Indonesian Journal on Health Science and Medicine
Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine
Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

Table Of Contents

Indonesian Journal on Health Science and Medicine
Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

Originality Statement

The author[s] declare that this article is their own work and to the best of their knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the published of any other published materials, except where due acknowledgement is made in the article. Any contribution made to the research by others, with whom author[s] have work, is explicitly acknowledged in the article.

Conflict of Interest Statement

The author[s] declare that this article was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright Statement

Indonesian Journal on Health Science and Medicine
Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

EDITORIAL TEAM

Complete list of editorial team (link)

Complete list of indexing services for this journal (link)

How to submit to this journal (link)

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine

Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

Article information

Check this article update (crossmark)

Check this article impact (*)

Save this article to Mendeley

(*) Time for indexing process is various, depends on indexing database platform

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine
Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

Assessment of Radionuclide Activity (238U, 232Th, 40K) in Airborne Dust from Dust Storms in Wasit and Al-Qadissiya, Iraq

Mohammad Yahya R Al-Yasiri, mohamedalyasry5@gmail.com (*)
University of Wasit Iraq, Iraq

Abdullah Ahmed Khalaf, abdallah@uowasit.edu.iq
University of Wasit Iraq, Iraq

Hadi D. Alattabi, Alattabih@uowasit.edu.iq
University of Wasit Iraq, Iraq

(*) Corresponding author

Abstract

General Background: Dust storms are recurrent environmental events in dry and semi-arid regions and can transport fine particles containing naturally occurring radioactive materials with potential implications for human health. **Specific Background:** This study assessed uranium-238 (238U), thorium-232 (232Th), and potassium-40 (40K) in samples collected during active dust storms from five sites in Wasit Governorate and one site in Al-Qadissiya Governorate, Iraq, using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). **Knowledge Gap:** Site-specific assessment is required because radionuclide concentrations can differ according to soil type, storm intensity, and source location. **Aims:** The study measured 238U, 232Th, and 40K activity concentrations, evaluated possible radiological health risks, and compared the findings with published research and international standards. **Results:** Activity concentrations varied among locations: 238U ranged from 12.1 to 113.5 Bq/kg, 232Th from non-detectable levels to 1.58 Bq/kg, and 40K from 1125.9 to 3546.9 Bq/kg. Sample E005 from Al-Qadissiya recorded the highest 238U and 40K concentrations, while 232Th was not detected in B002 and C003. The measured levels remained below international safety limits. **Novelty:** The study provides a site-specific comparison of three radionuclides across storm-derived samples from Wasit and Al-Qadissiya using ICP-OES. **Implications:** The findings support continued environmental monitoring, health-risk assessment, and mitigation measures including afforestation, soil stabilization, and public education.

Highlights

- The radiation level in of the dust in the air show noticeable geographic difference across Iraqi governorates.
- The dust sample that examined in the Al-Qadissiya hit high point of the concentrations of uranium-238 and potassium-40.
- The Measured of the radiation levels remain perfectly safe by global standards

Keywords : Dust Storms, Iraq, Radionuclides, 238U, 232Th, 40K, ICP-OES, Radiological Health Risks.

Published date: 2026-07-26

Indonesian Journal on Health Science and Medicine

Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

1. Introduction

Dust in the world's driest regions and in the semi-arid regions of the world, the Dust storms are amongst the most impactful environmental events that Carrying a huge amounts of fine particles over huge distances they are very severely harm the environment. This give the dust storm a directly impacts on human health, air quality, and local temperatures [1], [2]. The Given Iraq's geography and surrounded by deserts and lacking dense vegetation therefore the dust storms hit the country frequently, especially in spring and summer [3].

