Tikrit Journal of Pure Science Vol. 27 (4) 2022

TJPS

IASJ

المجلات الاكاديمية العراقية

Tikrit Journal of Pure Science

ISSN: 1813 – 1662 (Print) --- E-ISSN: 2415 – 1726 (Online)

Journal Homepage: http://tjps.tu.edu.iq/index.php/j

Determination of the Zinc level in Environmental and Biological Samples in Baiji City by Atomic Absorption Spectrophotometer

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https://doi.org/10.25130/tjps.v27i4.43

ARTICLE INFO.

Article history:

-Received: 22 / 8 / 2022

-Accepted: 5 / 9 / 2022

-Available online: / / 2022

Keywords: Zink Level, human serum, Atomic Absorption Spectroscopy.

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ABSTRACT

This study was conducted to measure Zinc levels in environmental and biological samples. The method was tested with three types of samples, including soil, water, and human blood serum. In this method, 50 samples from each soil, water, and human blood serum were used. The water and soil samples were collected from the Baiji oil refinery, while the human blood serum was collected from the patients in the Baiji hospital. The total Zinc concentration in the environmental and biological samples was measured by atomic absorption spectrophotometry (AAS). The results of the Zinc determination were obtained from the samples taken from the soil for each site under examination. The following values showed the mean average concentration for each site, respectively. site 1 (15±3.5), site 2 (11.5±1.1), site 3 (14.5) ±0.5), and site 4 (13.8±3.8) µg/g. Moreover, the Zinc concentration in the water samples was between 3-14.3 µg/ mL. The Zinc concentration in the blood serum samples of the control and the healthy group was 598 ± 32 µg/mL, and in the patient group was 450 ± 16 µg/mL.

Introduction

The quantity of Zinc in environmental samples is determined using a variety of analytical techniques, including spectrophotometric, inductive couple plasma, electrochemical, and atomic absorption techniques[1-5]. Due to its accessibility, sensitivity, and suitability, flame atomic absorption spectrophotometry was utilized in the current study. The Zinc metal bonded with many enzyme systems such as metalloenzyme and enzyme activators[6-8]. Zinc was determined in human blood for medical diagnosis[9], while in the environmental samples (water and soil), the Zinc concentration was determined to access the pollution index[10]. The total Zinc concentration in the biological and environmental samples does not indicate the fact of diagnosis and pollution[11]. The speciation of Zinc in soil was studied using Tessier Schem[11,12]. to determine Zinc in ion exchangeable, carbonate, Fe-Mn oxide, organic, and residual layers. The mobility of Zinc in water was studied using the total Zinc concentration of the pre-concentration of the water sample to reduce the volume [13-15]. Moreover, the total Zinc in serum was determined by flame atomic absorption using air-acetylene flame, while ionic Zinc was determined by colour spectrophotometry[16]. The subtraction of ionic Zinc from total Zinc indicated bound Zinc which is more revealed in the diagnosis of diseases such as ischemic heart disease, Angina Pectoris, Asthma, Diabetes Mellitus and warts[17,18].

Experimental part and methods

Sample area and collection of samples

The samples used in this work were soil, water, and serum. The soil and water samples were collected from the oil refinery in Baiji city at Salah-Alden governorate which is fifty kilometres north of Tikrit city. At the same time, the serum samples were collected from the patients in the Baiji hospital.

Materials

Pure chemicals from the BDH firm were used, including concentrated HNO_3, H_2O_2, CH_3COOH, ammonium acetate, hydroxyl amine hydrochloride, and $MgCl_2$. The atomic absorption type was a Germany-Varian AA24 FS.

Methods

The "as received" soil sample was first ground (~1 g) in a mortar and pestle and then mixed with HNO3 concentration, and the volume was diluted with deionized water. The water samples (100 mL) were evaporated to 10 mL, and 100 µl serum samples were digested with one drop of concentrated HNO_3. All samples were measured by FAAS. The chemical materials in procedure used as same as tessier scheme. The procedure pertionally Zinc into the following five fractions[11].

Results

The total Zinc concentration was determined by AAS using an Air-acetylene flame, a specific hollow cathode lamp, and a specific wavelength. The calibration curve of the standard solution was prepared using the same AAS method by measuring the absorbance at a wavelength of 213.9 nm figure (1). The results were described in tables (1-3).

