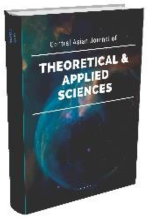

CENTRAL ASIAN JOURNAL OF THEORETICAL AND APPLIED SCIENCES

Volume: 04 Issue: 05 | May 2023 ISSN: 2660-5317
https://cajotas.centralasianstudies.org

Measurement of Radioactive Radon Gas in the Wheat Crop of the City of Tuz Kharmatu

Karar Samen Ali, Loqman Abdala Hussein
Ministry of Education, General Directorate of Salah al Din Education, Tuz Education, Iraq

Received 4th Mar 2023, Accepted 6th Apr 2023, Online 23rd May 2023

Abstract: Current research measured radon in wheat. main food source. Cylinder to measure the concentration of radon gas in wheat samples. The results showed that the highest complete concentration was model 9, with a concentration of (78.4Bq/m-3) while the lowest concentration was model 3, with a concentration of (27.7Bq/m-3) The results of the current Refers to the wheat samples that contain eleven samples.

Key words: *radon gas, wheat, solid state nuclear trace detectors, CR-39.*

1. Introduction

Man is permanently exposed to radiation from two main sources, natural and industrial. By industrial sources, man-made sources are meant for various purposes (medical, agricultural, industrial, military, etc.) Nature with the emergence of the earth, and an example of this is the cosmic rays and the rays from which the radioactive elements are naturally emitted. Almost all the materials surrounding us contain a certain percentage of radioactive materials, and for this reason man is exposed to a certain level of the radioactive background [1]. Radon gas 222Rn is known as one of the elements of the periodic table, and it is a radioactive noble gas with an atomic number (86). It is found in the form of a gas, as it is heavier than gases known in nature [2]. The taste and smell is a radioactive element with a half-life of 3.82 days, and the presence of radon gas increases in closed areas, i.e. it is emitted from building materials [3]. It is seven and a half times heavier than air, and its nuclei are dissolved by the emission of alpha particles [4]. The detection of the presence of radon gas Radiation in the air, at rates higher than the normal limit, indicates a clear threat to human life [5]. The methods for calculating the concentration of radon gas are divided into two main methods, the first of which is the short-term measurement method, through which the radon gas composition is calculated by observing changes in the level of radon gas emission from geological sites and in predicting earthquakes and volcanoes. In this method, a high-purity germanium detector and a flash counter are used. As for the second method, it is the long-term measurement method, and solid-state trace detectors (SSNTD, S) are used in it, and this method is more efficient in measuring the concentration of radon gas and its offspring [6]. Where the detectors are placed in closed diffusion chambers of a cylindrical shape, facing the sample whose radon concentration is to be measured, and these chambers are closed tightly to prevent leakage or air exchange with the outside environment, and after the spread of radon gas inside the chamber, the emitter of alpha particles dissolves and a state of balance occurs between it and its offspring. The reagent is then allowed to be exposed to the sample [7]. The technology of solid-state trace detectors is easy to install and does not require complex and highly efficient devices and systems to detect low concentrations and determine the energies of ionizing particles. It is also not sensitive to light, so it is easy to use [8].

Cereal crops are used by humans for food and animal feed. The global grain consumption rate is 170 kg/year, with West Asia consuming over 210 kg/year (UNSCEAR, 2000), implying that it has a major impact on human health. It is vital to monitor their radiation concentration since it can harm animals and has a detrimental impact on human health when eating animal products such as meat and dairy. The principal sources of radioactive elements in plants are soil, air, and water. Radioactive elements are delivered to plants by root uptake from the soil and direct absorption through the aerial portions of the plants. The radioactive elements found in plants reach the bodies of animals and humans via the food chain (Aziz, 2018; Hamilton, 1995 Radioactive materials can reach dangerous radiological levels, thus studying natural radioactivity is vital to understand the hazards to human health and the changes in environmental radioactivity (Mehra et al., 2010).. Natural radiation is caused by the spontaneous transition of unstable radionuclides in the Earth's crust as well as those from outer space entering the atmosphere (Hazrati et al., 2012). Our basic environmental system consists of soil, water, air, and plants, so we can measure the amount of radioactivity to understand the behavior of natural radionuclides and to learn about unsafe levels of environmental radiation contamination (Tome et al., 2003). The goal of this study is to determine the radioactive concentration of Radon gas in wheat from Tuz Khurmato areas. As a result, the Salahuddin Governorate Directorate The city had been bombed, and In addition to population congestion, the city has [9] environmental neglect more than other cities.

2. Used materials

Samples were collected from different locations in the city of Tuz Khurmato and its outskirts in Salah al-Din Governorate in Iraq, and the sites planted with wheat were selected from the local type.

