IndianJ.Sci.Res.4 (1):185-190, 2014 ISSN: 0976-2876 (Print)
ISSN: 2250-0138(Online)

SEASONAL VARIATION IN BACTERIAL CONTAMINATION OF DRINKING WATER IN BILASPUR CITY OF CHHATTISGARH STATE

D. K. SHRIVASTAVA[a1], T. P. CHANDRA[b] AND SEEMA YADAV[c]

[abc]Department of Botany and Microbiology, Govt. E. R. R. Postgraduate Science College, Bilaspur (C. G.)

ABSTRACT

Ground water is soul source of drinking water and the safe potable water is absolutely essential for healthy human community. Due to industrialization and urbanization it becomes contaminated / polluted along with the crisis of drinking water. The quality of drinking water, available / supplied in Bilaspur city has been studied in view of bacterial contamination. Total ninety samples of drinking water of three sources (TW, HW and BW) during three seasons (summer, rainy and winter) collected from entire town area dividing into ten study sectors have been examined, whereas total six bacteria, including coli-form bacteria have been isolated and characterized through biochemical test. The seasonal effect on bacterial occurrence and there frequency in respect to different source of drinking water has been analyzed. The result and its analysis revealed that the drinking water of the Bilaspur city is not safe up to mark for human society.

Keywords: Drinking water, Bacterial contamination, Bilaspur city.

Water is an essential ingredient of living beings in the universe, without it, the imagination of any sort of life on this planet futile and mirage. All biological reactions occur in water and it is the integrated system of biological metabolic reactions in an aqueous solution that is essential for the maintenance of life. Water as drinking required for satisfactory performance of various physiological function as a circulatory fluid, as a regulator of body temperature, as the solvent of electrolytes, as the carrier of nutritive elements and for the removal of waste products. So, everybody needs pure water to drink, but due to impurities, suspended or dissolved, the water becomes contaminated and / or polluted and as a result living community, particularly human beings are deprived of pure water.

Groundwater forms an ultimate source of drinking water supply for urban and rural people of India. In spite of this, there is paucity of data relating to groundwater pollution in India. There are several states of India where more than 90% population are depended directly on ground water for drinking and other purpose (Ramchandriah, 2004). Due to the diversion of sewage water and industrial effluents in to the near of stream courses, water bodies and tanks, the people residing in the colonies which are in close proximately to these tanks are facing serious problems in view of deterioration quality of drinking water. Water served to consumer must be free from disease carrying bacteria, toxic substance, and excessive amount of mineral and organic matter (Gadi *et al.*, 2003).

The microbial, especially bacteriological impurities caused by the presence of pathogenic or disease producing bacteria make water dangerous for human consumption and health. These bacteria capable of producing diseases in man are obtained from the wastewater of corporations, municipalities and other household activities. The potable water contaminated with municipal sewage is the root cause of dangerous diseases in human beings. The disease causing organisms present in the faeces of infected people get ultimately mixed with the water supply spreading chronic diseases.

Keeping in view the aforesaid facts the present investigation is being proposed to assess the quality and suitability of drinking water consumed by urban people of Bilaspur city (2nd largest city of Chhattisgarh state) as well as rural people of adjoining area by scientific study of bacterial contamination in various samples of drinking water available for public use. Obviously water is the carrier of several diseases, either chemical imbalance or microbial contamination, in human society.

1Corresponding author

MATERIAL AND METHODS

In order to assess the quality of drinking water available or supplied and consumed by urban as well as rural people resides within Bilaspur city and its adjoining area, an exhaustive survey for consideration of source of drinking water in practices, was performed by dividing the entire town area 10 study sectors and bacteriological analysis of water samples, as collected periodically throughout the investigation years, was done employing proper methods. Samples of three categories of drinking water on the basis of their source were taken into consideration viz. Municipal water / stored tank water or Tap water (Tw), Hand-pump water (Hw) and Bore-well water (Bw) were collected following the sampling method. The samples were collected in clean sterile glass polythene bottles without any air bubbles and transported to laboratory in ice within an insulated container and analysed within 24 hours of collection. The examination of coli-form organisms and microbiological studies were followed as per the methods given by APHA (1998), WHO (1996, 2004), Fresenives *et al.*(1988), Bonde (1977) and Patralekh (1991).

