HNSJ Humanities & Natural Sciences Journal
ISSN: (e) 2709-0833
www.hnjournal.net

Peer-Reviewed Journal
Indexed at: NSP - SJIF
Impact Factor 2022 = 4.91

RESEARCH TITLE

Estimation of ^{137}Cs in some surface Soil samples from different localities in Zintan City and Awiniya Region, (Al-Jabal Al-Gharbi) Mountain, Libya.

K.M. Musa [1], Naima .M. Al-kbashy [2], Souad M. Bogrin[1]

[1] Physics Department, Faculty of Science, Tripoli University, Tripoli, Libya.
[2] Higher Institute of engineering techniques, Tripoli, Libya.

Email: Ka.Musa@uot.edu.ly

HNSJ, 2024, 5(9); https://doi.org/10.53796/hnsj59/24

Published at 01/09/2024 **Accepted at 20/08/2024**

Abstract

The artificial radioactive contamination produced, namely by nuclear accident as happened by the Chernobyl, especially artificial ^{137}Cs radionuclide pollution. Due to having a long half-life, it still continues to remain in soil. This study measured radioactivity concentrations of ^{137}Cs and calculated the absorbed dose rate and the annual effective dose rate for ^{137}Cs for soil samples from different locations in Zintan City and Awiniya Region, Libya. The activity concentration of ^{137}Cs radionuclide was measured by gamma spectrometry using HPGe detector. The outdoor annual effective dose rate was found below the world's average level comparison with ICRP. It is concluded that soil contamination by artificial ^{137}Cs radionuclide does not pose radiation hazards in the investigated areas.

Key Words: ^{137}Cs, Soil, Absorbed dose rate , Annual effect dose rate , Zintan city, Awiniya Region , Libya, HPGe

عنوان البحث

تقدير السيزيوم ^{137}Cs في بعض عينات التربة السطحية من مناطق مختلفة في مدينة الزنتان ومنطقة العوينية، جبل (الجبل الغربي)، ليبيا.

HNSJ, 2024, 5(9); https://doi.org/10.53796/hnsj59/24

تاريخ النشر: 2024/09/01م تاريخ القبول: 2024/08/20م

المستخلص

إن التلوث الإشعاعي الصناعي الناتج عن الحوادث النووية مثلما حدث في تشيرنوبيل، وخاصة التلوث الإشعاعي الصناعي للسيزيوم ^{137}Cs ونظراً لطول عمر النصف له فإنه لا يزال موجوداً في التربة. وقد قامت هذه الدراسة بقياس تركيزات النشاط الإشعاعي للسيزيوم ^{137}Cs وتم حساب معدل الجرعة الممتصة ومعدل الجرعة الفعالة السنوية للسيزيوم ^{137}Cs لعينات التربة من مناطق مختلفة في مدينة الزنتان ومنطقة العوينية،الواقعة في (الجبل الغربي) ليبيا. تم قياس تركيز نشاط النويدات المشعة للسيزيوم بواسطة مطياف جاما باستخدام كاشف HPGe. وجد أن معدل الجرعة الفعالة السنوية أقل من متوسط المستوى العالمي بالمقارنة مع ICRP. وخلصت الدراسة إلى أن تلوث التربة بالنويدات المشعة الاصطناعية ^{137}Cs لا يشكل مخاطر إشعاعية في المناطق تحت الدراسة.