The hair was oven dried at 100 °C for 1 hour in an electric oven. Sample samples were obtained, then packed in a plastic case (7 cm in diameter, 10 cm in length), and for a 50-day exposure time stored (from 1/15/2023 to 3/6/2023) for measurements. . An upstream particulate matter recording technique, Donations Plastic Detector CR-39, was used to measure radon concentration, 63 g freezing 3 cm of a sample placed 7 cm from the detector. After 50 days, the detectors were chemically etched with a 6.25 N NaOH solution at 65 °C. in about 3hours. The track was counted by a 400 optical microscope with an area of view of 0.0825 cm^2.

To measure and determine radon levels The concentration of radon gas R-222, which is a

A natural product of the decay of uranium U-238.

$K = 1./4 \times r\ (2\cos\theta c. - r / R\alpha)$......(1)

in which r =. 1.77 cm is the diameter of the tube utilized as the coil in the reproduction chamber, and (c) CR-39 is the critical detector angle. The scale is (R), and the magnitude is (35 degrees).

When these values are paid off, radon gas produces and releases alpha particles into the environment at 4.15 cm. Reproduction's value is equal to the focus of Radon in cabin airflow between the sample surface and the detector in the equation.

The modules' surface was calculated to be ($Bq.m^{-3}$) [9]. Apply the appropriate equation:

$CRn= \rho\ /TK$……….(2) Where, T could be the length of exposing the air detector, (K) is the balance factor, is the tracks density (tracks*2mm), and (CRn) is the radon gas concentration [10]. The subsequent

The equilibrium concentration value, abbreviated as EEC, can be calculated using the following equation. [11,12]:

EEC = C Rn* K.. (Bq/m3) is the unit of measurement for (EEC). The following equation can be used to compute (D), which stands for the annual absorbed dose including its unit (mSv/y). [13]:

The yearly absorbed dosage (mSv/y) is represented by the equation **D = CRnH K Df T..........(4).** ($\boldsymbol{CRn}$)is .Radon concentration measured in Bq/m3. Internal occupancy is denoted by (H).0.8 is the factor. Internal occupancy (T) equals 24 hours multiplied by 365 days per year, or 8760 hours per year. The dose conversion factor (Df) is defined as ($9*10^{-6}$msv. Bq/ m^3.h). Detector of nuclear traces, model CR-39.

3. Results and discussion

The results obtained for the wheat samples are listed in see Table 1.

In the current paper, radon concentrations In wheat grown in different places in the region from the city of Tuz Khurmato. Table No. (1) shows the following Radon concentrations in such places. From measuring the concentration of radon in Such places, the results show that the max Concentration (78.4 Bq/m3) at site (9) Suleiman Bey District 1. The lowest concentration was (27.7 Bq/m3) was in the location of (3) Bastamali village, and the average concentration for all areas under study. was the annual active dose Taken in the calculation from the radon values The concentrations are as shown in Figure (1). also, It was found that the equivalent annual dose in some regions (0.698 mSv/year). It is much less than limit, such as housing

In (Bastamli village). highest value for The annual equivalent dose is (0.698 mSv/year), which is also less thanlimit allowed for In Suleiman Bey 1. Regarding limits Radon exposure IAEA

For prevention level of exposure to(200 Bq/m3) [14], and the cumulative annual exposure dose is (2.0 mSv/year) [14,15] It is taken into account that there is a contradiction in Radon concentrations are different The sites are as shown in Figure (2) represents the linear relationship between radon concentration and annual equivalent dose. This is due to

The different nature of the agricultural areas as well as the use of agricultural fertilizers and the proximity of some of Suleiman Beck 1 site to the sulfur springs. And the least area in the Bastamili site was dependent on rain water only The irrigation method and the fertilizers used lead to the accumulation of radon gas in the wheat product because it is transmitted to it The gas emitted from the ground and fertilizers, as well as the use of groundwater for irrigation

It caused high concentrations of radon in them. Some areas had radon concentrations in Much fewer sites than allowed Limit. These are reduced concentrations of radon Concentrations are lower than universally permissible Limit. Globally [15], it gives a good indication It is no hazard or radioactive Radon gas pollution in the wheat crop in the city Toz Khurmato.

