Sys Rev Pharm 2021;12(2):285-288
A multifaceted review journal in the field of pharmacy

Bioconcentration Factor Of Mercury Element In Mosul City, Northern Of Iraq

Omer Abdul Kareem Aswad, Huda Farooq Zaki2,
Estabraq Mohammed Ati*3, Reyam Naji Ajmi4

1,2,3,4 Department of Biology Science, Mustansiriyah University, POX 46079 Iraq-Baghdad
Corresponding Author: estabraqati@uomustansiriyah.edu.iq

ABSTRACT
A few studies have applied in Mosul city after liberation from ISIS 2016 to assess the extent of mercury contamination in three basic stations in Mosul of the soils and natural plant prevailing were conducted mercury and the BCF calculated as well as to determine the distribution of the mercury contamination with carbon in soil samples and analyzed for inorganic mercury. The highest mercury concentrations were recorded at the sites located lowest cover the plant and close Al-Nouri Mosque (A3). Mercury concentrations in leaf plant Ziziphusspina-christi higher concentration and soil were mostly higher mercury concentration , ratio of carbon to coincide with the increase in the concentration of mercury in the soil of the all sites . Mercury is more biologically because of his preference to bind with carbon. This research confirms that is a key area for formation of bioavailable mercury distribution to organic carbon in Mosul city .

Keywords: Mercury, Plant, Soil, Mosul city

Correspondence:
Estabraq Mohammed Ati
Department of Biology Science, Mustansiriyah University, POX 46079 Iraq-Baghdad

*Corresponding author: Estabraq Mohammed Ati email-address:
estabraqati@uomustansiriyah.edu.iq

INTRODUCTION

Mosul is the center of Nineveh Governorate and the second largest city in Iraq in terms of population after Baghdad, with a population of about three and a half million people. Mosul is approximately 465 km from Baghdad, for two years, it was subjected to neglect in the vital nature of the components of the environment. Mosul is characterized by a semi-arid climate, where the summer is dry and hot, and one of the reasons is its little height above sea level, which does not exceed 220 meters, while temperatures drop below zero, and the annual amount of precipitation reaches 375 mm, and snow sometimes falls. In Mosul, a record for the lowest temperature in Iraq was recorded, with a temperature of minus 17.6 degrees Celsius. Mosul is characterized by a semi-arid climate, where the summer is dry and hot, and one of the reasons is its little height above sea level, which does not exceed 220 meters, while temperatures drop below zero, and the annual amount of precipitation reaches 375 mm, and snow sometimes falls, where the temperature reached minus 17.6 degrees Celsius, with city coordinates extending between longitude 2 ° 36 and latitude 7 ° 43 (Curtis and John, 2003). Mercury consider is an a globally dispersed pollutant which exists in several different forms in ecosystems, this element transport and distribution in the environment originate from natural such as residues explosive materials and military operations out gassing, geothermal surfaces (Staddon, *et al.,* 1997), various species of mercury exist in soils including elemental mercury organic and inorganic and their potential toxicity depends on their concentration and species present in the soil solution (Boening, 2000). An excess of trace elements in an organism, especially those elements without biological function like mercury, can have a detrimental effect on metabolic processes in that organism (Revis, *et al.,* 1989), such as sulfhydryl influences the plant growth hormone auxin and mercury's affinity to these sulfhydryl groups is thought to be the main way the metal disrupts metabolic processes in plants (Schroeder and Munthe, 1998). Bioavailable metals steadily decline after being introduced to an environment and the weathering processes that make metals available from parent material are generally slow enough not to generate toxic levels of mercury (Becker and Bigham, 1995).

Since atmospheric deposition of mercury is an important pathway for both plants and soils, multiple potential uptake paths must be sampled (Baker, *et al.,* 1994; Pickhardt, *et al.,* 2005). By looking at soils and plants, our study will provide a sense of the primary source of contaminants to both producers of exposed to soil and consumers .This requires that we make the assumption that fluctuations in contaminant concentrations in an organism reflect changes in environmental concentrations-also known as the theorem of congruence originate from multiple sources including uptake by roots in the soil and uptake from the atmosphere via leaves, needles and bark (Kabata and Pendias, 2001). Therefore, mercury in plants could act as an indicator of atmospheric mercury and to a lesser extent an indicator of mercury in solution in soil water. Analyzing mercury in soil is important to the study because it may indicate risks of utilizing the soils, such as potential uses in the community garden , leaf plant can also be useful in measuring atmospheric pollution (WHO, 1996; Obrist, *et al.,* 2009). In this study, leaves of plant *Ziziphusspina-christi* and soil were chosen for sampling and analysis because mercury uptake in plants is potentially related to pollution levels in these area and document concentrations of mercury and the extent of the possible intended as a preliminary assessment of potential risk.