During present investigation the media were used for the bacteriological analysis of drinking water include nutrient agar media (NAM), lactose broth (LB), Eosin Ethylene blue agar (EMB) and Mac-Conkey. A serial dilution method was used for total viable count and the presumptive test for coli-forms. The pour plate method (Clesceri *et al*., 1998) was used to estimate the number of heterotrophic bacteria in plate count agar at 37 °C, for 48 hr. This method was based on the serial dilution of water sample, which were then pipette into each sterile Petri-dish. About 20ml of molten nutrient and Mac Conkey agar was cooled to 45^0C and poured into each Petri-dish containing 1ml of the drinking water sample. Plates were incubated at37^0C. After 24hrs of incubation, the plates were counted by colony counter to obtain the total bacterial and coli-form counts respectively. Pure cultures of bacterial strains were isolated by streak plate method. Bacteria were identified using Gram staining. To confer the specific bacteria, respective biochemical tests were applied whereas the IMViC tests were taken for identification of faecal contaminants of water used for drinking purposes. Besides it Catalase test, Glucose fermentation, lactose fermentation, and starch hydrolysis tests were also employed. For estimating the number of live heterotrophic bacteria in water, the Heterotrophic plate count (HPC), which is formerly known as the standard plate count procedure was used. Colonies may arise from pairs, chains, clusters or single cells, all of which are included in the term "Colony forming unit" (CFU).

RESULT AND DISCUSSION

Through survey of the proposed area it has been found that, the Tap water (Tw) supplied through overhead tank by Municipal Corporation is mostly used by urban people and people of semi urban area at some extant, however, rarely used also by the people residing at boundary of the city or people resides in slum area to whom the Hand-pump water (Hw) facility is provided by the Govt. agency; while people of urban, semi urban area are also using Bore well water (Bw) in Bilaspur town of Chhattisgarh.

Table 1: Occurrence of Bacteria drinking water of different sources (TW, HW and BW), isolated during different season.

Study Sector	Source of water	Bacterial Strains in different season																	
		Summer season						Rainy Season						Winter Season					
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Sector- I	TW	+	+	+	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-
	HW	-	-	+	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-
	BW	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- II	TW	+	+	+	+	+	-	-	+	-	+	+	-	+	+	-	+	-	+
	HW	+	+	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-
	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- III	TW	+	+	+	-	+	+	-	+	-	-	-	-	+	+	-	-	-	-
	HW	+	-	+	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-
	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sector- IV	**TW**	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
	HW	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- V	**TW**	+	+	-	+	+	-	+	-	+	-	-	-	-	+	-	+	-	-
	HW	+	+	-	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-
	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- VI	**TW**	+	+	+	+	-	+	+	+	+	-	-	-	+	-	-	-	-	-
	HW	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- VII	**TW**	+	+	+	+	+	+	+	-	-	-	-	+	-	+	+	-	-	-
	HW	+	+	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-
	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- VIII	**TW**	+	+	+	+	+	-	-	+	+	+	-	-	+	+	-	-	-	-
	HW	+	+	-	+	-	-		-	-	-	-	-	-	-	-	-	-	-
	BW	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- IX	**TW**	+	+	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
	HW	-	-	+	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-
	BW	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector- X	**TW**	+	+	+	+	-	+	-	+	-	-	-	+	-	-	+	-	-	+
	HW	+	+	-	-	-	+	-	-	+	+	-	-	-	-	-	-	-	-
	BW	-		+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1.*Staphylococcus aureus,* 2. *Escherichia coli,* 3. *Bacillus sp.*, 4. *Proteus* sp., 5. *Enteobacter aerogenes,* 6. *Klebsiella sp.,* TW = Tap Water (By Municipal corporation), HW = Hand pump Water (By Govt. PHE) BW = Bore well Water (Private)

TABLE - 2: Frequency of occurrence of bacterial strains in drinking water samples collected from different sources.

