International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 3 Issue 8, August – 2019, Pages: 55-61

Studying of Risk Factors for Selected Samples from Dulmaj Marsh in Wasit, Iraq

Heiyam Najy Hady, Zahrah Madhat Rifaaht

Department of Physics, University of Kufa,
Faculty of Education for Girls, Najaf, Iraq

Abstract: *In this study, the concentration of the natural radioactive elements, potassium ^{40}K, uranium ^{238}U and thorium ^{232}Th, as well as the calculation of radium equivalent values Ra_{eq}, external (H_{ex}), internal (H_{in}) risk factors and level index (I_{γ}) have been measured in 40 soil samples randomly distributed on the Al Dulmaj marsh, which is located in the South-West of Wasit province and North-East of Diwaniyah province using NaI (Tl) (3''x3'') detector. The results show that the radio activity of ^{40}K ranged between (87.44–705.86) Bq kg^{-1} with an average 344.12 Bq kg^{-1}, ^{238}U ranged between (1.24–35.65) Bq kg^{-1} with an average 13.94 Bq kg^{-1}, ^{232}Th ranged between (2.6–16.97) Bq kg^{-1} with an average 9.43 Bq kg^{-1}. Radium equivalent values Ra_{eq} ranged between (25.01–87.85) Bq kg^{-1} with an average 56.72 Bq kg^{-1}, external radiation hazard (H_{ex}) ranged between (0.067–0.23) with an average (0.153), Internal radiation hazard (H_{in}) ranged between (0.095-0.13) with an average 0.19 and activity index (I_{γ}) ranged between (0.18–0.70) with an average (0.44), representatively. The results were found to be comparable or lower than similar global reporting data in EPA and UNSCEAR. According to this result, research soil the area can be considered to have a normal level of natural background radiation.*

Keywords: ^{40}K, ^{238}U, ^{232}Th, Wasit, risk factors.

INTRODUCTION

The natural radioactivity as it was known by radiological background is considered very important in relation to the exposure of the population to radiation. Many countries of the world measure the average of exposure caused by natural radiation for various purposes, such as; choosing the location of nuclear facilities and contingency plans to monitor any case of increased radioactivity, its source and reason to ensure the security of the country and citizens [1]. The life of living organisms especially human is endangered by the presence of radiation activity in the environment in which he lives above the global limit this means the existence of high concentrations of radioactive elements which are called radioactive contamination [2, 3]. One of the causes of radioactive contamination of the world is the use of alternative energy sources such as Nuclear reactors, electric-nuclear power plants, and the dumping of nuclear waste, as well as the use of missiles and explosives containing such radioactive materials in nuclear explosions during war and nuclear testing on land, sea and air.

All of these causes led to the urgent need to radiological surveys for many infected and directly non infected countries of the world to measure radiation dose rates through quantitative and qualitative assessment of radiation for the purpose of identifying the risks posed by and identifying the international organizations and committees such as International Commission on Radiological Protection (ICRP), International Atomic Energy Agency (IAEA) and other international organizations specialized radiological and radiological protection [4, 5].

Study Area

Al-Dalmaj marsh lies in the southeast part of south east of Wasit governorate and northeast to Al-Diwaniyah governorate between latitudes (32°08) to (32°25) north and the two longitudes (452°42 to 452°09) east. The total immersed and not immersed area of the marsh is (682) km^2 divided between Wasit governorate (267) km^2 and Al-Qadisiyah governorate (435) km^2. The marsh obtain water from fall drain through feeding canal within Al-Qadisiyah governorate. Geologically, Al-Dalmaj marsh foundation goes back to Quaternary, Holocene age. It is longitudinal large flood plains formed by the foot hills streams and Tigris river through broken and water covered cliff fissure. The sediment is either on the surface or buried underwater. The study location is situated in the flood plain, which is slightly slopped towards southeast. The depth of the marsh starts from 1 m to 4.5 m in the deepest point. This point is in the southeastern part of the marsh. It is noted that the immersion of water in Al-Dalmaj marsh is different, where water covers 70% of the total area in 2002 and decreased to 18% in 2016 as shown in Fig. (1) [6].

