Evaluation of Total Suspended Particles and Heavy Metals in Air and Soil in Kerbala City

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Received Date: 23 / 1/ 2020
Accepted Date: 13 / 3 / 2020

الخلاصة

تعتبر العناصر الثقيلة من اهم الملوثات الكيميائية التي ركز الاهتمام عليها في السنوات الأخيرة والتي تتواجد في الهواء والتربة والماء بسبب النشاطات الصناعية والطبيعية وذلك لقابليتها التراكمية ولتأثيرها الكبير على صحة الانسان والحيوان. في الدراسة الحالية تم قياس حجم الدقائق العالقة الكلية (TSP) التي تعتبر من اهم ملوثات الهواء لثلاثة مناطق (صناعية، سكنية وزراعية) في مدينة كربلاء المقدسة باستخدام جهاز sniper الماني المنشأ. بينت نتائج الدراسة جود اختلاف معنوي($P\leq0.01$) بين المناطق بينما لا يوجد اختلاف معنوي بين الأشهر. كذلك تم قياس العناصر الثقيله وهي (الرصاص، الزنك والكادميوم) في كل من الهواء والتربة لثلاثة مناطق (الصناعية، السكنية والزراعية) وتم اعتبار المنطقة الزراعية للسيطرة. اوضحت النتائج ارتفاع معنوي ($P\leq0.05$) لعنصر الرصاص في تربة المنطقة الصناعية مقارنة مع المنطقة الزراعية بينما بينت الدراسة ارتفاع معنوي عالي($P\leq0.01$) لعنصر الرصاص في هواء المناطق الصناعية والسكنية مقارنة مع المنطقة الزراعية. كما أظهرت النتائج ارتفاع معنوي عالي($P\leq0.01$) لعنصر الزنك في تربة المنطقة الصناعية والسكنية مقارنة مع المنطقة الزراعية كذلك بينت الدراسة ارتفاع معنوي عالي لعنصر($P\leq0.01$) الزنك في هواء المنطقة الصناعية مقارنة مع المنطقة الزراعية. بينما كان هناك زيادة معنوية عالية في تركيز عنصر الكادميوم($P\leq0.01$) في تربة المنطقة الصناعية مقارنة مع المنطقة الزراعية.

الكلمات المفتاحية

تلوث الهواء، تلوث التربة، عناصر ثقيلة

Vol. 11, No. 21 and 22 P. (59-68), Jun., 2020

Abstract

Heavy metals are dangerous chemical contamination that escape to the air, soil and water from different anthropogenic and/or natural activities in which causes adverse effects on animals, humans and environment because it toxic and accumulation. In the present study measured (TSP) that consider the most important air pollution for three areas (industrial, residential and agriculture areas) found high significant differences among areas ($P \leq 0.01$) but no any significant differences among months. Heavy metals (lead, Zinc, Cadmium) measure in Air and soil for three areas (industrial, residential and agriculture areas) found significant differences ($P \leq 0.05$) for lead element in the soil of industrial area as compared to agriculture areas, while high significant differences ($P \leq 0.01$) for lead element in the air of industrial and residential area as compared to the agriculture areas. The result found high significant differences ($P \leq 0.01$) of Zinc element in the soil of industrial residential area as compared to agriculture areas, and high significant differences ($P \leq 0.01$) in the Air of industrial as compared to agriculture areas. On other hand found high significant differences ($P \leq 0.01$) in Cadmium element in the soil of industrial as compared to agriculture areas, while high significant differences ($P \leq 0.01$) in Cadmium element in the air of residential as compared to agriculture areas.

Key words

Air pollution, Soil pollution, Heavy metals

1.Introduction

In the last years, Iraq environment exposed to different types of pollution results from wars, unregulated industrial, agricultural and commercial activities that increased due to the population expansion, heavy metals are one of this pollution [1]. The term "heavy metals" as commonly held for those metals, which have specific weights more than 5g/cm^3 [2]. The most dangerous of these pollution perhaps go back to the viability of bioaccumulation in tissues and organs of plants and animals, their concentrations can be multiplied in the food chain, then arrive to humans and other organisms in form more toxic and dangerous to life [3]. Generally pollutant can be divided into three types include air, soil and water pollutant [4]. Air pollution is one of the main factors that affects every part of the earth surface and in the health of one-pillion peoples worldwide, so that air pollution called the silent killer because it spreads and is not specific to place [5]. Also soil contamination is one of the important topics for research because it is the final receptor for all kinds of pollutants that reach either from air or from irrigation, water sewage and other toxic sources, in soil the pollution does not spread but remains for very long time [6]. Because of the importance of the subject and for the few previous studies in the field of soil pollution and very few previous studies in the field of air pollution with heavy metals in Iraq and especially in Karbala, therefore this study focuses on the impact of these types of pollution, so the present study is aimed to:

1. Measure total suspended particles (TSP) in air for different areas in Kerbala city.
2. Measure the concentration of some heavy metals that found in Air and soil.

2. Material and methods

2.1. Samples collection

Samples collected in different areas in Kerbala city. The study consisted (108) samples from both soil and air (54 samples for each one) during three months (from January to March) 2014 from three stations (industrial, residential and agriculture areas). The total suspended particles (TSP) samples were collected using sniffer apparatus, at (1.5) m high, and the particles collected on filter paper according to [7], while soil sample taken in depth (5-10)cm.

2.2. Estimation heavy metals concentration in suspended particles and soils

These samples were prepared to analysis according to [8].

2.3. Measuring of concentration of heavy metals

Using atomic absorption spectrophotometer type HGA (800) for measuring heavy metals concentration that extracted from soil and suspended particles after preparing standard calibration for each elements Figs. (1,2 and 3).

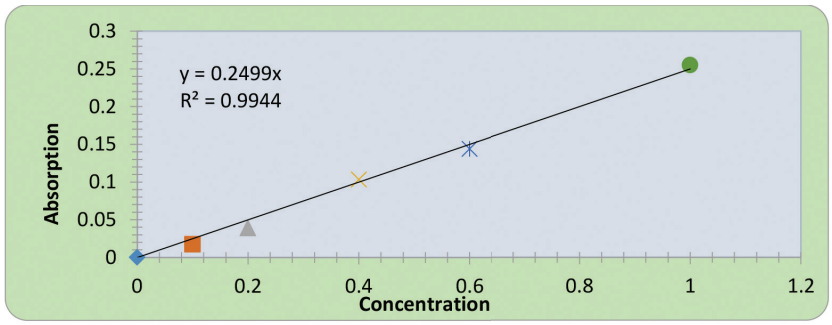

Fig. (1): Standard calibration for lead element

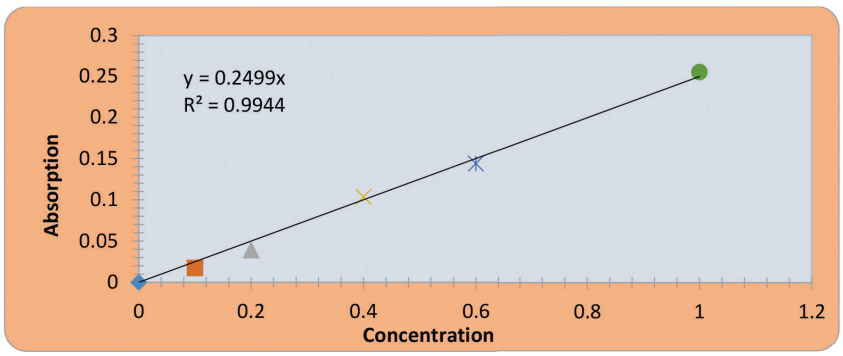

Fig. (2): Standard calibration for Zinc element

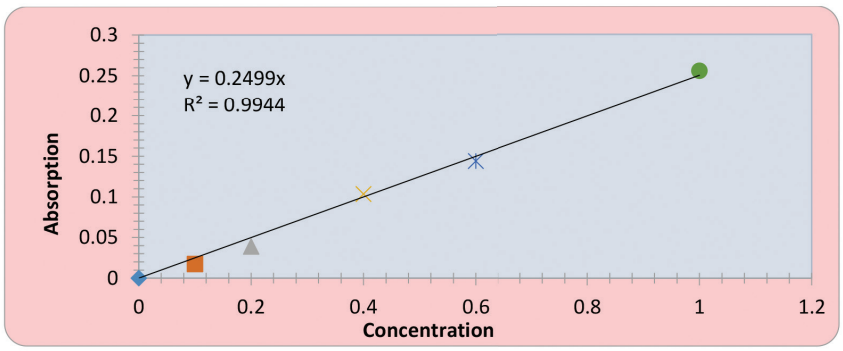

Fig. (3): Standard calibration for Cadmium element

3. Statistical

The software SAS program .USA/version 9 (2004) was used to analyses the data of present work by using complete random design (CRD), then compared the differences between the averages using the test of less significant difference (LSD) [9].

