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ORIGINAL ARTICLE

Determination of Heavy Metals level (lead, cadmium, chrome) in waters of Meshkinshahr River for agricultural use

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ABSTRACT
This study was conducted in order to investigate amounts heavy metals such as cadmium, lead and chrome in surface water sources in Meshkinshahr region by using 5 stations during both high and low rainfall seasons in year 2013. Sampling works and their measurements was accomplished based on Method standard and by using atomic absorption device (model Perkin Elmer 2380). Furthermore, one-way and two-way t-tests were run to compare the measured values with the standard values. Results from t-test for high rainfall season showed that mean values for lead and chrome were higher than limits set by WHO and EPA and Iranian standard value; whereas mean value for cadmium were higher from limits set by WHO and EPA, but lower than Iranian standard value. In contrast, during low rainfall season, mean values for chrome and lead were lower than all the standard values; whereas, mean value for cadmium was higher than limits set by WHO and EPA and lower than Iranian standard value. Results from paired samples t-test suggested that amount of lead in the water was lower in low rainfall period than in high rainfall period.
Keywords: *water pollution, heavy metals, agricultural standard, Meshkinshahr, Iran*

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INTRODUCTION

Increase in various water consumptions due to increasing world population has led not only to decreased quantity of available renewable fresh water, but also to pollution and diminished quality of the fresh water sources [11]. Numerous approaches have been put forward by different researchers as how to improve quality of the water sources during various stages such as identification, prevention and corrective actions. Identification and acquiring knowledge on qualitative status of the water is first step towards achieving a healthy and standard aquatic environment, while they can provide a proper foundation for the following stages of prevention and corrective actions required to improve quality of the water sources [7]. Water is the most vitally important inorganic compound for any living cell and all organisms rely on it for their survival. Currently, as the increasing population correspondingly reduces per capita share of water sources for the Earth's inhabitants and the situation is aggravated by the increasing water pollution, water crisis has emerged as an immense global challenge [8].

Rivers are among the most important renewable resources of freshwater for household, agricultural as well as industrial uses [9]. Furthermore, over the past decades optimized exploitation of water sources and qualitative management of river systems have been the focus of interest for researchers and policymakers of water industry [10]. Quality of surface waters in any region is the result of both natural processes including sedimentation rate, weather conditions and soil corrosion, and unnatural effects such as industrial and agricultural activities [3]. Heavy metals are non-biodegradable and have a toxic effect on organisms, while tend to accumulate in tissues of animals and plants [13], [12]. Moreover, the most toxic among these substances found in the environment are those that contain lead, mercury, cadmium and nickel. These metals accumulate and remain for a long time in bodies of the organisms and generally act as toxicants [1]. Talekar et al [4] in their study conducted to assess spatial and temporal variations of heavy metals levels at Bhal Region of Persian Gulf and Khambat Region in India by using 10 sampling stations, found that Bhal region contains more heavy metals than Khambat region.

Yahaya et al. [6] in their study on heavy metals content of surface water in Oke-Afa, Isolo - Lagos, Nigeria, by taking samples from 9 stations, found that amounts of zinc, lead, cadmium in the study area were higher than limits set by WHO.
Jafar et al. [2] in their study on amounts of heavy metals (lead, cadmium, mercury, Arsenic) in the western estuary of Orumieh Lake, involving four periods of studies and 9 sampling stations, concluded that high levels of heavy metals in the water was due to discharge of urban, agricultural and industrial wastewaters into the estuary.
Moreover, quality monitoring researches are necessary in order to maintain the quality of agricultural water in terms of its heavy metal concentration and to control any potential pollution by heavy metals in rivers such as Khiav-chay, Ghareh-su, Tazeh-kand, Kangarlou and Ghasabeh. Therefore, the present study focuses on measuring the concentrations of some heavy metals including cadmium, chrome and lead in surface waters in catchment of Meshkinshahr region during low and high rainfall seasons.

METHODOLOGY

In order to study the quality of surface water sources in villages of Meshkinshahr region located in northwestern Iran in Ardabil Province (Fig. 1), the stations were selected based on location of the pollutant sources, entrance of secondary branch to main branch, and availability of station; and sampling was done during the two low and high rainfall seasons and analysis was run on the samples in order to determine amounts of the heavy metals such as cadmium, chrome and lead.

