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PHYSIO-CHEMICAL ANALYSIS OF WATER SAMPLES FROM DISTRICT KARNAL, HARYANA, INDIA

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Abstract: The analysis of physiochemical parameters of groundwater from different locations of District Karnal, Haryana was carried out. The physiochemical parameters namely pH, electrical conductivity, Total Dissolved Solids, Total Alkalinity, Total Hardness, Chloride, Calcium, Magnesium, and dissolved oxygen were determined. Each parameter was compared with the standard desirable limits prescribed by World Health Organization (WHO), Bureau of Indian Standard (BIS) and Indian Council of Medical Research (ICMR) to assess the quality of ground water. Systematic calculation was made to determine the correlation coefficient 'r' amongst the parameters. Significant value of the observed correlation coefficients between the parameters was also carried out. It is concluded that the water quality of water supply systems in different locations of Karnal is of medium quality and suitable suggestions were made to improve the quality of water.

Keywords: pH, Kurukshetra, ground water, water quality, physiochemical parameter, water pollution

1. INTRODUCTION

Water is the most important natural resource on earth. We cannot imagine our life without water because we need it for different purposes. The main applications of water are domestic uses, irrigation, commercial uses, industrial uses and for the production of hydropower. Safe drinking water is the primary need of all human beings. The safety of drinking water is affected by various chemical and microbiological contaminants and these contaminants cause serious health problems. Due to these contaminants, the quality of the drinking water is getting poorer day by day, which causes many diseases in the humans. Water pollution may occur due to different phenomenon. In the villages, domestic sewage and animal wastes are leading causes of ground water pollution [1-4]. Quality of ground water is continuously changing due to natural and human activities. It varies from place to place and with the depth of the water table. Most of the waste products seep down into soil and hence contaminating the underlying ground water. Therefore all ground water sources are not safe. So, physiochemical analysis can be used to monitor water quality.

Many investigations have found a correlation between cardiovascular deaths and water composition. Many workers have studied the physio-chemical parameters of ground water from different areas of India [5-18]. The objective of the scientific investigations is to determine the hydrochemistry of the ground water in Karnal, Haryana and to classify the water in order to evaluate the water suitability for drinking, domestic and irrigation uses and its suitability for municipal, agricultural and industrial use. The social relevance of the problem has encouraged us in carrying out this work.

2. MATERIALS AND METHODS

Physio-Chemical Analysis was carried out for various water quality parameters such pH, electrical conductivity (EC), Total dissolved solids (TDS) , Total Hardness (TH), Total alkalinity (TA), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Dissolved oxygen (DO), as per standard procedure described "Standard methods for the examination of water and waste water American public Health Association (APHA)" [19]. The physical parameter pH was determined using the digital pH meter (LT-10, Labtronics, Panchkula, India) and EC was determined using the digital conductivity meter (LT-16, Labtronics, Panchkula, India).

2.1 STUDY AREA

The water samples were collected from nineteen locations of District Karnal for their physio-chemical analysis. The different sampling locations are given in Table 1. Samples were collected in good quality polythene bottles of one-liter capacity. Sampling of water is truly representative of any aquatic environment. Once a sample has been taken it should have no possibility of transporting trace elements either to or from the sampling container walls. Sampling was carried out without adding any preservative. The bottles were well rinsed before sampling and tightly sealed after collection and labeled in the field.

TABLE 1: SAMPLING LOCATIONS OF KARNAL

Sr. No.	Sampling Locations	Source	Location Code
1.	Kachwa Village	Submersible Tube well	K1
2.	Dabri Village	Hand pump	K 2
3.	Gandhi Nagar	Submersible Tube well	K 3
4.	Gandhi Nagar	Hand pump	K 4
5.	Bank Colony	Tube well	K 5
6.	Nirmal Kuttia (Zarifa Farms)	Submersible Pump	K 6
7.	Saudagar House, Pal Nagar	Submersible Pump	K 7
8.	Maan Colony	Tube well	K 8
9.	Railway Station	Tube well	K 9
10.	Bus Stand	Tube well	K 10
11.	Jyoti Nagar	Submersible Pump	K 11
12.	Nikka Singh Kuttia, By pass Karnal	Submersible Pump	K 12
13.	Civil Hospital	Submersible Pump	K 13
14.	CSSIR	Tube well	K 14
15.	Kalampura Village	Submersible Tube well	K 15
16.	NDRI, Karnal	Submersible Pump	K 16

