

Study on Physico-Chemical and Microbial Parameters of Water Supply from Hisar city, Haryana

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Abstract

The present research work deals with the study of some of the important physico-chemical and microbial parameters of 24 samples collected from water supply of Hisar city, for a period of four months June-September (2015) at weekly intervals. This study showed the result of four water works namely as Mahavir Colony Water Works, Kaimiri Road Water Works No. 2, Satroad water works and PTU Water Works and twenty wards of Hisar city. Twenty-four samples are subjected to physico-chemical analysis like pH, temperature, total hardness, conductivity, total alkalinity, turbidity and free residual chlorine. The most probable number (MPN) test was done to detect the total coliform and fecal coliform in water samples. The Hisar is major city of Haryana and the main source for water supply are Balsamend branch, Hisar major and Rana distributor canal interconnected to four water works. These water works supplied in twenty wards under Public Health Engineering Department, Haryana. The parameters pH, temperature, conductivity, total hardness, total alkalinity & chloride content were found within the BIS standard limits. The turbidity was found highest in the Mahavir colony water works and ward number (1) 3.3 and 11 NTU respectively. The free residual chlorine were deducted in three water works and ward number (17). The total coliform and fecal coliform were deducted only in PTU water works 300 and 50 MPN/100ml respectively. The total coliform and fecal coliform were deducted highest in ward number (3) 1600 MPN/100ml respectively.

Keywords: physico-chemical, microbial, water, pH, total hardness.

INTRODUCTION

Water quality is affected by a wide range of natural and human influences. The most important of the natural influences are geological, hydrological and climatic, since these affect the quantity and the quality of water available. More obvious are the polluting activities, such as the discharge of domestic, industrial, urban and other wastewaters into the watercourse (whether intentional or accidental) and the spreading of chemicals on agricultural land in the drainage basin. Their influence is generally greatest when available water quantities are low and maximum use must be made of the limited resource. The quality of water may be described in terms of the concentration and state (dissolved or particulate) of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water. The quality of the water for drinking purposes is a broader issue which can be described in terms of physical measurements of water temperature, pH, conductivity, light penetration, particle size of suspended and deposited material, dimensions of the water body, flow velocity, hydrological balance, etc. Increasing industrialisation and the growth of large urban centres have been accompanied by increases in the pollution stress on the aquatic environment. Since ancient times, water in rivers, lakes and oceans has also been considered as a convenient receiver of wastes. This use (or abuse) conflicts with almost all other uses of water and most seriously with the use of freshwater for drinking, personal hygiene and food processing. The analysis of water quality is necessary so that unsatisfactory water is treated before use in order to meet specific water quality requirements(Bartram, J. et al., 1996). The Hisar city is one of the important and fast growing urban centres of Haryana. The population of Hisar City served by Water Supply and Sanitation Department was 2,65,208 in Year 2008 and rate of water supply was 110 lpcd after treatment through three existing canal based water works namely Mahavir Colony Water Works, Kaimiri Road Water Works No. 2, Satroad water works and PTU Water Works (PWD, 2009).

Water quality is an index of health and well being of a society. Industrialization, urbanization and modern agriculture practices have direct impact on the water resources. These factors influence the water resources quantitatively and qualitatively (Parashar, C et al.,2007). The study determined the relationship between chlorine residual, other physico-chemical qualities of the treated water, and, bacteria regrowth. Results indicated that the treated water at the Kpong and Weija Treatment Plants conformed to WHO guidelines for potable water. However, the water quality deteriorated bacteriologically, from the plants to the delivery points with high numbers of indicator and opportunistic pathogens. This could be due to inadequate disinfection residual, biofilms or accidental point source contamination by broken pipes, installation and repair works (Karikari, A. Y., & Ampofo, J. A.,2013). The PRM samples exhibit poor quality in greater percentage when compared with POM due to effective leaching of ions, over exploitation of groundwater, direct discharge of effluents and agricultural impact. The overlay of WQI with chloride and EC correspond to the same locations indicating the poor quality of groundwater in the study area (Vasanthavigar, M et al.,2010). Mahim was found to be worst-affected

