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Evaluation of Physical Parameters and Determination of Lead (Pb) in the Surface Drinking Waters (SDW) of district Loralai, Balochistan, Pakistan

ABDUL MANAN KAKAR
Ph.D. Scholar
Institute of Biochemistry University of Balochistan
Quetta, Pakistan
MUHAMMAD ANWAR PANEZAI
Director
Institute of Biochemistry, University of Balochistan
Quetta, Pakistan
JAVED KHAN
Ph.D. Scholar
Department of Microbiology, Quaid-i-Azam University
Islamabad, Pakistan
JAHANGIR KHAN ACHAKZAI[1]
Ph.D. Scholar
Institute of Biochemistry, University of Balochistan
Quetta, Pakistan

Abstract:

    Flame atomic absorption spectrometry (FAAS) was used for the detection of Lead (Pb) in the Surface drinking water of different areas of district Loralai. Certain other physical parameters were also evaluated to understand water quality in qualitative terms and include water quality parameters like color, physical appearance, transparency, Electrical conductivity, odors, pH, taste and turbidity.

[1] Corresponding author: jahangir.biochemist@yahoo.com

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The average pH range 6.96- 8.8 and 7.75-9.17 was observedin surface drinking water respectively. In Pathan Kot area the pH of 6.96 and 9.17 were recorded in surfacedrinking water respectively exhibiting much difference while rest of the areas have 7 and 8 pH values for surface drinking water. The electrical conductivity provides a rapid and convenient mean for estimating the concentration of electrolytes. On determination of electrical conductivity (EC) the average value of 66.48 -119.54 µs/ cm and 59.86-70.48 µs/ cm was observed in surface drinking water respectively. All the water samples from different areas showed normal values of EC. The standard EC of most fresh water is in the range of 50-500 us/cm.Lead (Pb) was found in acceptable values in surface drinking water from all the areas. Lead is discharged by vehicles into air, and then adsorbed from the air by environmental sample such as soil and plants ppm then enters the water way from soil, thus affecting the levels of lead in natural water.

Key words: Lead, Surface Drinking Water, Physical Parameters, FAAS

INTRODUCTION

Lead is a growing toxin that moves in the body from lead water pipelines, lead-based paints and leaded petrol [1]. Lead is a venomous heavy metal and can affect several organs in the humanoid body. In the course of the past decades, far-reaching databank has been published given that an undeviating linkage between exposures to low levels of lead as well as mental deficiency in youngsters. Persistent consumption of even low concentrations of lead can cause severe complications for humanoid wellbeing [2]. Lead contamination in water systems has extremely influenced the worth of lifespan, particularly in unindustrialized nation state. Lead is stored in tissues and may cause severe fitness complications for human being and wildlife. This metal stops biosynthesis and upsets the kidneys, brain cells and the penetrability the liver membrane, in that

way decreasing certain of their functions. It can be stored in the body and can stimulate disorder for instance vomiting, nausea, diarrhea, perspiring and, in certain cases, tremors, unconsciousness and death [3, 4]. The U.S. Environmental Protection Agency (EPA) has categorized lead as a Group B2 (likely) human carcinogen [5]. The most common analytical methods for the lead trace determination are the flame atomic absorption spectrometry (FAAS) [6, 7]. Flame atomic absorption spectrometry (FAAS) is a more frequently used technique because of its ease and lower rate, though this method has a partial sensitivity for Lead so a preconcentration step is often requisite to develop the detection limit [8-10]. The determination of trace quantity of lead is very significant in the context of environmental observing. Atomic absorption and atomic emission spectrometry are used for routine trace examination of lead; though enormous number of spectrometric methods are stated. Hence, there is a sustained concern in the synthesis of novelcarbon-based reagents that could be able to be used for direct and rapid spectrophotometric determination of trace level of lead, particularly in aqueous solutions. Thioamides are organic reagents used in recent times for the determination of trace level of elements in biological and environmental samples [11-14]. Therefore, Lead concentration is determined in the surface drinking waters to observe the quality of water in district Loralai, Balochistan, Pakistan.