Materials and Methods

To measure radiation hazard index in soil surface 40 soil samples were collected from different sites, was taken by digging a hole at a depth of 5 cm from the ground surface. The soil texture for all samples was very similar. After collection samples each soil sample was kept in a plastic bag and labeled according to its location. The collected samples were transferred to labeled closed polyethylene bags and taken to the laboratory of radiation detection and measurement, research laboratory in the university of Kufa, college of education for girls, department of physics. The samples were prepared for analysis by drying, and keeping

International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 3 Issue 8, August – 2019, Pages: 55-61

them moisture -free by putting them for 24 hours in an oven at 100˚C. The samples were mechanically crushed using electric mill of micro soil grinded. To reach a suitable homogeneity, the samples were sieved using of 0.8mm pore size diameter sieve to reach homogeneity. In this work (1L) polyethylene Marinelli beaker of constant volume was used where the samples were packed in it. Before use, it the containers were washed with dilute hydrochloric acid and rinsed with distilled water. To remove the air completely from the sample, the latter is pressed on by the light cap of the Marinelli beaker and sealed with a PVC tape. The respective net weights were measured and recorded with a high sensitive digital weighting balance with a percent of ±0.01%. After that less, than about (1kg) of each sample was then packed in a standard Marinelli beaker that was hermetically sealed and dry weighted to get homogeneity. All samples were stored for about one month before counting, to allow secular equilibrium to be attained between ^{222}Rn and its parent ^{226}Ra in uranium chain, each sample was placed in face to face geometry over the detector for a long time measurement.

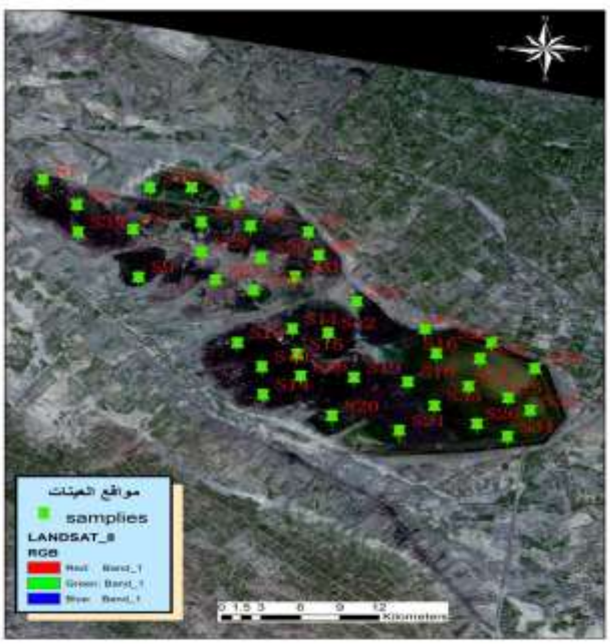

Figure (1): Al-Dalmaj marsh map and the locations soil samples

The specific activity of each radionuclide was calculated using the following equation [7]:

$$A = \frac{N_{net}}{\varepsilon . I_{\gamma} . m . t} \pm \frac{\sqrt{N_{net}}}{\varepsilon . I_{\gamma} . m . t} [Bq.kg^{-1}] \quad \text{......................(1)}$$

Where N_{net} is the net count (area under the specified energy peak after back ground subtraction) in (c/s), is the random error in (c/s), is the efficiency of the detector, Iγ is the transition probability of the emitted gamma ray, t is the time (sec) for spectrum collected and m is the sample weight (kg). Radium equivalent activity (Ra_{eq}) Distribution of ^{238}U, ^{232}Th and ^{40}K in environment is not uniform, so that with respect to exposure to radiation, the radioactivity has been defined in terms of radium equivalent activity (Raeq) in Bq kg^{-1} [7].