17.	Sanatan Dharam Mandir, Kunjpura Road	Submersible Pump	K 17
18.	Model Town, Karnal	Submersible Pump	K 18
19.	Rambagh Colony Near Randhir Cinema	Submersible Pump	K 19

3. RESULTS AND DISCUSSIONS

Characterization of the physiochemical parameters of groundwater from nineteen different locations in Karnal, Haryana are reported in Table 2. Each parameter was compared with the standard desirable limits prescribed by World Health Organization (WHO), Bureau of Indian Standard (BIS) and Indian Council of Medical Research (ICMR) to assess the quality of ground water [20-21]. The physiochemical parameters namely pH, electrical conductivity, Total Dissolved Solids, Total Alkalinity, Total Hardness, Chloride, Calcium, Magnesium, and dissolved oxygen were determined. Systematic calculation was made to determine the correlation coefficient 'r' amongst the parameters.

TABLE 2: PHYSIOCHEMICAL PARAMETERS OF GROUNDWATER FROM DIFFERENT LOCATIONS IN KARNAL, HARYANA

Sr. No.	Location Code	pH	EC(25°C) (µs/cm)	TDS (ppm)	TA (ppm)	TH (ppm)	Ca^{2+} (ppm)	Mg^{2+} (ppm)	DO (ppm)
1.	K1	6.94	1200	780	305	497.29	118.91	378.38	2.6
2.	K 2	6.92	900	585	215	356.76	210.81	145.95	2.9
3.	K 3	6.91	500	325	100	351.35	205.40	145.95	3.8
4.	K 4	7.23	400	260	60	443.24	248.65	194.59	2.3
5.	K 5	6.94	700	455	160	367.57	108.11	259.46	2.3
6.	K 6	7.07	1100	715	240	243.24	151.35	91.89	7.3
7.	K 7	7.21	1000	650	250	286.49	178.38	108.11	6.0
8.	K 8	6.92	300	195	55	189.19	108.11	81.08	6.2
9.	K 9	7.08	1100	715	195	524.32	281.08	243.24	4.8
10.	K 10	6.93	700	455	145	378.38	156.76	221.62	6.9
11.	K 11	7.47	300	195	65	205.41	118.92	86.49	6.9
12.	K 12	7.16	500	325	105	329.73	189.19	140.54	5.0
13.	K 13	7.1	700	455	150	432.43	297.29	135.14	7.7
14.	K 14	6.98	500	325	110	335.14	189.19	145.95	6.3
15.	K 15	7.01	1100	715	245	508.11	118.92	389.19	4.2

16.	K 16	7.5	900	585	210	454.05	259.46	194.59	6.1
17.	K 17	7.2	1200	780	195	605.41	394.60	210.81	4.5
18.	K 18	7.3	700	455	170	367.57	194.60	172.97	7.1
19	K 19	7.5	1000	650	200	421.62	194.59	227.03	6.7