beach due to incoming organic load from the Mithi river in comparison to other seafronts and beaches. Unaccounted sources of sewage and wastewater should be identified and rerouted through sewerage system by improving collection efficiency, treatment, and proper disposal for achieving designated receiving water quality standards (Kamble, S. R., & Vijay, R., 2010). Bacteriological pollution of drinking water supplies caused diarrhoeal illness in Bholakpur, which is due to the infiltration of contaminated water (sewage) through cross connection, leakage points, and back siphoning (Abdul et al., 2012). Sharma, D., & Kansal, A (2011) The study also identifies the critical pollutants affecting the river water quality during its course through the city. The indices have been computed for pre-monsoon, monsoon and post-monsoon season at four locations, namely Palla, ODRB, Nizamuddin and Okhla in the river (Battu et al. 2009; Joseph et al. 2010; Karunakaran, K et al. 2009; Kumar, S. K et al. 2009; Mishra, A., & Bhatt, V. (2008); Parashar, C et al. 2008; Patil, V. T., & Patil, P. R. (2010). The objective of present study was to assess the water supply quality of Hisar city.

MATERIAL AND METHOD

The study area selected were Hisar city water supply system contributed by Public Health Department. The public health department are four water works Mahavir Colony water works, kaimri road water works, Satroad water works and P.T.U water works. These water works are supply the water in twenty ward of Hisar city. The Hisar is fast growing city of Haryana. Geographically it is located at 29° 09' 0'' N latitude, 75° 42' 0'' E longitude. Hisar is located at 164 kilometre to the east of Delhi on national highway 10.

SAMPLING SITES

The sampling was collecting in four water works Mahavir Colony water works, kaimri road water works, Satroad water works, P.T.U water works and twenty wards of Hisar city. The water samplings were collected from each station at different site. The total 24 samples were collected in four months during june-september (2015). The water supply samples were collected in sterile plastic bottle. The sampling microbiological and physiochemical parameter were carried out according to standard methods (APHA 1995).

- The pH of the samples was determined using Digital pH meter.
- The conductivity were determined using the digital meter.
- Water temperature was recorded in the field using sensitive mercury thermometer.
- The Turbidity was determined by Nephelo – turbidity meter.
- The Total Hardness was determined by using EDTA Titrimetric method (APHA 1985).

- The Total Alkalinity was determined by Titrimetric method.
- The free residual chlorine was determined by OTA method (APHA 1985).
- The Chlorides were determined by Mohr's argentometric method (APHA 1985).
- The Total Coliform was determined by Fermentation Technique (APHA 1985)
- The Fecal Coliform was determined by Fermentation Technique (APHA 1985)

RESULTS AND DISSECTION

pH

The pH range was recorded during analysing the data. The minimum pH value was recorded 6.64 in kaimri road water works and maximum pH value was recorded 7.39 in PTU water works (table 1). The pH value was recorded minimum 6.45 in ward number 6 and the pH value recorded maximum 7.35 in ward number 1 (tables 2 & 3). For drinking water the pH standard value 6.5-8.5 is recommended (BIS 2012).

Temperature

The temperature was recorded of four water works and twenty wards of Hisar city. The temperature was observed maximum (31.5°C) and minimum (29°C) with Kaimri road water works and Mahavir colony water works respectively (table 1). In the wards the temperature was observed maximum (32.6°C) in ward 12 &16 and minimum (28.9°C) in ward 2 (tables 2&3).

Table number 1: Physico-Chemical and microbial Properties of Samples Collected from different four water works of Hisar city.

Parameter	Mahavir colony water works	Kaimri road water works	PTU water works	Satroad water works	BIS standard
pH	6.92	6.64	7.39	7.38	6.5-8.5
Temperature	29	31.5	29.1	30.5	
Conductivity	201.2	197.3	131.1	216	
Total hardness	97	93	104	88	200-600
Turbidity	3.3	0.5	1	0.6	1-5
Total alkalinity	108	84	212	108	200-600
Chloride content	11	12	22.5	12	

Free residual chlorine	0.7	0.9	00	0.9	0.2-1
Total coliform	00	00	300	00	00
Fecal coliform	00	00	50	00	00

Table number 2: Physico-Chemical and microbial Properties of Samples Collected from different wards of Hisar city.