Minerals, heavy metals, and naturally occurring radioactive materials (NORMs) including uranium, thorium, and potassium isotopes are frequently found in the airborne dust linked to these storms [4][5]. These radionuclides could be produced by geological developments or anthropogenic processes such as industries, military activities, and prior nuclear testing [6]. Numerous studies have established the airborne fine particulate matter related with dust storms (less than 50 μm) can penetrate the respiratory system and when augmented with radioactive elements can lead to respiratory diseases, cardiovascular problems, and increased risk of cancer [7], [8]. Alpha Radionuclides such as uranium-238 (238U) and thorium-232 (232Th) become entrapped in the lung tissues after inhalation that cumulative the internal radiation dosage [9]. An additional radioisotope like potassium-40 (40K), naturally augmented in clay minerals, significantly upsurges background radiation to an alike extent [10]. The Prior Middle Eastern Radiometric analyses have published mutable amounts of radioactive activity of the airborne of the dust. Some of the Notable radiological contributions of 40K have been documented in seasonal dust incidences in Jordan [12]. Simultaneously studies conducted in Baghdad and Ramadi that noted augmented 238U and 40K activity during sandstorms [11]. Equally important while typically in line with global safety guidelines, a recent study carried out in Hilla City, Iraq, described detectable concentrations of 238U, 232Th, and 40K in dust storm samples [13]. This research discloses the importance of tailored valuations since radionuclide concentrations can vary considerably between soil types, the storm intensities, and source sites [14]. The Preparation for the environment and public health necessitates an awareness of the radioactive gratified of dust storms, which are flattering more frequent and severe in Iraq. So, this study's objectives are to measure the amounts of ^{238}U, ^{232}Th, and ^{40}K in

Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

airborne dust samples taken during dust storm events from the governorates of Wasit and Al-Qadissiya, evaluate any possible health risks, and compare the findings with published research and international standards [15].

2. Materials and Methods

2.1 Study Area and Sample Collection

Five sites in Wasit Governorate (Sheikh Saad, Al-Hay, Al-Muwafaqiyah, Kut city center, and Al-Zahraa) and one site in Al-Qadissiya Governorate were used to gather dust samples. In order to prevent contamination, samples were collected during active dust storm occurrences using sterile plastic containers. After being gathered, the material was brought to the lab for processing and examination.

2.2 Sample Preparation

Dust samples were oven-dried for 48 hours at 150°C to remove moisture. Following drying, one gram of each sample was weighed and digested using one milliliter of 35% hydrogen peroxide and nine milliliters of 65% nitric acid. A high-pressure microwave digestion system (Milestone Ethos UP, Italy) was used to process the samples. In just 15 minutes, the temperature was raised from 25°C to 200°C and the pressure was increased from 10 to 100 bar. Thirty minutes later, digestion was finished. After filtering, the digestate was diluted with 50 milliliters of deionized water.

2.3 Analytical Techniques (ICP-OES)

Trace elements in liquid samples can be found quantitatively using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). It can be used to analyze metals, ceramics, polymers, ambient water, and plating solutions because of its excellent sensitivity, dependability, and broad dynamic range [16]. The technique uses photons released by excited atoms and ions in an RF discharge. Solid samples frequently need extraction or acid digestion, but liquid and gas samples can be injected straight [17]. ICP-OES uses a high-temperature plasma to dry, evaporate, and excite the sample mist. After that, the atomic emission is gathered and sent to a device that selects wavelengths [18]. A sampler, pump, nebulizer, spray chamber, ICP torch, monochromator's/polychromatic, and detector are among the primary parts [19]. ICP-OES reduces detector overload and maintenance requirements by efficiently handling complex matrices with up to 5% dissolved solids. As a result, it is a trustworthy instrument for screening for trace elements and metals [20]. A spectrometer, detector, data processor, plasma generator, and sample

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Indonesian Journal on Health Science and Medicine
Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

introduction unit make up the system, which can be modified for a number of uses [16].

3. Results

The measured radionuclide concentrations in airborne dust samples are presented in Table 1.