$$Ra_{eq}(Bq.kg^{-1}) = A_U + 1.43 A_{Th} + 0.077 A_K \quad \text{.............(2)}$$

Where A_U, A_{Th} and A_K are specific activity concentration in Bq kg^{-1} of ^{238}U ^{232}Th and ^{40}K, respectively. The index is useful to compare the specific activity of materials containing different concentrations of ^{238}U ^{232}Th and ^{40}K

Activity Concentration Index (Iγr)

In order to examine whether the sample meets limit of dose criteria, another radiation hazard index, representative level index I_γ, used to estimate the level of γ- radiation hazard. associated with the radionuclides in specific investigated samples, is defined as the following equation [8].

$$I_{\gamma} = \frac{A_U}{150} + \frac{A_{Th}}{100} + \frac{A_K}{1500} \quad \text{.......(3)}$$

External hazard index (Hex):

The external hazard index (Hex) was given by the following equation [9]

$$H_{ex} = \frac{A_U}{370} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \quad \text{......(4)}$$

Internal hazard index (H_{in})

exposure to ^{222}Rn and its radioactive progeny is controlled by the internal hazard index (H_{in}) is given by

$$H_{in} = \frac{A_U}{185} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \quad \text{..................................(5)}$$

For the safe use of a material in the construction of dwellings, index (H_{in}) should be less than unity and the maximum value of (H_{in}) to be less than unity [9, 10].

Results and Discussion

The specific activity values of ^{238}U,^{232}Th and ^{40}K radionuclide s for 40 soil sample are tabulated in table (1) and Figs. (2-4). They have been found to lie in the range of (35.65 S19 to 1.24 S25) Bq kg^{-1} with an average of 13.94 Bq kg^{-1}, from (16.97 S10 to 2.26 S4) Bq kg^{-1} with an average 9.437 Bq kg^{-1} and (705.86 S15 to 87.44 S35) Bq kg^{-1} with an average 344.12 Bq kg^{-1} for ^{238}U, ^{232}Th and ^{40}K, respectively. The results show that all values of ^{238}U, ^{232}Th and ^{40}K specific activity for all soils are in the worldwide average (35 Bq kg^{-1} for ^{238}U, 30 Bq kg^{-1} for ^{232}Th and 400 Bq kg^{-1} for ^{40}K) [11].

Table (1): The specific activity values of ^{238}U, ^{232}Th and ^{40}K for Al- Dalmaj marsh soil samples.

