Detection of Heavy Elements and Pathogenic Microorganisms in the Water and Sediments of Domestic Water Tanks in the Center of AL- Nasiriyah

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Abstract

The current study was conducted to show the presence of heavy elements and pathogenic microorganisms and the quality and validity of water and sediments in the household water tanks at the city center of Nasiriyah and their suitability for household and drinking uses from the autumn 2019 to summer 2020. Physical, chemical and biological checks of water were carried out in three stations, two selected stations located in the center of Nasiriyah city (1- Erido 2- Al-Salhiya), and the third station, Al-Asalah, which is located in Al-Shatrah district. Samples were collected monthly and quarterly, with three replications per station. The study included measuring the temperature of air and water, the pH, salinity, turbidity, dissolved oxygen DO, and the Biological Oxygen Demand BOD5. In addition, the concentration of four heavy elements (cadmium, copper, lead and zinc) in the water was measured in its entirety. The study included measuring the TOC content and mixing the sediment, and also the concentration of four heavy elements (cadmium, Copper, lead and zinc) are completely sediment. The study also included investigation of bacterial contamination by detecting the total numbers of aerobic bacteria, the number of coliform bacteria, the number of fecal coliform bacteria, the numbers of fecal and Pseudomonas Aeruginosa bacteria in the water and sediments. The results of the physical and chemical tests of water in the study stations showed that the values of air and water temperatures ranged between (20.1-40) C and (17.50-30) C, respectively, and that the water of the studied stations was basic as the pH values ranged between (7.00-8.20) The salinity values ranged between (485-837) ppm, and the turbidity values were between (2.50-6.79) NTU. The dissolved oxygen values ranged between (5.39-8.01) mg/liter, and the Biological Oxygen Demand BOD5 were between (2.93-8.5) mg/liter.

Keywords: *Heavy elements, pathogenic, microorganisms, sediments, domestic water, tanks, AL-Nasiriyah*

Introduction

Water is one of the main and basic pillars of life, and the presence of water is necessary for the existence of life, so water pollution is one of the basic and main risks that threaten the lives of all living things, especially human life. Therefore, the water must be free from the chemical, physical and biological contaminants of drinking water, and this water must be acceptable for being colorless, tasteless and odorless[(1)]. Attention has been paid by the World Health Organization, the US Environmental Protection Agency and many other health institutions to diseases that could result from water pollution and to control or prevent those diseases.[(2)]

Literature Review: Measuring the concentrations of heavy elements in the water cannot give a reliable and accurate indication of the degree of pollution due to the difference in the quantities of water discharges, the suspended load and the imbalance of the sources that throw these pollutants into the water environment. Therefore, its concentration in sediments was measured because it is the main and accurate indicator of contamination with these types of pollutants, and it is the

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direct recipient of pollutants in the aquatic environment [3] and represents an important source of heavy elements in the aqueous phase as the role of sediments is a store and transporter of heavy elements, and through the sediments we can identify the history of pollution, due to their ability to pollute and collect heavy elements significantly. It is possible that the concentration of these elements in sediments is more than (1000-10000) times than their concentration in water.[4]

Methodology

The following were performed to 3 water samples: air and water temperatures, volumetric analysis of sediment particles, extraction of heavy elements from water, extraction of heavy metals from sediments, the culture media and isolation.[5]

Results

- **Air and Water Temperature:** It was found that there are no significant differences. Among the stations, as no significant differences were found, as for the seasons, significant differences were recorded for all seasons. The temperatures showed a clear seasonal change during the study period, as the lowest values were during the winter season and the highest during the summer, and this can be explained by the nature of the climate in Iraq.[6]
- **The pH Values:** Results of the statistical analysis showed that there were no significant differences between the stations. This narrow range of values may be attributed to the pH in the stations during the seasons of the year refers to the amount of industrial water that is discharged and its dissolved salts that are directly proportional to the pH value and thus be basic[7].
- **Turbidity:** Results of the statistical analysis showed that there were no significant differences between the stations. The suspended matter that causes turbidity is organic and includes phytoplankton, animal and microscopic organisms, or inorganic materials such as soil, clay and silt particles, and turbidity is responsible for water color changes[8].
- **Dissolved Oxygen (DO):** Results of the statistical analysis showed that there are no significant differences between the stations, but in the seasons, there are significant differences for all seasons. The highest value was recorded in the third station during the summer of 2020 and the reason for this increase may be attributed to the fast water currents, good ventilation and the continuous mixing of water[9].
- **Biological Oxygen Demand (BOD5):** It was noticed that there were no significant differences, but in the seasons, there are significant differences for all seasons. From the results, the highest BOD5 values were observed in the third station, which is due to the arrival of organic wastes that were discarded in the river water or human and industrial activities near the first station. This may be due to rainfall and high water levels, and this result is identical to what Naji (1988) stated, and they agreed with him[10].