4. Results

4.1. Total suspended particles among different months and areas

Table (1) recorded that no significant differences in the total suspended particles (TSP) among different months, while that there were highly significant differences ($P \leq 0.01$) for (TSP) on both industrial and residential areas as compared with agriculture

area. However, the interaction showed that lowest value in January in agriculture area and a highest value at March in an industrial area.

Table (1): Total suspended particles concentrations in different areas and different months and the interaction between them.

Areas / Months	Industrial Area	Residential Area	Agriculture Area	Mean of TSP in month µg/m³
January	3902 ± 476.77	2921± 562.96	2019.3± 226.85	2947.4±305.19
February	4289± 1168.36	3650± 294.21	2211.9± 387.77	3383.7±448.82
March	4803±1055.73	3630 ± 182.60	2762.5 ± 390.36	3731.8±410.61
Mean of TSP in area µg/m³	4331.4*±522.8	3400.2±222.62	2331.3±201.39	
Iraq limits of (TSP)		350 µg/m³		
International limits of (TSP)		60-90 µg/ m³		

* Significant differences (P≤0.01).

LSD of months= (1025.2); LSD of areas = (1025.2); LSD of interaction = (1775.7).

4.2. Comparison lead concentration in the soil of the different study areas

Fig. (1) illustrated that significant differences (P≤0.05) of lead concentration in the soil in industrial area as compared with the agriculture area, while there was no significant difference in the soil of residential area as compared with agricultural area. Moreover, the results recorded that no significant differences of lead concentration in the soil of industrial areas as compared with residential area.

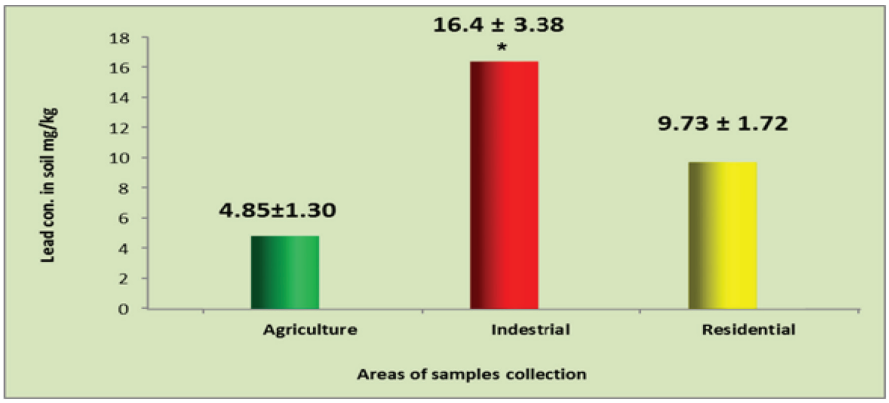

Fig. (1): Comparison of lead concentrations in the soil of different study areas.

* Significant differences (P≤0.05), (LSD=8.2595).

4.3. Comparison lead concentration in the Air of the study areas

Fig. (2) shows a highly significant difference (P≤0.01) of lead concentrations in the air of industrial and residential area as compared to agricultural area. Indeed highly significant differences (P≤0.01) of lead concentration in the air of industrial area as compared to residential area.

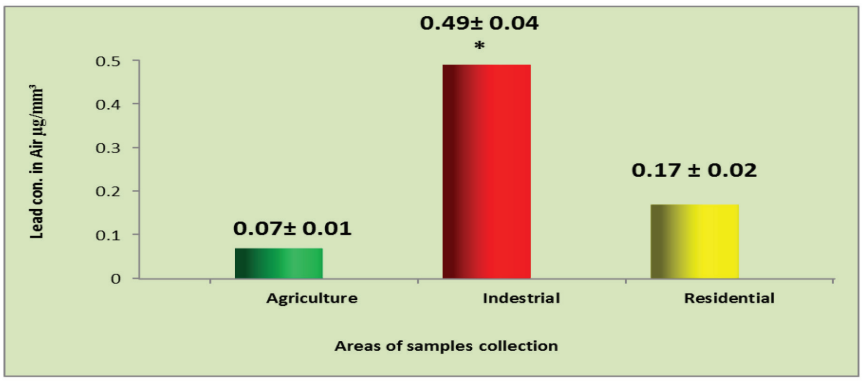

Fig. (2): Comparison of lead concentrations in the air of different study areas.