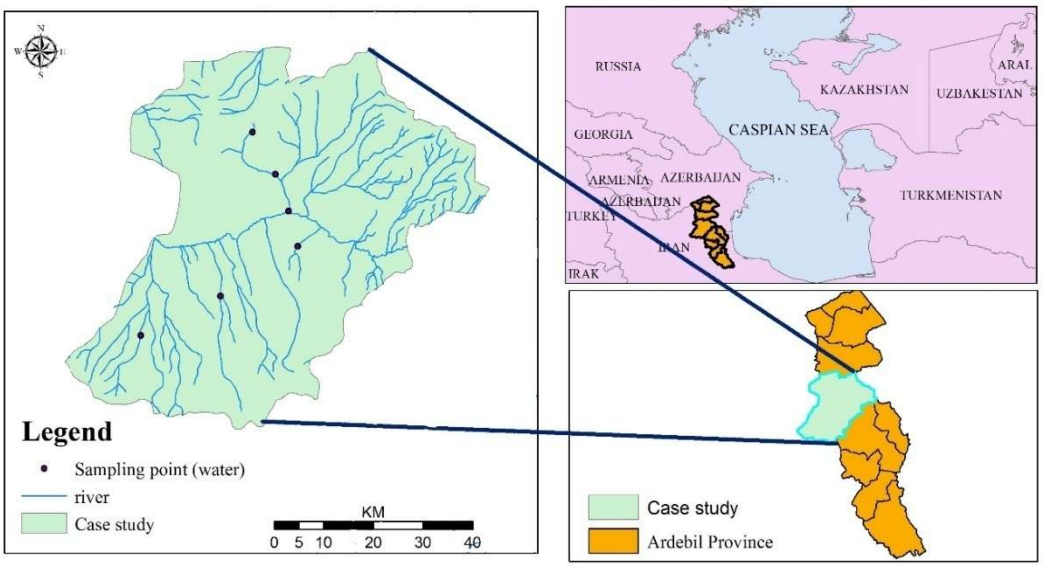

Fig. 1 – Location of the study area in Meshkinshahr, Ardabil, Iran

Sterilized polyethylene containers were used for sampling. After rinsed by nitric acid 10%, the containers were washed by detergent and then rinsed by distilled water. During the sampling, the place was also washed by water and sampling was done based on standard method 2008. The samples were consolidated by using nitric acid. More specifically, 0.05cc concentrated nitric acid was added for every 250cc of the samples. In order to prepare the samples, they were poured into sterilized glass containers and put on Hot Plat and heated to the point of evaporating, yet not boiling, while evaporation continued until their volume reduced to 20cc. Again, as much as 2cc nitric acid was added to each of the samples and they were evaporated so much that their volume reduced to 10cc. The samples then were filtered and Atomic Absorption Device (Model Perkin Elmer 2380) was used to measure amounts of the heavy metals. Results from measuring the amounts of heavy metals for the two high and low rainfall seasons were compared based on the standard values by using one-way and two-way t-tests through SPSS-16 software. Standards used in this study included standards of Institute of Standards and Industrial Research of Iran, EPA and WHO.

RESULTS AND DISCUSSION

Results from one-way t-test for comparison of the values measured for the heavy metals during each low and high rainfall seasons in waters of Khiav-chay, Ghareh-su, Tazeh-kand, Kangarlou and Ghasabeh rivers, which have agricultural use, are shown in the table below.

Table 1 – mean comparison on amounts of heavy metals in surface waters of villages of Meshkinshahr region during high and low rainfall seasons, based on national and international standard values

		WHO	EPA	iran
High rainfall lead	standard	b 0/5	b 0/5	b 1
High rainfall lead	Mean value	a 0/039	a 0/039	a 0/039
Low rain fall lead	standard	a 0/1676	a 0/1676	a 0/1676
High rain fall cadmium	Mean value	a 0/001	a 0/001	a 0/001
High rainfall cadmium	standard	a 0/013	a 0/013	a 0/013
Low rain fall cadmium	Mean value	a 0/0372	a 0/0372	a 0/0372
High rain fallchrome	standard	a 0/1	a 0/1	a 0/1
High rain fallchrome	Mean value	b 0/022	b 0/022	b 0/022
Low rain fall chrome	Mean value	b 0/0218	b 0/0218	b 0/0218