Table (1) showed the rates of the physical and chemical properties of the study stations water for the period from Autumn 2019 until Summer 2020

Season	St.	Air Tem.		Water Tem.		pH		Salinity		Turbidity		DO		BOD	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Autumn	St.1	26.2a	.27	24.00[a]	.61	7.97a	.05	837a	5.59	4.90a	3.02	6.61a	.49	6.43a	1.5
	St.2	25.1b	.41	23.00b	.70	8.00a	.07	820b	2.91	4.73a	2.84	6.63a	.36	6.35a	1.6
	St 3	25.00b	.25	23.00b	.50	7.00b	.02	785c	2.60	2.50a	1.10	6.90a	.10	8.5a	1.0
LSD		**0.77**		**1.12**		**0.30**		**4.22**		**2.99**		**0.36**		**1.75**	
Winter	St.1	21.0a	2.23	17.76b	.33	7.80a	.28	488b	1.78	4.27a	.62	5.39a	.50	5.67a	1.4
	St.2	22.3a	1.56	17.50b	.35	7.80a	.21	532a	6.22	4.20a	.60	5.40a	.43	5.69a	1.4
	St 3	20.1a	1.02	18.00a	.45	7.00a	.02	485b	3.50	3.00a	021	6.10a	.35	7.10a	.90
LSD		**3.79**		**0.54**		**0.26**		**4.84**		**0.60**		**0.47**		**1.34**	

Season	St.	Air Tem.		Water Tem.		pH		Salinity		Turbidity		DO		BOD	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Spring	St.1	33.6a	.54	24.00b	.00	7.96a	.04	580b	2.07	6.79a	.61	5.79a	.37	3.07a	.37
	St.2	33.6a	.54	24.80[ab]	.44	8.07a	.23	592a	3.56	6.67a	.70	5.71a	.42	2.93a	.56
	St 3	33.1a	.53	24.00b	.01	7.50b	.05	575c	2.02	4.80b	.50	7.01a	.38	3.30a	.31
LSD		**0.67**		**1.28**		**0.21**		**4.62**		**0.68**		**0.52**		**0.50**	
Summer	St.1	39.20b	.44	29.40a	.54	8.14a	.11	757b	4.61	6.25a	.45	6.87a	.43	3.91a	.69
	St.2	39.60[b]	.54	29.40a	.54	8.20a	.07	780a	3.56	6.31a	.47	6.90a	.40	3.93a	.72
	St 3	40.00a	.01	30.00a	.71	7.60b	.10	730c	2.21	5.40b	.39	8.01a	.39	4.90a	.68
LSD		**0.55**		**0.85**		**0.12**		**4.22**		**0.57**		**0.44**		**0.77**	

- **Sediment Total Organic Carbon Content (TOC %):** The statistical analysis revealed that there are significant differences between the stations. Human activities and natural processes lead to an increase in the carbon concentration of total organic matter in the sediments. Likewise, organic carbon in sediments increases with small grain size (silt) and has great affinity for new crystalline deposits[(11)].

Table (2): TOC% rates for study stations for the period from Fall 2019 until Summer 2020

TOC	Autumn		Winter		Spring		Summer	
	M	SD	M	SD	M	SD	M	SD
St1	2.41b	.44	2.18b	.09	3.56a	.12	4.12a	.16
St2	3.24a	.85	3.61a	1.26	3.50a	.48	3.86b	.05

- **Volumetric Analysis of Sediment Particles:** The statistical analysis showed statistically significant differences of sediment mixture between the stations. The results showed that the sediment mixture was Clay-silty in all the stations studied. The percentage of soil plays an important role in determining the quality of the sediment, as it affects the ability of the sediment to retain the ions of heavy elements, organic matter and salts in quantitatively and qualitatively[(12)], the more small-diameter granules are, the more quantities are preserved.

