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Physicochemical Status of Drinking Water of Quetta District

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Abstract: Water is a universal naturally occurring solvent found ubiquitous where the life exists. If no water then there would be no life. Therefore the present study was mainly aimed to conduct research and to get knowledge about the physical and chemical nature of drinking water found in Quetta city. The water samples were collected from three different sources *viz.,* Tube well, Karaiz and Spring of Quetta city during 2011. A total of eight physicochemical parameters i.e. air temperature, water temperature, electrical conductivity (EC), pH, Ca^{2+}, Ca^{2+}+Mg^{2+}, Na^{+} and K^{+} were investigated by standard methods. Results showed that the average value of air temperature was recorded as 20, 23 and 26 °C at Tube well, Karaiz and spring water locations, respectively. Average water temperature was reported as 22.66, 10.66 and 5.00 °C, electrical conductivity was noted as 278.33, 342.66 and 475.33 µS/cm and pH was recorded as 6.44 and 6.59 lowest to highest in Tube well, Karaiz and Spring water respectively. Average Ca^{2+} content was 1.45, 2.10 and 5.80 mg L^{-1}; Ca^{2+}+Mg^{2+} was 1.82, 0.85 and 1.27 mg L^{-1}; Na^{+} was 24.16, 49.76 and 62.86 mg L^{-1}; K^{+} was 22.98, 34.32 and 43,86 mg L^{-1} in Tube well, Karaiz and Spring water respectively. All the investigated parameters (except pH and EC) exhibited that all water samples are neutral and non-polluted, which can be used both for drinking and agricultural purposes. But the pH and conductivity of the tested samples indicated that water from spring and tube well is under deterioration and should be treated before to use mainly for drinking purposes.

Key words: Water · Physical · Chemical · Parameters · Drinking · Irrigation

INTRODUCTION

Water is a universal naturally occurring solvent found everywhere where the life exists. Water is indispensable for life. Quality of water is much more essential than quantity for maintaining a good health and agricultural productivity. The quality of water varies from time to time and place to place due to interaction of local factors. Water is a prerequisite for each and every living creature.

In Pakistan, only 40 to 60% of the available water is safe. Water borne diseases are caused by pathogenic microorganisms. Therefore it becomes very important to find out the physicochemical and bacteriological properties of drinking water [1]. Water is one of the most vital requirements for the sustained survival of all living organisms on earth. The day-to-day actions of all living organisms' requisite water in whatever form. It is efficiently and effectively put into use by man, plants, animals and microorganisms. In the microbial world, no single microorganism has been discovered to be lively at the tremendous lack of water for the singular reason that man cannot exist without water, it is of top significance to examine household water supply [2]. Water pollution is the precise impairment of water quality by agricultural, domestic or industrial wastes to a degree that has an adverse effect upon any helpful use of water yet that does not essentially generate a real danger to public health. Due to industrialization and urbanization, waste water that is being discharged into natural water reservoirs fallout in severe ground water contamination [3]. The water quality varies from time to time and place to place due to interaction of local factors. Here the water is being used for drinking purposes by human beings, cattle and wild life etc. It is also a source of water for other purposes like domestic water supply, municipal water

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supply and agriculture. In the absence of any in depth knowledge about the water quality and ill-effect of various construction activities *viz*. road construction, dam construction and various other human malpractices discharge of untreated sewage etc. People are increasingly concerned about the safety of their drinking water. As improvement in analytical methods allow us to detect impurities at very low concentration in water. Water supplies once considered pure and found to have contaminants. We can't expect pure water, but we want safe water. Water located beneath the ground surface in soil pore spaces and in fractures of lithologic formation [4]. This is the water that percolated downward from the surface through the soil pore. Ground water is naturally replenished by surface water from precipitation, streams and rivers. Groundwater contamination occurs when man made products such as gasoline, oil, road salts and chemicals get into the groundwater and cause it to become unsafe and unfit for human use (Anonymous, 2009) [4]. Generally rural dwellers rely on ground water as drinking water and for other domestic cores since it does not generally require treatment.