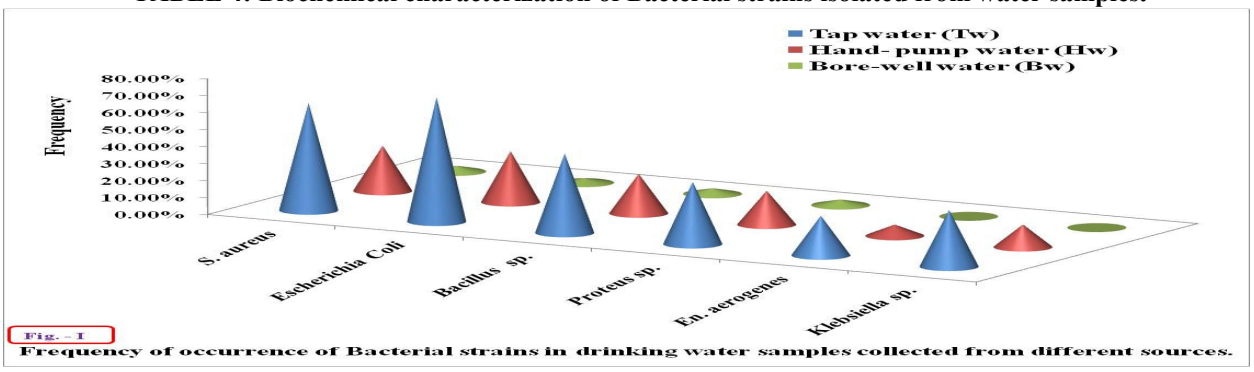
ISOLATED BACTERIAL STRAINS	SOURCES OF DRINKING WATER					
	TAP WATER (TW)		HAND- PUMP WATER (HW)		BORE-WELL WATER (BW)	
	No. of samples	Frequency (%)	No. of samples	Frequency (%)	No. of samples	Frequency (%)
S. aureus	19	63.33	8	26.66	1	3.33
E. coli	22	73.33	9	30.00	2	2.66
Bacillus sp.	14	46.66	7	23.33	1	3.33
Proteus sp.	11	36.66	6	20.00	1	3.33
En. Aerogenes	7	23.33	2	6.66	Nil	00
Klebsiella sp.	10	33.33	4	13.33	Nil	00

	ISOLATED BACTERIAL STRAINS (Denoted by No. as Table – 1)					
	1	**2**	**3**	**4**	**5**	**6**
Indole	-	+	-	+	-	+
Methyl Red	-	+	-	+	+	+
Voges Proskaur	+	-	+	-	+	-
Citrate	-	-	-	-	+	-
Catalase	+	+	+	+	-	+
Glucose	A	A	A/G	A	A/G	A
Manntol	-	A	A	_	A/G	-
Lactose	A	A	A/G	A	A	-

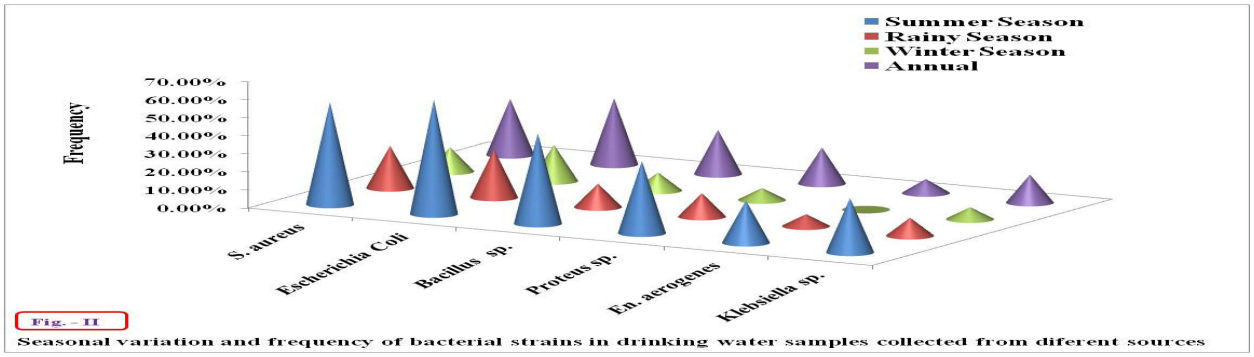
TABLE - 3: Seasonal variation and frequency of bacterial strains in drinking water samples collected from different sources.