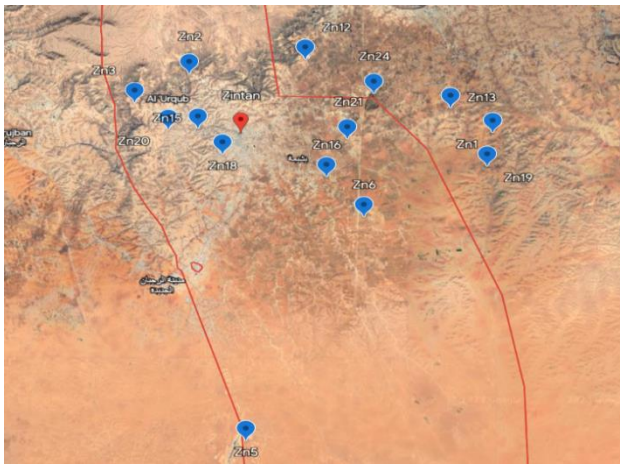
1. Introduction

The presence of artificial radionuclides in the environment is an important source of radiation exposure for human beings **[1].** Artificial radioisotopes may be released into the environment during the testing of nuclear weapons, nuclear explosions, and discharge of effluents from nuclear facilities. Artificial radioisotopes released from these sources are retained by environmental materials, including soil **[2]**. Worldwide contamination from artificial radioisotopes was partially caused by nuclear tests conducted by different countries from time to time and nuclear accidents such as the Chernobyl nuclear power plant disaster, which took place in 1986. In a Chernobyl disaster about, 3.8×10^{16} Bq of ^{137}Cs was reportedly released into the environment, the existence of it in soil therefore contribute to the external radiation exposure levels by emission of gamma rays from it **[3].** Most of the radiation dose received by mankind is due to natural radiation sources which is about 87%, and the remaining is due to man-made radiation. ^{137}Cs has a half-life about 30.2 years, and it has a gamma emission of 661.66 keV **[4].** ^{137}Cs was carried out to distant places by winds and clouds**[5]**. Then it was deposited on and into the soil surface, water, and also in the air. It was considered as a source of environmental pollution and cause of concern due to exposure to its radiation. This leads to increasing concern about the danger to human health and his wellbeing **[6]**. This study is to survey environmental radioactivity with the aim of building up an abroad database on man-made radionuclides for producing a radiation map of the country to be used as a reference in the event of any radiological accident of global dimension. To recognize the health effect of ^{137}Cs contamination due to the Chernobyl disaster, the dose rates and the annual effective doses were estimated.

2. Material and methods:

Preparation of samples

Thirty soil samples were collected from different locations in Zintan City and Awiniya Region, in the northwestern part of Libya **Fig.1 [7][8]**. These samples were prepared for γ-Ray spectrometric analyses by HPGe detector, and were placed in polyethylene bottles of 1000 cm^3 volumes, which have been sealed for more than a month.



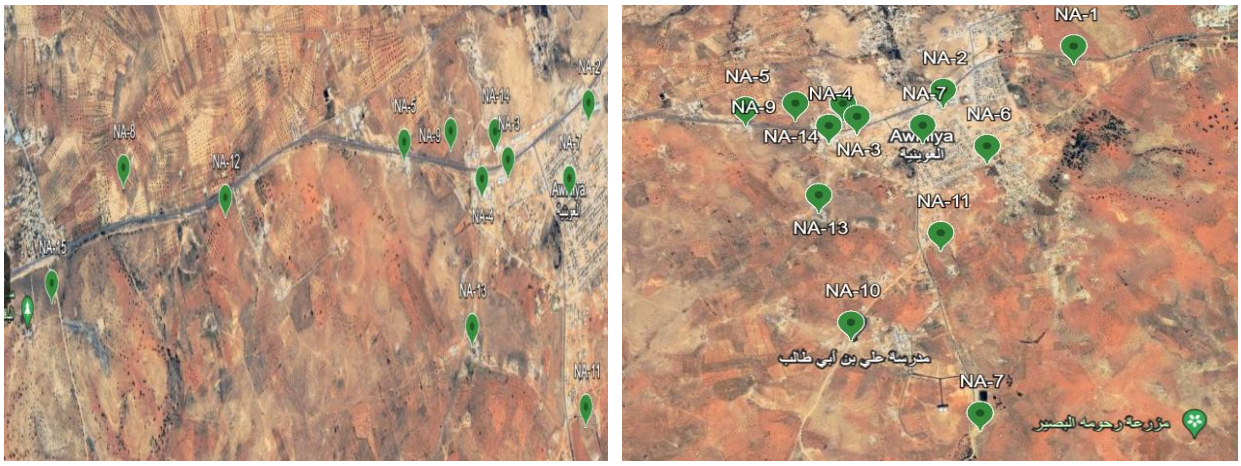


Fig.1: Location map of the studied area samples, Zintan city and Awiniya region [7] [8]

Estimation of Dose Rates

The activity concentrations of ^{137}Cs were estimated by equation (1):

$$A = \frac{CPS}{eff \times I \times W} \qquad (1)$$

Where, A is the specific activity in $Bq \cdot kg^{-1}$, cps is the net counts per second; eff is the counting efficiency of the gamma energy; I is absolute intensity of the gamma-ray; and m is the mass of the sample in kg **[8]**.

