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Bacterial Assessment in the Ground Water Samples of Kalaburagi Town, Karnataka, India

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Abstract: The present investigation was aimed to study the bacteriological characteristics of drinking water sources (borewells) of Kalaburagi town and 5 selected villages in Kalaburagi district for period of two years. Investigations on the microbial quality of drinking water sources of 25 sampling stations in Kalaburagi City and 5 selected villages in Kalaburagi district have been carried out seasonally and compared with next season during the study period. MPN (Most Probable Number) is a parameter which indicates the presence of coli-form bacteria in the water samples. Presence of coli-form also indicates the possibility of other pathogenic microorganism in the water samples. In the present investigation, the MPN ranged between 15/100 ml to 110/100 ml. All the samples have the MPN values above the permissible limits. The total bacterial count ranged between 1.0 x 10^2 to 1.8 x 10^4. The high MPN and total bacterial count in the present condition due to unhygienic conditions prevailed near the borewells. Hence, Kalaburagi City is considered to be endemic to diseases like gastroenteritis and jaundice and this is more in on set of southwest monsoon season. This is an alarming situation from the public health point of view. Hence, there is a necessity to extend such studies to the borewells of individual houses and investigate in the detail on water and microbial quality of drinking water supplies of Kalaburagi City. Local authorities should take suitable measures to control problem related to water quality and from public health point.

Keywords: Borewell, Bacteriological characteristics, Drinking water, Kalaburagi, *E. coli*, Most Probable Number

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Introduction

Water is one of the most essential constituents of the human environment and its occurrence in chemically pure form is very rare. Atmospheric water is subjected to considerable changes in quality both upon reaching the earth's surface and subsequently under ground. Water on the surface i.e., surface water, originate either directly from surface runoff, underground springs, groundwater depletion, lakes or other water bodies. Water emerging from the underground initially resembles the ground water body, but it progressively changes its characteristics when mixes with water from other sources or is subjected to surface condition. The quality of water depends on a large number of individual hydrological, physical, chemical and biochemical factors. Water intended for human consumption must be free from organisms and chemical constituents that may be hazardous to human health. A number of chemical substances if present in certain concentration in drinking water may be a danger to health. Water plays important resources for all kinds of life on this planet. In historic and pre-historic times, man thrived mostly in those regions of the earth, which had sufficient water supply. It is seen that ancient civilizations developed in river valleys where water was plentiful and readily available for use.

In both urban and rural India, groundwater is the predominant source of drinking water. Additionally, it is a significant water source for the agricultural and industrial sectors. Because it is an essential component of the hydrological cycle, its availability is determined by the conditions of the recharge and rainfall. Over the years, there has been an increase in the demand for water, which has resulted in water scarcity in numerous regions of the world. The issue of water contamination or pollution exacerbates this predicament. As a result of poor water resource management and environmental degradation, millions of people in India do not have access to clean water. As a result, India is headed for a freshwater crisis.

Groundwater emergency is not the consequence of normal variables, it has been brought about by human activities. Due to an increase in extraction over the past two decades, the water level in several regions of the country has been rapidly falling. The number of wells drilled for the irrigation of food and cash crops has increased rapidly and randomly. Domestic water consumption has also increased as a result of India's changing lifestyle and rapidly expanding population. The groundwater table is falling as a result of intense competition among users, including the agricultural, industrial, and domestic sectors. The widespread pollution of surface water is having a significant impact on the quality of groundwater. Additionally, unscientific solid waste disposal leachate and untreated wastewater discharged through bores contaminate ground-water and lower the quality of freshwater resources.

The human body's most abundant chemical, water regulates nutrient transport, the removal of toxic waste, thermal regulation and digestion, organ function, and metabolic processes. However, if water is contaminated in any way, it can spread diseases to a large number of consumers (Nakade, 2013; Kumar *et al*., 2013). In 2000, the World Health Organization estimated that there were four billion cases of diarrhea and millions of other illnesses caused by not having access to clean water (WHO, 2000). It is well established that infectious diseases are primarily transmitted through contaminated water supplies containing human and animal excrement, particularly faeces (WHO, 1993). Outbreaks of water-borne diseases continue to occur throughout the world, but are particularly serious in developing nations. (Manja *et al*., 1982; Emde and Finch, 1991; Kumar *et al*., 2013). *Salmonella, Shigella, Escherichia coli, Vibrio cholerae, Yersinia entercolitica, Campylobacter* species, various viruses like Hepatitis A, Hepatitis E, Rota virus, and parasites like *Entamoeba histolytica* and *Giardia* species are among the human pathogens that pose a significant health risk whenever they are present in drinking water (Emde and Finch, 1991; Geldreich, 1992; Kumar *et al*., 2013). To protect health of the public and the environment, safe drinking water must be free of pathogenic bacteria.

