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DETERMINATION OF METALS IN THE WATER OF TOBA KAKARI DISTRICT PISHIN

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ABSTRACT

Toba kakari is mountainous region consist of large and small number of residential and cultivated locations. It is situated in district Pishin of Baluchistan Province. The sources of water in this region is karez and bore holes, therefore, the water of the said region was analyzed to determine the existence of metals. Thus, the parameters like, pH scale, electrical conductivity and total dissolved solids were analyzed. Atomic absorption spectrometer was used for detection of metals in water. The sample was collected from seven different part of region for assessment of pH, TDS, EC, which were found in normal range, except pH of Goalie, Khalilah, and Killa haji khan which had higher values, while the concentration of metals were found greater than the range suggested by international agencies, but within tolerable limits.

KEYWORDS: Metals, Water, electrical conductivity, total dissolved solid.

INTRODUCTION

Toba Kakari is mountainous region situated in Pishin district of Baluchistan, Pakistan. This region lies between 30°55'55.65"(N) and 67°23'44.80"(E) containing many villages, this is snowfall region where temperature vary from -5 °C to 20 °C, mostly the population belongs to kakar tribe, the source of income in this region is agriculture and goat farming. The main source of water is karez (spring) and bore holes which is used for drinking, washing and agriculture purpose. Our body contain water up to 75% body weight.[1] Human brain is made up of 95% water and blood containing 82%.[2]

Surface and tube well water is an important reservoir in both rural and urban areas. Approximately, seven hundred eighty billion people do not have approach to pure water, due to contaminated water many deaths have been reported,[3] Water analyzing has become necessary in various part of world,[4] now a day the properties of water are decided by its taste, color and concentration of dissolved metals.[5]

The whole universe contains 118 elements; these are divided into metals, semimetal and nonmetals. Usually metals are found as dissolved cations in water, which vary in concentration and types area to area.[7] They are beneficial for human being when taken in specific concentration as approved by environmental protective agencies and world health organization.[6]

Usually, concentration of metals in water like iron, cobalt, antimony, lead, manganese and others are measured in ppm (part per million). The standard values for these metals ranges from 0.05 to 0.3 ppm.[8] Human body cannot tolerate these metals if concentration exceeds and water become toxic. The toxicity of metals in water affect the human body by reducing RBC, damaging vital body organs, nervous system, which may cause cancer and death.[9,11]

In this modern age, metals in ground and surface water gained great importance, which are categorized as idiopathic elements for human being,[10] there are large number of analytical techniques to investigate the various features of water.[12] Which are used to determine pH, TDS, electrical conductivity and trace metals.

METHODOLOGY

Water sample were collected from different residential and agricultural areas to determine the physical

parameters like pH, TDS and electrical conductivity of sample were investigated by considering the criteria and techniques suggested by international health agencies. The pH water sample was measured by using a pH meter (model 3505 jenway). The electrical conduction of the sample was calculated by using a conductivity meter (model 4520 Jenway).[17]

For elemental analysis samples were collected using properly labelled and roofed 500ml polypropylene plastic feeding bottle thoroughly cleaned with a metal-free, non-ionic detergent solution, rinsed with tap water, soaked in 1 + 1 HNO_3 acid for 24 hours at 70°C and then rinsed with metal-free water.[13]

50ml of each sample was measured using a pipette into labelled 100ml beakers and 10ml of Conc. Nitric acid was added, heated to a volume of about 12ml, gently three drops of thirty % hydrogen per oxide were added with continuous heating until the lowest possible volume of about 3ml without letting the sample dry up. The sample was then cooled for approximately 3 second, 5ml of Conc. Hydrochloric acid was added and sample was heated for about 5 minutes, Later on it was cooled, beaker walls were washed with distilled water, and filtered through a whatmann,s filter paper no.1 with about two portion of 5ml distilled water to rinsing the residue and filter paper, adding the rinsing to 100ml volumetric flask,[14,15] and proceed for metallic investigation by using Atomic Absorption spectrophotometer (thermo electron corporations series). The sample location and source is as shown in tab 1.

Table 1: Water specimen locations and source.

S/N	Location	Source
1	Goalie	Borehole
2	HabibManda	Spring
3	Sargargi Karas	Borehole
4	Khalilah	Borehole
5	Layghai	Borehole
6	Sheenah Chana	Spring
7	Killa Haji Khan	Borehole

RESULT

Percentage of hydrogen (pH)

H^+ ion concentration is considered as one of the necessary water property, it refer to the bitterness or alkalinity of the water. Acidic water can promote rapidly to decay and rusting of metal containers. While alkaline water shows purification in water. The pH value of all collected water sample of Toba kakari is found to be in between 7.9 and 9.1 Tab (2) and Fig(1) tolerable pH range is considered to be 6.7 to 7.2,[18] Whereas WHO recommended range for pH is 6.5 to 8.5.[16]

Table 2: The pH values of the water samples of Toba kakari, district Pishin, Baluchistan.

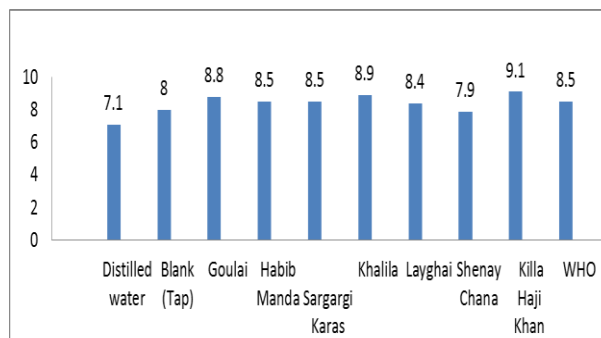| S/N	Location	pH
A	Distilled water	7.1
B	Blank(tap water)	8.0
1	Goalie	8.8
2	HabibManda	8.5
3	Sargargi Karas	8.5
4	Khalilah	8.9
5	Layghai	8.4
6	Sheenah Chana	7.9
7	Killa Haji Khan	9.1

Figure 1: The pH values of water sample of Toba Kakari, district Pishin, Baluchistan.

Total dissolved solid (TDS)

The measurement of Total dissolved solid in water sample was carry out as the standard procedures.[18] TDS consist of the mineralized particles and little quantity of hydrocarbons and derivatives of hydrocarbon matter; these are present as dissolved form in water. Tab (3) and Fig (2) shows TDS limits for all seven water samples. The ideal measure of the TDS suggested by authorized agency is 1000 mg/L. The drinking water containing TDS values below 1000 mg/l is assumed to be safe and tolerable.[19] The highest TDS values observed are 0.45 mg/L and the least TDS values was found 0.22 mg/L of sample from Killa Haji Khan and Sheenah Chana, respectively.

Table 3: TDS values in water sample of Toba Kakari, district Pishin, Baluchistan.

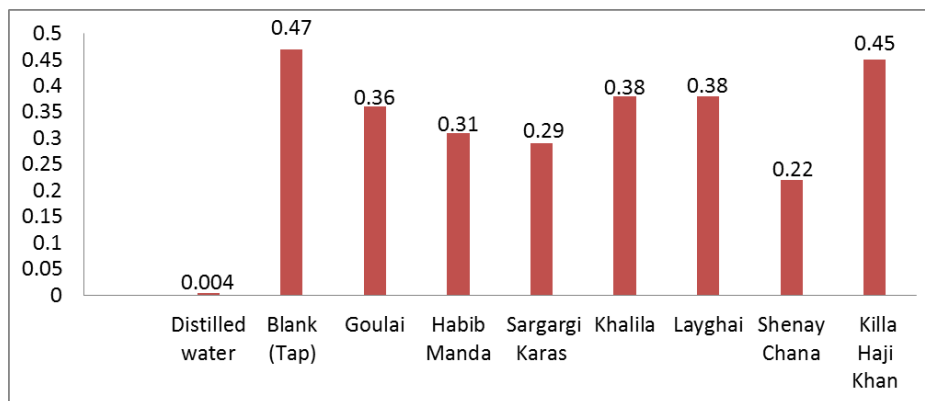| S/N	Location	TDS(mg/L)
A	Distilled water	0.004
B	Blank(tap water)	0.47
1	Goalie	0.36
2	HabibManda	0.31
3	Sargargi Karas	0.29
4	Khalilah	0.38
5	Layghai	0.38
6	Sheenah Chana	0.22
7	Killa Haji Khan	0.45

Figure 2: TDS values in water sample of Toba Kakari, district Pishin, Baluchistan.