High rainfall:
Mean values for lead and chrome were lower than limits set by WHO and EPA and Iranian standard value; whereas mean value for cadmium was higher than limits set by WHO and EPA and lower than Iranian standard value.
Low rainfall:
Mean values for lead and chrome were lower than limits set by WHO and EPA and Iranian standard value; whereas mean value for cadmium was higher than limits set by WHO and EPA and lower than Iranian standard value.
Moreover, single sample t-test was used to study the statistical difference between the values measured for the heavy metals based on the national and international standards.

Table 2 – Results from mean comparison on amounts of heavy metals in surface waters of Meshkinshahr during high and low rainfall seasons based on the national and international standards by using single sample t-test (*significant at 5% level - **significant at 1% level – ns not significant)

		WHO	EPA	Iran
High rainfall lead	Significant level	**-24/140**	**-24/140**	**-50/322**
High rainfall lead	**value t**	**0/000****	**0/000****	**0/000****
Low rain fall lead	Significant level	**-5/698**	**-5/698**	**-5/698**
Low rain fall sorb	**value t**	**0/000****	**0/005****	**0/005****
High rainfall cadmium	Significant level	**1/475**	**1/475**	**1/475**
High rainfall cadmium	**value t**	**0/241 ns**	**0/241 ns**	**0/010***
Low rain fall cadmium	Significant level	**3/442**	**3/442**	**-1/217**
Low rain fall cadmium	**value t**	**0/026***	**0/026***	**0/291ns**
High rainfall chrome	Significant level	**-9/682**	**-9/682**	**-121/399**
High rainfall chrome	**value t**	**0/001****	**0/001****	**0/000****
Low rain fall chrome	Significant level	**-63/015**	**-63/015**	**-788/256**
Low rain fall chrome	**value t**	**0/000****	**0/000****	**0/000****

High rainfall:
Studies showed that mean value for lead was significantly lower than limits set by WHO and EPA and Iranian standard value (sig < 0.05).
Based on the results, mean value for cadmium was not significantly different from limits set by WHO and EPA (sig > 0.05); however, it was significantly lower than the Iranian standard value (sig < 0.05).
Likewise, mean value for chrome was significantly lower than limits set by WHO and EPA and Iranian standard value (sig < 0.05).
Low rainfall
Results from the studies showed that mean value for lead was significantly lower than limits set by WHO and EPA and Iranian standard value (sig < 0.05).
Contrarily, the results showed that mean value for cadmium was significantly higher than limits set by WHO and EPA (sig < 0.05); whereas it was not significantly different from Iranian standard value (sig > 0.05).
Finally, based on the results mean value for chrome was significantly lower than limits set by WHO and EPA and Iranian standard value (sig < 0.01).

Table 3 – paired samples (dependent) t-test for mean comparison of amounts of heavy metals in the surface waters during low and high rainfall seasons

Dependent t test		Lead during summer/spring	Chrome during summer/spring	Cadmium during summer/spring
	Significant level	**-3/008**	**0/025**	**-1/771**
	value t	**0/040***	**0/981ns**	**0/151ns**

Results from paired samples t-test indicated that the two high and low rainfall seasons differed significantly for amount of lead (sig < 0.05), which was higher in low rainfall period than in high rainfall period.
Contrarily, difference between the two high and low rainfall periods was not found to be significant for amount of cadmium in surface waters of Meshkinshahr; whereas the same was true for the chrome content of the waters (sig > 0.05).

CONCLUSION

Results from mean comparison accomplished by using single sample t-test on amounts of the heavy metals in the surface waters during low and high rainfall seasons showed that mean values for lead and chrome were higher than limits set by WHO and EPA. In contrast, mean value for cadmium was higher than limits set by WHO and EPA; but, lower than Iranian standard value.
Results from paired samples t-test showed that amounts of lead in the surface waters during the two sampling periods were lower than limits set by WHO and EPA and Iranian standard value (sig < 0.05).
Moreover, the two high and low rainfall seasons did not differ significantly for amount of cadmium; while the same was true for chrome (sig > 0.05).

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