This study is intended to monster the underground water quality of Kalaburagi City and some selected villages in Kalaburagi district which would be helpful in preparing the water supply

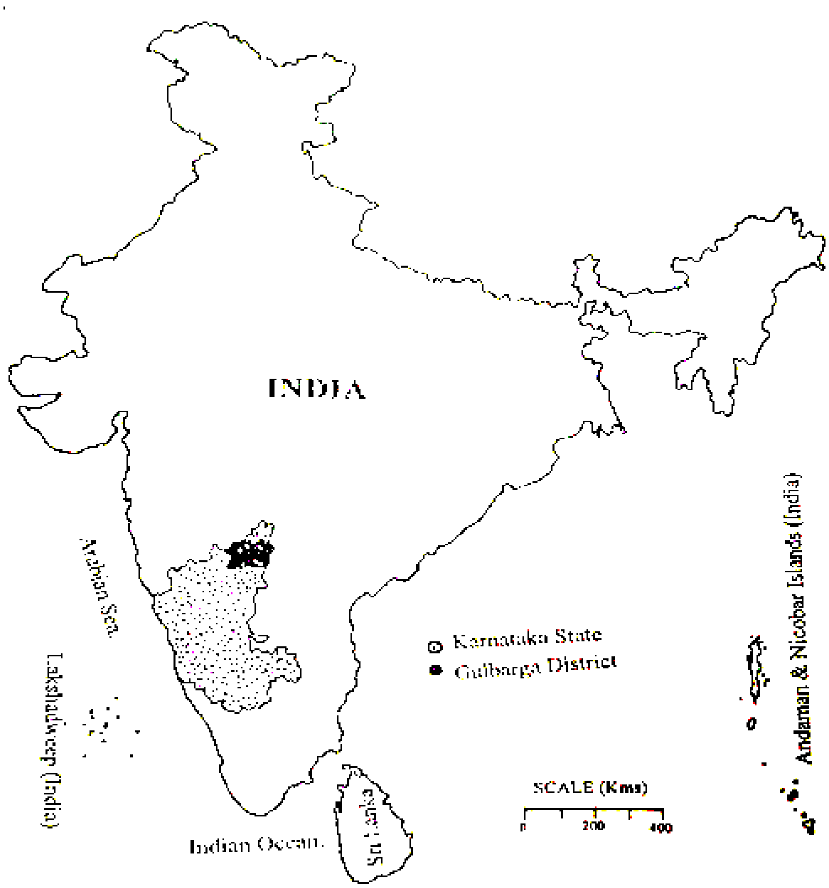


Fig. 1: Map of India showing Kalaburagi (Gulbarga) district in Karnataka state.

scheme of the rural Areas of the Karnataka and country as a whole.

Materials and Methods

Study area:

Kalaburagi district lies in the northern plains of Karnataka state, India (Fig. 1) and covers an Area of 16,244 sq.km. and lies between 16° -11′ and 17° -19′ N latitude and 76° -54' E longitude. The district is bounded by Bidar in the north, Mahaboobnagar and Medak district of Andhra Pradesh in the east, Raichur in the South and Bijapur in the West. The population of the district as per 2001 census is 31, 24, 858 and density of population is 192 persons/km^2. The decennial population growth rate is placed at 21%.

The northern parts of the district comprises Aland, Afzalpur, Chincholi, Chittapur and Kalaburagi taluks represent Deccan traps and is deeply intended with raviries. The southern part covering the rest of taluks exhibit a gently undulating terrain with sparsely distributed knolls and tors. The prominent hill ranges at Shorapur, Yadgiri and northern part of Chincholi. Taluk wise top an attitude ranged from 567 to 629 msl. The ground elevation varies significantly from 340 in the south-east- to 620 msl in the north. The district forms a part of the Krishna basin and is drained by Krishna and Bhima rivers. The Krishna river course in the south marks the district boundary with Raichur flows in a straight course in northeast southwest direction. The Bhima river flows across the central part of the district in the south-eastern direction and finally, meets the Krishna river at tri-Junction Kalaburagi and Raichur district of Karnataka and Mahaboonagar district of Andhra Pradesh. The northern part of district is drained by Kagina, Bennitora, Amarja and Mullamari rivers. All these rivers are perennial and effluent in nature. Drainage density varies from 0.8 to 2.1 km/km^2. The drainage pattern varies from dendrite to sub-parallel depending upon the geological structures.