Electrical conductivity

Electrical conductivity is the capability of any matter to pass electric current. The dissolved ionic particles in water are the main cause of conduction.[17] The values of electrical conductivity are given in Table(4) and in Figure (3). According to authorized agency, the highest permitted grade of electrical conductivity is 1000 μS/cm. The lowest value of electrical conductivity noted in water of Toba kakari was found to be 473μS/cm while highest value recorded was 892 μS/cm. The least value of electrical conductivity of water taken from testing spot was Sheenah Chana while that of highest values for Killa Haji Khan. While mean conduction of water of Toba kakari is 681μS/cm.

Table 4: Conductivity of water samples of Toba kakari, district Pishin, Baluchistan.

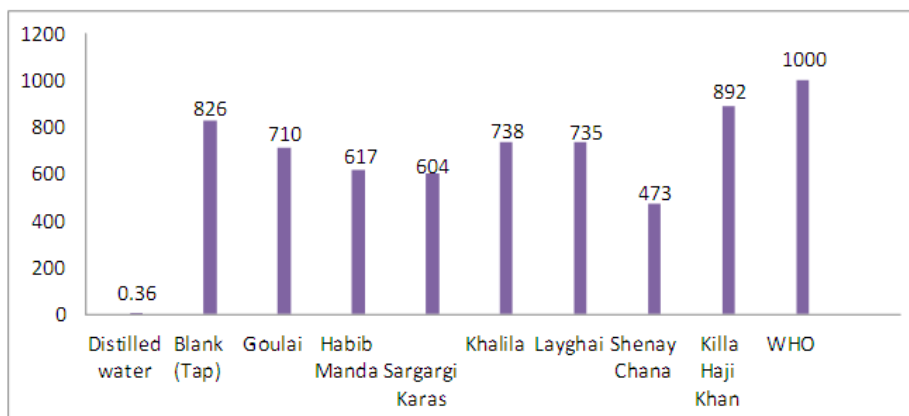| S/N	Location	Conductivity(μS/cm)
A	Distilled water	0.36
B	Blank(tap water)	826
1	Goalie	710
2	HabibManda	617
3	Sargargi Karas	604
4	Khalilah	738
5	Layghai	735
6	Sheenah Chana	473
7	Killa Haji Khan	892

Figure 3: Conductivity of water samples of Toba kakari, district Pishin, Baluchistan.

Investigation of metals

The abundancy of metal having greater atomic mass in water is assumed to be more harmful to health, therefore, it is very important to assess the concentration of metals.[19]

The standard values of concentration given by WHO for some metals found in water are shown in Table (V).

Table (V): The standard values of concentration given by WHO for some metals found in water.

S/N	Heavy Metal	WHO LIMIT (ppm)
1	Iron(Fe)	0.3
2	Cobalt(Co)	0.005
3	Antimony(Sb)	0.006
4	Lead(Pb)	0.015
5	Manganese(Mn)	0.05

Heavy metals concentrations in Toba Kakari water

After the analysis of water of Toba kakari the concentration of Fe, Co, Sb, Pb Mn along with RSD are shown in Tab(6) and Fig(4).

Table 6: Concentration (ppm) along with RSD of Heavy metals of drinking water samples in Toba Kakari, district Pishin Baluchistan.

| S/N	Sample	Fe /RSD	Co /RSD	Sb /RSD	Pb /RSD	Mn /RSD
1	Goalie	0.4993/1.1	0.7023/0.8	8.8768/0.4	2.9224/0.5	0.1836/0.1
2	HabibManda	0.7203/0.5	0.6824/0.1	9.4203/0.8	2.1693/1.1	0.1886/0.3
3	Sargargi Karas	0.8767/0.3	0.7533/1.5	8.2779/1.0	2.2111/0.5	0.5624/0.5
4	Khalilah	0.8975/0.2	0.7061/0.9	7.8797/0.6	2.7819/0.1	0.0728/1.1
5	Layghai	0.6819/0.2	0.9659/0.1	10.518/0.1	2.1466/0.8	0.1456/0.5
6	Sheenah Chana	0.6515/1.1	0.7537/0.9	9.8568/0.1	2.9138/0.1	0.651/0.1
7	Killa Haji Khan	0.8039/0.8	0.6356/0.5	9.4048/0.9	1.1929/0.5	0.7715/0.4
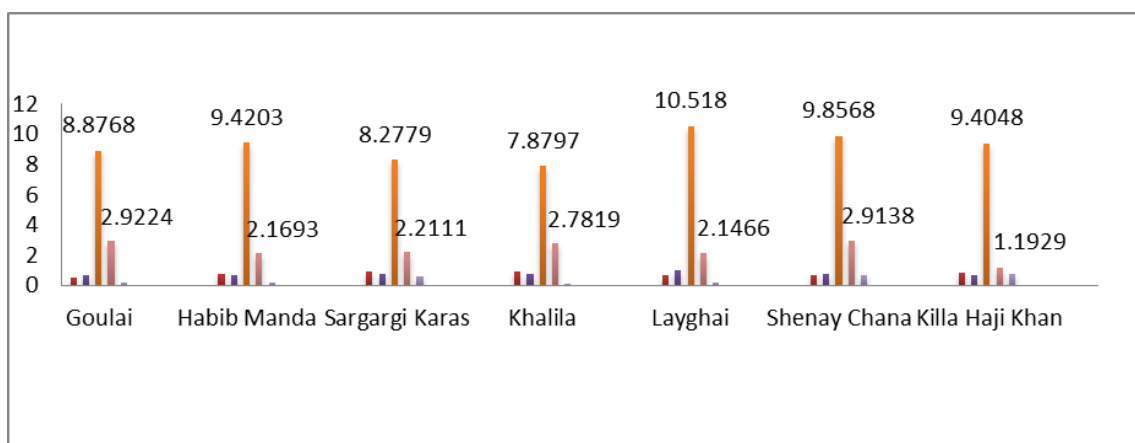
Figure 4: Concentration (ppm) of metals (Fe, Co, Sb, Pb & Mn) in drinking water samples in Toba Kakari, district Pishin, Baluchistan.

The concentration of iron in water sample of Toba kakari range is 0.49 to 0.89 ppm, the concentration is greater than recommended by WHO which is 0.3 ppm, lowest concentration was found in Goalie and highest in Khalilah.

The concentration of cobalt in water sample of Toba kakari range is 0.63 ppm to 0.96 ppm, the WHO suggested value is 0.005 ppm. the concentration was least in sample of Killa Haji Khan and greater in Layghai.

The antimony in water sample was found greater than other metals, which range is 7.8 ppm to 10.5 ppm where WHO limit is 0.006 ppm. The antimony in sample of Layghai was greater while Khalilah contain least concentration.

Lead concentration range is 1.1 ppm to 2.92 ppm, highest concentration was found in Goalie while least in Killa Haji Khan. Where recommended WHO value is 0.015 ppm.

The concentration of manganese in sample of Toba kakari range is 0.07 ppm to 0.77 ppm, the concentration of manganese in water sample of Khalilah was least while greater in Sheenah Chana. WHO recommendation was 0.05 ppm.

DISCUSSION

The pH values sample collected from different locations of Toba Kakari was found to be 9.1 to 7.9, while the pH value of Nkareta River was noted 9.1 to 7.8,[20] similarly pH of Ona River, Nigeria ranges from 6.59 to7.68,[21] most of the pH values obtained in this study were parallel with the WHO which ranges between 6.5 – 8.5 except samples collected from three locations like Goalie, Khalilah and Killa Haji Khan which had higher values 8.8, 8.9 and 9.1 respectively.

The TDS value of samples obtained from Toba kakari ranges from 0.45 mg/l to 0.22mg/l where 1730 mg/l were reported in water sample of Dallanj town and 0.45 mg/l was determined in Ona River in Itaogbolu area of Akure, Ondo Country, Nigeria.[21] The TDS values recommended by WHO is 1000mg/l.