The absorbed dose rate in outdoor air ($nGy\ h^{-1}$) due to artificial ^{137}Cs radionuclide, and the annual effective dose rate (AEDR) have been calculated by the following equations:

$$D = 0.03 \times A_{Cs} \qquad (2)$$

$$AEDR = D\ (nGyh^{-1}) \times 20\%\ of\ 8760\ h\ y^{-1} \times 0.7\ (Sv\ Gy^{-1}) \times 10^{-3} \qquad (3)$$

where, D is the absorbed dose rate ($nGy\ h^{-1}$), A_{Cs} is the specific activity and 0.03 ($nGy\ h^{-1}$ / $Bq\ kg^{-1}$) is the dose conversion factor for ^{137}Cs activity, 0.7 is the dose conversion factor ($Sv\ Gy^{-1}$), 20% is the outdoor occupancy factor, and 8760 is the time conversion factor ($h\ y^{-1}$) **[9] [10].**

3. Result and Discussion

The results obtained in this study are listed in **Table (1)**. The activity concentration of fallout ^{137}Cs ranged from 0.929 to 2.36 $\boldsymbol{Bq.kg^{-1}}$ in Zintan City, while in the Awiniy Region it varied between 0.943 and 2.36 $\boldsymbol{Bq.kg^{-1}}$. However, as seen from **Fig (2)** the outfall ^{137}Cs does not appear in all collected samples; only 7 localities in Zintan City and 6 localities in Awiniya Region. The distribution of the measured ^{137}Cs concentrations was not uniform, which is due to geomorphology, topographic differences, and meteorological conditions of the area.

The absorbed dose rate varied from 0.028 to 0.071 $nGy.h^{-1}$ with an average value of 0.056 $nGy.h^{-1}$. The outdoor annual effective dose rate varied from 0.034 to 0.087 $\boldsymbol{\mu Sv.y^{-1}}$, with average value of 0.069 $\boldsymbol{\mu Sv.y^{-1}}$ which plotted in **Fig (3)**. The determined annual effective dose rates were found to be lower than the worldwide standard value of annual dose (48 $\boldsymbol{\mu Sv.y^{-1}}$) reported by **UNSCEAR [10] [11]** and the recommended annual dose rate limit (1.0 $\boldsymbol{mSv.y^{-1}}$) noted by **ICRP [1] [12]** as shown in **Fig (4).**

Table (1) : The activity concentration of ^{137}Cs , Absorbed dose rate , Annual effective dose rate .

Sample Number	Region	The activity concentrations of ^{137}Cs ($Bq.kg^{-1}$)	Absorbed Dose Rate ($nGy.h^{-1}$)	Annual Effective Dose Rate ($\mu Sv.y^{-1}$)
NA1	Awiniya	0.943	0.028	0.035
NA4		1.848	0.055	0.068
NA5		2.279	0.068	0.084
NA12		2.334	0.07	0.086
NA13		2.087	0.063	0.077
NA15		2.36	0.071	0.087
Zn1	Zintan	2.181	0.065	0.08
Zn3		1.507	0.045	0.055
Zn6		1.764	0.053	0.065
Zn16		1.79	0.054	0.066
Zn18		2.085	0.063	0.077
Zn19		0.929	0.028	0.034
Zn24		2.325	0.07	0.086
Average		1.879	0.056	0.069
Max		2.36	0.071	0.087
Min		0.929	0.028	0.034