Sample No.	^{238}U	^{232}Th	^{40}K
S1	12.92 ± 0.69	5.60 ± 0.27	298.52 ± 3.43
S2	25.75 ± 0.85	6.06 ± 0.24	351.85 ± 3.21
S3	6.07 ± 0.47	12.03 ± 0.39	501.81 ± 4.3
S4	11.60 ± 0.66	2. 62 ± 0.18	125.46 ± 2.22
S5	30.85 ± 1.04	3.18 ± 0.200	173.65 ± 2.54
S6	6.43 ± 0.47	7.57 ± 0.30	359.14 ± 3.59
S7	8.06 ± 0.55	6.79 ± 0.30	362.25 ± 3.82
S8	27.11 ± 0.96	3.17 ± 0.19	476.79 ± 4.11
S9	10.80 ± 0.61	5.69 ± 0.266	480.02 ± 4.20
S10	11.89 ± 0.67	16.97 ± 0.47	606.14 ± 4.88
S11	8.74 ± 0.54	11.45 ± 0.36	150.70 ± 2.29
S12	13.28 ± 0.70	14.87 ± 0.44	363.65 ± 3.78
S13	8.08 ± 0.49	9.68 ± 0.32	438.88± 3.73
S14	10.20 ± 0.59	7.32 ± 0.29	220.82 ± 2.8
S15	11.02 ± 0.64	15.71 ± 0.45	705.86 ± 5.23
S16	28.97 ± 0.94	16.15 ± 0.41	433.93 ± 3.72
S17	26.50 ± 0.91	12.05 ± 0.36	528.29 ± 4.15
S18	3.46 ± 0.33	7.93 ± 0.29	387.07 ± 3.59
S19	35.65 ± 1.18	8.89 ± 0.35	498.10 ± 4.51
S20	30.12 ± 1.06	7.60 ± 0.31	393.19 ± 3.91
S21	24.84 ±1.007	10.80 ± 0.39	409.66 ± 4.17
S22	17.08 ± 0.79	14.12 ± 0.43	423.30 ± 4.05
S23	14.23 ± 0.67	10.67 ± 0.43	548.43 ± 4.24
S25	1.24 ± 0.22	9.23 ± 0.36	254.64 ± 3.26
S26	12.80 ± 0.68	7.66 ± 0.31	147.90±2.38
S27	11.10 ±0.61	6.26 ± 0.27	405.31 ± 3.76
S28	23.94 ± 0.96	10.53 ± 0.38	507.53 ± 4.54
S29	8.16 ± 0.48	8.80 ± 0.29	266.16 ± 2.81
S30	11.98 ± 0.59	8.42 ± 0.29	401.67 ± 3.51
S31	9.42 ± 0.52	11.56 ± 0.34	371.02 ± 3.38
S32	12.86 ± 0.68	12.89 ± 0.40	392.79 ± 3.84
S33	9.07 ± 0.50	10.27 ± 0.32	384.15 ± 3.37
S34	9.56 ± 0.54	6.76 ± 0.27	406.85 ± 3.62
S35	7.41 ± 0.47	12.33 ± 0.36	246.66 ± 2.82

International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 3 Issue 8, August – 2019, Pages: 55-61

S36	10.49 ± 0.54	6.693 ± 0.25	377.70 ± 3.32
S37	2.06 ± 0.24	.43 ± 0.277	317.67 ± 3.11
S38	13.63 ± 0.73	11.47 ± 0.40	458.01 ± 4.35
S39	10.65 ± 0..55	12.63 ± 0.36	348.90 ± 3.26
S40	9.15 ± 0.61	9.19 ± 0.36	352.25 ± 3.86
Average	13.94	9.43	344.12
Max. Values	35.65	16.97	705.86
Min. Values	1.24	2.6	87.44
Average world range	33	45	240

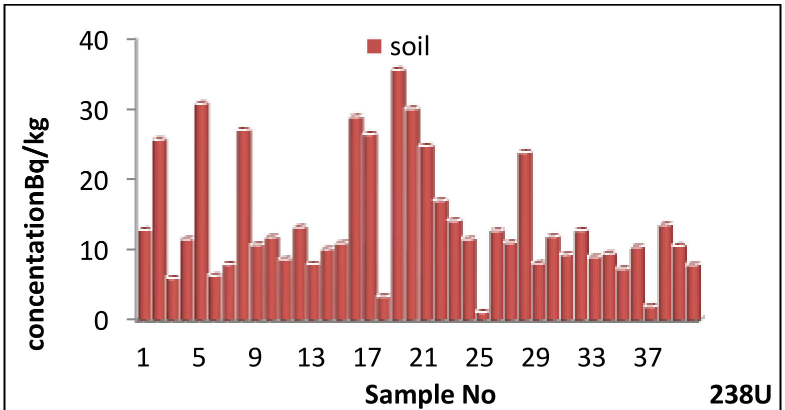

Figure2. The specific activity values of ^{238}U for Al- Dalmaj marsh soil samples.

