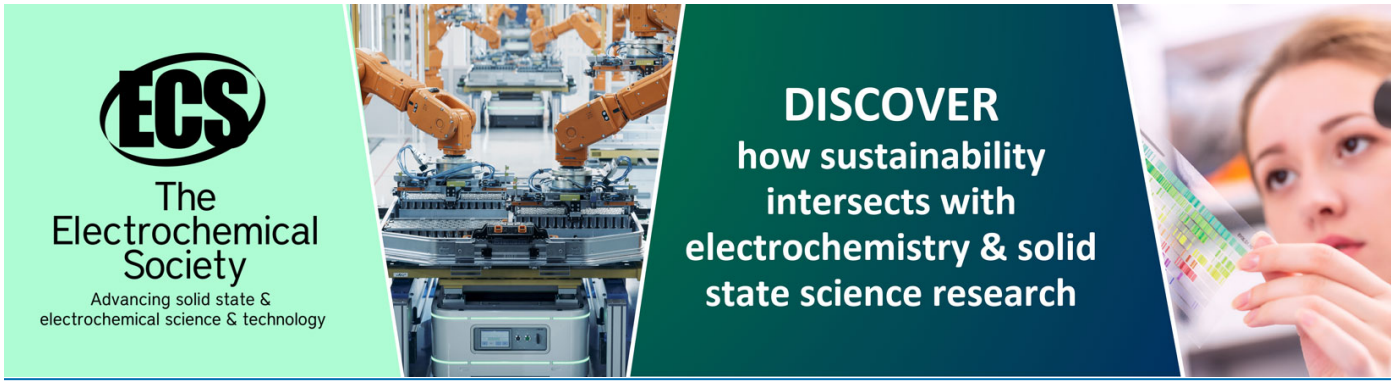
Radium and Uranium Concentration in Some Plants in Iraq



IOP Conf. Series: Journal of Physics: Conf. Series **1178** (2019) 012022 doi:10.1088/1742-6596/1178/1/012022

Radium and Uranium Concentration in Some Plants in Iraq

[1]Nidhala Hassan Kadim, [1]Basim Khalaf Rejah, [1]Ruwiadah Tarik Mahdi, [1]Ayaat Methaq Khalaf

[1]Physics Dept. College of Science for Women, University of Baghdad. Baghdad – Iraq

Author E-mail: basimkr_phys@csw.uobaghdad.edu.iq

Abstract: In this study, the concentration of radium and uranium in the samples radish leaves, radish stalk, onion leaves, onion stalk and garlic fruits were grown in arable soil in the Botanical Garden in the College of Science for women, and garlic in special plates, the soil was taken from the above at the beginning of November 2016 was studied by using CR-39 nuclear track detectors. The radium and uranium concentration varied from 0.023 to 0.052 and from 23.13 to 52.68 Bq/kg with an average value of 0.037 and 37.58 Bq/kg respectively. The maximum value of radon concentration was 0.052 Bq/kg in fruits of garlic sample, while the minimum value was 0.023 Bq/kg in radish leaves. The values of the radium and uranium concentrations obtained from this study are largely consistent with the other study [15].

1. Introduction

There are now three radioactive chains, uranium, thorium, and actinium. These sequences send alpha particles in a primary form that is faster than Beta and gamma.

The three natural chains share radiated gas within their members and end with a stable lead isotope. They also share the diversity of their dissolution. The weaker the detection technique, the greater the discovery of low-intensity branches in the series [1].

Natural chains are found in the first layer of the Earth's crust and most of the energy emitted from them is converted into heat absorbed by nearby materials.

The most important element in natural chains is uranium, which is found in soil and rocks at different rates around the world [2].

The uranium has devastating health effects when it is close to it for a long time, as well as the effect of dust if the particles enter the uranium into the human body in different ways, including by inhaling uranium dust enters the upper respiratory system and then enter the lungs through the movement of air (inhalation) The deposition process is limited to 25%, but a large part of the inhaled dust and up to 75% soon re-exhale it [3 and 4].