ISOLATED BACTERIAL STRAINS	SEASONAL VARIATION							
	SUMMER SEASON		RAINY SEASON		WINTER SEASON		ANNUAL	
	No. of samples	Frequency (%)	No. of samples	Frequency (%)	No. of samples	Frequency (%)	No. of samples	Frequency (%)
S. aureus	17	56.66	7	23.33	4	13.33	28	31.11
E. coli	19	63.33	8	26.66	6	20.00	33	36.66
Bacillus sp.	15	50.00	4	13.33	3	10.00	22	24.44
Proteus sp.	12	40.00	4	13.33	2	6.66	18	20.00
En.aerogenes	7	23.33	2	6.66	Nil	00	9	7.77
Klebsiella sp.	9	30.00	3	10.00	2	6.66	14	15.55

TABLE 4: Biochemical characterization of Bacterial strains isolated from water samples.



Frequency of occurrence of Bacterial strains in drinking water samples collected from different sources.



Seasonal variation and frequency of bacterial strains in drinking water samples collected from diferent sources

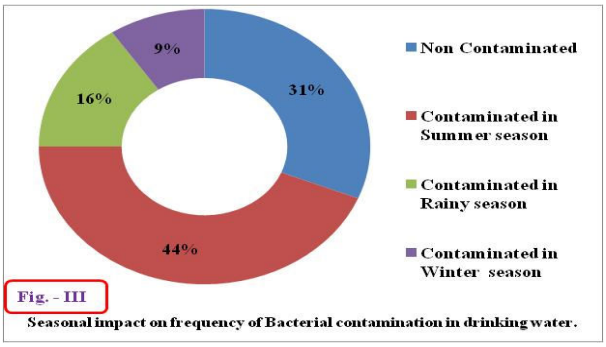


Fig. - III

Seasonal impact on frequency of Bacterial contamination in drinking water.