The EC value of Toba kakari water sample was is 892 μs/cm to 473μs/cm while the EC value noted in sample of Dallanj town and Ona River, Nigeria was 1870 μs/cm and 892 μS/cm respectively,[21] where WHO recommended value was 1000 μs/cm.

The highest concentration of iron in water sample of Toba kakari was recorded 0.89 ppm which is lower than the concentration determined in sample of Bangladesh that is 2.17 ppm,[22] while WHO recommended values is 0.3 ppm.

The concentration of cobalt recorded in water sample of Toba kakari was 0.96 ppm that concentration much lower than the concentration of cobalt in well water of south Tehran which was 0.216 ppm,[23] the WHO recommended value for cobalt is 0.005 ppm.

The highest concentration of antimony found in sample of Toba kakari was 10.5 ppm this concentration is higher than the recommended concentration of WHO which is 0.006 ppm, but the reported concentration is considered as unsafe or toxic when taken orally upto 36 ppm.[24] below this concentration antimony was found to be tolerable.[25]

The lead concentration in water of Toba kakari was 2.92 ppm less than the concentration of lead determined in water of Karun river, Iran, which is 3.17 ppm.[26] but much greater than the WHO limit which is 0.015 ppm, the lead concentration was reported in sample of Newmont Ghana, was 2.71 ppm,[27] the reported concentration is safe and in toxic because in Thailand and Myanmar (Burma) the lead was used up to 970 ppm in Daw Tway digestive aid.[28]

The concentration of manganese in sample of Toba kakari range 0.07 ppm to 0.77 ppm, the concentration of manganese in water sample of Khalilah was 0.07 ppm, while little above value than suggested by WHO, 0.05 ppm, while low concentration than values reported in water sample of Bangladesh up to 2.0 ppm,[29] concentration of manganese is also much lower than mentioned in report ATSDR, up to 1.3 ppm in neutral ground water and 9.6 ppm in acidic ground water have been reported.[30]

Water pH: In the dry season, the highest pH of 9.163 ± 0.050 was recorded in water tanks and the lowest pH value of 7.874 ± 0.008 was recorded in Nkareta River as shown in table-1. The mean pH of the sampled areas during the dry season was 8.545 ± 0.564. In the wet season, the highest pH was recorded in water pans with a value of 8.937 ± 0.006 and the lowest pH was recorded in the water tanks with a value of 5.128 ± 0.025. The mean pH value for all sampled areas during the wet season was 6.853 ± 1.150. The highest pH of 9.163 ± 0.050 which was recorded in water tanks during the dry season was alkaline and this could be due to the carbonates and bicarbonates present in water 13,14. The lowest pH of 5.128 ± 0.025 was recorded in the water tanks during the wet season and was slightly acidic and this could be attributed to the presence of carbon dioxide which dissolves to form carbonic acid 2,14-16 and reaction of water with chlorine to form hypochlorous acid and hypochlorite which could have led to the decreased pH value 17. Most of the pH values obtained in this study agreed well with those of studies done in Irigu river, Meru, surface water samples in Akot city and water supplies at Nsukka, south east Nigeria where the mean pH of the sampled water ranged between 7.38-8.41, 5.4- 9.5, 5.6- 6.4 respectively 13,15,18. Most of the pH values obtained in this study agreed well with those of WHO 19 which range between 6.5- 8.5 except three; of which one was low with a value of 5.128 ± 0.025 recorded in the water tanks and two which were higher than the WHO range and had values of 8.937 ± 0.006 and 9.163 ± 0.050 which were recorded in the water pans and water tanks respectively.

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CONCLUSION

The analytical work performed to test the physio chemical parameters and concentration of metals in water of Toba kakari confirmed that some features like pH, TDS, EC, are in normal range, except pH of Goalie, Khalilah and Killa Haji Khan which had higher values. While the concentration of metals was found greater than

the range suggested by international agencies, but within nontoxic and tolerable limits. The decreasing order of metal concentration in water sample of Toba Kakari was Sb > Pb> Co> Fe >Mn.

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