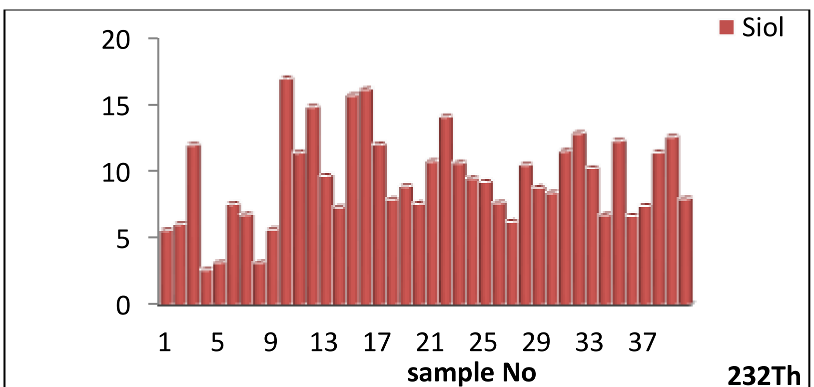

Figure 3. The specific activity values of ^{232}Th for Al- Dalmaj marsh soil samples.

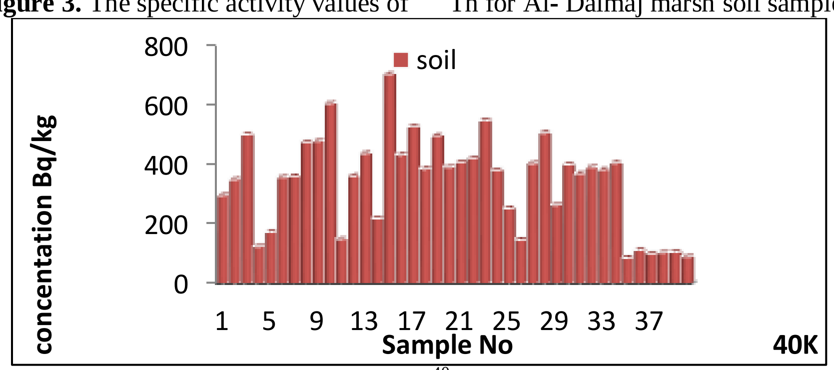

Figure 4. The specific activity values of ^{40}K for Al- Dalmaj marsh soil samples.

Where Radium equivalent Raeq Bq kg^{-1}, Activity Concentration Index(I_γ), External hazard index (H_{ex}) and Internal hazard index (H_{in}) wore calculated and the listed in Table 2. Ra eq values vary from (87.85 S15 to 25.01 S4) Bq kg^{-1} with an average value of 56.72 Bq kg^{-1}. It can be seen the Raeq values for all samples are lower than the recommended value 370 Bq kg^{-1}, Activity Concentration Index (I_γ) ranged between (0.70–0.18) with an average (0.44), External hazard index (H_{ex}) range from (0.237 S15 to 0.067 S4) with an average 0.153 and Internal hazard index (H_{in}) range from (0.13 S40 to 0.095 S25) with average 0.19, representatively. Activity Concentration Index (Iγ), External and Internal hazard indexes were lower than unity according to the Radiation Protection [12-14].

Table 2: Radium equivalent (Bq kg^{-1}), Activity Concentration Index(I_γ) External and internal hazard indexes for Al-Dalmaj marsh soil samples.