The district lies in the northern plains of Karnataka state and enjoys a semi-arid climate. Maximum temperature shoots upto 45°C during April and May and during winter it touches as low as 12°C. The south-west monsoon sets in the district around middle of June and lasts till the end of September and contributes about 15% of annual rainfall. The normal rainfall in the district is 776 mm. The rainfall is erratic as indicated by high coefficient of variability (32.5%) and the average value of standard deviation is 254.2 mm. The rainy days range between 35 to 56 in the district.

Block cotton soil and Red soils are the two important soil types in the Area,. The block cotton soil spread in the northern part of the taluks especially in the Deccan trap region. The sandy soils occupy Shahpur, Shorpur and Yadagiri taluks.

Agriculture is the main occupation of the rural population. Rice, bajra, maize, wheat and pulses are the major crops. Sugarcane, sunflower, groundnut and cotton are the prominent commercial crops. The net Area, sown in the district is 11,83,016 hectares. The irrigated area, is 1,66,813 (2000-2001) hectares, which is about 15% of the net Area, sown of the total area, irrigated, 43,552 hectares of land Come under groundwater irrigation. Well irrigation is significant in Aland, Afzalpur, Kalaburagi and Yadgiri taluks. Canal irrigation in Shahpur, Shorapur and Jewargi taluks under the 11ppe - Krishna project covers nearly 1,38,623 hectares, which accounts 74% of the total area, under irrigation. The remaining 7% of the area, is being irrigated by minor or medium irrigation tanks. Lift irrigation schemes are existing all along the course of Bhima river.

The district is underlain by various geological formations right from the Archaean to the pleistocene in age. The southern part or the district is covered by Archaen groups of rocks mainly granites and gneisses. Sedimentaries of the Bhima series (limestone and shales) of the pre-cambrian age are extending northeast-southwest directions, occupy the central part of the district. Northern and northwestern parts of the district are underlain by the Deccan traps of upper cretaceous to Eocene age.

The entire district is occupied by hard rock aquifers. Ground water occurs in the weathered and fractured zones. It occurs in water table condition in weathered zone and in semi-confined conditions in the fractured and jointed formation. The depths range of dug wells and dug-cum-borewells are 7.5 to 22.5m and 20.0 to 35 m, respectively.

To study the limnology of drinking water resources, Kalaburagi University Campus and 25 sampling stations were selected in the Kalaburagi City area (Fig. 2) and 5 sampling stations in rural areas (Fig. 3). Kalaburagi University Campus is 6 km away from the Kalaburagi city and represented as number 1 in the Figure 2 and from number 2 to 26 represents the different sampling stations in the Kalaburagi City.

Groundwater samples were collected from 25 public borewells in the Kalaburagi City and 5 in the surrounding villages, ones in a month using thoroughly washed bottles (the Pyrex glass 250 ml reagent bottles were washed with laboclean liquid soap and two times with distilled water, and then kept in BOD incubator for drying). Before collection of samples, the bottles were rinsed thoroughly with sample water for getting accurate results. All collections were made between 9.00 AM to 3.00 PM throughout the period of the study.

Water samples collected in 250 ml reagent bottles and plastic bottles (in replicate) for the purpose of estimation of various parameters and brought to the laboratory and subjected to the analysis immediately to get accurate results. Bacteriological studies were done according to APHA (l998), NEERT, (1986) and Trivedi and Goel (1986).

Bacteriological examination:

200 ml clean, sterile, glass bottle fitted with screw caps protected from contamination by aluminium foil was taken for sample collection. When the sample was collected from borewells, it was operated to flush out stagnant water. To avoid the changes that may occur in a bacterial count, samples were kept in cool place between 4°C to 10°C and examined within 24 h.

To assertion whether the coliform bacilli detected in the presumptive test are *E-coli,* the Eijkman test is employed. This test depends upon the ability of *E. coli* to produce gas which growing in bile salt lactose peptone water at 44°C and in ability of a typical coliform bacilli to do this. After usual presumptive test the subcultures are made from the test tubes showing acid and gas into fresh tube of single strength MacConkey's medium.

These tubes are then incubated at 44°C for 24 h and examined. Those yielding acid and gas are regarded as containing *E. coli* and computation of number in 100 ml of water can be made as per the McCradey's chart.

Standard statistical analysis was applied to determine the correlation-co-efficient between each parameter as per the Bliss (1970) and Champbell (1978). The Bivariate correlations computed using Pearson's correlation co-efficient package. Statistical analysis was done and p values and r values were calculated.

Results and Discussion

Investigations on the microbial quality of drinking water sources of 25 sampling stations in Kalaburagi City (Fig. 2) and 5 selected villages in Kalaburagi district (Fig. 3) have been carried out seasonally i.e., once in northeast monsoon, summer and southwest monsoon seasons and compared with next season.

