Determination Radon Concentration (Radon Gas) in Urine of Patients with Cancer

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Abstract

The present study aims at studying the measurement radon concentration (Radon gas) in the urine of patients with cancer, that made up of (23) different samples of patients' urine. These samples have collected from Kirkuk Oncology & Hematology Center. Chemical etching process for CR-39 track detector has used to record the traces of Alpha particles "alpha rays" or "alpha radiation" that comes from Radon included in the models. The Plastic Tubing – Tubes that contain some models in reagent irradiation process, which shaped as U letter, have been used. The results illustrated that the highest concentration of Radon is (8.9) Bq.m^{-1} in R_{14} model, as well as the lowest concentration of Radon is (1.5) Bq.m^{-1} in R_4 model. The *Radon* levels that have been measured are within the natural limits of radioactive decay caused by radioactive nuclide or "radioactive isotope" in urine of patients with cancer; these are not a risk in humanity.

Key Words: Radon Gas, CR – 39 Detector, Urine.

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Introduction

The radioactive elements generally pass through a natural cycle through the main elements of the environment represented by air, water and soil. The radioactive elements are usually transmitted to humans, animals and plants through several mechanisms. The carrier waves of radioactive elements differ in their physical and chemical properties, which are reflected in the time of radioactive elements staying in the environment then these elements transmitted to humans, as the air is usually a moving medium and involves a fast-moving pollution. Body of water and Groundwater are considered medium moving and lead to medium speed transmission. On the other hand, the soil is a relatively static medium compared to air and water and leads to short-term and long-term pollution.

The soil significance is due to the fact that it is the ultimate receiver of radioactive elements, and that its long-term role is as a repository of radioactive elements, and at the same time as a source of these elements in air and water pollution and thus plants and humans (abass, 2002). The dangers of *Radon* concentration (gas) lie not only because it is a radioactive element, but also because it is a gas that can spread to large areas, as well as, after 83.3 days, Radon changes to the Polonium element that is making alpha radiation. Polonium seeps into plants at homes that may cause a big problem to people who live in these areas.

Radioactivity is a specific type of radiation emitted from radioactively active substances, and radioactivity is an eternal phenomenon that surrounded the human environment and

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contaminated with this or that amount of water, air and earth according to warren's classification of the elements of the environment, as well as contaminated plant and animal food by the presence of nuclide radioactive elements of this phenomenon (Warren, 1971).
Pollution is "the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected" (Environmental, 1995).

Theoretical Part

Radon Gas is one of the periodic table elements. It is a noble "the inert gas" and radioactive gas; its anatomic number is (86) and it is found as a gas in nature. Moreover, It is known to be one of nature 's heaviest and most popular gases. A scholar named "Dorn" discovered it in 1900, he found it in radium salts (G.A. Ali, 1999). Radon Gas is colorless and odorless, it emits into the air from the soil by the spread of molecules. It consists of three elements:

1. Radon is the isotope of (Rn^{222}) and it belongs to the (U^{238}). This isotope is considered to be the most stable among all the other isotopes of the Radon. Its half- life time is about (3.825) days, where this period enables it to spread in the air for limited distances. In addition to that, it emits Alpha particles with a capacity of (5.4Mev).
2. Thoron is the isotope of (Rn^{220}) and it belongs to the (Th^{232}) series. Its half- life is almost about (55s). In addition to that, it emits Alpha particles with a capacity of (6.2Mev).
3. Actinon is the isotope of (Rn^{219}),it belongs to the(U^{235}) series. Its half- life is about (4s).It is found rarely because of the lack of availability of the(U^{235})series and because it's short half- life (Al-Saad, 1999).

Radon has the ability of transporting in the air from one place to another without any hindrance, which makes the ability of exposure to it and to its radiance happens to a large number of people with high probability, studies have shown that the soil granules are convergent when there is a low porosity of soil, whenever the radon atom emits from the granule, the capacity of its recoil joins it to another granule and by this it cannot escape easily, and when the distance between the granules is large, probability of the ceasing of recoiled radon atoms is high as well as it spreads easily on the surface.