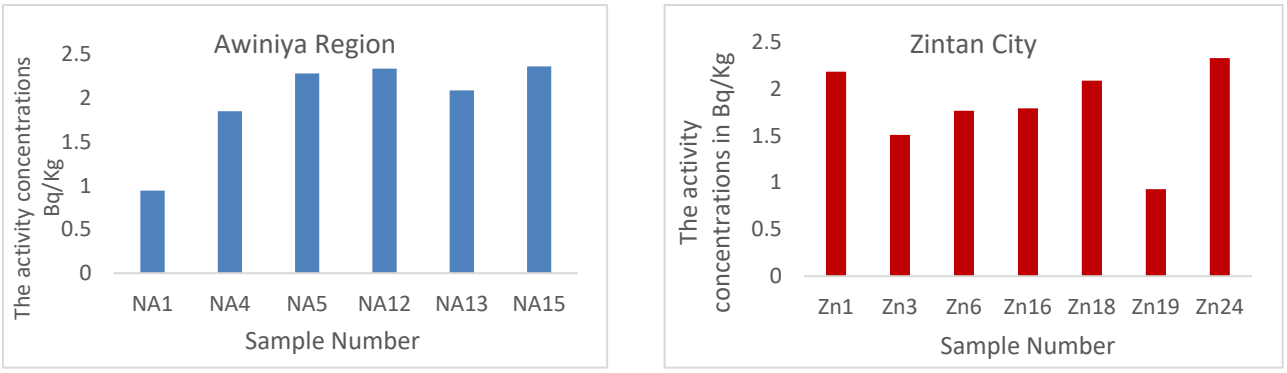


Fig.2: The activity concentration of ^{137}Cs

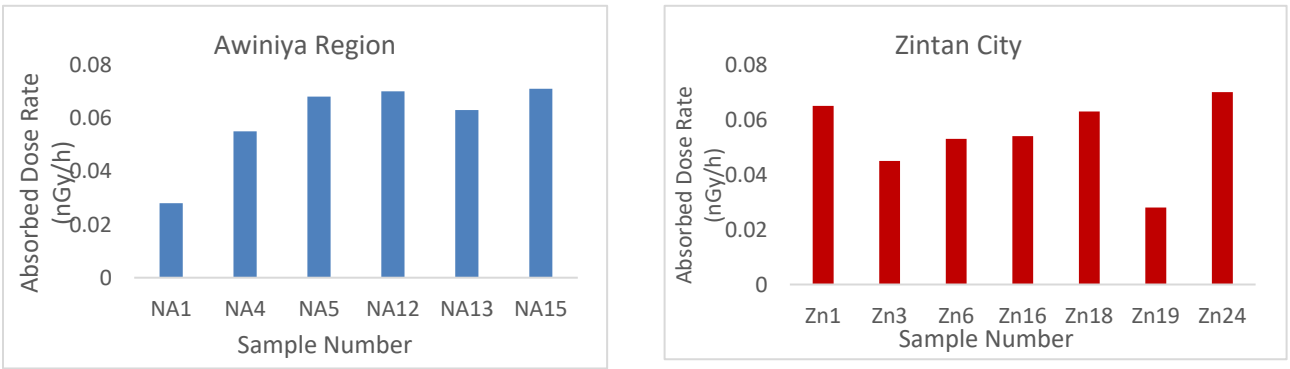


Fig.3: The absorbed dose rate.

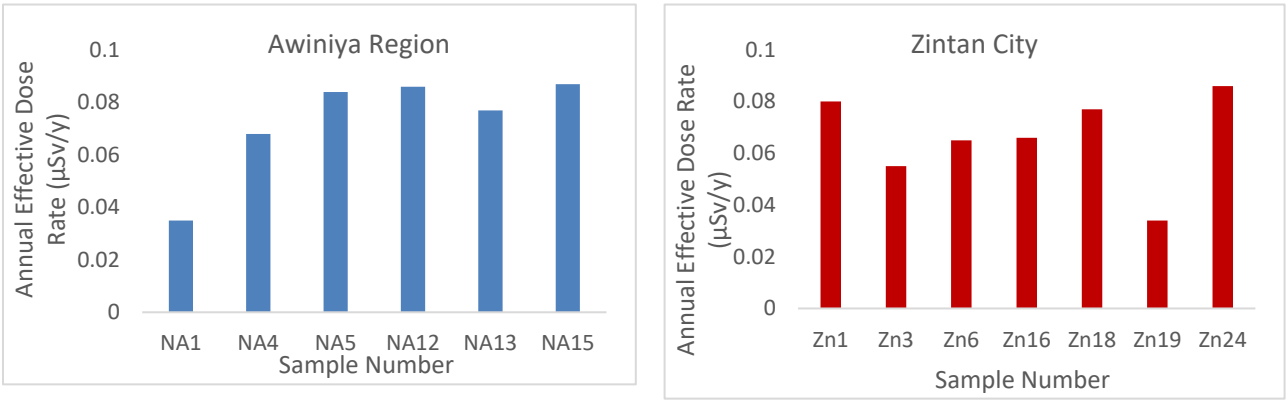


Fig.4: The annual effective dose rate.