Parameter	Ward Numbers										BIS standard
	1	2	3	4	5	6	7	8	9	10	
pH	7.35	6.87	6.74	7.03	6.60	6.45	6.78	6.97	7.09	7.17	6.5-8.5
Temperature	29.3	28.9	29	29.5	29.3	29.4	30.7	30.5	30.9	30.8	
Conductivity	134.2	206.8	210.7	266.2	200.8	200.2	219.7	142.9	143.3	213.8	
Total hardness	108	81	107	88	94	100	68	157	161	60	200-600
Turbidity	11	2.4	2.8	3.6	5.1	4.6	1.4	0.5	0.5	0.8	1-5
Total alkalinity	222	108	36	36	32	30	54	200	170	46	200-600
Chloride content	25	9.5	13.5	25	13.5	22	9.5	18.5	17.5	13.5	250-1000
Free residual chlorine	00	00	00	00	00	00	00	00	00	00	0.2-1
Total coliform	350	240	1600	130	170	130	300	00	21	8	00
Fecal coliform	220	80	1600	4	00	00	50	00	00	00	00

Conductivity

The conductivity was recorded maximum and minimum with four water works and twenty wards. The conductivity was recorded maximum 216 $\mu\text{m}/\text{cm}$ and minimum 131.1 $\mu\text{m}/\text{cm}$ with Satroad and PTU water works respectively (table 1). In the wards the conductivity was recorded minimum 134.2 $\mu\text{m}/\text{cm}$ and maximum 266.2 $\mu\text{m}/\text{cm}$ with 1 and 4 ward number (tables 2&3).

Total hardness

The total hardness was recorded different with four water works and twenty wards. The total hardness was recorded minimum 88 ppm and maximum 104 ppm with Satroad and PTU water works respectively (table 1). The total hardness was observed minimum 60 ppm in ward number 10 and maximum 161 ppm in ward number 9

(tables 2&3). The permissible limit for total hardness was recommended 200-600 ppm (BIS 2012).

Turbidity

The turbidity was observed in four water works and twenty wards of Hisar city. The turbidity was recorded maximum 3.3 NTU and minimum 0.5 with Mahavir colony and Kaimri road water works (Table 1). The permissible limit of turbidity was recommended 1-5 NTU (BIS 2012). The turbidity was recorded maximum 5.1, 5.2, 5.8 & 11 NTU with 5, 12, 15 & 1 wards number respectively which is higher than the permissible limit 5 NTU (Tables 2&3). The minimum value was recorded 0.5 NTU in wards number 8 & 9 (Table 2).

Table number 3: Physico-Chemical and microbial Properties of Samples Collected from different wards of Hisar city.

Parameter	Ward Numbers										BIS standard
	11	12	13	14	15	16	17	18	19	20	
pH	7.04	6.91	7.04	6.55	7.34	7.00	6.53	6.86	6.90	6.84	6.5-8.5
Temperature	30.9	32.6	32.4	32.5	32.2	32.6	29.1	30	30.2	29.8	
Conductivity	208.1	186.4	190.5	221.8	193	263.1	178.9	226.9	244.5	241.7	
Total hardness	63	90	96	99	155	97	104	93	101	102	200-600
Turbidity	0.6	5.2	3.2	4.3	5.8	4.5	1.2	3.9	1.6	0.8	1-5
Total alkalinity	44	40	50	56	152	48	34	36	48	44	200-600
Chloride content	13.5	12.5	12	16	32	17	13.5	15.5	12.5	13.5	250-1000
Free residual chlorine	00	00	00	00	00	00	0.1	00	00	00	0.2-1
Total coliform	900	00	00	00	02	04	00	00	00	00	00
Fecal coliform	30	00	00	00	02	02	00	00	00	00	00

Total alkalinity

The total alkalinity was recorded in four water works and twenty wards. The alkalinity was recorded maximum 212 ppm in PTU water works and minimum 108 ppm with Mahavir colony and Satroad water works (Table 1). The total alkalinity was recorded maximum 222 ppm and minimum 30 ppm in 1 and 6 ward number

respectively (Tables 2&3). The BIS are recommended the permissible limit for drinking water 200-600 ppm (BIS 2012).