Table (3) showed mixing rates of sediments%

		St.1	St.2
Autumn	Sand	10.3	17.5
	Clay	48	50
	Silt	41.7	32.5
Winter	Sand	5.1	6.2
	Clay	54.8	55.1
	Silt	40.1	38.7
Spring	Sand	1.7	2.4
	Clay	50.1	56.7
	Silt	48.2	40.9
Summer	Sand	18.1	22.4
	Clay	40.9	50.4
	Silt	41	27.2

- **Heavy Elements in Water:** The results of the current study showed that the average levels of concentrations of heavy elements in the water for the three study stations of cadmium, copper, lead and zinc (5.32, 0.46, 0.00432, 0.0052) mg/liter, respectively, as an input of heavy elements in the aquatic environment changes over time, and the main factor that effects on this change in element concentrations is the receipt of water for untreated household, agricultural and industrial wastes, and the highest concentrations of elements were recorded in the summer and the lowest in the fall. This may be due to differences in water levels between seasons, as high water leads to dilution and dispersion of elements, and that the change in the level of water level It contains two-fold concentrations of heavy elements, for example, high water levels reduce the concentrations of heavy elements in the water, and their decrease leads to an increase in the concentrations of these elements[13].

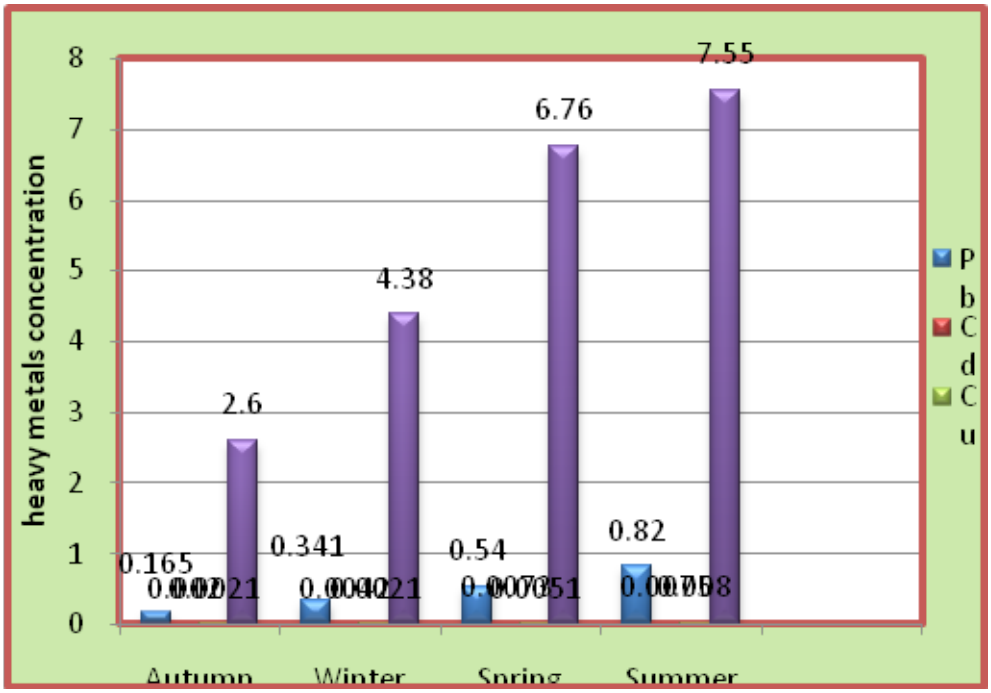

Figure (1) Shows the annual rate of heavy elements in water

- **Total Number of Aerobic Bacteria (TBC):** The results of the statistical analysis recorded the presence of significant differences between the stations. This group represented mostly the bacteria that enter the water from sewage waste and the types of bacteria that wash with the soil into water bodies during the rainy and flood seasons, in addition to the original bacteria present in the water and the types of pathogenic bacteria, including optional aerobic and anaerobic bacteria[14].
- **Total Coliform Bacteria Count (TC):** The results of the statistical analysis recorded the presence of significant differences between the stations. Coliform bacteria are usually found in the intestines of human and warm-blooded animals and are associated with pathogenic bacteria, which is an appropriate microbial indicator to determine the quality of drinking water due to its ease of detection and calculation[15].
- **Number of Fecal Coliform Bacteria (FC):** Statistically, significant differences were recorded between stations except for the second and third stations. No significant difference was recorded between them. Bacteria E. coli is a fecal source due to its permanent presence in human feces and other mammals and birds in large numbers and is rarely found in soil or water not contaminated with fecal waste[16].
- **Counts of Fecal Coliform Bacteria (FSb):** Statistically, a significant difference was recorded

between the stations, as no significant difference was recorded between the second and third stations. The current study recorded the highest rates of fecal coliform bacteria in the first station during the summer of 2020, and this may be due to the previously mentioned reasons about the rates of coliform bacteria and the plant itself. Seasonal changes also play a role in increasing the numbers of this bacterium[17].

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