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Determination of Heavy Metals in Ground Water near City Nala, Quetta

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Abstract

Water plays very significant role in the life of living creatures. Without water if one says life is impossible may not be wrong. Human uses different sources for drinking water. Ground water is one of the sources in Quetta city. Present study was conducted to assess the levels of heavy metals in ground water near city Nala of Quetta. Total eight samples were gathered from different sites (A, B, C, D, E, F, G & H) near city Nala. Iron (Fe), Manganese (Mn), Lead (Pb), Cadmium (Cd), Copper (Cu), Nickel (Ni) and Cobalt (Co) were analysed through atomic absorption spectrometer. In this study, Cu was not detected. However, it showed the presence of Fe, Cd, Ni, Co and Pb. The accumulations of Fe and Mn were found within the range of standard limits set by World Health organization in all specimens of water used. The level of Pb was detected within the range of WHO in A and D sites samples of water while it has crossed the permissible limit in the samples of water taken from B, C, E, F, G and H sites. Concentration of Cd was not detected in the samples of water in B, D, E and F sites. While the samples of water from G and H areas showed the level of Cd within permissible limit of WHO. However, A and C sites samples of water have crossed the standard limit. The concentrations of Ni and Co have crossed the WHO standards in samples of water used for analysis. The higher accumulations of heavy metals may be due to the effect of city Nala which contains the wastes discharged in it. It is concluded that immediate measures are needed to be taken for the purification of ground water used for drinking purpose near city Nala of Quetta.

Keywords: Ground Water, Heavy Metals, Atomic Absorption Spectrometer, Quetta

INTRODUCTION

For all living things, water is crucial because it sustains all of the processes involved in life. It's unimaginable that life could have survived on Earth without water [1]. Because of its negative impacts on both humans and aquatic life, water pollution achieved a

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crucial area of study around the world [2]. Heavy metal pollution of surface water is a severe environmental issue. They are no biodegradable and can build up in the food chain. However some metals, such as Fe, Cu, and Zn, are important micronutrients, larger quantities can be damaging to the physiology of living creatures [3-4].

The environment has an immediate impact on water pollution. Humans may poison the environment in a variety of ways, such as by disposing of garbage in bodies of water [5] Rainwater flows via numerous pathways, such as mining sites, carrying polluted particles to streams, rivers, lakes, and dams, which are the primary supplies of drinking water. Water becomes polluted with heavy metals in this manner. In addition to the foregoing, industrial waste is the primary source of drinking water pollution [6]. All of the waste created by human activities on Earth finds its way into drinking water sources, resulting in contaminated water [7].

The lithology of the spring has an impact on the groundwater quality, but so does human activities. Such anthropogenic actions may alter the hydrology of it and pollute it in many ways [8]. Illnesses and geographic circumstances are related.. To be sure, geochemical situation gets a significant role in actual medical difficulties. Drinking water science is frequently cited as a crucial role in a variety of ailments [9].

Drinking water contaminated with heavy metals like Cd, Hg, Se, Cr, Ba, Ag, Pb, and others may be harmful or detrimental to human health [10].

In this respect, present research was organized to evaluate the content of various heavy metals in water samples from the Quetta near city Nala that is being utilised by the local people for drinking purposes.

EXPERIMENTAL STUDY AREA AND SAMPLING

This research study has been performed at the analytical chemistry laboratory in Balochistan University, Pakistan during the month of July 2022. The water samples were gathered from various locations of Quetta near City Nala. The sampling sites are Law College Quetta, Cantt

Public School and College Quetta, Doctor's home Shahbaz Town Quetta, Dispensary Colony Model Town Quetta, Arbab Khan Jee Villas NIM Back Side, Arbab Town Near Beacon House Quetta, Kidney Hospital (BINUQ) Quetta and Madrasa Farooqia Sur Pull Quetta. The collected samples of water were used separately for analysis of heavy metals. The coding IDs for areas of water samples is given below table 1.

