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Physico-Chemical Analysis of Drinking Water in Hanumangarh District, Rajasthan India

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ABSTRACT
Water samples were taken at twenty different locations along Hanumangarh District and were subjected to physicochemical analysis. The result of pH was found to range between 7.05-7.50, Electrical conductivity was found to be between 0.31-0.52 mmho/cm. The lowest value of Chloride, 32.5mg/l was recorded at location C19. Sulfate, Calcium and Magnesium, DO & BOD were found to range between 10-13 mg/l, 1.70-4.97 meq/l, 1.19-3.19 meq/l, 5.15-9.79 mg/l & 4.12-4.86 mg/l.
Keywords: *Physicochemical analysis, Electrical conductivity, Dissolved oxygen, Biochemical Oxygen Demand.*

INTRODUCTION

Water is most abundant and is an essential part of our life supporting systems. But due to the rapid growth of population, urbanization and industrialization the water has become polluted(1). Water is considered as one of the nutrients, although it yields no calories, yet it enters into structural composition of the cell and is an essential component of diet(2).

It is estimated that over 70 per cent of India's food grain production comes from irrigated agriculture, in which ground water plays a major role(3). In India, 6.73 mha of land is affected by salinity and sodicity(4). Groundwater contains a varying amount of different kinds of ions such as carbonate, bicarbonate, calcium, magnesium, sulphate, hardness, etc. (5). Among them, the major cations are Calcium, Magnesium and sodium which influence the suitability of groundwater for human consumption, agricultural irrigation and other purposes. Some of these cations are beneficial to crop production at expected concentration, otherwise cause toxicity to plant, affect properties of soil and management practices(6). Majority of the underground tube well waters contain high concentration of salts and their continuous use for irrigation adversely affects the crop production and cause soil deterioration. It necessitates continuous monitoring of ground water for assessing the possible damage on salinity and alkalinity induced soil health(7).

Physico- chemical changes may be natural or human induced. Naturally, by leaching and percolation toxic metals and chemicals may enter the ground water and contaminate the aquifer. Human induced or anthropogenicaly pesticides and fertilizers which are applied to crop can accumulate and migrate to ground water table[8].

The groundwater is important for the existence of human society; it is a liberal part of environment. Hence, it cannot be looked in isolation especially, where high degree of dependence is upon groundwater for drinking purpose like Rajasthan. The main water resources in Hanumangarh district are canals and tube-wells. Hanumangarh district is connected by canal systems, Indira Gandhi and Bhakra Canal. Most of the land is irrigated by these canal systems; rest of the lands is irrigated by the ground water.

Therefore the basic objectives for groundwater quality analysis of Hanumangarh are to analyze Physico-chemical parameters of the drinking water and apply some new approaches for prevention of water borne diseases.

MATERIALS & METHODS

Study Area

The ground water of Hanumangarh is used for agricultural as well as drinking purpose. In the present study, 20 samples were taken from different resources of Hanumangarh.

Sample Collection

Potable water samples were collected from Canal system of Northern Rajasthan (Indira Gandhi &Bhakra canal). These samples were collected in sterile capped containers[9]. To avoid contamination disposable gloves washed with HCl (1N) were worn during water sampling. The water containers were kept in air tight large plastic ice-cold containers and were transported to Biotechnology lab within six hours for the further processing.

Physico-chemical Analysis

The Physico-chemical parameters which were analyzed include pH, Electrical Conductivity, Chloride, Sulphate, Calcium, Magnesium, Sodium, Potassium, Dissolved Oxygen and Biochemical Oxygen Demand. Following methods were used to assess the quality of ground water.

RESULTS & DISCUSSION

In order to explore Physico-chemical study of Drinking water in different areas of Hanumangarh District, Rajasthanseveral experiments were conducted and observed with respect to the analysis of Physico-chemical parameters.

pH Determination

The pH of water reveals almost uniform magnitude in all the study samples and it is lying from 7.05 to 7.50, (Table 1 & Fig 1) which is tolerable for living system as specification given by[10],[11]. The fluctuations in optimum pH ranges may lead to an increase or decrease in the toxicity of poisons in water bodies[12]. According to WHO[10] and Ministry of work and Housing[13] highest desirable range of pH is from 7.0 to 8.5. The higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition[14].

EC Determination

Electronic conductance showed variability in samples rather than pH. Maximum EC (0.52 mmho/cm) and minimum EC (0.31 mmho/cm) was recorded at sample C6 and C13 respectively (Table 1, Fig 2). High EC value in water promotes solubility of other chemicals. Ukpong EC[15] obtained the values of electrical conductivity obtained from the private borehole water samples ranged from 18.13-38.62 µs/cm while that of the public ranged from 89.18 to 103.00µs/cm.

