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Determination of the Concentrations of Heavy Metals in Water in Asser Governorate

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ABSTRACT

The quality of water is one of the most essential solicitudes. Heavy metals are main constituents of wastes which have been involved in several metal diseases and food poisoning in man. This study evaluated concentration of iron, lead, cobalt, nickel, chromium, cadmium, vanadium, aluminum, cobalt, selenium, molybdenum, mercury, lithium, manganese, boron, beryllium, zinc, and arsenic in water samples from different locations in Asser province, Saudi Arabia. Results revealed that about eighteen heavy metals were detected in water samples. Two heavy elements, Mercury and manganese have highest concentrations (mg/L) of 0.0086, 0.0034, 0.0021, and 0.1433 in samples from Alshaboa-quarter, Al rakla-quarter, Tathleeth-industry, Tathleeth-Bisha gate and Abha-Alryiad Road, respectively. pH is measured for all samples at room temperature. Total hardness (TH) was determined by a titration method. The detection of heavy metals in samples rendering for consciousness. This is important to dishearten researches which could lead to high metals concentration and mineral toxicity.

1. Introduction

Pollution occurs by heavy metals brings unfavorable changes in the environment, which could affect the forms of an ecosystem. Pollution of aquatic environments could be imputing to increasing agricultural practices, industrial development, urbanization and inadequate consideration for environmental impact. The random release of organic liquid and inorganic nature which changes physicochemical merit of water and give rise to jeopardy to flora and fauna of the aquatic ecosystem and man [1].

Water contamination has been a source of health troubles in the developing countries [2]. Heavy metals piling up in the environment is as a consequence of direct or indirect human activities such as rapid industrialization, urbanization and anthropogenic sources [3-5]. Others like Hg, Cd, AS *etc*. have no beneficial role in human system [6]. Determination of heavy metals is one of the most important aspects in water studies [7]. In recent times, increasing focus is being given to studies on water contamination. Since water some time is directly in contact with soil, rocks, and plants, the constituents of these sources might contaminate the environment [8].

Trace elements constitute a natural component of the earth crust and they are not biodegradable, hence persist in the environment. Trace elements might occur from natural provenances, leached from rocks and soils according to their geochemical mobility or anthropogenic sources [9].

In addition, it has been observed that the mechanical unrest of the sediment increases the peril of pollution when they are re-suspended [10]. Toxicity of zinc, copper and cadmium boosts the hazard of step inside in to the living systems directly or indirectly, give rise to dangerous health troubles [11-14]. Exposure to zinc, copper and cadmium be in charge of health troubles such as physiological problems in blood output and liver malfunction. Exposure to zinc and cadmium through polluted water could give rise to metal toxicity for which convenient medical auspices must be taken to avoid further damage [15].

This study aims to investigate and to assess concentration of heavy elements in water collected from different places of Asser Governorate (Abha-Alryiad Road, Alshaboa-quarter, Tathleeth-industry, Tathleeth-Bisha gate, Al rakla-quarter). Therefore, this research may provide opportunities for water research, which could be profitable for public health in the KSA.

2. Materials and Methods

2.1 Sample Collection and Preparation

In total, 5 water samples were collected in various places (Tathleeth-industry, Tathleeth-Bishsa gate, Al raka-quarter, Alshaboa-quarter and Abha-Alryiad Road) in Aseer region-Saudi Arabia, during June - July 2017. At each sampling location, samples were gathered in polyethylene bottles, all bottles were washed with dilute acid followed by distilled water and then dried. Before taking final samples, the bottles were rinsed three times, and then samples were prepared for analysis for physicochemical parameters. Finally, samples were

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transferred to laboratory for analysis to assess the heavy metals elements concentrations using ICP –MS and other technique.

pH is measured for all samples at room temperature upon arrival in Laboratory using an Oakton PC 450 Waterproof Portable Meter. Total hardness (TH) was determined. Each water sample was titrated with 0.01 M EDTA disodium, including ammonia buffer and using Eriochrome Black T as the indicator.

2.2 Elemental Measurement by Using ICP-MS

The appliance used was Inductively Coupled Plasma Mass Spectrometry (ICP-MS), iCAP Q, Thermo Fisher Scientific, Waltham, MA, USA).

3. Results and Discussion

The various physico-chemical parameters were measured in the water samples. Concentration levels (mg/L) of all measured heavy elements, their mean and standard deviation presented in Table 1.

Table 1 Samples water (mg/L).