The MPN (Most Probable Number) is a parameter which indicates the presence of coliform bacteria in the water samples. Presence of coliform also indicates the possiblity of presence of other pathogenic microorganism in the water samples and further indicates the possibility of contamination of the water sources with sewage. During the period from October, 1999 to September 2001 the MPN ranged from minimum of 15/100 ml to a maximum of 110/100 ml. During northeast monsoon season, the MPN varied between 17/100 ml to 145/100 ml lowest recorded in Om nagar, S.B. Temple, Shantinagar, Jewargi borewells while highest recorded in Super Market, Darga and Anand Nagar. While during the same season of 2000, the MPN ranged between 17/100 ml to 133/100 ml while lowest recorded in Om nagar and highest recorded in Anand Nagar, Super Market, Vithal nagar and Darga (Tables 1, 2).

During summer season, the MPN ranged between 15/100 ml to 180/100 ml while highest recorded in Anand Nagar, Supermarkets, Gunj, Vithal nagar and Darga. While during the same season of 2001, the MPN ranged between 16/100 ml to 124/100 ml again recorded higher MPN values in the above localities i.e., 23/100 ml to 142/100 ml.

The total bacterial count indicates the bacterial status of water samples and higher total counts indicate that the drinking water source is contaminated with organic substance. The total count like the MPN index was comparatively higher in the samples collected during October 1999 to September 2001. The total bacterial count ranged between 1.0×10^2 to 1.5×10^4 during northeast season of 1999. Similar observation was observed during the same season of 2000 while highest was noticed in Super Market area and Anand Nagar.

During summer, the total bacterial count varied between 2.0×10^2 to 1.7×10^4 and same season of second year, the total bacterial count ranged between 1.0×10^2 to 1.3×10^4 while highest recorded in Anand Nagar and Super Market area. The total bacterial count showed higher values during southwest monsoon season of 2000, 2.0×10^2 to 1.7×10^4 and 2.0×10^2 to 1.8×10^4 during the same season of 2001. Highest

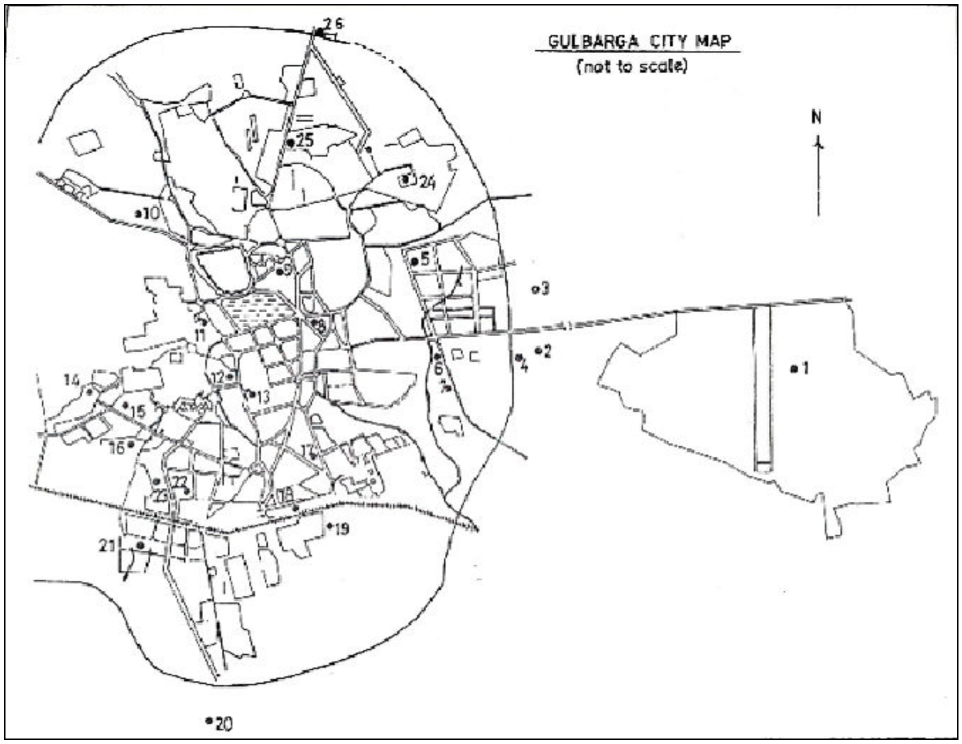


Fig. 2: Sketch map of Kaliburagi city (formerly known as Gulbarga city) showing Sampling stations: (1) Kalaburagi University Campus; (2) Okaly Camp; (3) Om Nagar; (4) Jayanagar; (5) Basaveshwar Colony; (6) Ambedkar Hostel; (7) Anand Nagar; (8) Jagth; (9) Super Market; (10) Shahabazar; (11) Sharanabasaveswar Temple; (12) Sangameshwar Colony; (13) Vithal Nagar; (14) M.S.K. Mill; (15) Shantinagar; (16) Bhagavathi Nagar; (17) Chandrashekar Patil Nagar; (18) Railway Station; (19) Tarpail; (20) Jail; (21) NGO's Colony; (22) Venkateshwara Colony; (23) City Improvement Board Colony; (24) Darga; (25) Gunj; (26) Revanasiddeshwar Nagar.