Sample No.	**radium equivalent Ra_{eq} Bq kg^{-1}**	**Activity Concentration Index (I_γ)**	**external Hazard Index (H_{ex})**	**Internal Hazard (H_{in})**
S1	43.29 ±1.35	0.34±0.009	0.118±0.0036	0.153±0.0055
S2	61.52 ± 1.45	0.46 ± 0.010	0.166 ± 0.00391	0.235 ± 0.0062
S3	61.92 ± 1.38	0.49 ± 0.0100	0.167 ± 0.00372	0.183 ± 0.0050
S4	25.01 ± 1.10	0.18 ± 0.0077	0.067 ± 0.0029	0.098 ± 0.0047
S5	48.78 ± 1.53	0.35 ± 0.0106	0.131 ± 0.0041	0.215 ± 0.0069
S6	44.91 ± 1.18	0.35 ± 0.0085	0.121 ± 0.0031	0.138 ± 0.0044
S7	45.67 ± 1.28	0.36 ± 0.0093	0.123 ± 0.0043	0.145 ± 0.0049
S8	68.37 ± 1.58	0.53 ± 0.0111	0.184 ± 0.00420	0.257 ± 0.0068
S9	55.90 ± 1.3	0.44 ± 0.0095	0.150 ± 0.0035	0.180 ± 0.0052
S10	82.85 ± 1.72	0.65 ± 0.0125	0.223 ±0.0046	0.255 ± 0.0064
S11	36.72 ± 1.24	0.27 ± 0.0088	0.099±0.0033	0.122 ± 0.0048
S12	62.54 ± 1.63	0.47 ± 0.0117	0.168±0.0044	0.204± 0.0063
S13	55.72 ± 1.24	0.44 ± 0.0090	0.150 ± 0.0033	0.172 ± 0.0047
S15	87.85 ± 1.69	0.70 ±0.0123	0.237 ± 0.0045	0.267±0.0063
S16	85.48 ±1.83	0.64 ±0.0129	0.230 ± 0.0049	0.309 ± 0.0074
S17	84.42 ± 1.75	0.64 ± 0.0125	0.228 ± 0.0047	0.299±0.007
S18	44.61 ± 1.03	0.36 ± 0.0076	0.120 ± 0.0028	0.129 ± 0.0037
S19	86.72 ± 2.03	0.65 ±0.0144	0.234 ±0.0054	0.330±0.0086
S20	71.27 ± 1.81	0.53 ± 0.0128	0.192 ±0.0049	0.273±0.0077
S21	71.84 ±1.89	0.54 ± 0.0134	0.19 ± 0.0051	0.26 ± 0.0077
S22	69.87 ±1.72	0.53 ± 0.0123	0.18 ±0.0046	0.23 ± 0.0068
S23	71.72 ±1.49	0.56 ± 0.0107	0.19 ± 0.0040	0.23 ± 0.0058
S24	54.65 ± 1.52	0.42 ± 0.0109	0.147 ± 0.0041	0.17 ± 0.0059
S25	34.06 ± 0.99	0.27 ± 0.0072	0.091 ±0.0026	0.09 ± 0.0032
S26	35.15 ± 1.32	0.260 ± 0.009	0.094 ± 0.0035	0.129 ± 0.0054
S27	51.27 ± 1.28	0.40 ± 0.0093	0.13 ±0.0034	0.16 ± 0.0051
S28	78.09 ± 1.86	0.603 ± 0.013	0.210 ± 0.0050	0.275 ± 0.0076

S29	41.25 ± 1.12	0.31± 0.0080	0.11 ± 0.0030	0.139 ± 0.0043
P29	16.82 ± 1.36	0.13 ± 0.0097	0.04 ± 0.0036	0.05 ± 0.0054
S30	54.95 ± 1.29	0.431 ± 0.009	0.148 ± 0.0034	0.180 ± 0.0050
S31	54.52 ± 1.288	0.425 ±0.0092	0.147 ± 0.0034	0.172 ± 0.0049
S32	61.55 ± 1.56	0.47 ± 0.011	0.166 ± 0.0042	0.20 ± 0.0060
S33	53.35 ± 1.22	0.419 ± 0.008	0.144 ± 0.0033	0.168 ± 0.0046
S34	50.55 ± 1.21	0.40 ± 0.008	0.136 ± 0.0032	0.162 ± 0.00 47
S35	36.32 ± 1.09	0.283 ± 0.007	0.098 ± 0.0029	0.118 ± 0.0042
S36	49.14 ± 1.16	0.388 ± 0.008	0.132 ± 0.00315	0.161 ± 0.004
S37	37.15 ± 0.88	0.299 ± 0.0065	0.100 ± 0.0023	0.105 ± 0.003
S38	65.30 ± 1.64	0.510 ± 0.011	0.176 ± 0.0044	0.213 ± 0.0064
S39	55.58 ± 1.32	0.42 ± 0.0095	0.150 ± 0.0035	0.17 ± 0.0051
S40	42.86 ± 1.23	0.33 ± 0.0089	0.115 ± 0.0033	0.137 ± 0.0047
Average	56.72	0.44	0.153	0.19
Max.	87.85	0.70	0.23	0.13
Min.	25.01	0.18	0.067	0.095
Average world range	370 Bq kg^{-1}	≥ 1	≥ 1	≥ 1

