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Research Article

POTABILITY ANALYSIS OF DRINKING WATER IN VARIOUS REGIONS OF LUDHIANA DISTRICT, PUNJAB, INDIA

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ABSTRACT

The present study aimed at evaluating the water potability of the different regions of the Ludhiana, the Industrial hub of Punjab and the Manchester of India. The physicochemical and the bacteriological potability analysis was conducted by affable means to test the water samples collected from six areas of Ludhiana city: Civil lines, Chandigarh Road, Ferozepur Road, Haibowal, Pakhowal Road, Model Town. All the areas of study showed only 20-40 percentage potability although the hardness and pH values were found to be within the permissible limits. The present findings provide an insight into the quality of drinking water in the areas of study and can be used by local water authority to ensure the supply of safe drinking water among population.

Keywords: pH, Hardness, Potability, Bacteriological analysis, Water quality.

INTRODUCTION

Water is an abundant source to the living organisms on Earth and is one of the basic necessities. However, in India 70% of available water has been polluted by industrial/domestic wastes[1]. The basic necessity of a civilized population is pure and clean water and it is an undeniable fact that germ free safe water brings high standards to the public health[2]. Efficient monitoring of the quality of drinking water is the need of hour and is not impossible. The parameters that reflect the water quality can be categorized as Physical, Chemical and Biological. It is not the number of microbes that affect water quality but the kind of specific organism that is determinative[3, 4, 5]. As the microbes have high potential of water borne diseases viz. *Yersinia, Enterococcus, Klebsiella, Enterobacter, Campylobacter, Staphylococcus, Listeria, Aeromonas* therefore it becomes very important to find out the bacteriological condition of drinking water to ensure its safety. Potable water is subjected to various treatment processes including sedimentation, coagulation, filtration and chlorination. Perfect safety of consumption of water requires a methodology to evaluate the efficiency and effectiveness of treatment procedure. Safety is established on the presence of coliforms. The presence of non-pathogenic intestinal types such as *Escherichia coli* or *Streptococcus faecalis* in the water indicates that the faecal material has contaminated the water supply as these organisms are always found in the intestine and are not normally present in soil or water[6]. Therefore, microbial examination is used worldwide to monitor and control the quality and safety of drinking water. Keeping in view, water samples from different regions of Ludhiana district were subjected to potability analysis to have an insight into the bacteriological condition of drinking water.

MATERIALS AND METHODS

Total number of 30 drinking water samples (Tap and filtered) were collected from six areas (Area 1- Area 6) of Ludhiana city viz. Haibowal, Pakhowal road, Chandigarh Road, Ferozepur Road, Model Town and Civil Lines (Table 1). These samples were subjected to potability analysis for various physicochemical along with bacteriological parameters. Samples for water analysis were collected in sterilized narrow mouthed bottles (Autoclavable) with stopper of 500ml capacity. The bottles were autoclaved before sampling for 20 minutes. Five samples from each region were collected with utmost care to ensure that no contamination occurs at the time of collection and were labelled as S1 to S30 (Table 2) along with boiled water sample as Control. The water analysis was carried out within one hour of collection.

Bacteriological Examination: Bacteriological water testing kits procured from Department of Microbiology, PAU, Ludhiana were used for bacteriological examination for detection of total coliforms, E. coli and emerging pathogens from drinking water. The kit is based on a defined substrate to detect presence or absence of total coliforms and emerging pathogens without need of confirmatory or complete tests[7].The aluminium seal of bacteriological water testing kit was cut open and the testing water was filled into the kit aseptically under laminar air flow cabinet. This was followed by rubber stopper replacement and kit was incubated upto 48 hours. Each sample bottle was examined at the end of 24 hours for color change and popping of lid (gas production) and if no change in color was observed, these were re-incubated for 24hours and examined again. Samples were observed for color change and gas production. No color change and absence of gas production constitutes negative test whereas color change from purple to yellow along with gas formation (if any) indicates positive test.

Physico-Chemical Examination of Water: Ten samples were selected at random from the collected water samples and further analyzed for physicochemical parameters.

pH: The pH value determines whether the water is hard or soft. pH meter was used to determine the alkalinity of water samples.

Total Hardness: Hardness in water was determined by EDTA complexometric titration using N/50 EDTA solution, buffer solution (Amino chloride and Amino Sulfate), Erichrome T indicator, Distilled water and titration apparatus etc[8].

Calcium Hardness: EDTA complexometric titration method was used for the determination of Calcium hardness as per standard APHA methods. Murexide was used as an indicator and NaOH (buffer) was added to the contents.