MATERIALS AND METHODS

2.1. MATERIALS
2.1.1 Atomic Absorption Spectrometer
The Atomic Absorption investigations in this work involved the use of S4.A.A system Spectrometer, NC 9423- 50-60 Hz Model Atomic Absorption Spectrometer. The spectrometer consists of a six- lamp turret, a deuterium hollow cathode lamp for

background correction, an optical system incorporating a chopper, mirrors, lenses, monochromator, and photomultiplier detector. The basic components of the A.A.S model atomic absorption is a radiation source; atomizer cell (contains the gaseous atomized sample), a wavelength selector, a detector, and a signal processor and readout (Plate ii). The monochromator is of the Ebert type of geometry. Its wavelength is selectable between, 100-240 nm via a micrometer screw drive connected to an arm adjusted to a linear relation between wavelength and rotation of the control knob. The slit width may be varied in discrete steps by means of the "band pass" control knob, which can be selected to give a band pass of 0.2, 0.5, 1.0, 5.0 and 10.0 nm.

Hollow Cathode Lamp Sources

Pb hollow cathode lamps were used in the atomic absorption investigations and manufactured by Thermo Limited, England. The lamps maximum operating currents and wavelengths of the absorbing lines used for this study are given in Table 1. The lamp current setting has a significant effect on the sensitivity, thus lamp current setting of 75% of the maximum was used.

Table 1Hollow Cathode Lamp and their Operating Currents (A.S.S)

H. Cathode Lamp	Fuel Flow	Units	Flame Type
Pb	0.9-1.2 /min	7mg/L	Air/acetylene

Reagents and Stock Solutions

All chemicals used in the preparation of the stock solutions of elements and compounds were of analytical reagent grade. Unless otherwise stated, stock solutions were prepared in dilute nitric acid, with a final concentration of 0.1%. Deionized water was used throughout. Working solutions were freshly prepared from these stock solutions as required by dilution with deionized water.

Sampling Site and Sample Collection

Representative water samples were collected from each site, taking care to assure that all samples represent as closely as possible, in situ conditions of sample water body. The field work of this study was done in times of the rainfalls in the valley, exactly when spring had initiated in Baluchistan. So the samples belong to a seasonal period when the river transports a small amount of material in suspension. Total of 25 surface Drinking Water samples collected from different areas of district Loralai, Baluchistan were evaluated for the assessment of Lead and different physical parameters by Atomic absorption spectrophotometer.

Sample Handling

The environmental samples collected from the various points of the study area were kept in polyethylene containers. The effluents collected were not subjected to further treatment except for appropriate acidification at the sampling spot using (1:1) nitric acid. Acidification of the sample at the sampling site helps in preserving the sample by minimizing adsorption of the trace heavy metals onto the container walls.

Evaluation of Techniques

The performance characteristics of the developed method with the use of atomic absorption spectrometer were assessed using quantitative performance criteria; such as sensitivity, detection limit, precision and accuracy.

Sensitivity

Sensitivity is defined as that concentration of the element in part per million (or µg/ml or mg/l) in aqueous solution, which gives an absorbance of 0.0044, equal to a 1% of the transmitted radiation. Sensitivities are checked by aspirating a freshly prepared aqueous solution of the element, to give an absorbance

reading of about 0.1A. Instrumental parameters are then adjusted for optimum sensitivity of the element in mg/L.

Detection Limits

Detection limit is a statistical function which takes into account blank levels, sensitivity and signal to noise ratios. It is defined as that concentration of an element in mg/L, which gives a reading equal to three times the standard deviation of a signal measured close to the blank level. The standard deviation is calculated using at least 10 sequential readings. The detection limits depend on the signal to noise ratio and are therefore a function of the performance of the various instrument components.