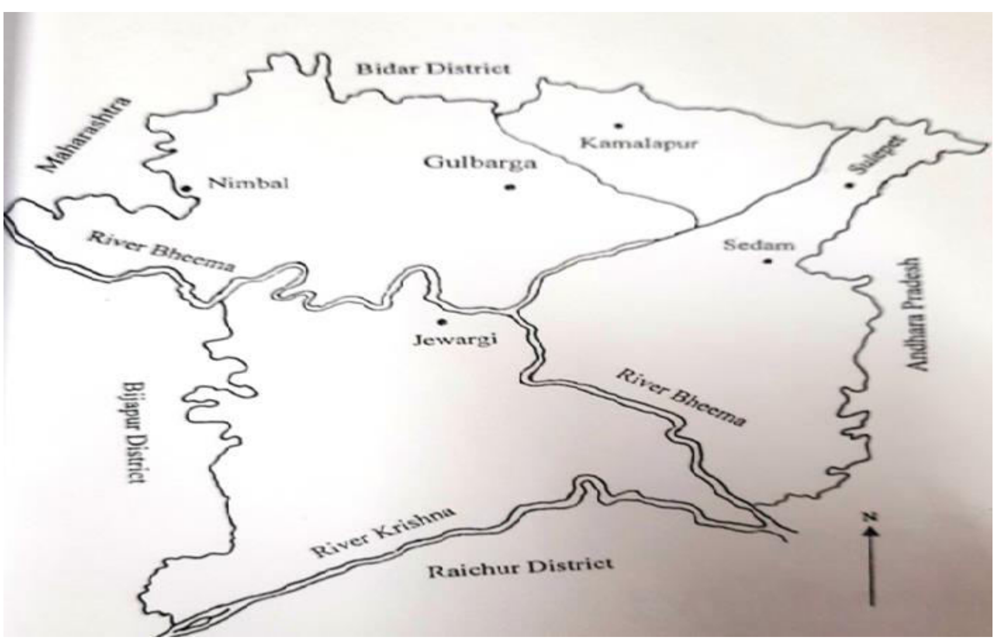


Fig. 3: Sampling villages in Kaliburagi (formerly Gulbarga) Sub-urban area: (1) Jewargi; (2) Sulepet; (3) Nimbal; (4) Kamalapur; (5) Sedam.

Table 1: Seasonal variations in Most Probable Number (MPN/100 ml) in different sampling stations of Kalaburagi City

Stations	NEM	Summer	SWM	NEM	Summer	SWM
Okaly Camp	27	23	34	28	23	35
Om nagar	17	15	22	18	16	23
Jayanagar	22	20	30	23	20	31
Basaveshwar Colony	17	17	27	17	17	27
Ambedkar Hostel	30	27	34	30	26	34
Anand Nagar	134	130	145	133	124	142
Jagath	22	17	35	21	17	36
Super Market	110	90	123	98	92	123
Shahabazar	27	23	32	26	23	32
S.B. Temple	17	17	30	17	18	30
Sangameshwar Colony	26	22	42	26	23	42
Vithal Nagar	90	80	110	**90**	80	110
M.S.K. Mill	32	26	33	30	23	33
Shanti Nagar	17	17	26	18	17	26
Bhagavati Nagar	26	23	34	25	22	34
C.P. Nagar	30	27	46	28	26	45
Railway Station	33	30	52	31	27	51
Tarapail	80	76	110	78	78	110
Jail	22	17	33	21	18	35
N.G.O.'s Colony	26	23	33	29	22	32
Venkateshwar Colony	26	23	33	29	22	32
C.I.B. Colony	70	62	80	68	60	82
Darga	110	96	123	110	95	123
Gunj	90	82	110	90	80	110
Revanasiddeshwar Nagar	36	33	43	35	30	45

Table 2: Seasonal Most Probable Number (MPN/100 ml) of selected villages in Kalaburagi

Stations	NEM	Summer	SWM	NEM	Summer	SWM
Jewargi	17	17	26	18	19	26
Sulepet	34	33	42	31	30	42
Nimbal	26	23	33	25	22	34
Kamalapur	33	30	43	31	31	45
Sedam	90	80	110	90	82	110