The desirable limit of pH value for drinking water is specified as 6.5 to 8.5. Measured pH value of the water samples ranges from 6.9 to 7.5. pH values are within desirable limit. The electrical conductivity of the samples ranges from 300μs/cm to 1200μs/cm. BIS prescribed that the desirable limit of TDS is 500 ppm and the maximum permissible level is 2000 ppm. The TDS value ranges from195 ppm to 780 ppm. TDS of all samples is within maximum permissible limit. The standard desirable limit of alkalinity in portable water is 120 ppm and the maximum permissible level is 600 ppm. The values of alkalinity in the water samples of villages of District Karnal are in between 55 ppm to 305 ppm. Total alkalinity of all samples is within maximum permissible limit but in maximum samples it is above desirable limit. The value of alkalinity of water provides an idea of natural salts present in water. Main cause of alkalinity is the mineral, which dissolves in water from the soil. Water hardness is a measure of capacity of water to react with soap. Hardness is very important property of ground water from utility point of view for different purposes. Standard permissible limit for total hardness specified by ICMR and BIS is 300 ppm of $CaCO_3$. A fluctuating trend, i.e., from 189.19 ppm to 605.41 ppm is observed in the measured total hardness values in the samples. Also, in maximum samples it is above permissible limit. For domestic use, the maximum desirable limit for calcium is 75 ppm whereas in case of non availability of water, calcium upto 200 ppm could be accepted. Calcium concentration in water samples from all the locations was found to vary from 108.11 ppm to 394.60 ppm. It is above maximum desirable limit in all samples. Also, in many samples it is above maximum permissible limit. Magnesium concentration in water samples from all the locations ranged from 81.08 ppm to 389.19 ppm. The highest permissible limit of Magnesium concentration is 150 ppm. Magnesium concentration in most of the samples is above the highest permissible limit. Dissolved oxygen (DO) in water is the vital gas for many animal organisms. It is consumed in water from decomposition of organic matters. It is a highly fluctuating factor in water. In this study dissolved oxygen content varied in a limited range of 2.3 ppm to 7.7 ppm.

4. CORRELATION STUDIES

Study of correlation reduces the range of uncertainty associated with decision making. The correlation coefficient ‘r’ was calculated using the equation

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \times \sum y^2}}$$

The correlation matrix for the water quality parameters are given in Table 3.

TABLE 3: CORRELATION MATRIX FOR THE WATER QUALITY PARAMETERS

Parameters	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	DO
pH	1	0.0081	0.0081	-0.0325	0.0434	0.2651	0.7315	0.3931
EC		1	0.9999	0.9349	0.6129	0.2618	0.5463	-0.1154
TDS			1	0.9348	0.6128	0.2617	0.5464	-0.1153
TA				1	0.4382	0.0205	0.5344	-0.1109
TH					1	0.6126	0.7315	-0.1662
Ca^{2+}						1	-0.0909	0.0269
Mg^{2+}							1	-0.5057
DO								1

4.1 TEST OF SIGNIFICANCE OF THE OBSERVED CORRELATION COEFFICIENTS

Significance of the observed correlation coefficient has been tested by using 't' test. A total of 36 correlations were found between the two parameters. Negative correlations were found in cases between the TA and pH, between TDS and DO, between TH and DO, between Mg and DO, TA and DO, between DO and EC, between Ca and Mg. Some of the highly significant correlations were discernible between the EC and total dissolved solids, between EC and TA, between TDS and TA.

5. CONCLUSIONS

Study of physiochemical parameters of groundwater from nineteen areas of District Karnal, Haryana was carried out. Theses samples were collected from different locations. The water samples were analyzed for pH, EC, total alkalinity, total hardness, soluble cations Ca^{2+} and Mg^{2+} following the standard procedures. The quality of drinking water depends upon the harmful elements present in it. Systematic calculation was made to determine the correlation coefficient 'r' amongst the parameters. Significant value of the observed correlation coefficients between the parameter was also carried out. The results showed significant variations in water quality parameter in the study areas. Total Alkalinity of all samples is within maximum permissible limit but in most of the samples average of alkalinity has exceeded the desirable limits which are due to improper drainage system and due to domestic and agricultural activities in the villages. TDS of all samples is within maximum permissible limit. Total Hardness in maximum samples is above permissible limit. Calcium concentration is above maximum desirable limit in all samples. Also, in many samples it is above maximum permissible limit too. Magnesium concentration in most of the samples is above the highest permissible limit.

Ground water of the villages of District Karnal is suitable for drinking and domestic purposes but in some areas there is need of treatment to minimize the contamination specially alkalinity. However, the hazardous effects of fertilizers, pesticides, animal wastes and sediments have not been detected in the ground water samples. It is advised that waste products should not be deposited near the water sources. The use of fertilizers and pesticides in the agriculture should be limited.

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