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) (1983) about natural sources of radiation confirms that radon gas represents more than 50% of the total exposure humans experience from a radiation dose caused by the natural radiation of radon (Masoud Salih Khalifa, 1996).
The exposure to radon gas is one of the serious health problems, and the relationship between exposure to alpha particle emitters and the occurrence of lung carcinoma cases has proven, since through inspiration and the air saturated with this gas enters the human lung, a large proportion of it is deposited on the walls and the lining of the respiratory system, which leads to absorption of doses by the bronchi.
The statistics and estimates made in this regard have found that every (200) cases of death occur in a year for every (105) persons of the population when exposed only to the background reading of radon and its offspring (Archer, 1973).
Nuclear trace detector technology, which is considered one of the most important techniques in determining the concentrations of radioactive elements, because of its availability, accuracy, and the absence of sophisticated electrical equipment. Impact detectors are defined as electrically insulating materials whose specific resistance ranges from (106-1020 ohm.cm) in which narrow paths of radiation damage are called hidden effects, and when the charged particles pass through them, several techniques have emerged, including the impact detector technique that was used in this study to calculate radon concentrations in the urine of patients with cancer (Durrani & Bull, 2013).

The Practical Side

Twenty-three samples have been collected from different patients with cancer in Kirkuk city, as shown in table (1). Then, the models of urine have been prepared for each sample as large as (5ml) in plastic mug the upper base is (5cm), the bottom base diameter (4.5cm) and high (6.5cm), then put the detector (CR-39) on the cover of the pot and record the effects of the resulting 1,000 body fragments from the radon gas emissary as in figure (1), where the content used for irradiation to obtain radon concentrations where the dimensions of the mug are ideal, the separation is between radon gas and *Thoron gas* based on half-life, radon (3.8days) and *Thoron* (55s), And the emission from the administration sample to the detector takes more than half of the eruption period, after which the reagents are lifted after irradiation for (30days) and the chemical skimming process. After the irradiation phase and for the purpose of showing the effects of fission fragments caused by uranium fission U238 and interacting with the detector. This process was carried out using (NaOH) skimmer solution (6.25 N), temperature of 70°C and time (6h) as the best favorable conditions, where the solution was heated by a water bath with the note of tightening the closure of the conical flask block to prevent evaporation of the solution during the skimming process and change Its concentration, as well as the condensation process in the skimming solution, and at the required degree the detector is placed inside the skimming solution in the ring after being suspended by a wire. After the process of skimming, samples is taken out of the skimming solution mediated by tong and washed with distilled water and then dried (Kleeb RW.; Sudanese, 201).

The effects at this stage are revealed by choosing the appropriate magnification of the amount (400X) and then the number of effects for the unit of space Using a special lens that is split into several squares according to the rate of the number of effects, and the area of the square is calculated by placing a special gradient located on a glass slide in front of the object lens, where it calculates the length of a rib the small or large square and then the calculation of the area, and then divides the rate of the number of effects (N_{ave}) for model (x) on the unit of the calculated area (A) to get the density of the effects (ρ_x) in order to measuring the level of radon concentration by the said technology, the constant of the spread of the system, which varies from system to system according to the dimensions The system and its form of engineering. When the sample blocks and sizes remain stable, the concentration of radioactive materials does not depend on the geometric measurements of the structure, as the constant spread of the system used in this research (K) was calculated according to the following relationship (E.S. Ali, Mohammed, Mohammed, & Mahmoud, 2020; Azam, Naqvi, & Srivastava, 1995).

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

Where, r = radius of the tube used as a propagation chamber (1.77cm) and (θc) the critical angle of the detector (CR-39) and its magnitude (35°) and (Rα) represents the range of alpha particles in the air produced and emitted by radon gas equal to 4.15cm and when these values are compensated in the equation, the value of the constant propagation In units of length equal to. K=0.8 Radon gas concentration was found in the air space of the compartment between the sample surface and the detector surface of units (Bq.m-3) (Tawfiq, Nasir, & Khalid, 2012), by using the following equation:

$$C_{Rn} = \frac{\rho}{TK} \qquad (2)$$

Where, Where, CRn is concentration of the radon gas, (ρ) is the tracks density (tracks*mm^{-2}), T is the time of exposure of the air detector and (K) is the equilibrium factor (UNSCEAR, 2008).

EEC, which represents the concentration-equilibrium concentration value, can be found through the following equation (Assembly, 2010):

$$EEC = C_{Rn} * K \qquad (3)$$

unit of measure (EEC) is (Bq*m^{-3}).

(D) is the annual absorbed dose as well as its unit (mSv*y^{-1}), which may be found the through following equation (UNSCEAR, 2000):

$$D = C_{Ra} * K * H * T * Df \qquad (4)$$

(D) is the annual absorbed dose (mSv*y^{-1}).
(C_{Rn}) is Radon of Concentration of (Bq*m^{-3}).
(H) is the indoor occupancy factor = (0.8).
(T) is the indoor occupancy = 24h*365 = 8760 h.y^{-1}.
(D_f) is the dose conversion factor= 9*10^{-6} (msv.m^3/Bq.h).