MATERIALS AND METHODS

Description and samples collection of this study

Three stations were selected on the basic location from Mosul city .

1-First site at the beginning of the forests (Station 1)

2-Second site Rashidiya of the middle city (Station 2).
3-Third site is the nearby area on the Al-Nouri Mosque (Lighthouse Al-Hadbaa) (Station 3).

Five replicates were collected environmental sample for dominant Plant in the sites had a long period of years to grow plant samples (*Ziziphus spina-christi*)

Preparing Experimental and Analysis:

The samples were collected from the study areas during October in 2018 were taken for each site samples of the plant, surrounding soil , then rinsed thoroughly with deionized water and dried outdoors at room temperature for 3-5 days, then grinded with a mill and sifted with a 1 mm diameter sieve to be ready for analysis (Baker, *et al.,* 1994; Markert*, et al.,* 1995).

Soil Samples:

Soil samples were collected using modified clean-hands/dirty-hands protocols wearing nitrite gloves and using a trowel. The sampler would first remove the vegetative layer and then collected soil from 10 cm under the surface enough sample for analysis of carbon and mercury. An effort was made to remove roots and other plant matter at the time of sampling. Each sample was collected from three replicate within one site. Site code as follows: A1S, A2S, A3S.

Leaf Plants Sampling

Leaf plants samples were collected in locations. Samples were collected in each quadrate prior to soil sampling, nitrite gloves were worn and samples were stored in Ziploc bags. Procedures similar to soil sample collection were followed for sample identification and data recording. Have been chosen type of leaf plant Family : Rhamnaceae Genus : Zizphus Species : Spina-christi.

Laboratory Analysis:

Samples received at field moisture were air dried for 3-4 days before being oven dried at 60 °C for 24 h. Once fully desiccated, samples were ground with a mortar and pestle till fine enough to pass a 2 mm stainless steel sieve. Once segmented, each piece was homogenized as much as possible using a mortar and pestle and then wrapped in tinfoil. All soil samples were air dried for 2 days to prevent volatilization of certain Hg species that occur above 30 °C.

Carbon Analysis:

Carbon soil content were measured in homogenized and dried soil, using a CHN Fissions NA 1500 Analyzer, calibrated with sulphanilamide standards. Procedural blanks were obtained by running several empty ashed tin capsules. Organic carbon was estimated by difference between total detection of Mercury in Soil and Leaf Plant carbon and inorganic carbon after heating samples at 450 °C for 2 h in order to remove the organic carbon from the soil samples. Samples were weighed in a target in capsule (PerkinElmer, N2411362) using a Perkin Elmer AD6 Autobalance accurate to 0.006-0.02 g for samples below 100 g. Samples ranged in weight from 10 mg to 80 mg. Due to the high mineral content of the soils, the standard vial receptacle No. (N2411335) was replaced with the quartz tube insert No. (N2411401) to prevent dentrification, the process of crystallization of non-crystallized material in quartz combustion tube . All samples were run on an EA2400 CHNS/O Elemental Analyzer.

Mercury Analysis

Samples were analyzed with a DMA 80 M (Direct Mercury analyzer Milestone) determines total mercury within one standard deviation of certified values which heats samples in a regent matrix to 850 °C and measures the gaseous mercury vaporized in the process. Our analysis used a high calibration curve for all measurements. Quality assurance was done by the analysis of samples triplicate sample that was collected (Patra and Sharm, 2000; Ati, 2017), the inclusion of blanks, certified reference materials and matrix spikes, as well as by doing a standard calibration run using matrix-matched standards. Procedural blanks were run along with matrix-matched standards with each analytical batch to determine analytical accuracy. The percentage recoveries of the soil and plant standards were between 79%-99% and 82%-99%, respectively.