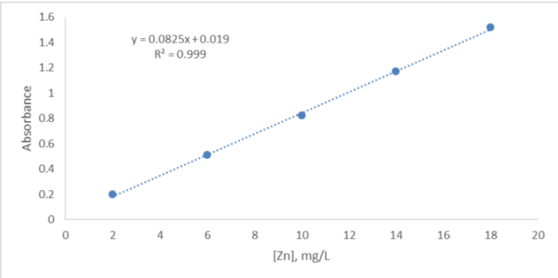

Fig. 1: calibration curve for Zinc

Table 1: Total concentration of Zinc in soil (µg / g)

Site	Zn	Site	Zn	site	Zn	Site	Zn
1	12	2	12	3	13	4	12
	10		11		14		15
	21		11		15		15
	16		11		13		14
	17		11		16		14
	15		12.9		15		13
	15		12		16		13
Mean	15		11.5		14.5		13.8
SD	±3.5		±1.1		±0.5		±3.8

Tabl 2: Total concentration of Zinc in water (µg /mL)

Site	Zn
1	14.3
2	14.3
3	7.3
4	10
5	3.4
6	3
7	6.5

Table 3: Total concentration of Zinc in human serum (µg / mL)

Parameters	Rate	Zn concentration ± SD
Control	30 person	598 ± 32
Patients	50 person	450 ± 16

Studying the species of Zinc in soil, water and serum of human blood

The scheme listed in Tisser scheme was selected to study the Zinc species in different sites in Baiji refinery soil. The results obtained are listed in table (4).

The species of Zinc in water at different sites of Tigris river approach to Baiji refinery was listed in table (5).

The Zinc species in the serum of human blood are illustrated in table (6).

Table 4: species of Zinc (µg / g) in soil

Fraction	Zn concentration (µg / g)
Exchangeable	2.8
Carbonate	11.5
Fe – Mn oxide	27.3
Organic	3.6
Residual	8.7
Totale	53.9

Table 5: species of Zinc in water (µg / mL)

Site	Zinc (µg / mL)
1	6.1
2	5.4
3	3.4
4	N.D
5	N.D
6	N.D
7	N.D

N.D : Not Detected

Table 6: species of Zinc in serum of human blood (µg/mL)

Concentration of Zinc (µg/mL)		Specia of Zinc
Control	Patient	
628.5	451.8	Ionic
29.5	75.4	Bonding
658	527.2	Total

Discussion

The results in table -1- indicate that all sites are not contaminated with the Zinc, as shown in figure 2.

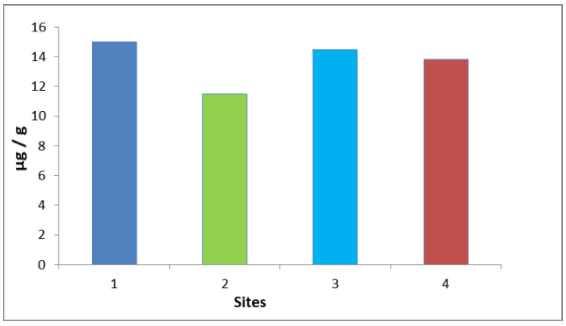

Fig. 2: Total concentration of Zinc in soil (µg / g)

The results in table -2- illustrate that the concentration of the total Zinc in the water of the Tigris river is not contaminated with the Zinc, as shown in figure 3.

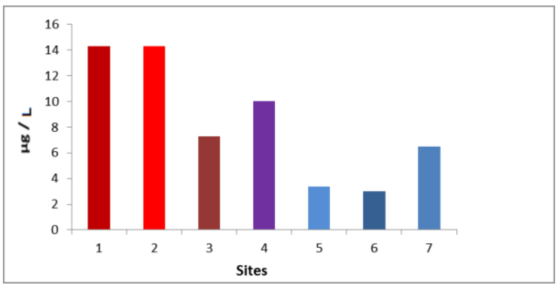

Fig. 3: Total concentration of Zinc in water (µg /mL)

The results in table (3) show that the Zinc concentration in the patients is less than the concentration in control health patients (figure 4).

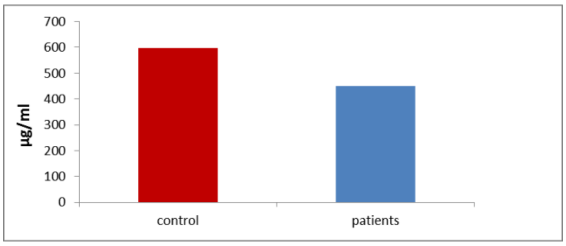

Fig. 4: Total concentration of Zinc in human serum (µg / mL)

In general, the results in tables (1-3) illustrate that the Zinc accumulated in human blood serum is more concentrated than its concentration in water and soil of all sites.