Magnesium Hardness: Calculated by obtaining the difference between the values of total hardness and calcium hardness of the water sample[9]

Statistical Analysis: To calculate correlation analysis, correlation matrix was constructed by calculating the coefficients of different pairs of parameters viz. Mg^{2+}-Ca^{2+}, TH, Mg^{2+}, pH; Ca^{2+}- TH, pH and TH-pH[10].

Table 1: Areas of Water Sample Collection

S.No	Sample ID	Locality
1	Area 1	Haibowal
2	Area 2	Pakhowal Road
3	Area 3	Chandigarh Road
4	Area 4	Ferozepur Road
5	Area 5	Model Town
6	Area 6	Civil Lines

Table 2: Results obtained from potability analysis through kit method[7]

AREA/LOCALITY	SAMPLE NO	RESULT	INFERENCE
Area 1	S1	Positive	Non-Potable
	S2	Positive	Non-Potable
	S3	Positive	Non-Potable
	S4	**Negative**	**Potable**
	S5	Positive	Non-Potable
Area 2	S6	Positive	Non-Potable
	S7	**Negative**	**Potable**
	S8	Positive	Non-Potable
	S9	**Negative**	**Potable**
	S10	Positive	Non-Potable
Area 3	S11	Positive	Non-Potable
	S12	Positive	Non-Potable
	S13	Positive	Non-Potable
	S14	Positive	Non-Potable
	S15	**Negative**	**Potable**
Area 4	**S16**	**Negative**	**Potable**
	S17	Positive	Non-Potable
	S18	Positive	Non-Potable
	S19	Positive	Non-Potable
	S20	Positive	Non-Potable
Area 5	S21	Positive	Non-Potable
	S22	Positive	Non-Potable
	S23	**Negative**	**Potable**
	S24	**Negative**	**Potable**
	S25	Positive	Non-Potable
Area 6	**S26**	**Negative**	**Potable**
	S27	Positive	Non-Potable
	S28	Positive	Non-Potable
	S29	Positive	Non-Potable
	S30	**Negative**	**Potable**

Table 3: results of physico-chemical analysis in study areas

	Magnesium (mg/lt)	Calcium (mg/lt)	Hardness (mg/lt)	pH
Control	2.05	1.7	3.75	8.0
S1	7.65	4.6	12.25	8.1
S2	8.25	4.0	12.25	8.29
S3	7.95	4.25	12.2	8.1
S4	8.45	3.85	12.3	6.64
S5	7.5	4.55	12.05	8.05
S6	5.3	5.85	11.15	6.84
S7	6.8	5.0	11.8	7.6
S8	1.85	3.3	5.15	7.95
S9	0.55	3.2	3.75	8.18
S10	0.5	1.0	1.5	7.86
Mean Value	**5.48**	**3.96**	**9.44**	**7.76**
WHO Limits	**30**	**75**	**300 (as $CaCO_3$)**	**6.5-8.5**

Table 4: correlation analysis of water samples

	Magnesium	Calcium	Hardness	pH
Magnesium	1			
Calcium	0.696773975	1		
Hardness	0.972667206	0.84428668	1	
pH	-0.20992508	-0.3241625	-0.261775038	1