Table 1. Activity concentrations of radionuclides in airborne dust samples

Sample Code	238U (Bq/kg)	232Th (Bq/kg)	40K (Bq/kg)
A001	12.103	0.1218	1125.978
B002	19.6365	0	1283.602
C003	54.34	0	1581.085
D004	36.9265	1.218	1894.072
E005	113.4965	1.5834	3546.863
F006	31.2455	0.812	1881.798

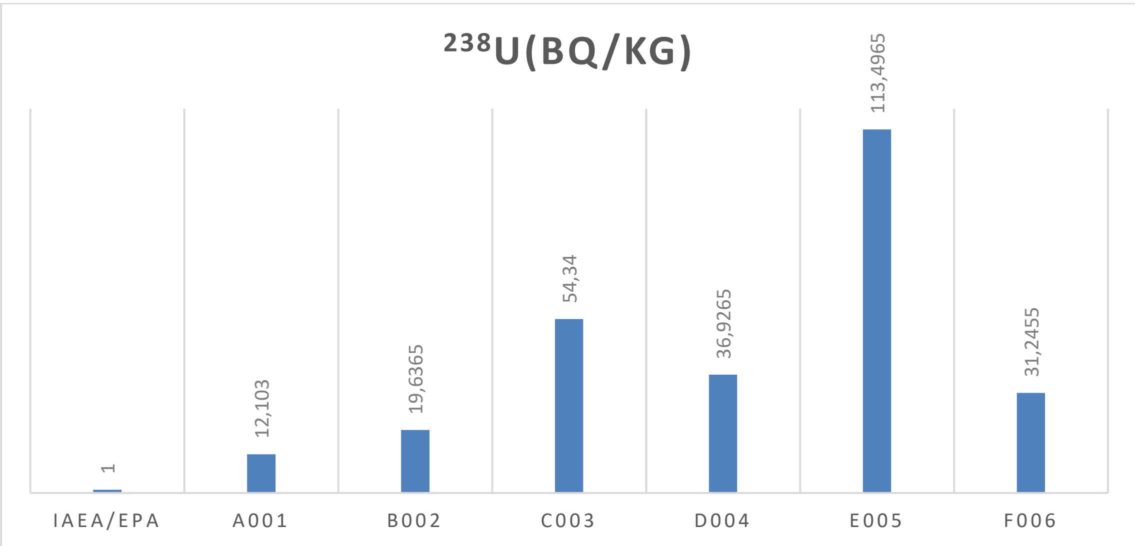
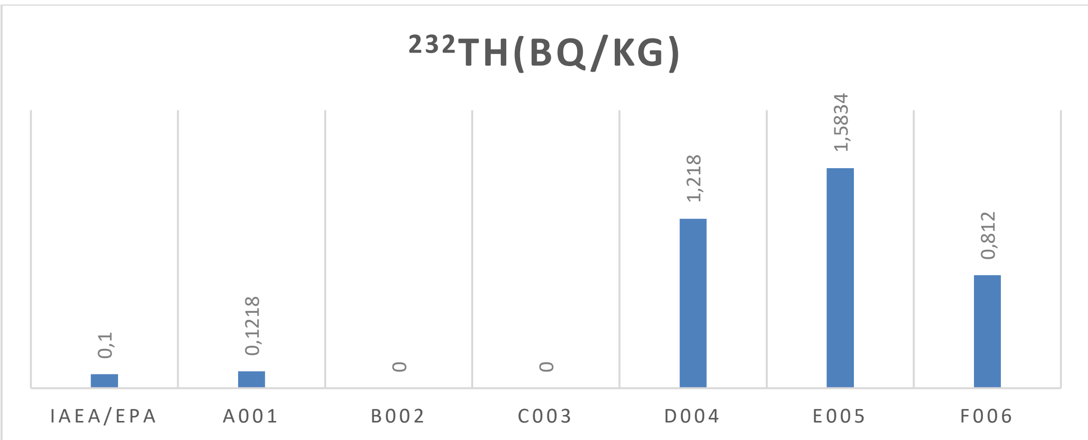