The high levels of radiation are produced from the sources of radiation and nuclear explosions that cause pollution of the environment, which affects the impact on humans and animals, leading to a genetic defect that appears in subsequent generations. Moreover, the effect of this pollution reaches water and soil and enters the food chain of both human and animal [4 and 5].

Therefore, there is a need to study the effect of radiation and detection and to identify the extent of pollution of the environment and how to address it. Several research [6-8] has been conducted and several techniques have been developed to calculate concentrations of radioactive materials in soil, water, air, building materials, plants and others.

Various techniques have been used for the detection of radioactive materials, including the technique of impact detectors, which are important techniques in determining concentrations of

radioactive materials due to availability and accuracy of their results and the need for complex systems in their measurements [10 and 11].

The aim of this study to calculate radium and uranium concentration in radish leaves, radish stalk, onion leaves, onion stalk and garlic fruits were grown in arable soil in the Botanical Garden in the College of Science for women, and garlic in special plates, the soil was taken from the above at the beginning of November 2016 as in fig. 1.

2. Materials and Experimental

The samples were taken with 2 samples of stems and leaves and left to dry. They were then ground and 50 g of each sample of the stems and leaves was taken and placed in the dose measurements using the CR-39 detector for 30 days to obtain the eternal equilibrium of the nuclei derived from the radioactive decay to calculate the uranium concentration - 238 therein.

After the 30 day exposure period, reagents were taken and chemically scrubbed using NaOH at 6.25 N and using a water bath at 70 ° C for 5 hours. Pictures of the reagents were taken after washing them with distilled water using a light microscope and CCD camera. 20 snapshots were taken for each detector [11 and 12] as shown in fig. 2 and 3.

Radium concentration was calculated in the studied samples using the equation [13]:

$$C_{Ra} = \frac{\rho h A}{KTM} \quad (1)$$

Where:

C_{Ra} Concentration of radium Bq / kg

ρ Track intensity / cm^2

h The distance between the detector and the sample surface (4.75 cm).

A Space and quantity (9.6211 $X10^{-4}$ m^2).

M Mass of the samples 50 g.

T Time exposure.

The number of uranium atoms was calculated from the equation [14]:

$$N_U = \frac{C_{Ra}}{\lambda_{Ra}} \quad (2)$$

λ_{Ra} half lifetime of the radium analogue.

The weight of the uranium was calculated from the equation:

$$W_U = \frac{N_U M_U}{N_{av}} \quad (3)$$

M_U The mass number of uranium 238.

N_{av} Avogadro number $6.02*10^{23}$.

The concentration of uranium in ppm units was calculated from the equation [13]:

$$C_U(ppm) = \left(\frac{W_U}{M}\right) \times 10^6 \quad (4)$$

The uranium concentration units of ppm were converted to Bq/kg by multiplying them by the conversion factor 12.4

3. Results and Discussion

Table 1 shows the concentrations of uranium, radium and the intensity of the effects for each sample used radish leaves, radish stalk, onion leaves, onion stalk and garlic fruits.

From this table, one can show that the radium and uranium concentration varied from 0.023 to 0.052 and from 23.13 to 52.68 Bq/kg with an average value of 0.037 and 37.58 Bq/kg respectively as shown in fig. 4 and 5.

The maximum value of radium concentration was 0.052 Bq/kg in fruits of garlic sample, while the minimum value was 0.023 Bq/kg in radish leaves.

4. Conclusions

From this study, we can conclude that garlic fruit can be used to treat soil contamination with radium and uranium, so it is recommended to reduce its use as food. As for the Radish leaves, they are the low absorption of radium and uranium contaminations, so it is recommended to use this plant as food.

The values of the radon and uranium concentrations obtained from this study are largely consistent with the other study [16].