* Significantly differences (P≤0.01), (LSD= 0.0901).

4.4. Comprise Zinc concentrations in the soil of the study areas

Fig. (3) Shows a highly significant difference (P≤0.01) of Zn concentration in the soil of industrial area as compared to agricultural area, also a highly significant difference (P≤0.01) of Zn concentration in the soil of residential area as compared to agriculture area. However, no significant difference of Zn concentration in the soil of industrial area as compared to residential area.

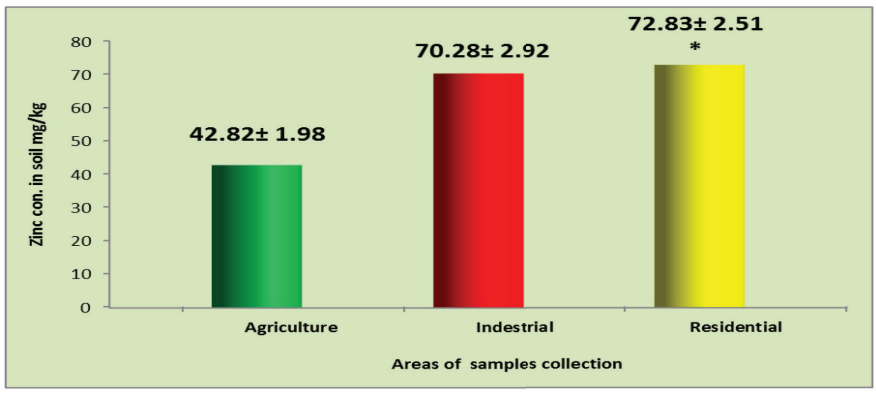

Fig. (3): Comparison of Zinc concentrations in the soil of different study areas.

* Significant difference (P≤0.01), (LSD=7.1123)

4.5. Comprise Zinc concentrations in the Air of the study areas

Fig.(4) shows that there was a highly significant difference (P≤0.01) of Zn concentrations in the air of industrial area as compared with agricultural area, while no any significant difference of Zn concentrations in the air of residential area as compared to agriculture area. However, there was a highly significant difference (P≤0.01) of Zn concentrations in the air of industrial area as compared to the residential areas.

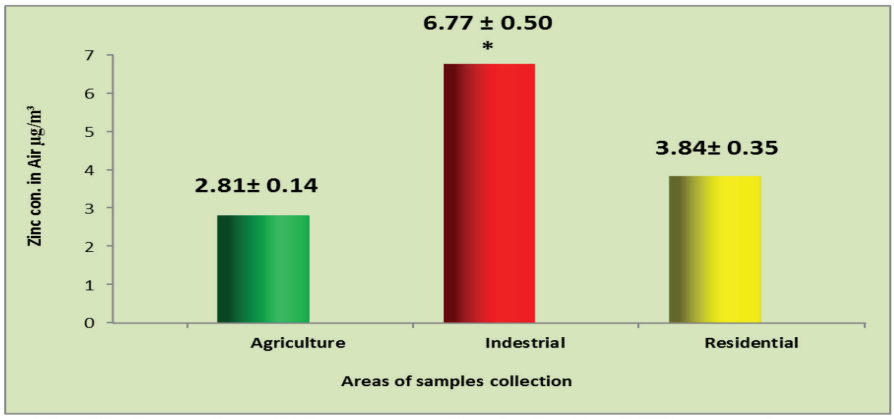

Fig. (4): Comparison of Zinc concentrations in the Air of different study areas

* Significant differences (P≤0.01), (LSD=1.0455).