Quality control of the analysis was verified by the routine analysis of the following certified reference materials: CNS392-050 for metals in soil, CNS392-050 for Hg in soil and IAEA-405 for Hg in plant.

Element Accumulation Estimation:

Bioconcentration Factor (BCF) The accumulation of element in plants and soil was estimated by bioconcentration factor method As in the following equation According (Baker*, et al.,* 1994) method

BCF=The average concentration of the element in the plant/ Total rate of element concentration in soil.

Statistical method:

Statistical analysis of the Hg results was performed using one-way analysis of variance and Sigma plot. Test of equality of variance showed equal variance ($P > 0.05$), linear regression analysis was used to determine any significant correlations between Carbon and Hg in soil concentrations (Thompson, *et al.,* 2006).

RESULTS AND DISCUSSION

Mercury Concentrations in Soil

The total mercury concentrations in soil samples range between 51.65 to 38.18 (ng^2) , A3 is much higher than all the samples in the rest of the sites so as to being the most areas along today It is exposed on a daily basis to the causes of pollution in addition to its exposure during that period to explosions and events and the movement of military equipment and equipment during the war on ISIS, as well as the lack of vegetation cover and the excessive presence of diesel generators. Also notes the declining ratio of carbon to coincide with the increase in the concentration of mercury in the soil of the study areas, this element is more biologically because of his preference to bind with carbon (Rea, *et al.,* 2002; Fytianos and Lourantou, 2004; Ati, 2017). However, the high organic nature was overlooked at the time of sampling, and the site reported the lowest concentration of soil mercury. The community garden soil is a 50% organic balanced garden soil and had the lowest soil mercury concentration (38.18 ng^2) and lowest %C (5.3%), the authors could make an assumption that mercury concentrations are higher in all sites compared with the limited factors due to a higher amount of human impact, this agree with (EPA, 1997; Ajmi, 2012; Ajmi and Zaki, 2015). Fig.1 show the correlation between mercury concentration in soil and carbon in station under the study.

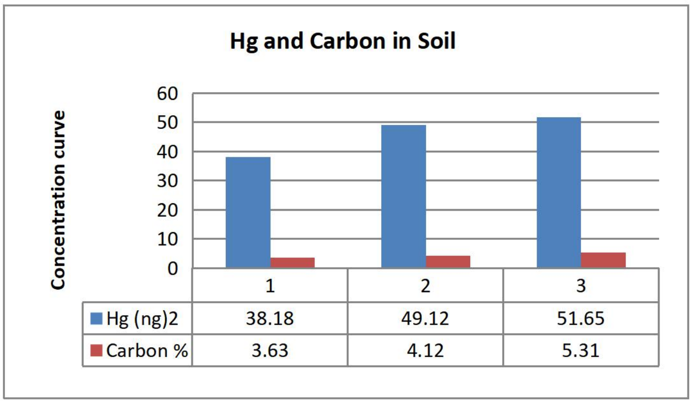

Fig (1) The correlation between mercury concentration in soil and carbon in station under the study.

Mercury Concentrations in Leaf Plant

Comparing our mercury results to other studies we tend to see higher concentrations of mercury compared to the study of Ref. (UNEP, 2001; Ajmi, 2012), whereas the current study mercury concentrations ranged of 5.92-2.73 ng^2. The mercury concentrations for leaf plants provide evidence of atmospheric mercury contaminants risks (Fig.2). Shows the correlation between mercury concentrations in leaf plants in station under the study is likely due in large part to the limited sample size. The elevated concentration of mercury in *Ziziphusspina-christi* in our study is likely due to the cumulative nature of the sample type relative to the leaf parts analyzed , we can account for the degree of separation between expected (USEPA, 2012;Ajmi, 2010). It possible explanations are that residual mercury from previous samples could have affected the reported value for mercury concentrations. Future studies should use more purges to reduce this instrumental error and more regent blanks to account for the residual mercury contamination in the instrumentation from previous samples may be the xylem and phloem in plant responsible are taken to be the main vectors of exposure for leaf mercury contamination, then the movement through multiple years of cells instead of only cells involved in a given year's growth might be considered a confounding variable when trying to isolate a temporal trend in mercury pollution (Wang, *et al.,* 2004; Wuana and Okieimen,2011; Ajmi and Zaki, 2015). No significant differences between soils with varying leaf plant. Mercury concentrations do not follow a gradient from expected sources of mercury, contamination, which could have been the past emissions from the burning and fuel oil used to electric generators, equipped with electric power during power outages or intermittent emissions vehicles from passing from street (Baker, *et al.,* 1994; WHO, 1996; Ati, 2017) .