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (International down to individual aquifers and wells). It has been suggested that it is the leading worldwide cause of deaths and disease [5, 6] and that it accounts for the death of more than 14,000 people daily. [7] estimated that 700 million Indians have no access to proper toilet and 1,000 Indian children die of diarrheas sickness every day. While some of 90% of China's cities suffer from some degree of water pollution and nearly 500 million people lack access to safe drinking water [8]. In the most recent national report on water quality in the United States, 45% of assessed stream miles, 47% of assessed lake acres and 32% of assessed bay and estuarine square mile were classified as pollutant [9]. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water and/or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena as volcanoes, algae blooms, storms and earthquakes also cause major changes in water quality and the ecological status of water.

The water quality of the study area (Quetta) is now on the path of deterioration, but why? In order to find out an answer to this problem, a study of various resources which are responsible for the deterioration was undertaken in the 5th part "Sources of Environmental Deterioration". The problems of water in Quetta are not that of availability but of portability. The water quality of the city is generally neglected based on the general belief that it is pure through the natural purification process. There is inadequate information or knowledge of the quantity, quality and pattern of distribution of Quetta's water resources. Therefore, the present study was mainly designed to investigate the physicochemical attributes of drinking water collected from three different sources of Quetta.

MATERIALS AND METHODS

Study Area: The present experiment is conducted at Botany Department, University of Balochistan, Quetta. The Quetta city is an urban area and is the head quarter of the province Balochistan. The coldest months here are December to February and the hottest months are June to July. The temperature varies from -5 to 20°C in winters and 30 to 38°C in summers. But some time winter temperature ebbs to 3°C and summer temperature shoots up to 42°C. In the summers, which begin from March and last till mid June the temperature starts rising. On the average there are 49-55 rainy days (day with rain fall of 2.5 mm or more) in a year. In the district, July and September the relative humidity are high being over 70%. During the Post-Monsoon and winter season the humidity is high in the morning. By summer the relative humidity become very low i.e., <25%.

Sampling and Sampling Sites: A fluorinated plastic bottle of 2 liter capacity has been used to collect the water samples. Before sampling evacuation of the stored water in the pipelines has been made to take the fresh ground water samples. The selected sample sites are populated and urban areas of the city. The water sampling has been carried out in the month of September and October during year, 2011. Three kinds of water samples are collected viz., Spring water, tube well water and Karaiz water fro Quetta city. At each sampling location, composite water sample was taken and stored in clean poluethylene bottles that have been pre-washed with HNO_3 and thoroughly rinsed with deionized water.

Temperature: Water temperature was determined in the field because of their unstable nature and it was recorded with the help of mercury thermometer. For accuracy, the sample was taken in a container and thermometer, after dipping it in water for 2-3 minutes and then the reading of thermometer was recorded as °C. While the atmospheric

temperature is recorded after keeping the thermometer in air for about 5 minutes. Thereafter the water samples are brought to Physiology Labotatory of Botany Department, University of Balochistan, Quetta for the measurement of other physicochemical attributes of collected water samples. The methods used are those described by [9].

Conductivity: The electrical conductivity of the collected water samples are determined with the help of electrical conductivity meter (Pen Type DIST 3 Model).

Hydrogen Ion Concentration (pH): The ph value of the water samples are determined by the electrical pH meter (Model PE 132).

Ca^{2+} Hardness: About 100 ml of water sample taken in a flask followed by the addition of muroxide indicator and 1 ml of 1N NaOH. After this the sample is titrated by standard EDTA solution till the color changed and then calculated the Ca^{2+} (mg L^{-1}) with the help of following equation:-

$$Ca^{2+} \text{ hardness (mg } L^{-1}) = \frac{\text{ml of EDTA used x 100}}{\text{ml of water sample titrated}}$$

Mg^{2+} Hardness: It is calculated by using the given formula:-

$$Mg^{2+} \text{ Hardness (mg } L^{-1}) = \text{Total Hardness-Ca Hardness}$$

Total Hardness: Total hardness is determined by using EDTA titration method. About 100 ml sample of water is treated by 0.01 NEBT + 1 ml of ammonia buffer. End point is recorded at the time of first color change (pink or blue) and total hardness is then calculated by using the given formula:-

$$\text{Total Hardness} = \frac{\text{ml of EDTA used* 100 mg/l}}{\text{ml of sample taken}}$$

Chemical Analysis of Water Samples: The water samples are prepared for chemical analysis by taking 1 ml sample in 10 ml conical flask and added in it 0.5 ml concentrated HNO_3. The final volume is made 6N HCl for analysis by atomic absorption spectrophotometer (Model AA. 2380 PERKIN ELMER) and sample was then employed in the analytical Lab of Chemistry Department, University of Balochistan, Quetta for other parameters.