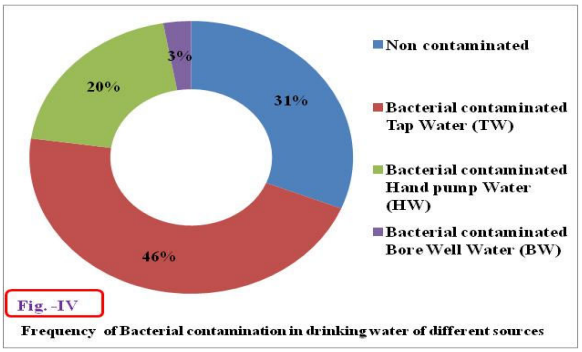


Fig. -IV

Frequency of Bacterial contamination in drinking water of different sources

The bacteriological examination of water samples revealed the presence of total coli-form in most of the samples including other bacterial strains. Out of the total 90 samples of drinking water only a few samples were deprived of total coli-form and rest was contaminated with total coli-forms. During present study seven bacterial strains, including five coli-forms were isolated, identified and biochemically examined. Under various study sector & sample wise occurrence of isolated bacteria from different source of water has been mentioned inTABLE-1, and the result of its biochemical test has been noted in TABLE-2. Occurrence and characterization of isolated strains of bacteria are – (1) *Staphylococcus aureus:* this bacterial strain was observed in total 28 samples (out of 90 samples) during all three season of all three source of drinking water. It was characterized as Gram positive cocci and opaque golden colony grown on nutrient agar media at pH-7 & 37^0C and specific media; (2) *Escherichia coli:* this bacterial strain was observed in total 33 samples (out of 90 samples) and was characterized as Gram positive cocci and smooth & circular translucent colony grown on nutrient agar media at pH-7 & 37^0C; (3) *Bacillus sp.:* strain of *Bacillus sp.* was observed in total 22 samples (out of 90 samples) and was characterized as Gram positive and creamy white colonies grown on nutrient agar media at pH-7 & 37^0C and specific media; (4) *Proteus sp.*:it was also observed in total 18 samples (out of 90 samples) and was characterized as Gram negative and large swarming colonies of creamy colour grown on nutrient agar media and specific media; (5) *Enterobacter aerogenes:* only in 20 samples (out of 90 samples) of all four source of drinking water it was noticed and characterized as Gram negative and smooth & circular, creamy white colonies with soft appearance grown well on specific media at pH-7 & 37^0C and (6) *Klebsiella sp.:* out of the entire sample examined, only in fourteen samples of all sources of drinking water this strain was observed and characterized as Gram negative, non-motile, capsulated and dome shaped mucoid colonies grown on nutrient agar media & specific nutrient media. Different source and season wise occurrence frequency of isolated total six bacteria in available water sources during prominent three has been computed in TABLE -3 & TABLE -4 respectively and its corresponding histograms have been presented in Fig. –I & Fig. –II. As the result of present investigation conferred that the strains of *E. coli and Staphylococcus aureus* were most frequent, whereas *Klebsiella sp.* and *Enterobacter aerogenes* were rather less frequent and *Bacillus sp. & Proteus sp.* were shown average occurrence. Simultaneously frequency of bacterial occurrence was observed maximum in tap water and minimum in bore-well water. The higher values of bacterial population recorded during summer might be due to increased ambient temperature which favours the growth of bacteria. The lower value during winter can be explained on the basis of lower multiplication and poor growth due to low temperature.

CONCLUSION

Through forgoing investigation, we have confer the bacterial contamination of drinking water of Bilaspur town which reveal the fact that the drinking water of this town, especially a part of boundary area, slum area and few patches of midtown area is more or less contaminated, particularly the tap water and hand-pump water at some extant. It may be safely concluded that majority of the water samples depict its unsuitability for drinking without proper treatment. The main cause of water quality deterioration in the region is lack of

proper sanitation and protection of hand-pump and tap water coupled with domestic sewage contamination. Thus, bore-well water samples are least contaminated, hand-pump water samples are more contaminated, whereas Tap water samples are most polluted. Such drinking water is not safe for human society.

REFERENCES

APHA, AWWA, WEF; 1998. Standard method for the examination water and wastewater. 20th edition, USA, edn. Washington, D.C.

Bonde G. J.; 1977. Bacteriological indication of water pollution. In: Advances in aquatic microbiology. Eds.Droops MR, Januas HW Academic press London and New York, Pp -273-364.

Clesceri L. S., Greenberg A. S. and Eaton A. D.; 1998. *Standard methods for the examination of water and wastewater.* 20th ed. American Public Health Association (APHA).

Fresenives Z., Quentin W. K. E. and Schneider W.; 1988. Water analysis. A practical guide to Physico-Chemical, Chemical and Microbiological water Examination and Quality Assurance. Springer Verlag Berling Heidelberg, Germany, Pp -0-804.

Gadi S. D., Barbuddhe S. B., Hazel D. and Dolly; 2003. *J. of Ecotoxicity & Environmental monitoring*; Vol. - 13 (3), Pp - 203-209.

Patralekh L. N.; 1991. Bacterial density in the Ganga at Bhagalpur, Bihar. *J. Ecobiol*.; Vol. - 3, Pp -102-105.

Ramachandraiah C.; 2004. Right to drinking water in India, Centre for Economic and Social Studies. Pp -56.

WHO; 1996. Guidelines for Drinking Water Quality. Recommendations 2nd edition, Volume-II, Health criteria and other supporting information. World Health Organization, Geneva.

WHO; 2004. Guidelines for Drinking Water Quality. Supporting Documentation to the Guidelines, 3rd edition, Vol. - 2, Pp -552.

ACKNOWLEDGEMENT

Authors are thankful to the Principal, Govt. E. Raghavendra Rao Postgraduate Science College, Bilaspur (C.G.) for providing the required laboratory facility and also thankful to staff and research students of the department of Microbiology for their supports during present investigation.