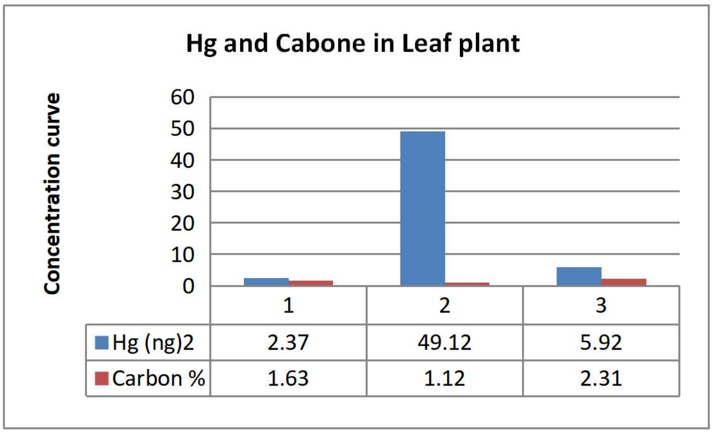

Fig (2) The correlation between mercury concentration in leaf plant and carbon in station under the study.

CONCLUSION

Considering all sample types analyzed, this study follows the general trend of mercury concentrations being highest in soil, followed by leaf plants (*Ziziphus spina-christi*). This aligns with previous studies comparing mercury concentrations of different tree parts this does not negate potential risks at the areas study as some experts feel a lower threshold level of 10 ng^2 is more acceptable, giving grounds for concern at site A3 in our study area specifically. In biomonitoring research, outliers should not be immediately discounted, but rather receive special attention in the interpretation of results and direction for further analysis, this study also corroborated previous research assessing the relationship between %C and mercury, such that the lower the %C, the higher the mercury in soils. Future research should improve on the sampling regime and laboratory quality assurance and quality control (QA/QC) protocols by including sub-samples, adjusting calibration curves, and using more reference and blank assessments in the laboratory. Due to budgetary constraints, we were limited in these aspects of analysis. Also, should be included in the sampling protocol and assessed relative to mercury contamination as pH will have an effect on mercury bioavailability at each site.

In site A3 deserves more research attention due to its relatively elevated levels of mercury in the samples analyzed. If additional sampling occurs priority should be given to this site and additional locations should be selected in close proximity to it.

Community garden: It is recommended that mercury levels be checked in the area where the compost is created for the community garden to be certain, it is not in an area of elevated mercury. Further research should also consider expanding the number of sites assessed and selecting new locations based on potential spatial patterns of contamination associated with pollution sources in the area.

Acknowledgment

Extremely grateful to Al- Mustansiriyah University and to all the people for their cooperation and help to get our data.