Samples

25 Samples were taken from 5 different areas which are agricultural and also residential area.

Chemicals

a) Nitric Acid
b) Water samples from Loralai District
c) Standard solution of Pb

Apparatus

a) 1L clean polyethylene bottles that had been washed with deionize water before sample collection
b) Label of the bottle for identification
c) Micropipette / pipette to prepare accurate concentration of standard solution
d) Volumetric flask 100 ml
e) Small beaker

GENERAL PROCEDURE FOR METALS ANALYSIS BY ATOMIC ABSORPTION

Standard solutions of the elements lead of various concentrations were prepared and aspirated using the conventional flame atomic absorption spectrometric method. The same standards were analyzed using the developed modified atom- trap method, in which 0.2 ml of the standard solution was evaporated for about 10 minutes at 105ºC. The tube was then inserted into the flame and the signal measured.

SAMPLE ANALYSIS

The collected water samples were processed in (Hi Tech. Laboratory Institute of Bio-Chemistry University of Balochistan, Quetta, Pakistan) for the determination of Lead. PH was measured by pH meter (JENWAY pH METER MODEL No.3520) and conductivity was measured with the help of mobile conductive meter (JENWAY CONDUCTIVITY METER MODEL NO.470). The concentration of Lead (Pb) was analyzed in water samples. SOLAAR AA SERIES S4 SYSTEM ATOMIC ABSORPTION spectroscopy (AAS) Flame method was used for the detection of Lead presence and for sample analysis with the help of Nitrous oxide/Acetylene gases (Michael, 1981).

Three (3) different reagents as standard stock solution of 1000 ppm were prepared for the detection of Lead.

The reagents prepared were in below concentrations.

Lead (Pb)

For the preparation of 1000 ppm stock solution of Lead (Pb) three different concentrations of 7.00 mg/l, 14.00 mg/l and 21.00 mg/l of Lead (Pb) was dissolved in de-ionized water and was made to volume with de-ionized water in 25ml volumetric flask.

The atomic absorption spectroscopy (AAS) was set according to above conditions for the detection of Lead. The instrument was calibrated with the above mentioned standard solutions. These working standards were then run as unknown/blank. The results were compared with certified values and were found within the confidence limit. After making sure that the instrument is properly calibrated the water samples were run using the atomic absorption spectroscopy for the estimation of Lead.

RESULTS

Total of 25 surface Drinkingwater samples collected from different areas of district Loralai, Balochistan were evaluated for the assessment of Lead different physical parameters by Atomic absorption spectrophotometer.

pH estimation in Surface Drinking water
The average pH range 6.96-8.8 and 7.75-9.17 was observed in surface Drinking water respectively. the average pH of the surface water was 9.178, 8.60, 7.75, 8.54 and 8.122 in Sagar, Mahol Sydan, Shakaryz and Marah areas respectively.

Electrical Conductivity (EC) estimation
The average EC value of 66.48 -119.54 µs/ Cm and 59.86-70.48 µs/ Cm was observed in surface Drinking water respectively. The average EC value of the Pathan Kot was 119.54 µs /cm. Similarly the average EC values 71.52 µs/ Cm, 69.14 µs/ Cm, 70.32 µs/ Cm and 66.48 µs/ Cm in Sagar, Mahol Sydan, Shakaryz and Marah area respectively were recorded. The average EC value of the surface water from Pathan Kot area was recorded as 70.48µs/cm. Similarly 59.86 µs/ cm, 85.16 µs/ cm, 112.38 µs/ cm and 92.02 µs/ cm values were recorded in

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Sagar, Mahol Sydan, and Shakaryz and Marah area
respectively. (Table-2)

**Table 2 Average pH and Electrical conductivity values of water
samples collected from Loralai, Balochistan**.

Area		pH	*E/C µs/cm
Pathan kot	S.W	9.178	70.48
Sagar	S.W	8.60	59.86
Mahol sydan	S.W	7.75	85.16
Shakaryz	S.W	8.54	112.38
Marah	S.W	8.122	92.02

Lead Detection

Total of 25 water samples were collected from different areas of
District loralai, Balochistan in order to estimate the Lead
concentration.

The average Lead (Pb)value of surface water was
recorded as 0.014 mg/l, 0.013 mg/, 0.014 mg/l, 0.015 mg/l, &
0.013 mg/l in Pathan Kot, Sagar, Mahool Sydan, Shakaryz and
Marah areas respectively.