Acknowledgement
The author acknowledges the financial support of the Kufa University, Iraq. The authors are grateful to Dr. Basim Almayahi, University of Kufa (basim.almayahi@uokufa.edu.iq) for assisting throughout conducting the present research.

Conclusions

The concentration of ^{238}U, ^{232}Th, and ^{40}K in samples are found to be lower than the world average allowed maximum values 32, 30, and 400 Bq kg^{-1} respectively. Some samples have high concentration in potassium due to the bioactivities of some animals living around the marsh. Radium equivalent activity (Ra_{eq}) are turned to be within the international average allowed maximum value of 370 Bq kg^{-1}. Activity Concentration Index (Iγ), External and internal hazard indexes less than unity. The results were found to be comparable or lower than similar global reporting data by EPA and UNSCEAR. According to this research the area can be considered to have a normal level of natural background radiation.

References

1. Maruf Baha Eddin, Environmental Radiation Activity in Iraq] the Scientific Conference on the Effects of the Use of Depleted Uranium weapons (DUW) on Man and Environment in Iraq, (2002).
2. Al-Sabha, Laith Ahmed Application of Nuclear Technology in the Study of Plant Fertilizers. Journal of Al Rafidain Science, (2001).
3. Ali, Amer Hassan, Mohammed, Ahmed Khalaf, Hassan, Hanaa Ihsan Determine the Level of Radiation Background on the Campus of Mosul University Using Multiple Techniques. Accepted publication in the Journal of Al Rafidain Science (2013).
4. G.W, Easley Basic Radiation Protection, Principles, and Organization. Gordon and Bleach Science Publishers: New York (1969).
5. Sindelar, Robert L. Nuclear Radiation, Savannah River National Laboratory: U. S (2008).
6. Abdul Rida Matar Al Hashimi and Jamil Abdul Hamza Al Omari, Uruk Journal of Human Sciences, 2018.
7. H. N. Majeed, A. K. Hasan and H. J. Hamed, Measurement Natural Radioactivity in Soil Samples from Important historical locals in Alnajaf Alashraf city, Iraq], Journal of Advances in Chemistry, (2014).
8. F. Al–Saleh and B. Al-Berzan, Journal of Nuclear and Radiation Physics, (2007).

9. S. Radenković, V. Alshikh, V. Andric, and S. Miljanic, J. Serb. Chem. Soc. 74: 461–470, (2009).
10. S. Harb, A.El-Kamel, A.Abd El-Mageed and R.Wafaa, Proceedings of the 3 rd Environmental Physics Conference, 19-23 Feb. Aswan, Egypt (2008).
11. Organization for Economic Cooperation and Development (OECD), Exposure to radiation from the natural radioactivity in building materials Report by a group of experts of the OECD Nuclear Energy Agency, Paris, France, (1979).
12. European Commission. Radiation Protection112. Radiological protection principles concerning the natural radioactivity of building materials], Brussels, European Commission, (1999).
13. Environmental Protection Agency, (EPA, 2007). United States. Ionizing radiation Fact book. EPA. Office of Radiation and Indoor Air 2007. EPA-402-F-06e061.
14. United Nation Scientific Committee on the Effects of Atomic. (UNSCEAR), Radiation Sources and effects of ionizing radiation. New York, USA: United Nations. Report of the United Nations Scientific Committee on the Effect of Atomic Radiation to General Assembly, 2000 .