Table 1: Samples Sites of water and their Samples codes

S.NO	Sample Codes	Samples Sites
1	Sample A	Law College, Quetta
2	Sample B	Cantt Public School & College Shahbaz Town
3	Sample C	Doctor's Home Shahbaz Town
4	Sample D	Dispensary Colony Model Town
5	Sample E	Arbab Khan Jee Villas NIM Back Side
6	Sample F	Arbab Town Near Beacon House
7	Sample G	Kidney Hospital (BINUQ)
8	Sample H	Madrasa Farooqia Sur Pull

Standards Preparation

The standards and reagents were all of analytical quality. Merck provided the stock solution for each element, specifically manganese, iron, cobalt, nickel, copper, cadmium, and lead

(Darmstadt, Germany). The standards reagents were made from a 1000 ppm stock solution (Merck). A working standards solution sequence (for FAAS calibration) was produced from stock solution, and at least three standards were employed for each metal analysis. For dilution of samples and standards, distilled water was used.

Instrumentation

The heavy metal content was determined using a Flame Atomic Absorption Spectrophotometer (FAAS) from Thermos - Electron Corporation, S4 AA System, S. No, GE711544, China. Double beam and deuterium background standard hollow cathode lamps of Mn, Fe, Co, Ni, Cu, Cd, and Pb, employed at certain wavelengths for metal analysis. Atomic absorption spectrometer was adjusted at triplicate.

RESULT AND DISCUSSION

In this research study the concentration of seven incongruent metals (Fe, Mn, Pb, Ni, Cd, Cu, Ni and Co) were examined through Atomic Absorption Spectrometer in Water collected from various sites near City Nala, of Quetta Balochistan and the findings are exhibited in table 2. The attained data of concentrations of heavy metals in water samples was correlated with MPL designated by World Health Organization (WHO) (Figures 1- 6). Different parameters of Atomic Absorption Spectrometer are given in table 3.

Table 2: Concentrations of Heavy Metals in ground water samples of Quetta (mg/L).

Metals	Samples ID								WHO Permissible Limits*** mg/L (2008)
	A	B	C	D	E	F	G	H	
Fe	0.1435	0.4097	0.1435	0.1293	0.1570	0.4206	0.1502	0.1383	0.5-50
Mn	0.0747	0.1066	0.0906	0.1029	0.0981	0.1112	0.1006	0.1287	0.5
Pb	0.0075	0.0324	0.0636	0.0070	0.0135	0.0249	0.0178	0.0281	0.01
Cd	ND**	ND	ND	ND	ND	ND	ND	ND	0.003
Cu	ND	ND	ND	ND	ND	ND	ND	ND	-
Ni	0.0478	0.0335	0.0528	0.0359	0.0403	0.0495	0.0644	0.0450	0.02
Co	0.0441	0.0560	0.0520	0.0570	0.0701	0.0702	0.0882	0.0812	0.01

ND** = Not Detected WHO*** = World Health Organization

Table 3: Flame Atomic Absorption Spectrometer Parameter

Metals	Wavelength (nm)	Lamp Current %	Bandpass (nm)
Fe	248.3	75	0.2
Mn	279.5	75	0.2
Pb	217.0	75	0.5
Cd	228.8	50	0.5
Cu	324.8	75	0.5
Ni	232.0	75	0.2
Co	240.7	75	0.2

Iron (Fe):

Iron is a significant element for all living things and is required for maintaining cell homeostasis. It is the primary component of haemoglobin in red blood cells (RBCs), which transports oxygen throughout the body. It is necessary in varied amounts for men and women at all ages. For both men and women, the post-menopausal stage iron need is 8 mg/day, while the pre-menopausal stage requirement is 18 mg/day. A

pregnant woman requires more iron per day (127mg/day), whereas a six-year-old youngster requires 11mg of iron per day [11]. The current study for the determination of heavy metals in water samples showed presence of Fe in all the collected water samples. This study indicated the lowest level (0.1293 mg/L) of Fe in water samples taken from Dispensary Colony Model Town Quetta and the highest accumulation (0.4206 mg/L) of Fe in the sample of water gathered from Arbab Town near Beacon House Quetta. The achieved result was compared with acceptable limits (0.5-50 mg/L) given by WHO (2008) [12] and found within the range.

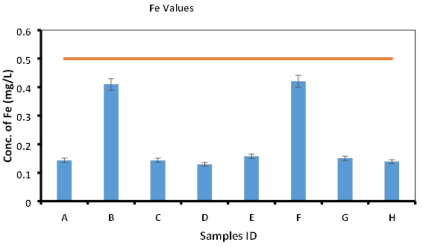

Figure 1: The Conc. of Fe in water Samples with WHO Standard Values

Manganese (Mn):

Manganese is an essential element that is only required in trace amounts by the human body. It is an important anti-oxidant agent in the metabolic processes of glucose, protein, and lipid metabolism in the human body. The RDA for Mn is 2.5 mg/day, while the human body has roughly 12-20 mg of Mn. Mn deficiency leads to bone fragility, weight loss, osteoarthritis, and joint discomfort. It is kept in animals' livers, skins, and kidneys. Fruits, vegetables, and whole grains are natural sources of Mn [13]. The existent study indicated the presence of Mn in all the specimens of water. It showed the lowest accumulation (0.0747 mg/L) of Mn in water specimen taken from Law College Quetta and the maximum concentration (0.1287 mg/L) of Mn was observed in water sample collected from Madrasa Farooqia Sur Pull Quetta. The consequences were compared with standard limit (0.5 mg/L) given by WHO (2008) which indicated that all the achieved results were in permissible limits.

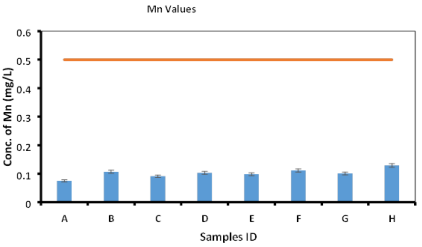

Figure 2: The Conc. of Mn in water Samples with WHO Standard Values

Cobalt (Co):

Cobalt is a trace metal that is present in the earth's crust in a chemically bonded form. It is an essential component of vitamin B12 and aids in the production of RBC. It also contributes to the prevention of pernicious anemia and the appropriate functioning of the Central Nervous System (CNS) [14] However, the highest accumulation of Co may

have a harmful impact on digestion, heart muscles, congestive heart failure, and skin diseases, while a deficit leads in anemia [15]. Among the samples of water collected from disparate sites, cobalt showed diversity in the detected level. It indicated the lowest level (0.0441 mg/L) in the specimen taken from Law College Quetta and highest concentration (0.0882 mg/L) in the water specimen of Kidney Hospital (BINUQ). On comparison with standard value (0.01mg/L) of WHO (2008), the concentration of Co indicated higher values than permissible limit. It may be due to the domestic and other wastes in large quantities in City Nala, Quetta.

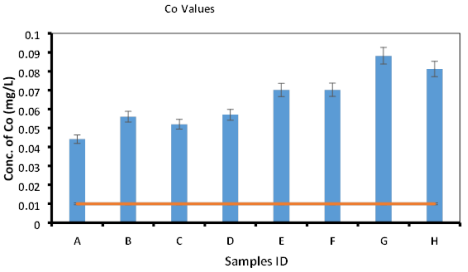

Figure 3: The Conc. of Co in water Samples with WHO Standard Values

Nickel (Ni):

Nickel is an essential element that appears in greater abundance in plants than in mammals. It plays an important part in the body's processes such as physiological processing, the immunological system, activating the enzymatic system, and serving as a cofactor in Fe absorption from the small intestine [16]. Excessive Ni intake results in weight loss, an enlarged heart, and decreased liver weight [17]. The metal nickel was determined in all the water samples that were collected from various sites near the city Nala. But the lowest level (0.0335 mg/L) of Ni was detected in water samples of doctor's home Shahbaz Town Quetta and the highest level (0.0644 mg/L) of Ni was found in water sample taken from Kidney Hospital (BINUQ). However, the overall result has crossed the standard value (0.02 mg/L) given by WHO (2008). It is concluded that the wastes of City Nala have a great impact on the water drilled nearby. Because it may contain various and dangerous wastes are being discharged in it.

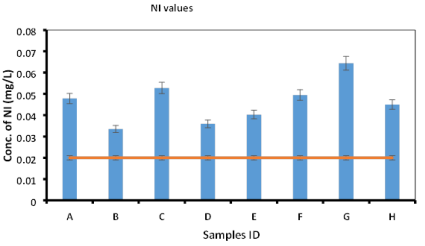

Figure 4: The Conc. of Ni in water Samples with WHO Standard Values

Copper (Cu):

Copper is a necessary micronutrient that functions as a biocatalyst in the creation of cellular energy in living organisms. The human body has around 9 grammes of Cu. It is found in an enzyme that is involved in the oxidation process and metabolism of estrogen, which is necessary for women to remain fertile throughout pregnancy [18]. Cu

deficit affects thyroid gland functioning, causes CNS diseases, and hair abnormalities; whereas Cu deficiency affects thyroid gland functions, causes CNS disorders, and hair abnormalities [13]. An analysis was accomplished for the detection of Cu metal in the samples of water collected from diverse sites near City Nala of Quetta. In this study, copper was not detected in the collected specimens of water.

Cadmium (Cd):

It is a harmful non-essential transition element that may be found in food, fresh water, phosphate fertilizers, and petroleum products. Cd concentrations in soil are increased by industrial wastes and acid rain. Consumption of contaminated Cd fruits and vegetables results in diarrhea, stomach discomfort, vomiting, bone breakage, and CNS failure [19]. Recent research study indicated the absence of cadmium in the samples of water collected from law college Quetta, doctors home Shahbaz town Quetta, Kidney Hospital Quetta (BIUNQ), Madrasa Farooqia sur pull Quetta, Cantt Public Boys School & College Shahbaz Town Quetta, Dispensary Colony Model Town Quetta, Arbab Khan Jee Villas NIM Back Side NIM back side, and Arbab Town Quetta.

Lead (Pb):

Lead is a hazardous heavy metal that is present all over the world and is exceedingly harmful to plants, animals, and microbes. Even trace amounts of lead may pollute the environment and create health concerns [20]. Human contact with Pb occurs as a result of polluted air, water, and food, and produces toxicity to the RBC, kidney, reproductive system, and CNS, primarily affecting intelligence quotient (I.Q) and child behavior [21]. The recent survey showed the presence of Pb in all the sections of water. It showed the lowest accumulation (0.0070 mg/L) of Pb in water sample taken from dispensary colony model town Quetta while the highest level (0.0636 mg/L) of Pb in the sample of water taken from doctor home Shahbaz town Quetta. The detected levels of Pb in water samples were compared with standard values given (0.01mg/L) by WHO (2008). It indicated that water specimens of Law College Quetta and Dispensary Colony Model Town Quetta were within the range while the water samples of Cantt Public Boys School & College, Doctor's home Shahbaz Town Quetta, Arbab Town near Beacon house, and Madrasa Farooqia Sur Pull have crossed the permissible limits. It might be due to the effect of City Nala wastes.

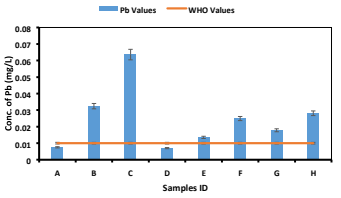

Figure 5: The Conc. of Pb in water Samples with WHO Standard Values

CONCLUSION

In a nutshell the heavy metals Pb, Co, Ni were found above the allowable parameters of WHO. Therefore, the application of water drilled near City Nala is not favorable for drinking purpose. Because, it may produce health impact due the presence of heavy

metals in higher levels. Pb are carcinogenic. They may cause cancer when enter the body in greater amount.

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