Potassium Determination: Potassium (K^+) is determined by Flame Photometry, using Corning 400 Flame Photometer.

Reagents and Procedure: Potassium chloride stock solution (100ppm) is prepared by dissolving 0.095 g of KCl in 500 ml of deionized water. A series of standard solution containing 0.0, 5, 15, 20, 25 and 30 ppm of potassium are prepared. In the beginning water is aspirated for about 15 minutes and the Galvanometer is adjusted to zero with blank (deionized water). This procedure is repeated after every each sample. Unknown samples are then aspirated simultaneously and the Galvanometer reading is noted. Similarly the standard working solutions are aspirated and their readings are noted respectively. A plot of intensity vs potassium concentration is drawn. The data obtained for K^+ (ppm) is then converted into mg L^{-1}.

Sodium Determination: Sodium (Na^+) in different water samples are also determined by Flame Photometry.

Reagents and Procedure: Sodium chloride stock solution (100 ppm) is prepared by dissolving 0.127g of NaCl in 500ml distilled water. The same procedure is adopted as for K^+ after setting the Na^+ filter. A plot of intensity vs sodium concentration is also established and then recalculate the unknown Na^+ concentration in three different sources of water samples. The data obtained for Na^+ (ppm) is then converted into mg L^{-1}.

RESULTS

Results described in Table 1 indicated that air temperature at all the spots is recorded in the range of 20-26 °C. The minimum air temperature is recorded as 20 °C at location of tube well water sampling and maximum of 26 °C is found at space where spring water is collected. The temperature of water is in the range of 3-5 °C. The maximum water temperature (25 °C) is recorded in tube well water and minimum (3°C) in spring water. The level of pH is noted in the range of 6.37-6.83 and highest value is recorded for spring water while lowest for tube well water. The electrical conductivity of water samples are found in the range of 259-506 µS/cm. However, highest conductivity i.e., 506 µS/cm is noted for spring water and lowest i.e., 259 µS/cm for tube well water.

Results described in Table 2 also indicated that Ca^{2+} contents at all the spots are recorded in the range of 1.5-4.16 mg/l. The minimum (1.50 mg/l) and maximum

Table 1: Physical Characteristics of Different Water Samples Collected from Three Different Sources of Quetta.

Water Samples	Air Temperature (°C)	Water Temperature (°C)	pH	E.C. (µS/cm)
Spring water	26	7.00	6.80	506
	26	5.00	6.82	462
	26	3.00	6.83	458
Tube well water	20	20	6.37	259
	20	23	6.40	291
	20	25	6.56	285
Karaize water	23	14	6.53	349
	23	10	6.60	341
	23	8	6.64	338

Table 2: Nutrients Status (mg/l) of Different Water Samples Collected from Quetta City.

Water Samples	Ca^{2+} (mg/l)	$Ca^{2+} + Mg^{2+}$(mg/l)	Na^{+} (mg/l)	K^{+}(mg/l)
Spring water	0.00	0.00	68.6	39.00
	1.90	0.90	59.0	45.60
	3.90	2.90	61.0	47.00
Tube well water	0.00	0.00	23.3	32.30
	1.50	1.56	24.6	35.66
	2.86	3.90	24.6	35.00
Karaize water	0.00	0.00	49.3	24.33
	2.16	0.83	50.0	22.30
	4.16	1.73	50.0	22.33

Table 3: Average Value of Physical Characteristics of Different Water Samples Collected from Quetta City.

Water Samples	Air Temperature (°C)	Water Temperature (°C)	pH	E.C. (µS/cm)
Spring water	20	22.66	6.44	278.33
Tube well water	23	10.66	6.44	342.66
Karaize water	26	5.00	6.59	475.33

Table 4: Average Value of Nutrients in Different Water Samples Collected From Quetta City.

Water Samples	Ca^{2+} (mg/l)	$Ca^{2+} + Mg^{2+}$(mg/l)	Na^{+} (mg/l)	K^{+}(mg/l)
Spring water	2.10	0.85	49.76	22.98
Tube well water	5.80	1.27	62.86	43.86
Karaize water	1.45	1.82	24.16	34.32

(4.16 mg/l) values are recorded for water samples collected from tube well and Karaize, respectively. The $Ca^{2+} + Mg^{2+}$ value is in the range of 0.83-2.90 mg/l. The maximum $Ca^{2+} + Mg^{2+}$ value i.e., 2.90 mg/l is noted in spring water and minimum i.e., 0.83 mg/l in Karaize water sample. The level of Na^{+} is noted in the range of 23.3-68.6% lowest to highest in the tube well water and spring water, respectively. K^{+} is found in the range of 22.30-47.00% and highest is noted in spring (47.00%) water sample and lowest in Karaize water samples (22.30%).