The results in table (4) of Zinc-associated species are shown in figure –5.

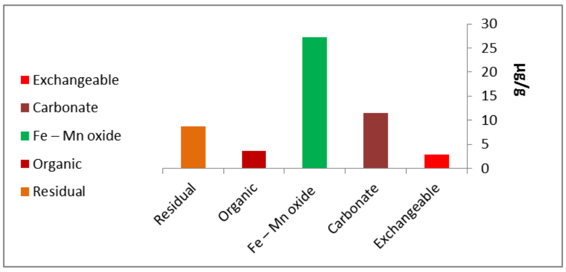

Fig. 5: species of Zinc (µg / g) in soil

The Zinc species is less soluble than other metals in water, its concentration is deficient, and the analytical technique does not detect it sometimes.

The results in table (6) indicate that the bound Zinc is higher in the patients than in control which is more significant in medical diagnosis than the total Zinc (figure 6).

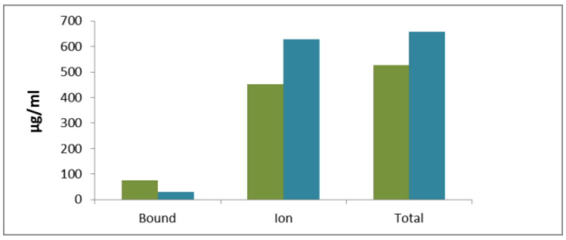

Fig. 6: species of Zinc in serum of human blood (µg/mL)

Conclusions

The results in table (1) show that the Zinc concentrations are close to each other in all the soil samples taken from four locations, as shown in figure (2). The Zinc concentrations values in table (2) for the measured water samples showed a disparity in the measured concentrations of all selected locations, as shown in figure (3). Moreover, table (3) illustrates the Zinc concentrations in the serum of the control and healthy people compared to the sick people. Furthermore, the results showed that sick people have low Zinc in their serum. The Zinc associated with Fe-Mn Oxide layer in the site's soil is higher than its concentration in the exchangeable, carbonate, organic and residual layer. This fact is illustrated in table(4).

The Zinc species is less soluble than other metals in water. Its concentration is deficient and sometimes not detected by the analytical technique (table 5).

In (table 6) and figure -6- Zinc in human serum blood, the total concentration of Zinc in serum decrease due to decrease of immunity in such disease due to increase with blood cells.

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تقدير مستوى الزنك في العينات البيئية والبيولوجية في مدينة بيجي بواسطة مطياف الامتصاص الذري

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قسم الكيمياء الصيدلانية، كلية الصيدلة، جامعة تكريت، تكريت، العراق

الملخص

أجريت هذه الدراسة لقياس مستويات الزنك في العينات البيئية. تم اختبار الطريقة بثلاثة أنواع من العينات تشمل التربة والماء ومصل الدم البشري. في هذه الطريقة تم استخدام 50 عينة من كل من التربة والماء ومصل الدم البشري. تم جمع عينات المياه والتربة من مصفاة بيجي للنفط بينما تم جمع مصل الدم البشري من المرضى الراقدين في مستشفى بيجي. تم قياس تركيز الزنك الكلي في العينات البيئية والبيولوجية بواسطة مقياس الامتصاص الذري الطيفي (AAS). وقد تم الحصول على نتائج تقدير الزنك في النماذج المأخوذة من التربة لكل من المواقع قيد الفحص و توضح القيم التالية متوسط التركيز لكل موقع على التوالي الموقع رقم 1 (3.5±15) , الموقع رقم 2 (1.1±11.5) , الموقع رقم 3 (0.5±14.5) , الموقع رقم 4 (3.8±13.8)مايكروغرام.غم$^{-1}$.

اما النماذج لعينات الماء فقد تم الكشف عن تراكيز تتراوح بين (3 – 14.3)مايكروغرام.مل$^{-1}$. وكان تركيز الزنك في نماذج مصل الدم لمجموعة الاصحاء (32±598) مايكروغرام.مل$^{-1}$, و لمجموعة المرضى (16±450) مايكروغرام.مل$^{-1}$.