Table 3: Seasonal Total bacterial count (Total Cfu/ml) in sampling stations of Kalaburagi

Stations	NEM	Summer	SWM	NEM	Summer	SWM
Okaly Camp	1.0×10^3	1.0×10^3	2.0×10^3	1.0×10^3	1.1×10^3	1.9×10^3
Om nagar	1.5×10^3	1.5×10^3	2.5×10^3	1.4×10^3	1.6×10^3	2.5×10^3
Jayanagar	2.4×10^3	1.8×10^3	3.2×10^3	2.2×10^3	1.7×10^3	3.3×10^3
Basaveshwar Colony	1.2×10^3	1.0×10^3	1.8×10^3	1.1×10^3	1.0×10^3	1.9×10^3
Ambedkar Hostel	1.3×10^2	1.1×10^2	2.0×10^2	1.2×10^2	1.0×10^2	2.0×10^2
Anand Nagar	1.2×10^4	1.0×10^4	1.6×10^4	1.3×10^4	1.0×10^4	1.7×10^4
Jagath	3.4×10^3	2.5×10^3	3.8×10^3	3.3×10^3	2.6×10^3	3.7×10^3
Super Market	1.5×10^4	1.2×10^4	1.7×10^4	1.5×10^4	1.3×10^4	1.8×10^4
Shahabazar	8.8×10^3	6.2×10^3	9.6×10^3	8.7×10^3	6.1×10^3	9.5×10^3
S.B. Temple	2.3×10^3	2.3×10^3	4.2×10^3	2.1×10^3	2.1×10^3	4.0×10^3
Sangameshwar Colony	8.5×10^3	7.2×10^3	9.2×10^3	8.4×10^3	7.2×10^3	9.0×10^3
Vithal Nagar	1.6×10^3	1.4×10^3	2.4×10^3	1.5×10^3	1.4×10^3	2.5×10^3
M.S.K. Mill	6.2×10^3	5.6×10^3	7.4×10^3	6.0×10^3	5.5×10^3	7.3×10^3
Shanti Nagar	1.0×10^2	1.0×10^2	1.8×10^2	1.0×10^2	1.1×10^2	1.9×10^2
Bhagavati Nagar	5.2×10^2	4.6×10^2	6.4×10^2	5.2×10^2	4.5×10^2	6.5×10^2
C.P. Nagar	5.2×10^2	4.8×10^2	6.2×10^2	5.1×10^2	4.6×10^2	6.2×10^2
Railway Station	3.6×10^3	3.0×10^3	4.2×10^3	3.5×10^3	3.1×10^3	4.1×10^3
Tarapail	8.8×10^3	8.0×10^3	9.0×10^3	8.6×10^3	8.1×10^3	9.0×10^3
Jail	1.2×10^3	1.1×10^3	1.5×10^3	1.0×10^3	1.1×10^3	1.6×10^3
N.G.O.'s Colony	1.1×10^3	1.0×10^3	1.6×10^3	1.0×10^3	1.1×10^3	1.6×10^3
Venkateshwar Colony	4.5×10^3	4.2×10^3	5.0×10^3	4.4×10^3	4.3×10^3	4.9×10^3
C.I.B. Colony	1.5×10^3	1.2×10^3	2.0×10^3	1.4×10^3	1.1×10^3	2.1×10^3
Darga	6.5×10^3	5.5×10^3	7.6×10^3	6.4×10^3	5.4×10^3	7.5×10^3
Gunj	8.3×10^3	7.6×10^3	9.0×10^3	8.1×10^3	7.5×10^3	9.0×10^3
Revanasiddeshwar Nagar	5.0×10^3	4.5×10^3	6.2×10^3	4.8×10^3	4.6×10^3	6.1×10^3

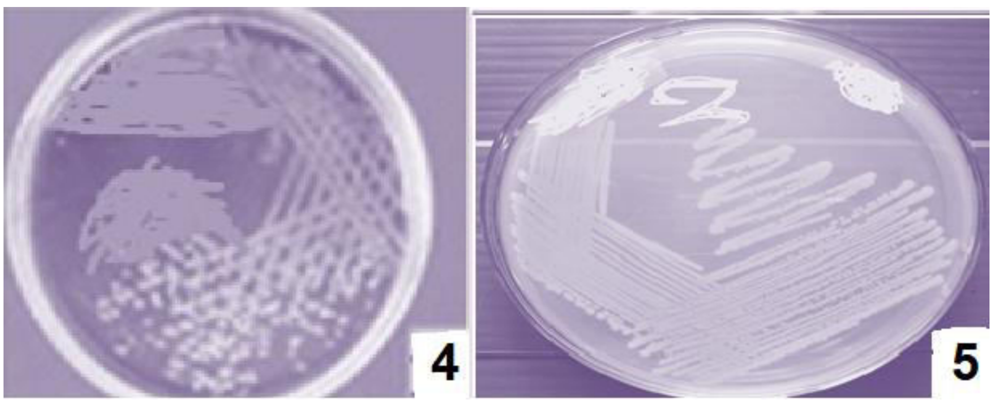
recorded in Anand Nagar and Super Market area (Tables 3, 4).