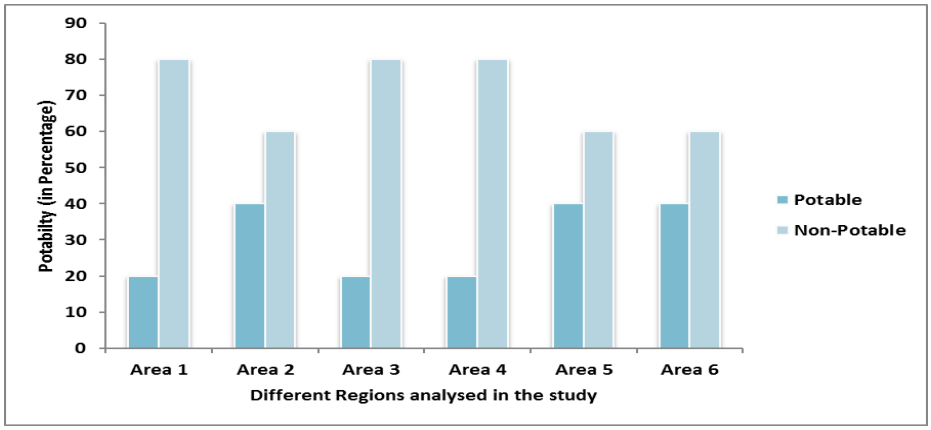

Figure 1: results of bacteriological kit analysis in different study areas

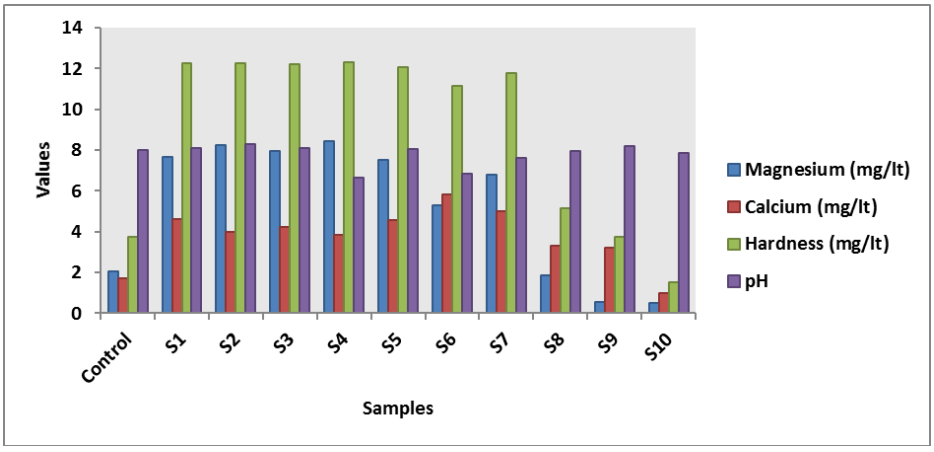

Figure 2: analysis of physico-chemical parameters

RESULTS

Microbiological Kit Analysis: Nine out of the 30 samples studied from six different regions were found to be potable as per the result shown in Table 2; Figure 1. The non potability of water samples suggests the possibility for presence of coliform group and that the water may have been contaminated with faecal matter.

Physico-Chemical Analysis: (Table 3, Figure 2): The pH value of water samples varied from 6.64 to 8.29 with the average value of 7.76 thus following within the value range as per WHO standards. The pH is dependent on carbon dioxide- bicarbonate[11, 12]. In the present study, the pH values were found to be within the permissible limits[13]. The degree of hardness of water may be classified in terms of calcium carbonate concentrations[14, 15]. Calcium and Magnesium cause the principle hardness in water.

In the present work done the total hardness of the study area varied from 1.5 mg/ litre to 12.25 mg/litre with mean value of 9.44mg/ litre and found to be within range. The least value obtained from the studied area 1.5 mg/litre was of tap water sample whereas the highest value 12.25mg/litre was obtained from the filtered sample (Table 3). Magnesium is an essential element of our body and its daily requirement for the adult is 200-300 mg. Excess of magnesium in our body leads to laxative effect and its deficiency leads to many structural and functional changes, chronic mal absorption problems, chronic renal failure, severe diarrhoea and protein calorie malnutrition[16]. The values obtained for the studied water samples varied from 0.5 mg/ litre to 8.45mg/ litre with mean value of 5.48 mg/ litre. All the values were found to be within WHO limits of 30mg/ litre[13]. The amount of Calcium in studied water samples with the average values of 3.96 mg/ litre with minimum value 1.0 mg/ litre and maximum value 5.85 mg/ litre and was found to be within WHO permissible limits (Table 3). The average of $Mg^{2+,}$ Ca^{2+} and Total Hardness in the present study fall within the standard values of Mg^{2+} (30mg/litre), Ca^{2+} (75 mg/ litre) and Total hardness (300mg/ litre)[13].

Statistical Analysis: The statistical relationship between Mg^{2+}-Ca^{2+} (0.69677), Mg^{2+}-TH (0.97266), and Ca^{2+}- TH (0.84428) showed the positive correlation (Table 4) indicating the same source of origin of ions. Calcium and Magnesium ions are contributing to the total hardness of water samples analyzed. A correlation coefficient of +1 indicates that two variables are related in a positive linear sense, whereas a correlation coefficient of -1 indicates that two variables are related in a negative linear sense and a correlation coefficient of 0 indicates that there is no relationship between the two variables[17].

DISCUSSION AND CONCLUSION

From the above results, it was inferred that nearly 73% of samples studied had bacteriologically non-potable water. The high prevalence of non-potable water was even reported by Sahota *et al*., 2010, which pointed out that water sources in these regions were contaminated. However, regarding the standard pH, Calcium, Magnesium and Total Hardness, all values of samples were found to be within the safe limits. As human population suffers from various water borne diseases by the contaminated drinking water, it is therefore necessary that the quality of drinking water should be checked at regular intervals and local water authorities need to take essential measures to ensure safe drinking water among population. Further work is needed to find out any association between various morbidities amongst the people and non-potable water to draw attention of concerned authorities.

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