To increase environmental awareness among the general public, we suggest similar studies of other types of plants that are frequently used as food by citizens.

References

[1] Lilley J.S. (2006), "Nuclear physics, principle and application".
[2] Maarouf B. H., (1989) "Ionizing Radiation Protection", Iraqi Atomic Energy Publications.
[3] Somogyi G and Hundayi I.H, (1979), Proceeding of the 10th Conference on (SSNTD'S), Lyon, 2-6 July, 443.
[4] Granzer F., (1976), Proceeding of the 9th Conference on (SSNTD'S), Munich, 440.
[5] UNSCEAR (1993), Sources & effects of Ionizing Radiation. New York Catherin T.M, "Fertilizer Application, soil, plants, animal", London, Grosby. Applicatoin, soli, plants and animal", London, Grosby.
[6] Oriel W., (2003), "Nuclear Energy", urban studies program, San Francisco University.
[7] Jubouri A. (2004), "Determination of depleted uranium concentrations in the remains of military equipment in certain locations in southern Iraq using HpGe and CR-39". Master Thesis, College of Science, Mosul University.
[8] Nidhala H.K. AL-Ani Hala M.H.(2016), "Measurement of Uranium Concentrations in soil of some regions in south east of Baghdad using nuclear track detector CR-39", Baghdad Science Journal; 13(4) pp: 254 – 251.
[9] Ruwiadah T. M. (2017)", Measurement of Indoor Radon Gas Concentration in same Region of Baghdad Governorate Using CR-39 Nuclear Track Detector" Baghdad Science Journal; 14 (4) pp: 123 - 128.
[10] Cartwright B.G., Shirk E.K. & Price P.B., (1978), "Nuclear Instruments and Methods", Vol. 153, pp: 457 - 459.
[11] Singh N.P., Singh N., Singh S. and Virk H.S., (1986), "Nuclear Tracks", Vol.12, pp: 793-697.
[12] Basim Kh. R., (2015), "Natural Occurring Radioactive Materials (NORM) and Technologically Enhanced NORM (TENORM) Measurements on Oil Field in North Region of Iraq", Ph.D. Thesis, University of Baghdad.
[13] Nada F. T., Hussein M. N. and Rafaat Kh., (2012), "Determination of Radon Concentrations in AL-NAJAF Governorate by Using Nuclear Track Detector CR-39", Journal of Al-Nahrain University ,15 (1), pp.83-87.
[14] Tykva, R. and Sabol, J. (1995) Low-Level Environmental Radioactivity Sources and Evaluation. Washington State University, Pullman.
[15] Hashim, A.K. and Ali, R.H.A. (2015) Measurement of Annual Effective Doses of Radon in Plastic Bottled Mineral Water Samples in Iraq. Australian Journal of Basic and Applied Sciences, 9, pp: 31-35.
[16] Abdalsattar K. H. and Laith A. N. (2015), "Radium and Uranium Concentrations Measurements in Vegetables Samples of Iraq", Detection, 3, pp: 21-28.

Table 1: The concentration of radium and uranium in cultivated samples.

Sample	Track density	Mass	C_{Ra}	M_U	W_U	$C_U\ (ppm)$	$C_U\ (Bq.kg^{-1})$
Radish leaves	30.25	0.05	0.023	4.7×10^{15}	1.8×10^{-6}	1.87	23.13
Radish leg	61.6	0.05	0.047	9.6×10^{15}	3.8×10^{-6}	3.8	47.1
Onion leaves	35	0.05	0.027	5.46×10^{15}	2.2×10^{-6}	2.16	26.76
Onion stalk	50	0.05	0.038	7.8×10^{15}	3.1×10^{-6}	3.1	38.23
Fruits of garlic	68.9	0.05	0.052	10.7×10^{15}	4.2×10^{-6}	4.26	52.68
Average			0.037				37.58

Fig. 1: Cultivation of studied samples.