4.6. Comprise Cadmium concentrations in the soil of the study areas

Fig. (5) Showed a high significant difference (P≤0.01) in Cd concentration in the soil of industrial area as compared to the agriculture area. While no any significant difference in the soil of residential area as compared to the agriculture area. Moreover, a high significant difference (P≤0.01) in Cd concentration in the soil of industrial area as compared to the residential area.

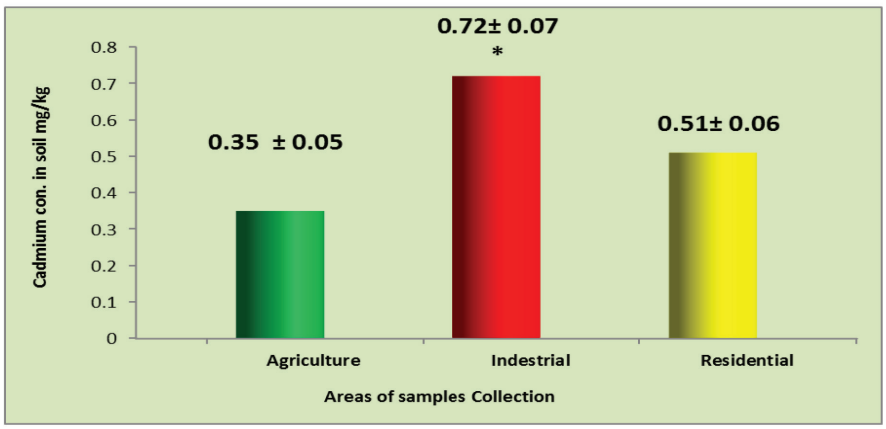

Fig. (5): Comparison of cadmium concentrations in the soil of different study areas.

* Significant differences (P≤0.01), (LSD=0.1911).

4.7. Comprise Cadmium concentrations in the Air of the study areas

Fig. (6) shows no significant difference in Cd concentration in the air of industrial area as compared to the agriculture area, while a highly significant difference (P≤0.01) in Cd concentration in the air of residential area as compared to the agricultural area. Moreover, a high significant difference (P≤0.01) in Cd concentration in the air of industrial area as compared to the residential area.

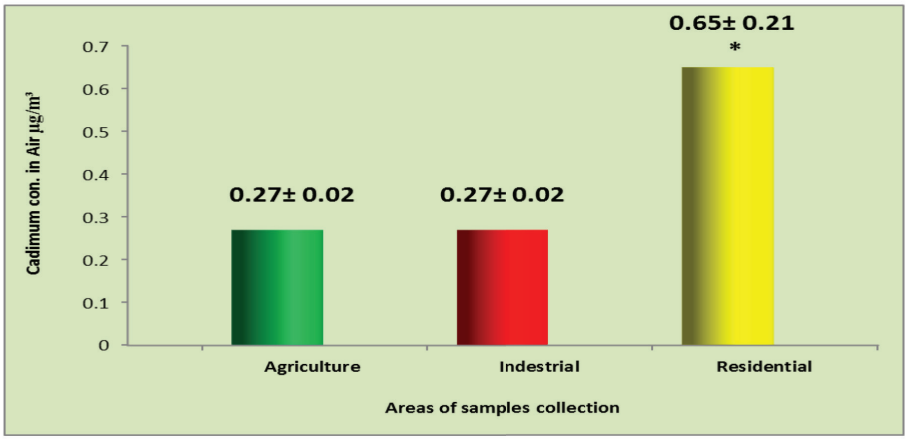

Fig. (6): Comparison of cadmium concentrations in the Air of different study areas.

* Significant differences (P≤0.01), (LSD= 0.3632)

Note: All values are mean ± SE.

5. Discussion

The results of the present study demonstrated a highly significant increase (P≤0.01) in (TSP) as pollutant in the air for all study areas. The reasons behind these result may be attribute to broken ground layers because of the previous wars in Iraq, lack of green spaces; another reason is that the city of Karbala is the first among provinces in terms of religious tourism, in which it receives millions of Iraqi visitors.