**Table 3 The Average concentration of Lead in the surface drinking
water sample by atomic Absorption (mg/l)**

Area	Water	Pb
	W.H.O	0.015
Pathan kot	S.W	0.014
Sagar	S.W	0.013
Mahol saydan	S.W	0.014
Shakaryz	S.W	0.015
Marah	S.W	0.013

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Table 4 Physical characters and Lead concentration of Surface drinking water samples collected from Pathan Kot area, Loralai, Balochistan.

S. ID	water	pH	E/C µs/cm	Pb mg/l
1	SW	9.19	77.0	0.010
2	SW	9.12	63.0	0.013
3	SW	9.17	79.9	0.009
4	SW	9.26	89.0	0.025
5	SW	9.19	43.5	0.015

Table 5 Physical characters and Lead concentration of the Surface drinking water samples collected from Sagar area, Loralai, Balochistan.

S. ID	water	pH	E/C µs/cm	Pb mg/l
1	SW	9.24	99.4	0.017
2	SW	8.75	42.6	0.005
3	SW	7.16	127.6	0.018
4	SW	9.63	98.9	0.014
5	SW	8.24	40.5	0.013

Table 6 Physical characters and Lead concentration of Surface drinking water samples collected from Mahol Sydan, Loralai, Balochistan.

S. ID	Water	pH	E/C µs/cm	Pb mg/l
1	SW	8.30	97.3	0.008
2	SW	7.40	102.2	0.014
3	SW	7.2	75.2	0.021
4	SW	8.0	57.7	0.012
5	SW	8.27	102.0	0.018

Table 7 Physical characters and Lead concentration of Surface drinking water samples collected from Shakaryz, Loralai, and Balochistan.

S. ID	water	pH	E/C µs/cm	Pb mg/l
1	SW	8.2	145.0	0.011
2	SW	9.35	75.1	0.013
3	SW	8.42	116.3	0.014

4	SW	8.29	100.9	0.019
5	SW	9.65	136.4	0.020

Table 8 Physical characters and Lead concentration of Surface drinking water samples collected from Marah, Loralai, Balochistan.

S. ID	water	pH	E/C µs/cm	Pb mg/l
1	SW	8.94	125.1	0.013
2	SW	9.0	126.1	0.012
3	SW	8.75	76.3	0.017
4	SW	8.66	79.3	0.010
5	SW	9.07	70.2	0.015

Table 9 Water Quality Standards by EPA (ENVIRONMENTAL PROTECTION AGENCY)

Serial No	HEAVY METALS	STANDARD (mg/l)
1	Lead	0.015 mg/l

DISCUSSION

Surface Drinking Water samples were collected from different areas of district Loralai and were subjected to assess for the detection of Lead concentration. Lead (Pb) was analyzed using Atomic Absorption spectroscopy (AAS). Certain other physical parameters were also evaluated to better understand water quality in qualitative terms and include water quality parameters like color, physical appearance, transparency, Electrical conductivity, odors, pH, taste and turbidity. The average pH range 6.96- 8.8 and 7.75-9.17 was observed surface drinking water respectively. In Pathan Kot area the pH of 6.96 and 9.17 were recorded in surface water respectively exhibiting much difference while rest of the areas have 7 and 8 pH values for surface drinking water. Electrical conductivity depends upon the ionic strength of water and relates to the nature of various dissolved substances, their actual and relative

concentration and the temperature at which the measurement is made. The electrical conductivity provides a rapid and convenient mean for estimating the concentration of electrolytes. On determination of electrical conductivity (EC) the average value of 66.48 -119.54 µs/ cm and 59.86-70.48 µs/ cm was observed in surface drinking water respectively. All the water samples from different areas showed normal values of EC. The standard EC of most fresh water is in the range of 50-500 us/cm.

Lead (Pb) was found in acceptable values only in surface water from all the areas. Lead is discharged by vehicles into air, and then adsorbed from the air by environmental sample such as soil and plants ppm then enters the water way from soil, thus affecting the levels of lead in natural water.

Acknowledgement

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