Table (1) shows the study areas in the city of Tuz and radon concentration and absorbed dose per year

Sq	home sites	C_{Rn} (Bq/m^3)	EEC(Bq/m3)	D(mSv/y)	K
1	Tuz district1	44.7	17.88	1.12772736	0.4
2	Tuz district2	61.4	24.56	1.54904832	0.4
3	Bastamli village1	27.7	11.08	0.69883776	0.4
4	Bastamli village2	56.8	22.72	1.43299584	0.4
5	Gardagli village	37.5	15	0.94608	0.4

6	Touz District 1	41.8	16.72	1.05456384	0.4
7	Touz District 1	38.4	15.36	0.96878592	0.4
8	Heliwa Village 1	64.5	25.8	1.6272576	0.4
9	Suleiman Bey district1	78.4	31.36	1.97793792	0.4
10	Suleiman Bey district2	32.7	13.08	0.82498176	0.4
11	Tuz district1	44.7	17.88	1.12772736	0.4
lowest value		27.7	11.08	0.69883776	
highest value		78.4	31.36	1.97793792	
the average		48.39	19.356	1.220821632	
global average		200(Bq/m^3)		(2.0mSv/y)	

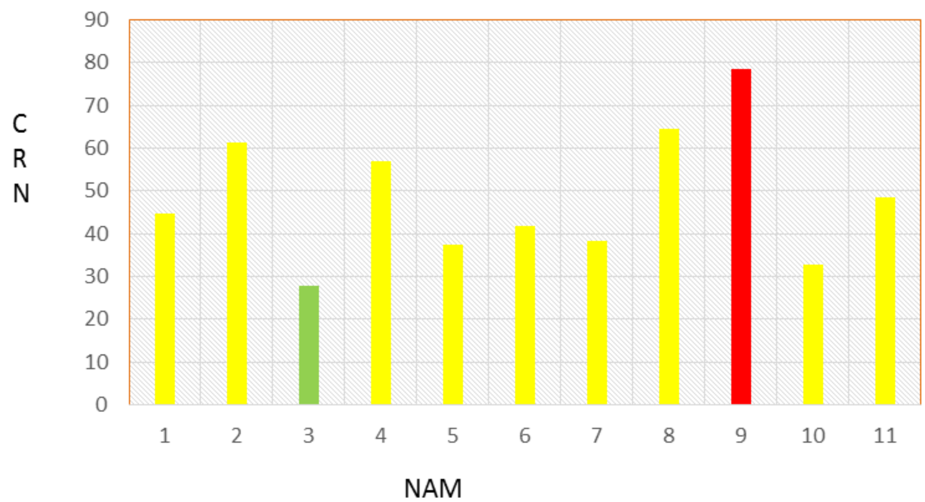

Figure.1 Radon concentration represents radon in the models

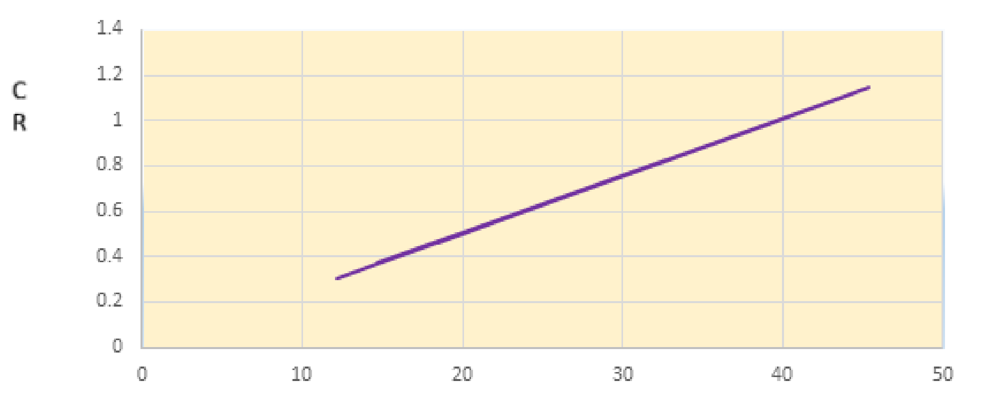

Figure (2) represents the linear relationship between radon concentration and annual equivalent dose

4. Conclusions

The study's goal is to evaluate radon concentrations in Iraq's Salah al-Din Governorate.

Wheat crop samples from the Tuz Khurmato district. Which results are shown - which:

1.The samples with elevated radiation levels from Solomon Peak 1's Site (9), are

An agricultural area consisting of fields and fertile soil enriched with animal manure and fertilizers.

It is utilized in wheat agriculture and is dependent on irrigation in addition to rain.

2. Phosphate rock fertilizers contain naturally radioactive chemicals. There exist nuclides, which are members of the uranium-thorium decay series. These radionuclides enter the crop via fertilizer absorption. The location is also close to sulfur springs.

3. Pastamali village had the lowest concentrations. Wheat cultivation is entirely dependent on rain.

4. The results acquired in comparison with the work of other authors revealed that the results in Iraq and other nation measurements were among the other authors' findings.

5. The results were far lower than the internationally authorized level.

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