No.	Analyte	Limit design results (mg/L)	Al rakla-quarter (mg/L)	Tathleeth-Bish gate (mg/L)	Tathleeth-industry (mg/L)	Alshaboa-quarter (mg/L)	Abha-Alryiad Road (mg/L)
1	AL	5.00	0.7209	0.7937	0.3519	1.799	0.7589
2	AS	0.10	0.0072	0.0103	0.0141	0.0094	0.0091
3	B	0.75	0.7318	0.7481	0.7174	0.7028	0.7421
4	Be	0.10	0.0116	0.0005	0.0006	0.0007	0.001
5	Cd	0.01	0.0001	0	0.0001	0.0002	0.0005
6	Co	0.05	0.004	0.002	0.0037	0.0024	0.0032
7	Cr	0.10	0.0095	0.0092	0.0105	0.0087	0.007
8	Cu	0.40	0.0009	0.0002	0.0004	0.0007	0.0021
9	Fe	5.00	0.0044	0.0042	0.0138	0.0009	0.0031
10	Hg	0.001	0.0006	0.0015	0.0021	0.0034	0.0086
11	Li	2.50	0.0021	0.0016	0.0028	0.0216	0.0013
12	Mn	0.20	0.1483	0.141	0.5372	0.1007	0.1433
13	MO	0.01	0.0007	0.0003	0.0007	0.0002	0.0003
14	Ni	0.20	0.1057	0.097	0.0928	0.0216	0.0387
15	Pb	0.10	0.0098	0.0081	0.0093	0.0056	0.0045
16	Se	0.02	0.0028	0.001	0.0023	0.002	0.0045
17	V	0.10	0.0511	0.0544	0.0802	0.0558	0.0338
18	Zn	4.00	0.0272	0.0218	0.0471	0.0154	0.0286
Average		0.80	0.07	0.06	0.09	0.06	0.06
STD		3.25	0.18	0.18	0.21	0.17	0.18

For the collected samples, pH values of water samples ranged from, 4.6 to 6.24, Total Dissolved Solids (TDS) was 149 to 287 pmm, Turbidity Nephelometric Turbidity Units (NTU) from 12 to 45, Total suspended solids (TSS) from 14 to 28 parts per million as presented in Table 2. Results of collected samples show that low levels of major dissolved components of water , Fluorides from 0.46 to 0.84 ppm, Ammonia NH_3 from 0.14 to1.43 and Free Chlorine Cl_2 from 0.03 to 0.12 ppm were reported, Table 2.

Based on our results reported for the Total Dissolved Solids (TDS), samples were suitable for use, because they not exceeded the guideline value set by WHO. A bar charts representation of the distribution of the metals in each of the samples types shown in Figs. 1 and 2.

As revealed in the results, it is obvious that the concentration of the heavy metals in the water samples was relatively low, within the allowed limits. Statistical analysis displayed that concentration of heavy metal varies, indicating that due to the nature of area, Fig. 1.

Table 2 Analysis of major components Chloride, Fluorides, Ammonia and Nitrates

Location	BOD	Fluorides (F ppm)	Ammonia NH3 (ppm)	Nitrates NO3 (ppm♣)	Free Chlorine Cl 2(ppm)	Turbidity (NTU)*	TSS+ (ppm♣)	TDS× (ppm♣)	PH
Abha-Alryiad Road	23	0.46	0.14	0	0.05	12	14	149	5.28
AL Shaboa-quarter	OFL (Over range)	0.67	1.43	2.4	0.03	33	28	287	4.90
Tathleeth-bisha gate	38	0.84	0.3	1.1	0.09	21	15	180	4.99
Industrial area-Tathleeth	0	0.81	0.25	1.6	0.12	30	24	232	4.6
Alraka	0	0.70	0.32	2.9	0.09	45	28	210	4.96
Drinking water	-	Over range	0.11	1.4	0.04	33	53	193	6.24

* TSS: Total suspended solids
+ TDS: Total Dissolved Solids
× NTU: Nephelometric Turbidity Units
♣ ppm: Parts Per million

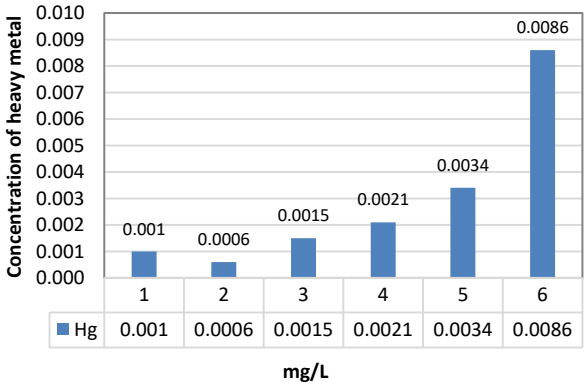

Fig. 1 Concentration of mercury in samples.

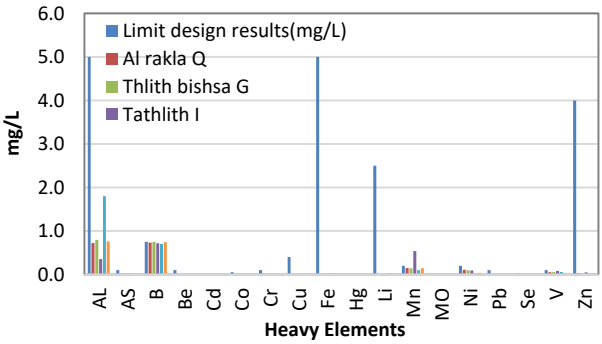

Fig. 2 Concentration of all heavy elements in samples.