REERENCES

1. Ajmi, R.N. (2009). Biogeochemical Assessment to heavy metals in some marsh in south of Iraq by using GIS. PhD Thesis science college Women, University of Baghdad.190-197p.
2. Ajmi, R.N. (2010).Biogeochemical Assessment of some heavy metals in Al-Hammar marsh by using GIS. PhD Thesis to college of science/ University of Baghdad.170p.
3. Ajmi, R.N. (2012).An Investigation of Elements (Mercury) Status in Marshes in South of Iraq. Journal of Environmental Science and Engineering A1:1211-1217.
4. Ajmi, R.N. and Zeki, H.F.(2015).Mercury biomagnifications in Iraqi marshland (AL-Hawizeh (HZ) food chain using stable isotope analyses.*International Journal of Scientific &Engineering Research, 6*(4),2229-5518.
5. Ati, E.M. (2017). Bioindicator of Mercury and Isotope Stable Radioactive Elements in Missan Marshlands by Geographic Information Systems (GIS).Msc. Thesis, boil. Dep. Coll. of science, Mustansiriyah University.page 47-54.
6. Baker AJM, Reeves RD, Hajar ASM (1994). Heavy metal accumulation and tolerance in British populations of metallophyte Thlaspi caerulescens. New Phytol. 127: 61-68.
7. Becker, D.S., G.N. Bigham, Distribution of mercury in the aquatic food web of Onondaga Lake, New York, Water, Air, and Soil Pollution 80 (1995) 563-571.
8. Boening, D.W.Ecological effects, transports, and fate of mercury: A general review, Chemosphere 40 (2000) , 1335-1351.
9. Curtis, John (2003). "The Achaemenid Period in Northern Iraq". L'archéologie devl'empire achéménide. Paris ‹France. Unknown parameter month ignored.
10. EPA.(1997).Exposure Factors Handbook .Office of Research and Development National Center for Environmental Assessment U.S. Environmental Protection Agency Washington, DC 20460.
11. Fytianos, K., A. Lourantou, Speciation of elements in sediment samples collected at lakes Volvi and Koronia, Greece, Environment International 30 (2004) 11-17.
12. Kabata, A., H. Pendias, Trace Elements in Soils & Plants New York, CRC Press, 2001, p. 413.
13. Markert, B., J. Oehlmann, R. Mechthild, General aspects of heavy metal monitoring by Plants and animals, in: K.S. Subramanian, Environmental Biomonitoring: Exposure Assessment and Specimen Banking, 1995, pp. 19-29.
14. Obrist, D., D.W. Johnson, S.E. Lindberg, Mercury concentrations and pools in four Sierra Nevada forest sites, and relationships to organic carbon and nitrogen, Biogeo. Sciences 6 (2009) 765-777.
15. Patra, M., A. Sharm, Mercury toxicity in plants, The Botanical Review 66 (2000) 379-422.
16. Pickhardt, P.C., C.L. Folt, C.Y. Chen, B. Klaue, J.D. Blum, Impacts of zooplankton composition and algal enrichment on the accumulation of mercury in an experimental freshwater food web, The Science of the Total Environment 339 (2005) 89-101.
17. Rea, A.W., S.E. Lindberg, T. Scherbatskoy, G.J. Keeler, Mercury accumulation in foliage over time in two northern mixed-hardwood forests, Water, Air and Soil Pollution 133 (2002) 49-67.
18. Revis, N.W., T.R. Osborne, G. Holdsworth, Distribution of mercury species in soil from mercury contaminated site, Water Air and Soil Pollution 45 (1989) 105-113.
19. Schroeder,W.H., J. Munthe, Atmospheric mercury—an overview, Atmosphere of the Environment 32 (1998) 809-822.
20. Staddon, W.J., L.C. Duchesne, J.T. Trevors, Microbial diversity and community structure of postdisturbance forest soils as determined by soil-carbon-source utilization patterns, Microb. Ecol. 34 (1997) 125-130.
21. Thompson, M., Ellison, S., Wood, R. (2006): The international harmonized protocol for proficiency testing of analytical chemistry laboratories. Pure Applied Chemistry 78 (1), 145-196.
22. UNEP, Partow, H. (2001). The Mesopotamian Marshlands: Demise of an Ecosystem, Division of Early Warning and assessment, United Nations Environment programmer. Nairobi, Kenya.
23. -USEPA. (2009). Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. EPA-540-R-070- 002. OSWER 9285.7-82. January.
24. -USEPA, 2012. Estimation Programs Interface Suite™ for Microsoft® Windows. United States Environmental Protection Agency, Washington, DC, USA, 4.11.
25. Wang, Q., Kima, D., Dionysios, D., Dionysioua ,George, A., Soriala, and Timberlakeb, D. (2004). Sources and remediation for mercury contamination in aquatic systems- literature review. Environmental Pollution 131: 323-336.
26. World Health Organization (WHO), 1996. Biological Monitoring of Chemical Exposure in theWorkplace, vol. 1. WHO, Geneva, Swiss.
27. Wuana, R. A. and Okieimen, F. E. (2011). Heavy Metals in Contaminated Soils: A Review of Sources, Chemistry, Risks and Best Available Strategies for Remediation. Communications in Soil Science and Plant Analysis, 42, 111-122.