The present study in agreement with [10] demonstrated that in Kirkuk province it is found that, a high pollution with TSP in the industrial area (3555.6 µg/m³), while in the residential area (2371.8 µg/m³) and finally in the agriculture area (1666.7 µg/m³), also our result in agreement with [11]. Considerable attention has been given for heavy metal contamination in the environment, the reasons behind air pollution can be attributed to the fact that the development of economic, population increase in growth, rapid urbanization, heavy traffic, vehicle emission and different industrial activity, these findings are also in agreement with [12] who showed that high air polluted with (Cu, Zn, Mn, Co, Cr and Cd) elements in Baghdad city. Many other results showed the

same effect [13, 14, and 15]. In the last (50) years economic and social development occur very rapid which that changes live style lead to accumulation high toxic level of heavy metal in the soil [16].

The result of present study showed significant increase in heavy metals (Pb, Zn, Cd) in the soil of different areas that in agreement with what found by [17,18]. In addition, the present study deal with [19]. As well as present data in agreement with [20] found the concentration of heavy metals (Cd, Cu, and Zn) in the soil of urbanization and industrialization two times greater than the background level contributed to anthropogenic sources also found highly soil pollution by Pb more than others heavy metal related to development especially anthropogenic sources. Rapid industrialization in to development especially anthropogenic sources. This study deal with other study in Romania found pollution soil with five heavy metals (Co, Cr, Cu, Hg, Pb) can attributed to anthropogenic activity such as agriculture, mining, smelting and natural activities, the most important sources of soil pollution are metallurgical and chemical industries [21].

References

[1]. Rainbow, P. S.; Poirier, L.; Smith, B. D.; Brix, K.V. and Luoma, S.N. Mar. Ecol. Prog. Ser., 308: 91–100, (2006).

[2]. Raikwar, M. K., Kumar, P., Singh, M., & Singh, A Veterinary world, 1(1), 28, (2008).

[3]. Al-Mamoori, A.M. A Thesis. Collage of science, Dept. Biology.Unv. of Babylon, (2013).

[4]. WHO, Revised WHO Air Quality Guidelines for Europe, (1996).

[5]. Kampa, M., & Castanas, E. Environmental pollution, 151(2), 362-367, 2008)).

[6]. Lasat, M. M. Journal of Environmental Quality, vol, 31. pp: 109–120, (2002).

[7]. Naik, S.D. Doctoral Thesis. National Institute of Technology – 769008(Orissa), (2005).

[8]. Homady, M. ;Hussein ,H. ;Jiries,A. ;Mahaneh ,A. ;AL-Nasir ,F. and Khleifat , K. J Enviromental research section A vol, 89, pp:43-49, (2002).

[9]. AL-Rawi,K. Entrances to the statistics. Book, second edition. Faculty of Agriculture and forestry, University of Mosul/Iraq.

[10] AL-Dabbas, M.A.; Ali, A. A.; Afaj, A.H. J .Iraq science vol,4 (2).pp8-13, (2012).

[11] Jimoda, L.A. Working and Living Environmental Protection Vol. 9, (1), pp.:27-44, (2012).

[12]. Al-Thwainy,M.N Ibn Al-Haitham

Jour. for Pure & Appl. Sci.Vol.26.(2) .pp:1-7, (2013).

[13]. Sabri,A.A. Diyala Journal of Engineering Sciences. Vol. (4), No. 2, pp. 150-165, (2011).

[14]. Ahmed,W.A Journal of Basrah research science, Vol 38(B1),pp:53-63, (2012).

[15]. Rajab,H.H. Qadisiyah Journal of Agricultural Sciences, Vol,3 (1),pp:62-72, (2013).

[16]. Liang, J.A.; Cuicui, C.S.; Song, X.K.; Han, Y.U. and Zhenhai, L.X. Int. J. Electrochemical. Sci., 6 PP 5314 – 5324, (2011).

[17]. AL-Jumaily, H. A. kirkuk university journal for scientific studies, 4(1), 1-11, (2009).

[18]. Fagbote, E. O., and Olanipekun, E. O. American-Eurasian Journal of Scientific Research, 5(4), 241-248, (2010).

[19]. Onder, S., Dursun, S., Gezgin, S., & Demirbas, A. Polish Journal of Environmental Studies, 16(1),(2007).

[20]. Hu, Y., Liu, X., Bai, J., Shih, K., Zeng, E. Y., & Cheng, H. Environmental Science and Pollution Research, 20(9), 6150-6159, (2013).

[21]. Suciu, I., Cosma, C., Todică, M., Bolboacă, S., & Jäntschi, L. International journal of molecular sciences, 9(4), 434-453,(2008) .