In southwest monsoon season the MPN ranged between 22/100 ml to 145/100 ml. The highest MPN values recorded in Anand Nagar and lowest in Om nagar, Similar observation recorded in the same localities i.e., 23/100 ml to 142/100 ml (Figs. 4, 5).

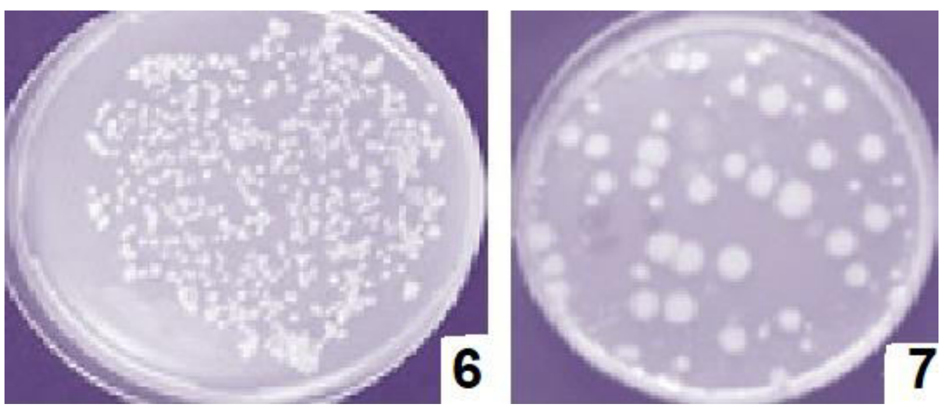
Though majority of the samples exhibited an MPN above the permissible limits of 10/100 ml, however, it is significant to note that almost all the samples are not free from MPN. Few samples

Table 4: Seasonal variations in Total bacterial count (Total Cfu/ml) of selected villages in Kalaburagi District

Stations	NEM	Summer	SWM	NEM	Summer	SWM
Jewargi	2.3×10^3	1.8×10^3	3.2×10^3	2.1×10^3	1.9×10^3	3.1×10^3
Sulepet	1.1×10^3	1.0×10^3	1.5×10^3	1.0×10^3	1.1×10^3	1.6×10^3
Nimbal	5.2×10^2	4.8×10^2	6.2×10^2	5.0×10^2	4.7×10^2	6.1×10^2
Kamalapur	4.0×10^3	3.5×10^3	4.8×10^3	4.0×10^3	3.6×10^3	4.8×10^3
Sedam	6.2×10^3	7.8×10^3	6.8×10^3	6.0×10^3	7.6×10^3	6.7×10^3



Figs. 4, 5: MPN values and total bacterial count in the ground water samples of Kalaburagi.



Figs. 6, 7: Coliform bacteria an indication for sewage contamination in ground water of Kalaburagi.

collected from Darga, Anand Nagar and Super Market area were clearly above the permissible limit. This indicates that the drinking water sources in Kalaburagi City are invariably contaminated. Presence of Coliform bacteria is indication for sewage contamination (Figs. 6, 7) and there is a possibility of the presence of other enteric pathogens like *Escherichia coli, Salmonella typhimurium, Shigella sp., Vibrio cholerae* etc. It is alarming to note that *E. coli* the opportunistic pathogen causing enteric diseases is detected in most of the samples. *S. typhimurium*, the causative agent of typhoid fever, is detected in 12 samples out of 25 investigated. *Shigella sp.*, the causative agent of bacillary dysentery was present in two samples. Other opportunistic pathogenic coliform like *Citrobactor, Aeromonas, Froteus* and *Serratia* etc., were invariably present in the drinking water sources of Kalaburagi City and selected villages.

Similar observations were made by Aboo *et al.* (1986) who have reported MPN/100 ml less than 20.0 in only 40% of well waters of Bhopal. Olamiya *et al.* (1979) found high bacterial count in well water after rains. Bhatia and Dave (1980) showed high bacterial counts for total and fecal coliform in the range of 17.0 to more than 1600 in groundwater in village Munirka near Delhi. Jana *et al.* (1980) observed bacterial population of water samples in borewells of west Bengal. Rao *et al.* (1986) observed MPN from 0.0 to 16,000/100 ml in borewells of Nuzvid town of Andhra Pradesh. Saha *et al.* (1987) studied bacteriological quality of Bhagalpur well waters. Shah and Patel (1989) reported presence of diarhoea causing entero-pathogen in drinking water of rural Panchanahols of Gujarat. Rai and Sharma (1990) performed bacteriological studies in borewell waters of Nainital, Uttar Pradesh. Bacteriological analysis of water revealed the contaminated nature of drinking water resources of Bikaner (Rajasthan) (Sharma and Bharadwaj, 2000).

