th Ed., APHA, AWWA and WPCF Inc. Newyork.

APHA, 1989. Standard Methods for the examination of water and waste water, American Public Health Association, 17th Ed., Washington, DC.

Aulicino, F.A. and Pastoni, F. 2004. Microorganisms surviving in drinking water systems and related problems, Annali d'igiene 16: 265–272.

IOSWQ, 2000. International Organization for Standardization Water quality. Detection and enumeration of Escherichia coli and coliform bacteria. Part 1. Membrane filtration method (ISO 9308-1:2000), Geneva: International Organization for Standardization.

Lamikanra, A. 1999. Essential Microbiology for students and practitioner of Pharmacy, Medicine and microbiology. 2nd ed. Amkra books, Lagos, p. 406.

Manivaskam, N. 2005. Physicochemical examination of water sewage and industrial effluent, 5th Ed, Pragati Prakashan Meerut.

Nikoladze, G.D.M. and Akastal, S. 1989. Water treatment for Public and Industrial Supply MIR Publisher Moscoul, p. 163

Shrinivasa Rao, B. and Venkateswarlu, P. 2000. *Indian Journal of Environment Protection*, 20(3), pp 161-164.

Trivedy, R.K. and Goel, P.K. 1986. Chemical and Biological methods for water pollution studies, Environmental Publication, Karad.

****