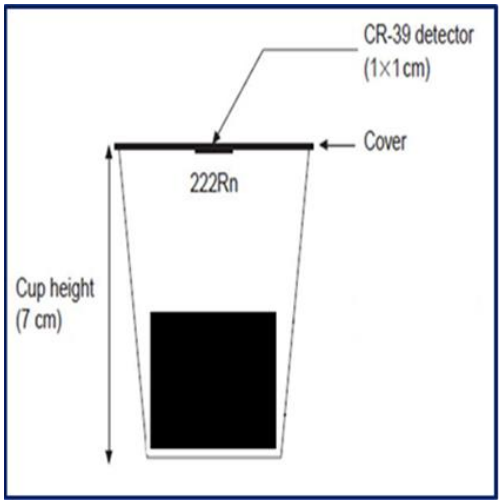


Fig. 2: shows the dose scale were used.

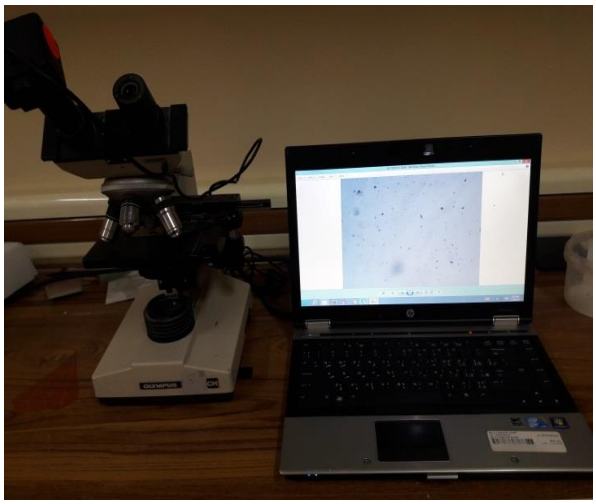


Fig. 3: Illustrates the optical microscope and the camera used.

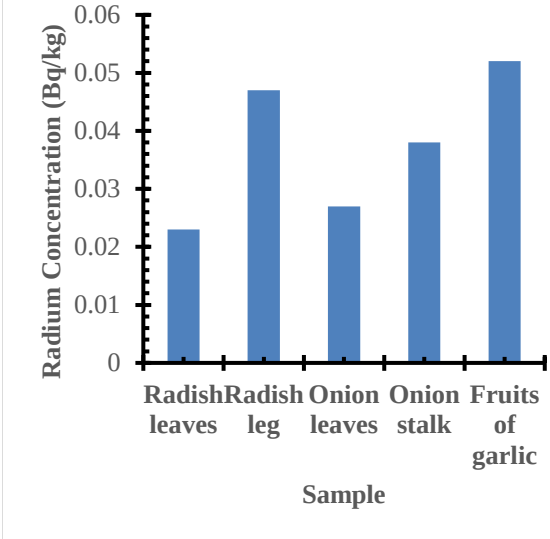


Fig. 4: Radium concentration in all samples.

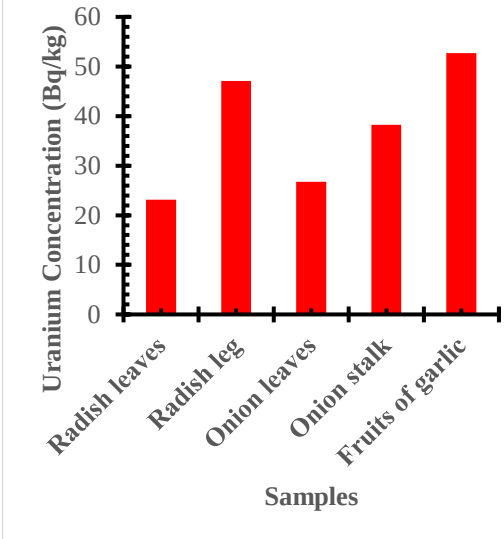


Fig. 5: Uranium concentration in all samples.