4. Conclusion

In the present study, the activity concentrations of fallout ^{137}Cs in some soil samples from different localities in Zintan City and Awiniya Region (Al-Jabal Al-Gharbi) is lower than the worldwide data, The ranges of ^{137}Cs concentrations in soils are fairly normal compared with those reported for most of the regions of the world. The absorbed dose rate and the annual effective dose rate are still lower than in many areas, and their limit is below 1.0 $\boldsymbol{mSv.y^{-1}}$. So the concern of transfer to man through the food chain, such as consumption of vegetables, fruits, and through air breathing, further study is necessary in order to draw a detailed radiation map (Al-Jabal Al-Gharbi) of Libya.

REFERENCES:

[1] International Commission on Radiological Protection, "1990 Recommendations of the International Commis- sionon Radiological Protection," Annals of the ICRP, ICRP Publication 60, Vol. 21, No. 1-3, Pergamon Press, Oxford, 1991.

[2] M. A. Shenber, "Fallout 137 Cs in Soils from North Western Libya," *Journal of Radioanalytical and Nuclear Chemistry*, Vol. 250, No. 1, 2001, pp. 193-194. doi:10.1023/A:1013224122677

[3] K. Jamil, S. Ali, M. Iqbal, A. A. Qureshi and H. A. Khan, "Measurements of Radionuclides in Coal Samples from Two Provinces of Pakistan and Computation of External Gamma-Ray Dose Rate in Coal Mines," *Journal of Envi- ronmental Radioactivity*, Vol. 41, No. 2, 1998, pp. 207- 216. doi:10.1016/S0265-931X(97)00094-5

[4] Dizman, S., Görür, F.K., Keser, R., 2016. Determination of radioactivity levels of soil samples and the excess of lifetime cancer risk in Rize province, Turkey. Internatuinal J. Radiat. Res. 14, 237–244. doi:10.18869/acadpub.ijrr.14.3.237

[5] Kritidis, P., Florou, H., Eleftheriadis, K., Evangeliou, N., Gini, M., Sotiropoulou, M., Diapouli, E., Vratolis, S., 2012. Radioactive pollution in Athens, Greece due to the Fukushima nuclear accident. J. Environ. Radioact. 114,100–4. doi:10.1016/j.jenvrad.2011.12.006

[6] Alsaadi , S., Younis,A ., Hazawi, A ., Arhoma , N, 2018 (Characterization of ^{137}Cs in Soil from the Surrounding of Al Bayda City, Libya) (IOSR Journal of Applied Physics) (IOSR-JAP) e-ISSN: 2278-4861.Volume 10, Issue 5 Ver. II (Sep. – Oct. 2018), 26-31 www.iosrjournals.org

[7] K.M. Musa, Naima M Al-kbashy, Asma. A. Abouaza. "Assessment of radioactivity levels and hazards for some soil samples from different localities, Zintan city, Libya", Rwafed Al-

Maerefah Journal – Faculty of Sciences – Azzaytuna University. Vol. 10, No. 02, pp 92-98, (2023).

[8] Naima .M. Al-kbashy, K.M. Musa, Asma. A. Abouaza, "Natural radioactivity measurements and excessive lifetime cancer risk for some surface Soil samples in (Al-Jabal Al-Gharbi) Mountain, (Awiniya) Region, Libya", Humanities & Natural Sciences Journal, Volume 5. Issue1, pp 185-193. HNSJ, 2024, 5(1); https://doi.org/10.53796/hnsj51/14

[9] Rafique, M. (2014). Cesium-137 activity concentrations in soil and brick samples of Mirpur, Azad Kashmir; Pakistan. International Journal of Radiation Research, 12(1), 39.

[10] UNSCEAR, 2010. Sources and Effects of Ionizing Radiation. Report to General Assembly with Scientific Annexes (New York, United Nations Scientific Committee on the Effect of Atomic Radiation).

[11] UNSCEAR, Sources and Effects of Ionizing Radiation. (2000). United Nations Scientific Committee on the Effect of Atomic Radiation Report Vol. 1 to the General Assembly, with Scientific Annexes.

[12] Smith, H. (1991). 1990 recommendations of the International Commission on Radiological Protection. International Commission on Radiological Protection.