Results described in Table 3 indicated that average air temperature at all the spots are recorded 20, 23 and 26 °C lowest to highest in tube well, Karaize and spring water samples, respectively. Average value of water temperature is noted as 22.66, 10.66 and 5.00 °C highest to lowest in tube well. Karaize and spring water samples, respectively. The average level of pH is noted as 6.44 and 6.59 in the water of tube well, karaize and spring, respectively. Similarly the average values for electrical conductivity are found as 278.33, 342.66 and 475.33 µS/cm in tube well, karaize and spring water samples.

Results described in Table 4 enumerated that average Ca^{2+} at all the spots are recorded as 1.45, 2.10 and 5.80 mg/l lowest to highest in tube well, karaize and spring water, respectively. Average value of Ca + Mg is noted as 0.85, 1.27 and 1.82 mg/l lowest to highest in karaize, spring and tube well water samples, respectively. The average level of Na^{+} is recorded as 24.16, 49.76 and 62.86 mg L^{-1} lowest to highest in the water of tube well, karaize and spring, respectively.

DISCUSSION

The quality of water resources depends on the management of water sources. This would include anthropogenic discharges as well as the natural

physicochemical properties of the area. Water temperature depends on the season and on the temperature of the ground with which it is in contact. In this study the results of physicochemical characteristics of 3 different sources of water samples from each site are reflected in Table 1 and 2. Results revealed that water temperature ranges from 3 °C – 25 °C showing minimum and maximum values in spring and tube well water during all the seasons. Similar observations are also reported by Schaefer and [10] in their studies of nitrogen and phosphorus in Altamaha river, Georgia.

The pH of a water body is very important in determining the water quality since it affects other chemical reactions such as solubility and metal toxicity [11]. pH values ranges from 6.37-6.83. It was found to be acidic in nature during all seasons and no significant difference in pH is observed between the samples during the study period except tube well water that the pH dropped to an acidic range less than 6.50. The pH of the water under study in all the seasons is within WHO standards of 6.50-8.50 except tube well water. Other water could therefore, be regarded as neytral and unpolluted [11].

Electrical conductivity is a good and rapid method to measure the total dissolved ions and is directly related to total solids. Higher the value of dissolved solids, greater the amount of ions in water [12]. In this study the conductivity values are minimum (259 µS/cm) in tube well water and maximum (506 µS/cm) in spring water and this conductivity value are high than the recommended values and hence the water can be used for agricultural purposes and after treatment for domestic use too. Similar results are are also obtained by [13, 14].

Total hardness of water is a parameter that used t o describe the effect of dissolved minerals (mostly Ca^{2+} and Mg^{2+}), determining suitability of water for domestic, industrial and drinking purposes and attributed to presence of bicarbonates, sulphates, chlorides and nitrates of calcium and magnesium [15]. The values of $Ca^{2+} + Mg^{2+}$ in three water samples varied from 0.83 – 2.90 mg/l. Minimum value is recorded for spring water and maximum for karaize water. The results of total hardness ($Ca^{2+} + Mg^{2+}$) in all the water samples of this investigation are found under the standard limits. Therefore, it can be used for domestic and agricultural purposes. Similar trend of results are also reported by [16, 17].

The calcium content showed fluctuation i.e., from 1.5-4.16 mg/l. The minimum value of Ca^{2+} (1.5 mg/l) is recorded for tube well water and the maximum for karaize which might be due to prevailed drought conditions. The concentration of Ca^{2+} is mainly due to the bedrocks of water bodies, but the solid waste due to human activities, when entered the water system showed its profound effect. The level of Na^{+} is noted in the range of 23.3-68.6, lowest to highest is recorded for tube well and spring water, respectively. K^{+} is found in the range of 22.30-47.00, lowest to highest is noted for karaize and spring water samples, respectively. An increase in Na^{+} and K^{+} content might be owe to surface water run-off, which has been added to it. There is also a combined impact of the erosion of base rock of the water body basin and of domestic activities.

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