Lack of access to clean, plentiful water is to blame for a significant portion of human health problems, particularly in developing nations. Without clean water, there is no state of good health and well-being. We expect water to be safe and clean because it is so important for our survival. Even water that looks clear might not always be safe or appropriate. Since water is the most important potential source of infectious diseases, water purification is the most important potential available for ensuring public health. Water intended for human consumption must be free of pathogenic and chemical agents, taste good, and be usable for domestic purposes (Goel *et al*., 2007; Kumar *et al*., 2013).

Conclusion

Most of the water samples analysed in the present investigation are contaminated, this is an alarming situation from the public health point of view. Hence, there is a necessity to extend such studies to the borewells of individual houses and investigate in detail the microbial biochemical quality of drinking water supplies of Kalaburagi. Based on these studies recommendation can be made to the local authorities to take suitable control measures.

References

Aboo KM, Sastry CA and Aex PG. (1986) A study of well waters in Bhopal City. Environ Hlth. 10: 189-203.

APHA (1998) Standard Methods for the Examination of Water and Waste Water, New York, 20th Edition. (APHA, AWWA, WEF).

Bhatia R and Dave JM. (1980) Study of water quality of an urban village in Delhi. J Ind Wat Works Assam 12(4): 337-349.

Bliss CI. (1970) Statistic in Biology. Mc Graw-Hill Co., New York.

Champbell RC. (1978) Statistics for Biologists. Blackie Son Publishing Pvt. Ltd., Bombay.

Emde KME and Finch GR. (1991) Detection ad occurrence of waterborne bacterial and viral pathogens. Res J Water Poll Control Federation 63(4): 730-735.

Geldreich EL. (1992) Water borne pathogens invasions: A case for water quality protection in distribution. Proc American Water Works Association. Water Quality Technology Conference, pp. 1-18.

Goel S, Sood R, Mazta SR, Bansal P and Gupta A. (2007) Bacteriological quality of water sample of a tertiary care medical campus in North western Himalayan region of India. Internet J Third World Med. 5(1): 1-7.

Jana BB, Patel GN, Roy SK and DE VK. (1980) Growth characteristic of heterotropic bacterial population of water and bottom sediments in the borewells under different tropical conditions. Hydrobiol. 75: 231-239.

Kumar D, Malik S, Molly M, Pandey A and Asthana AK. (2013) Bacteriological analysis of drinking water by MPN method in a tertiary care hospital and adjoining area Western UP, India. IOSR J Environ Sci Toxicol Food Technol. 4(3): 17-22.

Manja KS, Maurva MS, Ran KM. A simple field test for the detection of faecal pollution in drinking water. Bull. WHO., 1982;60:797-801.

Nakade DB. (2013) Assessment of bacteriological quality of water in Kolhapur city of Maharashtra, India. Int Res J Environ Sci. 2(2): 63-65.

NEERI (1986) Laboratary Manual of Water Analysis. National Environmental Engineering Research Institute. Nehru Marg. Nagpur.

Olaniya MS, Sharma HC, and Sexena KL. (1979) Turbidity and bacteriolgical removal from tank water during natural filtration. Proc Symp Environ Biol. 419-428.

Rai JPN and Sharma HC. (1990) Impact of industries on the quality of surface and groundwaters in the northwest region of Uttar Pradesh. National Symp Protection Environ City Water Fronts, New Delhi, pp. 25-29.

Rao KS, Thathaih K, Krishana MV and Rao MM. (1986) Quality of groundwater of Nazvid town, A.P. Indian J Environ Hlth. 28(4): 349-351.

Shah LC, Pandit B and Pandey BK. (1987) Bhagalpur well waters bacteriological quality. Nat Acad Sci Letters 19(9): 311-313.

Shah PR and Patel HH. (1989) Diarhoea causing enteropathogen in drinking water of rural Panchanahols of Gujrat. Indian J Environ Hlth. 31: 171-172.

Trivedi RK and Goel PK. (1986) Chemical and biochemical methods for water pollution studies. Environmental Publication (Karad, India), 6: 10-12.

WHO. (2000) Global water supply and sanitation assessment 2000 report.

WHO. (1993) Guidelines for drinking water quality. Vol.1, Geneva, World Health Organisation, pp. 1- 29.