Chloride Determination

Spatial variability chloride showed that study sample C8 was rich in chloride content (40 mg/l) also its values are higher than Indian specification for drinking water[11].The application of chlorine is essential to insure the safety of drinking water. Minimum chloride value (32.5mg/l) was recorded in C19 study sample. (Table 1, Fig 3) Higher chloride value reveals that samples are salt

abundant samples. Chloride, it is one of the major anions found in water and waste water. This result was positively correlated with the chloride content of the ground water in Prakasamdistrict[16]. The high concentration of chloride is due to dissolution of salts, soil erosion and discharge effluents into the water sources. The reason for the high amount of salinity might be the dissolution of organic waste due to discharge of industrial effluents containing high concentration of chlorides.

Sulfate Determination

Spatial variation of sulfate content in water sample showed that there was significant difference in sulfate contents between different study samples. Maximum sulfate content (13 mg/l) was recorded at sample C14. Lowest value (10 mg/l) of sulfate was obtained in C12 (Table 1, Fig 4). Sulphate occur naturally in drinking water and health concerns regarding its level has been linked with diarrhea due to its laxative effects especially when there is change from drinking water with low sulphate to drinking water with high sulphate concentration[17]. Saravanakumar K & Kumar RR[18] selected 10 different locations for the study and compared Groundwater samples were collected from ten different locations of Ambattur town during the post-rainy season and obtained 150-230 mg/l sulfate value.

Calcium Determination

The calcium content was found to be between 1.7 – 4.95 mg/l in C10 and C1 respectively (Table 1, Fig 5) and it was lesser than the ISI, WHO and ICMR permissible limit for fresh water[19]. Calcium is an element that is found naturally and in abundance in the earth crust. It is an important and abundant element in the human body and an adequate intake is essential for normal growth and health. Ca is the most important element causing hardness in water.

Magnesium Determination

The magnesium values which were obtained ranged lies between 1.19 meq/l-3.19 meq/l. The minimum value was recorded in C11 and maximum in C10. In observations lowest values were obtained from C11 to C15 samples. Pindi PK et al[20] observed the value 11.06- 17.01 mg/l Magnesium content in study samples (Table 1, Fig 6). The desirable limit of magnesium in water is 50 mg/l as per ISI. Linaet al[21]reported significant association between hardness and magnesium or calcium Concentrations. This result was positively correlated with the magnesium content of the water samples collected from the village of Velsao at Goa, which ranged from 60 to 110 mg/l[22].

Dissolved Oxygen Determination

DO is very important parameter of water quality and an index of physical and biological process occuring in water. When temperature increases gas solubility of water decreases and microbial activity increases; both these changes can reduce DO in water. DO shows significant difference at different study samples the maximum DO (9.79 mg/l) was recorded at study samples C8. Minimum value (5.15 mg/l) was obtained in C13 (Table 1, Fig 7). The same trend was also reported in Beeshazaari Lake by Burlakoti[23]. Dissolved oxygen present in drinking water adds taste and it is a highly fluctuating factor in water. Dissolved Oxygen (DO) is a parameter of aeration and inverse pollution. The level of the oxygen in water (3 to 5 mg/l) is an indicator of healthy state of water and values below 3 mg/l are hazardous to human. Well aerated water has reduced pollution than a poorly aerated water body. When the DO is high the pollution is low when the DO is low, the pollution level is high[24]. The reason for the low dissolved oxygen content was due to high decomposition of organic matter, which indicates a high pollution load in the water. The deficiency of the oxygen in the water is shelter for bacteria and other pathogens, which are anaerobic and injurious to human health.

Biochemical Oxygen Demand (BOD) Determination

BOD is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water[25]. It is very important indicator of the pollution status of a water body. BOD shows

significant difference at different study samples the maximum BOD (4.86 mg/l) was recorded at study samples C20 (Table 1, Fig 8). Organic matter was indicated by comparatively high BOD level. BOD range was too high, showing wide presence of organic matter, which is not potable.Water with BOD levels <4mg/L are deemed as clean, while those >10 mg/L are considered polluted and unsafe[26].

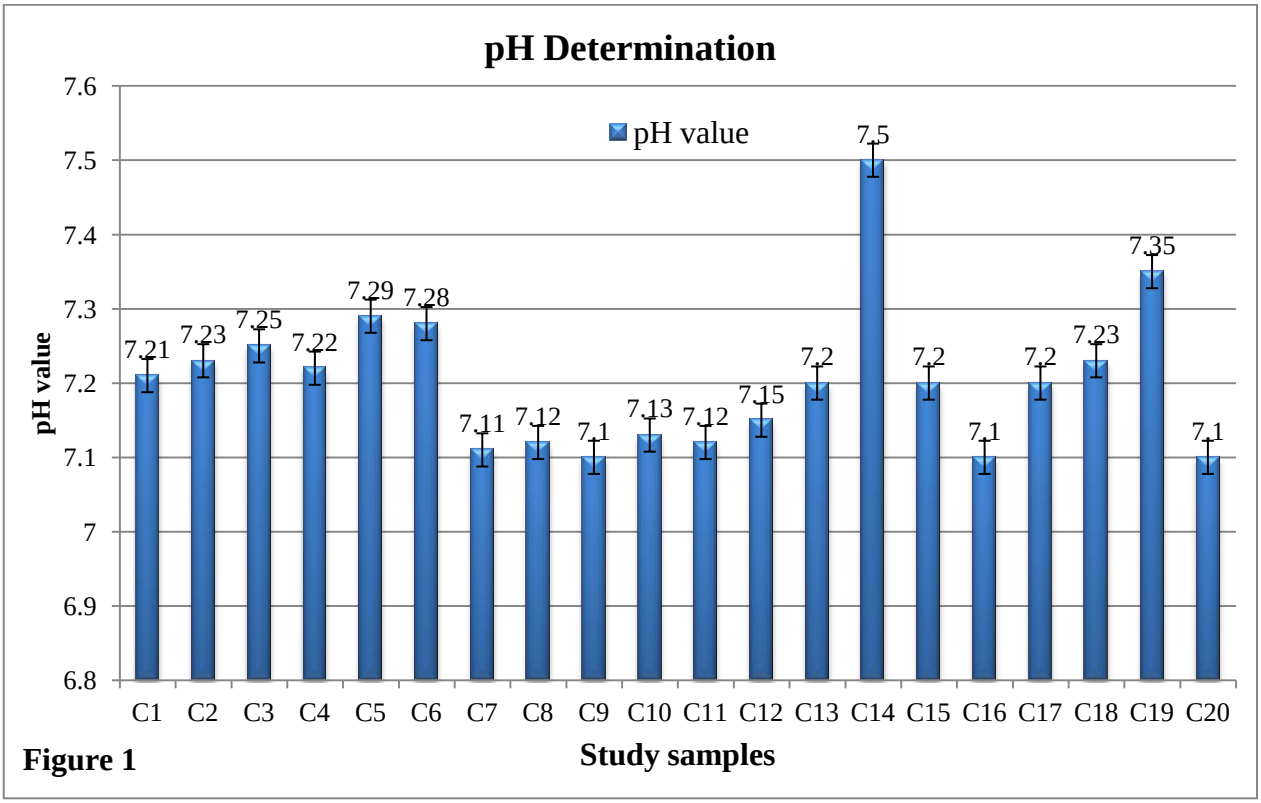
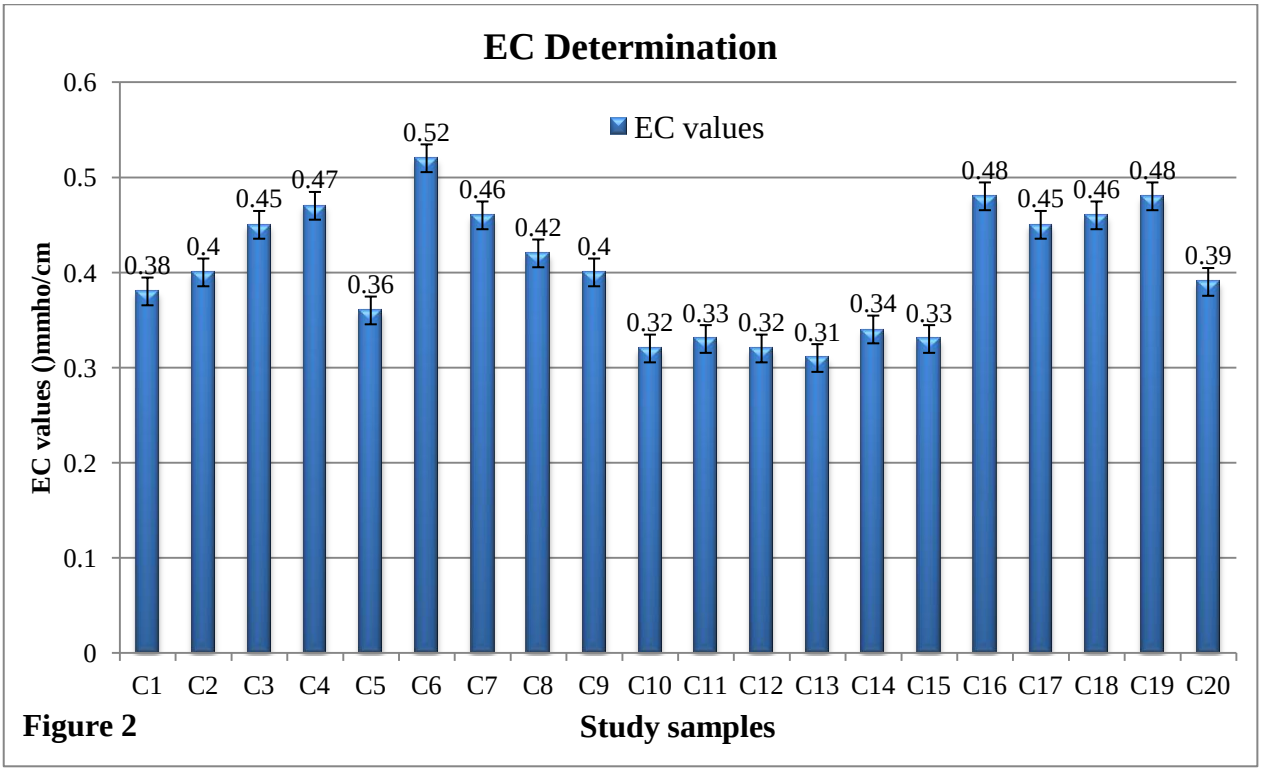


Figure 1



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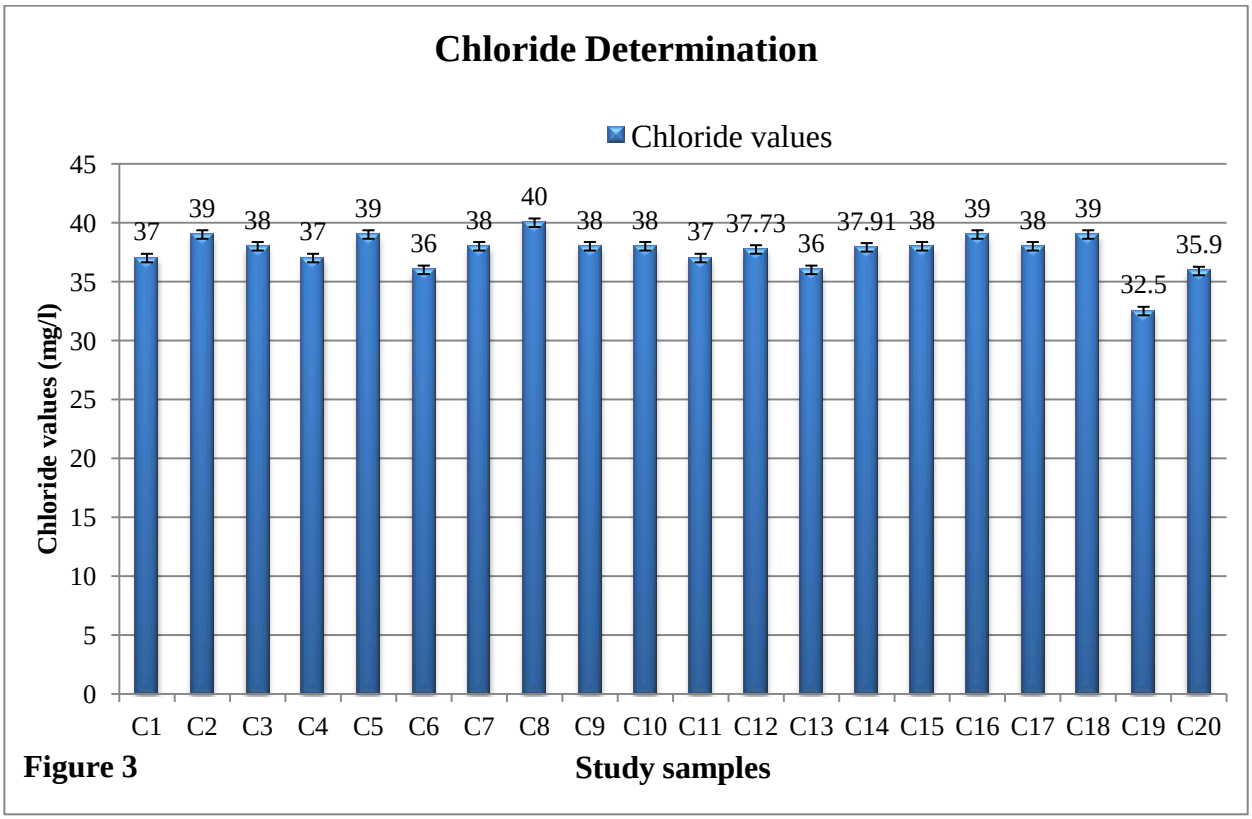

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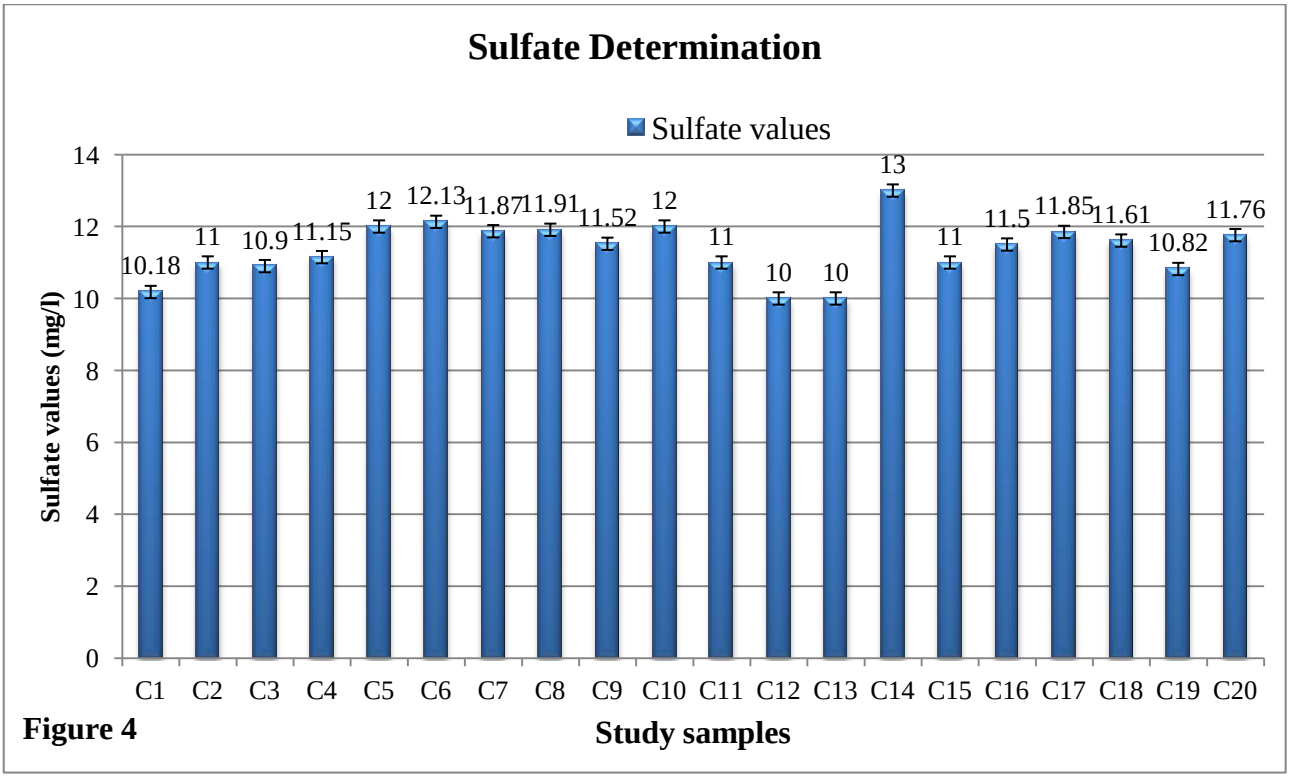

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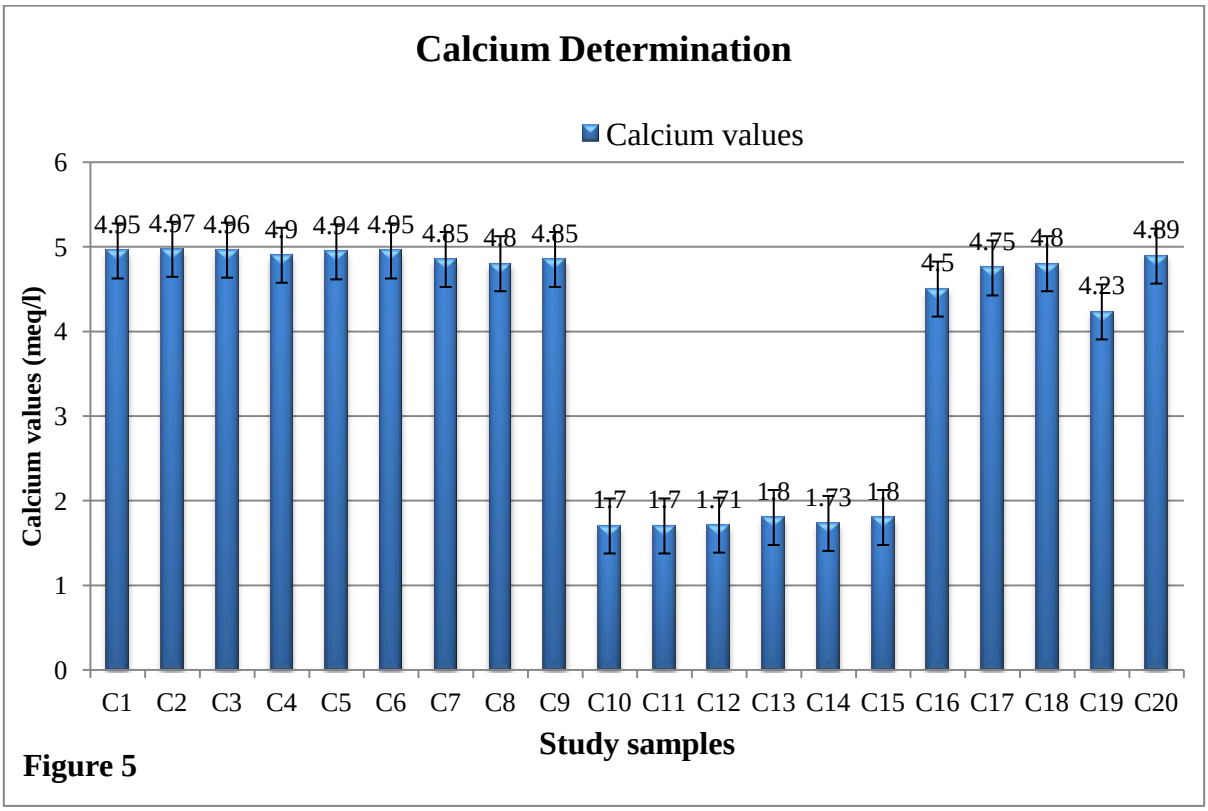

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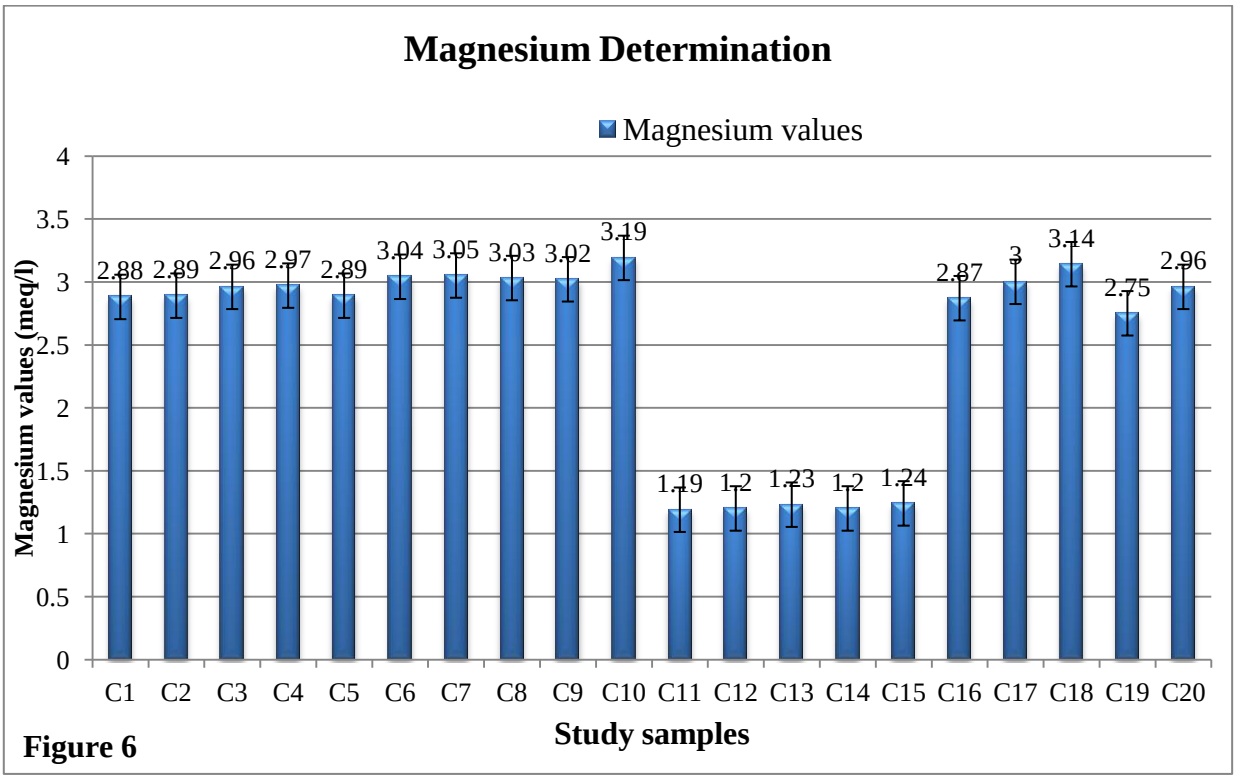

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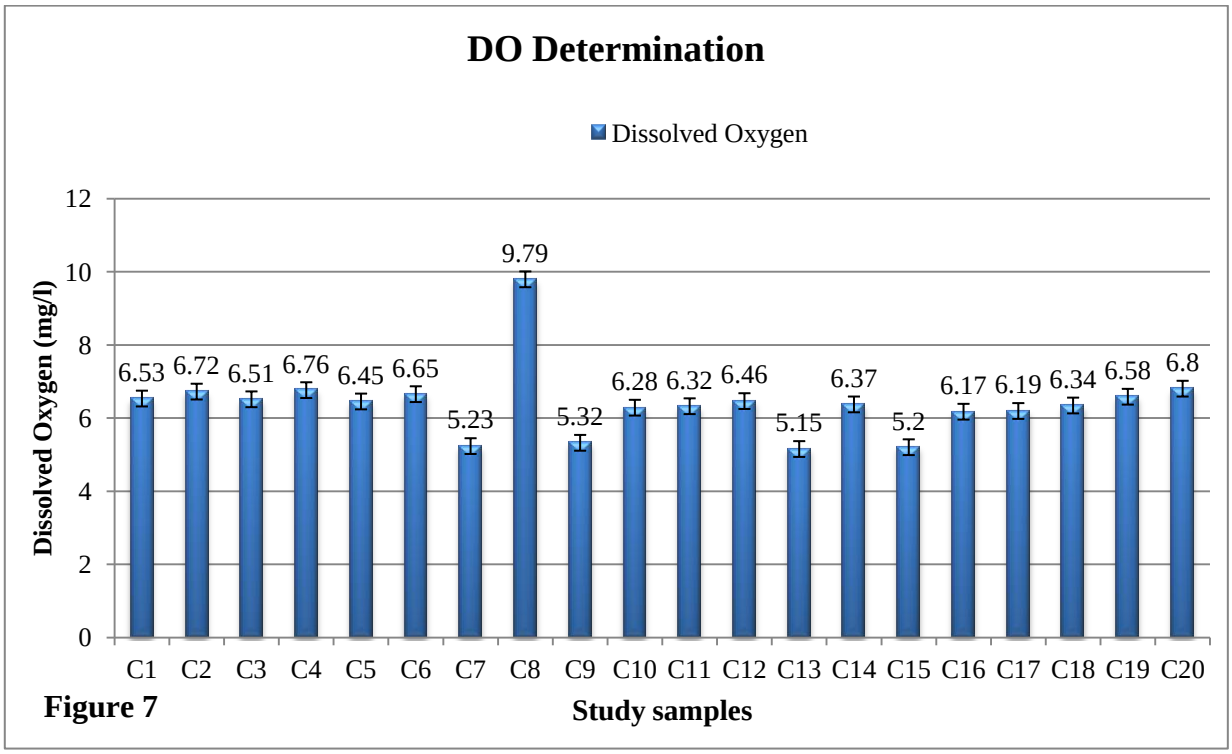

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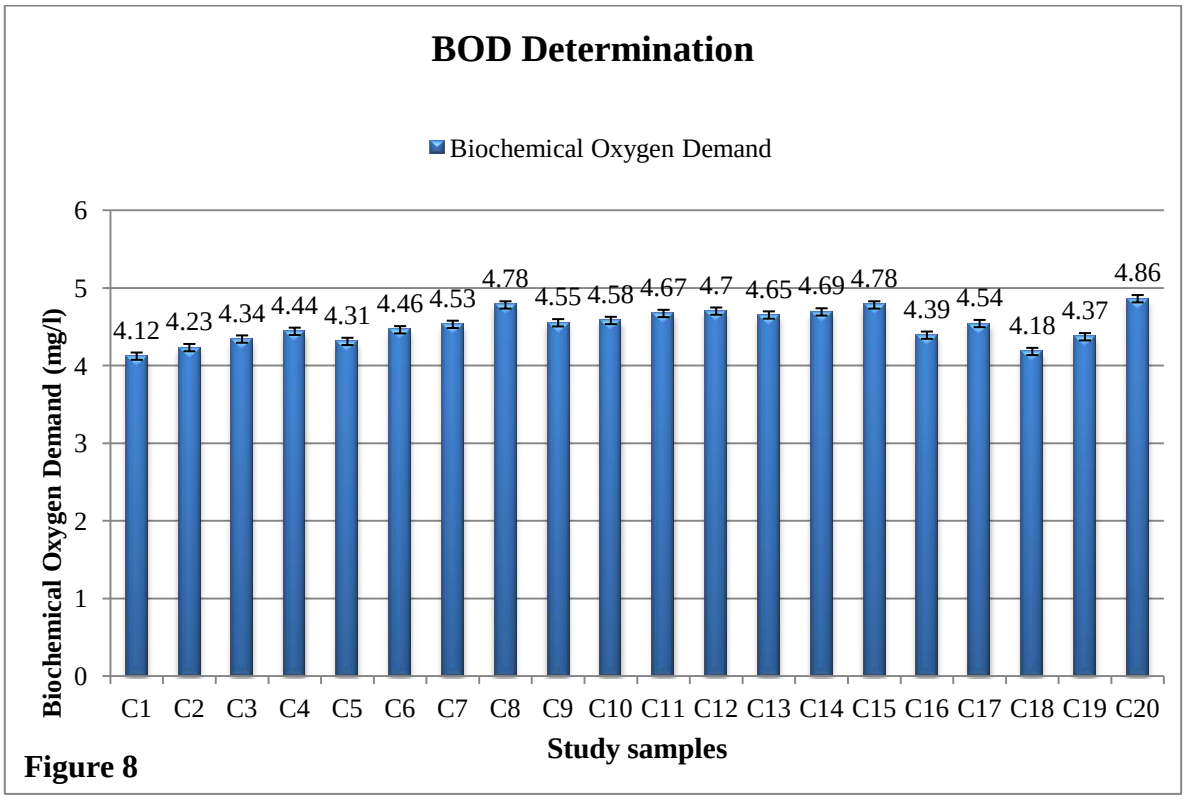

Figure 8

Table 1 showing obtained results C1-C10 showing the sample Points of Bhakra Canal; C11-C20 showing the sample Points of Indira Gandhi Canal

Sampling Point	Area	pH	EC Value in mmho/cm	Cl (mg/l)	SO_4 (mg/l)	Ca (meq/l)	Mg (meq/l)	DO (mg/l)	BOD (mg/l)
C1	Sangria	7.21±0.23	0.38±0.15	37±1.20	10.18±0.32	4.95±1.26	2.88±0.32	6.53±0.65	4.12±0.10
C2	Nagrana	7.23±0.45	0.40±0.25	39±0.90	11±0.45	4.97±1.08	2.89±0.43	6.72±1.18	4.23±0..42
C3	Ratanpura	7.25±0.12	0.45±0.21	38±0.98	10.90±0.82	4.96±1.10	2.96±0.18	6.51±0.78	4.34±0.35
C4	Manaksar	7.22±0.18	0.47±0.10	37±1.25	11.15±0.12	4.90±1.12	2.97±0.76	6.76±0.93	4.44±1.12
C5	Jandawali	7.29±0.09	0.36±0.2	39±0.45	12±1.31	4.94±0.76	2.89±0.89	6.45±0.86	4.31±0.77
C6	Dabhan	7.28±0.21	0.52±0.12	36±1.38	12.13±0.89	4.95±1.02	3.04±0.93	6.65±1.10	4.46±0.63
C7	Pakkasaharana	7.11±0.11	0.46±0.18	38±1.10	11.87±0.72	4.85±0.88	3.05±0.48	5.23±0.34	4.53±0.56
C8	Fatehgarh	7.12±0.15	0.42±0.11	40±0.82	11.91±0.36	4.80±0.48	3.03±0.22	9.79±0.58	4.78±0.78
C9	Makkasar	7.05±0.16	0.40±0.07	38±0.86	11.52±0.88	4.85±1.10	3.02±0.35	5.32±0.42	4.55±0.89
C10	DabliRathan	7.13±0.08	0.32±0.16	38±0.58	12±0.79	1.72±1.05	3.19±0.12	6.28±0.67	4.58±1.18
C11	Tibbi	7.12±0.28	0.33±0.10	37±1.05	11±0.62	1.70±1.21	1.19±0.16	6.32±0.36	4.67±0.27
C12	TalwaraJheel	7.15±0.24	0.32±0.13	37.73±1.40	10±1.92	1.71±0.98	1.20±0.24	6.46±0.48	4.70±0.68
C13	Munda	7.20±0.09	0.31±0.08	36±1.35	10±1.30	1.80±0.32	1.23±0.10	5.15±0.19	4.65±0.56
C14	Rampura	7.50±0.32	0.34±0.13	37.91±0.88	13±1.20	1.73±0.48	1.20±0.30	6.37±0.28	4.69±0.42
C15	Rawatsar	7.20±0.18	0.33±0.20	38±1.98	11±1.15	1.80±0.69	1.24±0.26	5.20±0.45	4.78±0.37
C16	Naurangdesar	7.10±0.45	0.48±0.12	39±0.97	11.50±0.98	4.50±053	2.87±0.15	6.17±0.76	4.39±0.18
C17	Jakharanwali	7.20±0.36	0.45±0.08	38±0.65	11.85±0.82	4.75±0.39	3.00±0.21	6.19±1.20	4.54±0.68
C18	Chahuwali	7.23±0.17	0.46±0.11	39±1.52	11.61±1.18	4.80±0.68	3.14±0.19	6.34±0.67	4.18±1.05
C19	Dhannasar	7.35±0.26	0.48±0.09	32.50±2.49	10.82±0.24	4.23±1.40	2.75±0.68	6.58±0.65	4.37±0.48
C20	Gandheli	7.10±0.42	0.39±0.25	35.90±1.68	11.76±0.76	4.89±1.25	2.96±0.24	6.80±0.75	4.86±0.78

CONCLUSION

The outcome of the study can help to develop a water quality awareness culture and practice in present as well as in future generation.

Water provides a unique medium to many physical, chemical and biochemical reactions. Any minute change in water quality parameter may adversely and favorably affect the particular reaction as well as whole ecosystem[27]. So water chemistry has a keen scope for this project.

So, this study will helpful to many water quality analysts as well as biologist, ecologist and environmentalists and also very useful to Public Health Department and Municipal Corporation to improve public health in epidemiological issues.

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