Figure 1. Concentration of ^{238} U in the dust flaying samples



ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

Figure 2. Concentration of ^{232} Th in the dust flaying samples

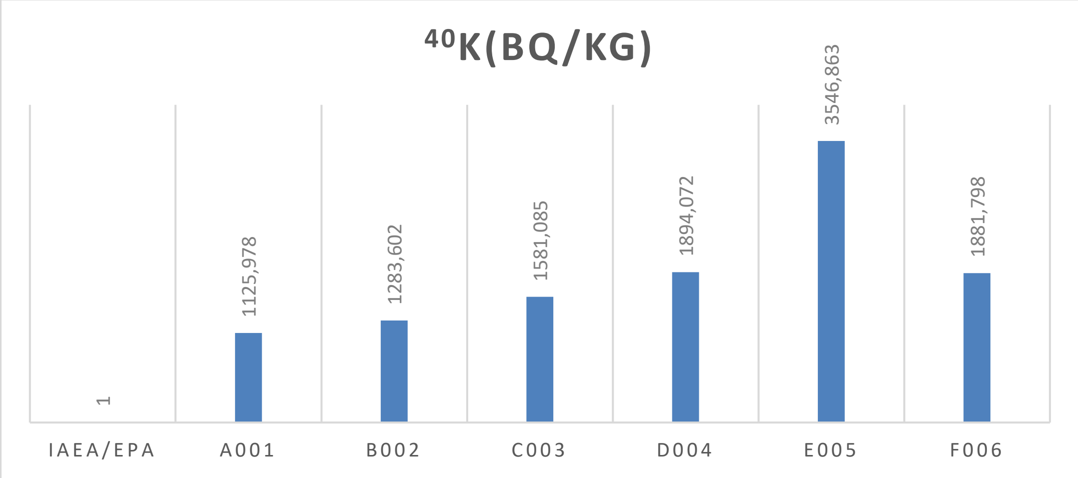


Figure 3. Concentration of ^{40} K in the dust flaying samples

4. Discussion

The ^{238}U, ^{232}Th, and ^{40}K contents show significant variances among sample location In the Al-Qadissiya city (Sample E005) has the maximum activity of ^{238}U (113.5 Bq/kg) and ^{40}K (3546.9 Bq/kg), they representing the Possible ground risks or human influences and effect . On the other hand, radiation level or radioactive concentrations were smaller in samples that collected from AL-Kut and Al-Hay city. Some of samples (B002 and C003) do not comprise of 232Th, maybe due to regional soil difference. For all locations, potassium contents are similar to common values for silicate rock and some clay minerals.

This situation is accordance with the previous studies tested different samples from Baghdad, and Ramadi showing higher concentrations of individual radioactive materials due to historical air pollution and natural Contrary, the results of this site dose not seems homogenous which was unforeseen as global studies including research from Jordan and Hilla showed that activity levels for these materials appeared in either expected level ranges or only slightly elevated. Naturally circulating radioactive dust is then an obvious danger to breathe in – particularly when it comes to alpha-emitting isotopes like 232Th and 238U, which can bio accumulate inside lung tissue making the nearby cells more likely to become cancerous over a separate range of time. The ramifications of these data for longterm monitoring and risk mitigation measures in occupier countries (but particularly Iraq) would seem to be self-evident. In fact, in some situations dust storms can aggravate it and thus continuous monitoring along with precautionary measures should be put in place to curb people's health.

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

5. Conclusion

The current study confirmed there are a heterogeneity and different in the distribution of radiation level amongst the airborne dust that collected during the dust storm that occur in the Iraq. The radiation exposure with People left without protection from 238U and 40K are suspected, because of the high level of the isotopes especially in the Al-Qadissiya [11]. While these feedbacks are still beneath international limits for safety, it is strongly advised to continuous monitoring and assess health hazards and adopt mitigation techniques like afforestation soil stabilization and public education programs.

References

[1] A. A. Attiya and B. G. Jones, 'A Huge Dust Storm Influenced Air Quality on 16 May 2022 in Baghdad City, Iraq,' IOP Conf. Ser. Earth Environ. Sci., vol. 1371, no. 2, 2024.