Mercury is a metallic element that occurs naturally in the environment. Naturally occurring mercury has been widely distributed by natural processes. Naturally occurring levels of mercury in groundwater and surface water are less than 0.5 µg/liter. [16]. Mercury for water samples (Alshaboa-quarter, Tathleeth-industry, and Abha-Alryiad Road), values were in the range 0.0021 to 0.0086 mg/L. Physicochemical properties of different manganese compounds vary substantially. At concentrations exceeding 0.1 mg/L. the manganese ion imparts an undesirable taste and stains plumbing fixtures and laundry [17].

Manganese compounds existing in the atmosphere as hanging particles consequence from emissions, soil denudation. Manganese occurs naturally in many surface water and groundwater sources and in soils. Higher levels in aerobic waters are associated with industrial pollution.

Manganese (Mn), for Al rakla-quarter, has values 0.1433 mg/L, was reported to have the highest concentrations in some samples, Table 1. Table 3, show the Biochemical oxygen demand (BOD) of water samples of different area.

Table 3 Biochemical oxygen demand (BOD).

Date	Abha-Alryiad Road	Al Shaboa	Tathleeth-Bisha gate	Industrial-Tathleeth	Araka-quarter
17/11/2018 Day 1	5	6	9	0	0
18/11/2018 Day-2	10	14	18	0	0
19/11/2018 Day-3	11	16	19	0	0
20/11/2018 Day-4	18	33	30	0	0
21/11/2018 Day-5	23	OFL (Over range)	38	0	0

Result of chemical analysis of water samples show that, the Ammonia 0.00, Nitrite 0.003, Nitrate 0.90, TDS 77, Chloride 38, Sulphate 4.00, Hardness 38.0, Calcium 30.0, Manganese 8.00, Iron 0.00, Fluorides 0.93 and Total Alkalinity 33.0, E. conductivity 1590, pH 7.20, Color unit 1.0, Turbidity 0.39, Odor 0.00, Free residual chlorine 0.00 and Manganese 0.01, Table 4.

Table 4 Result of chemical analysis of water samples

Analyte	Maximum Permissible level mg/L		Results	Sort of chemicals	Maximum Permissible level mg/L		Results
	Filled	Non-filled			Filled	Non-filled	
Ammonia	0.5	1.5	0.00	E. conductivity	--	--	159
Nitrite	3	3	0.003	pH	6.5-8.5	6.5-8.5	7.2
Nitrate	50	50	0.9	Color unit	15	15	1.0
TDS	50-100	1000	77	Turbidity	5	5	0.39
Chloride	150	250	38	Odor	Not found	Not found	--
Sulphate	150	250	4	Free residual chlorine	1ppm	1ppm	0.00
Hardness	200	500	38	Magnesium	--	--	0.01
Calcium	--	--	30	Sodium			
Magnesium	--	--	8	Potassium			
Iron	0.3	0.3	0.00	Phosphate			
Fluorides	1.5-0.8	1.5	0.93	Sulphide			
Total Alkalinity	--	--	33				

Total permanent hardness is the sum of calcium hardness plus magnesium hardness, which is the concentration of calcium and magnesium ions, the hardness of samples was determined. Bacteriology Test Shown in Table 5. Total Bacteria equal zero, Coliform Bacteria – ve and E. *coli* – ve. Test of water samples shown in Table 6.

Table 5 Bacteriology test /100 ml*

Total Bacteria	0
Coliform Bacteria	-ve
E. coli	-ve

*According to the Gulf measurement for the filled water No. 1025/2000 and for the Non-frilled No.149/2000

Table 6 Analysis of water samples

Location	PH	TDS (ppm*)	TSS (ppm*)	Turbidity (ppm*)	Cl2 (ppm*)	Nitrite NO3 (ppm*)	Ammonia NH3 (ppm*)	Florides F- (ppm*)
Abha- Riyadh Rood	3.68	255	30	69	0.22	9.8	0	0.84
Tathleeth –Bisha gate	3.64	398	33	90	0.30	15	0.34	0.79
Jash	5.06	690	60	70	0.02	15.1	1.17	0
Lags	5.55	250	56	58	0	8.3	0.38	0.22
Elwageed	8.37	180	0	0	0	0.8	0.40	1.22
Station of water treatment of Bisha	5.56	907	0	0	2.20	13.8	0.40	0.21

* ppm= Parts Per million

4. Conclusion

It is obvious from this study that water contains different levels of heavy metals as detected in the samples. The detection of Hg and Mn elements calls for lookout environmental monitoring; higher value of mercury is toxic and causes neurological damage, paralysis and blindness. Although some of the origins of these metals could be natural, it is of great importance to control the discharge of pollutants from sources. Ensuring healthy status of the water resource will improve the water quality, and preserve the types of the water body without posing any health risk to humans who consumed. There is need for public enlightenment on the importance of cease from deposition in water bodies. This will not only reduce incidence of water pollution but also allow for effective use of various water resources.

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