The Optical microscope that has been used, is made in Germany with object lenses (x10, x20, x40 and x100), as well as two eyepieces "ocular lens" with (x10) to measure the intensity of the effects.

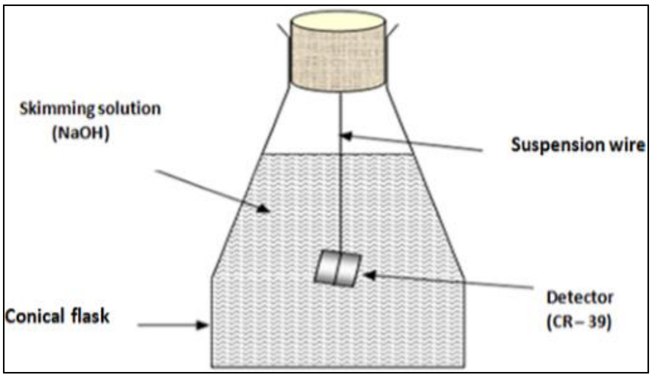

Figure 1. Chemical skimming process for nuclear trace detector (CR-39)

Discussion of the Result

The radon gas concentrations in the urine of cancer patients in Kirkuk governorate, by recorded alpha-emitting radon were measured. 23 samples were collected from urine as shown in Table (1). The results show that the higher concentrations for Radon is (8.9) Bq/m^3 which was registered in sample No. (R_{14}) and lowest concentrations was

(1.5)Bq/m³ in sample No. (R_4) And that all samples have an average concentration of (3.7) Bq.m^{-3}. The value of the balance radon concentration was also calculated and shown that the maximum amount is (7.1) Bq.m^{-3} in sample (R_{14}) and the lowest level is (1.2) Bq.m^{-3} in sample (R_4), and the average of samples is (3) Bq.m^{-3}. The annual active dose was then determined from the radon concentration levels, where the lowest equalized annual dose value was measured (0.1) mSv.y^{-1} in sample (R_4) And the total annual cumulative dosage for the samples is (0.2) mSv.y^{-1} And remains within the limits permitted.

Table 1. Shows Radon Concentrations in Urine of Patients with Cancer

No.	Gender	Symbols	C_{Rn}(Bq*m^{-3})	EEC(Bq*m^{-3})	AED (mSv*$^{-1}$y)	LCR*10^6	PAEC(WL)
1	F	R_1	3.6	2.9	0.2	3.2	0.4
2	F	R_2	2.4	1.9	0.1	2.2	0.3
3	F	R_3	2.4	1.9	0.1	2.2	0.3
4	F	R_4	1.5	1.2	0.1	1.4	0.2
5	F	R_5	2.2	1.8	0.1	2	0.2
6	F	R_6	2.7	2.1	0.1	2.4	0.3
7	F	R_7	2.9	2.3	0.1	2.6	0.3
8	M	R_8	3.1	2.5	0.2	2.8	0.3
9	F	R_9	4.5	3.6	0.2	4.1	0.5
10	F	R_{10}	2	1.6	0.1	1.8	0.2
11	F	R_{11}	1.7	1.4	0.1	1.6	0.2
12	F	R_{12}	5.2	4.2	0.3	4.6	0.6
13	M	R_{13}	3.8	3	0.2	3.5	0.4
14	F	R_{14}	8.9	7.1	0.4	8.1	0.1
15	F	R_{15}	3.3	2.7	0.2	3	0.4
16	F	R_{16}	4.3	3.4	0.2	3.9	0.5
17	M	R_{17}	5.4	4.3	0.3	4.9	0.6
18	F	R_{18}	6.5	5.2	0.3	5.9	0.7
19	M	R_{19}	1.8	1.5	0.1	1.7	0.2
20	F	R_{20}	2.5	2	0.1	2.3	0.3
21	F	R_{21}	3	2.4	0.2	2.7	0.3
22	M	R_{22}	4.8	3.9	0.2	4.4	0.5
23	F	R_{23}	6.3	5.1	0.3	5.8	0.7
24		Minimum	1.5	1.2	0.1	1.4	0.2
25		Maximum	8.9	7.1	0.4	8.1	0.1
26		Average	3.7	3	0.2	3.4	0.4

Conclusion

The highest rates of radon concentrations were found in sample No. (R_{14}) are (8.9) Bq/m³, so the value is for annual equivalent dose (0.4) mSv.y^{-1} And remains within the limits permitted. Substantial research efforts are also requested all over Kirkuk in Urine and blood of Patients with Cancer to evaluate the average Radon concentration of our country.

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