Chloride content

The chloride content was observed in the four water works and twenty wards of Hisar city. The chloride content value was recorded maximum 22.5 ppm and minimum 11 ppm with PTU and Mahavir colony water works (Table 1). The chloride content was recorded maximum 32 ppm in ward number 15 and minimum 9.5 ppm in ward number 2 and 7 (Tables 2&3). The chloride content value was observed much lower than BIS are specify permissible limit 250 ppm for drinking water.

Free residual chlorine

If no residual disinfectant is present, pathogens survive in drinking water distribution pipelines and are delivered to consumers at the tap. It was observed that the free chlorine levels at the booster stations and beyond were not very different from other stations which suggest that chlorine is not frequently applied at the booster stations. Though, residual chlorine was detected in the waters at various stations, the presence of bacteria was also encountered (A. Y. Karikari . J. A. Ampofo 2013).

The free residual chlorine were observed in four exiting water works and twenty wards of Hisar city. The free residual chlorine were recorded in all water works. The maximum 0.9 mg/l range of chlorine was found in Satroad water works and minimum 0.7 mg/l range was recorded in Mahavir colony water works (Table 1). Only one PTU water works which have no free residual chlorine recorded (Table 1). So that, the pathogens were recorded in PTU water works water. In wards, the only in one ward number 17 was recorded free residual chlorine 0.1 mg/l which is lower than BIS standard value recommended (Table 3). In the nineteen wards were recorded no free residual chlorine. The permissible limit of free residual chlorine was recommended 0.2-1 mg/l (BIS 2012)

MICROBIOLOGICAL ANALYSIS

The total coliform and fecal coliform counts were determined by multiple tube dilution procedure given in the Standard Methods for the Examination of Water using lauryl tryptose broth (LTB) for the presumptive phase and brilliant green lactose bile broth (BGB) for confirmed phase. The EC Medium were used for fecal coliform test . Standard methods were followed in collecting, handling, preserving, and analyzing samples for the abovementioned parameters (APHA 1995). The bacteria were dedcted in four water works and twenty wards. The total 24 samples were collecting from these stations. The exiting three water works were recorded free residual chlorine in water sample so that the bacteria were not found in these water works. The PTU water works was recorded no free residual chlorine in the water sample so that the total coliform bacteria were dedcted 300 MPN/100ml and 50 MPN/100ml fecal coliform in

the water sample (Table1). The coliform bacteria were not deducted in wards number 8,12,13,14,17,18,19 & 20 (Tables 2&3). The total coliform bacteria were deducted maximum 1600 MPN/100ml and 1600 MPN/100ml fecal coliform in ward number 3(Table 2). The total coliform bacteria were deducted minimum 02 MPN/100ml and 02 MPN/100ml fecal coliform in ward number 15 (Table 3)

CONCLUSION

The study was informed about the physiochemical and microbiology parameter of water quality of exiting four water works and twenty wards of Hisar city. The parameters ph, temperture, conductivity, total hardness, total alkalinity & chloride content were found within the BIS standard limits. The turbidity was found highest in the Mahavir colony water works among the four water works. In the twenty wards the turbidity were deducted highest in ward number 1. The free residual chlorine were deducted in three water works and only in one ward and among the one water works and nineteen wards were found no residual chlorine. However, in the one water works and nineteen wards were found the microbial bacterial growth. The total coliform and fecal coliform were deduct only in PTU water works among the exiting four water works. In out of twenty wards the total coliform and fecal coliform were found in twelve wards. The total coliform and fecal coliform were deducted highest in ward number 3.

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