[2] S. M. Awadh, 'Impact of North African Sand and Dust Storms on the Middle East Using Iraq as an Example,' Atmosphere, vol. 14, no. 1, 2023.

[3] J. Al-Khalidi, D. Bakr, and A. A. Abdullah, 'Synoptic analysis of dust storm in Iraq,' EnvironmentAsia, vol. 14, no. 1, pp. 13–22, 2021.

[4] M. Al-Dabbas and R. A. Al-Khafaji, 'Some Geochemical, Textural, and Radioactive Characteristics of the Sandstorms Loads Blown over Baghdad and Ramadi Cities, Middle Iraq,' 2012.

[5] K. K. Ali and S. J. D. Shejiri, 'The radiological effects of dust storms in Baghdad-Ramadi area,' Iraqi J. Sci., vol. 60, no. 2, pp. 255–262, 2019.

[6] UNSCEAR, Sources and Effects of Ionizing Radiation: Report to the General Assembly, with Scientific Annexes. United Nations, New York, 2000.

[7] A. Goudarzi, 'Respiratory effects of dust storm particles on human health: A review,' Environ. Health Eng. Manage. J., vol. 3, no. 2, pp. 59–65, 2016.

[8] Y. Cao, J. Xu, Y. Chen, and Z. Wang, 'Health impacts of dust storms: a systematic review and meta-analysis,' Environ. Res., vol. 196, p. 110391, 2021.

[9] ICRP, the 2007 Recommendations of the International Commission on Radiological Protection, ICRP Publication 103, Ann. ICRP 37 (2–4), 2007.

[10] E. S. A. Mohamed, 'Natural radioactivity in dust samples and associated radiological risks,' Radiat. Prot. Dosim., vol. 174, no. 1, pp. 108–116, 2017.

[11] K. A. Hussein, A. S. Ahmed, and A. H. Al-Hamzawi, 'Evaluation of natural radionuclides in dust storms in Baghdad city,' J. Radiol. Prot., vol. 41, no. 2, pp. 320–333, 2021.

[12] A. M. Al-Khashman, 'the radioactivity of seasonal dust storms in the Middle East: The May 2012 case study in Jordan,' J. Environ. Radioact. vol. 136, pp. 148–154, 2014.

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Vol. 2 No. 2 (2025): Oktober
DOI: 10.21070/ijhsm.v2i2.262

[13] H. M. Al-Zubaidi, 'Assessing the Radioactivity of Samples Taken during a Dust Storm in the Iraqi City of Hilla,' Iraqi J. Phys., vol. 22, no. 3, pp. 45–55, 2023.

[14] R. Hamad et al., 'Characterization of dust storm particles and their radiological impacts in the Middle East,' Sci. Total Environ., vol. 650, pp. 2682–2690, 2019.

[15] J. P. Hagen and J. Sneddon, 'Determination of copper, iron, and zinc in crayfish by ICP-OES,' Spectrosc. Lett. vol. 42, no. 1, pp. 58–61, 2009.

[16] Y. Morishige and A. Kimura, "Ionization interference in inductively coupled plasma-optical emission spectroscopy," *SEI Tech. Rev.*, no. 66, pp. 106–111, 2008.

[17] X. Hou, R. S. Amais, B. T. Jones, and G. L. Donati, "Inductively Coupled Plasma Optical Emission Spectrometry," *Encycl. Plasma Technol.*, pp. 655–678, 2017,.

[18] V. A. Fassel and R. N. Knfseley, "Inductively Coupled Plasma: Optical Emission Spectroscopy," *Anal.Chem.*,vol.46,no.13,pp.1110A-1120a, 1974

[19] S. Iti, "ICP-OES: An Advance Tool in Biological Research," *Open J. Environ. Biol.*, no. December 2020, pp. 027–033, 2020,.

[20] R. Log, "Standard Operating Procedure No . 30 Icp-Oes Analysis," no. 30, pp. 1–19, 2008.

ISSN 3063-8186 (online), https://ijhsm.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo