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# Measurements of radium and uranium concentrations in blood samples of lung cancer patients in Iraq

***Fatima Abbas Shaker[1]** **Shaymaa Awad kadhim[1]** **Emad Kareem Alsabari[2]**

*Department of Physics, College of Science/University of Kufa/ Najaf, Iraq[1]*
*Collage of medicine/university of kufa / Middle Euphrates Center Cancer[2]*

*Corresponding Author E-mail: fatmaab994@gmail.com

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**ABSTRACT**

In this study, 30 samples of lung cancer patients were collected from Middle Euphrates Oncology Center in Najaf, Iraq. A plastic track CR-39 Reagent technique, strippable was used to measure radium and uranium concentrations. Normality was a washing solution (NaOH ) was ٦.٢٥ to clarify chemical drilling to read under the electron microscope to calculate alpha particles paths. Effective radium content values were ranged from 0.1592 Bq / kg to 3.2278 Bq / kg with an average value of 1.246Bq/kg where uranium concentrations values were ranged from 5.5671ppm to 112.8615ppm with an average value of 43.5883ppm for healthy human compared with patients were effective radium content values were found from 0.261Bq/ kg to 3.286 Bq/ kg with an average value of 1.345 Bq/kg where uranium concentrations values were found to be from 9.1099 ppm to 114.8859 ppm with an average value of 47.052ppm. A positive relationship was observed between Radium concentration and uranium concentrations in blood samples. Measurements of Radium and uranium concentrations in lung cancer patients, this research important in terms of health protection, simple and reliable analysis methods which available.

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## قياسات تراكيز الراديوم واليورانيوم في عينات الدم لمرضى سرطان الرئة في العراق

**فاطمة عباس شاكر[١]** **د. شيماء عواد كاظم[١]** **د. عماد كريم السعبري[٢]**

قسم الفيزياء /كلية العلوم/جامعة الكوفة / نجف، العراق[١]
كلية الطب / جامعة الكوفة / مركز الفرات الأوسط للسرطان[٢]

**الـــخُـــلاصـــة**

في هذه الدراسة ، تم جمع ٣٠ عينة من مرضى سرطان الرئة من مركز الأورام الفرات الأوسط في النجف ، العراق. تم استخدام تقنية كاشف الاثر النووي CR-39 البلاستيكي القابل للقشط ، لقياس تراكيز الراديوم واليورانيوم. كانت نورمالية محلول غسيل (NaOH) ٦.٢٥

**الكلمات المفتاحية:**

الراديوم
اليورانيوم
كاشفات CR-39
إحصائيات spss 20

لتوضيح الحفر الكيميائي لقراءتة تحت المجهر الإلكتروني لحساب مسارات جسيمات ألفا. تراوحت القيم الفعالة لمحتوى الراديوم من ٠.١٥٩٢ بيكريل / كغم إلى ٣.٢٢٧٨ بيكريل / كغم بمتوسط قيمة ١.٢٤٦ بيكرل/كغم حيث تراوحت قيم تراكيز اليورانيوم من ٥.٥٦٧١ جزء في المليون إلى ١١٢.٨٦١٥ جزء في المليون بمتوسط قيمة ٤٣.٥٨٨٣ جزء في المليون لصحة الإنسان مقارنة بالمرضى تم العثور على قيم محتوى الراديوم الفعالة من ٠.٢٦١ Bq / kg إلى ٣.٢٨٦ Bq / kg بمتوسط قيمة ١.٣٤٥بيكرل/كغم حيث تم العثور على قيم تراكيز اليورانيوم من ٩.١٠٩٩ جزء في المليون إلى ١١٤.٨٨٥٩ جزء في المليون بمتوسط قيمة ٤٧.٠٥٢ جزء في المليون. ولوحظ وجود علاقة إيجابية بين تركيز الراديوم وتركيزات اليورانيوم في عينات الدم. قياسات تركيزات الراديوم واليورانيوم في مرضى سرطان الرئة ، هذا البحث مهم من حيث الحماية الصحية وطرق التحليل البسيطة والموثوقة المتاحة.

## 1. INTRODUCTION

Studies on radiation levels and the distribution of radionuclides in the environment provide basic information on radiation. This information is necessary to understand human exposure to natural and man-made sources of radiation and is necessary in establishing rules and regulations on radiation protection [1].

Uranium and radium belong to the primitive radionuclide group, because they were always present in the earth. Radioactive nuclides such as 238U, 235U and 232TH, are through three distinct strands of radionuclides, are of great importance in the nuclear fuel cycle.

Gas radionuclides can also be inhaled .For example 226Ra (half-life of 1600 years), 224Ra and 228Ra (half-life of 3.6 days, ٥.٨years, respectively, both usually mix with uranium ore) are of radioactive importance because radium behaves chemically like calcium, where it is deposited on bone surfaces and metabolic areas [2].

226Ra in the environment widely distributed, its presence in different concentrations in water, soil, waste and rock [3]. When taking radium, the majority of substances are rapidly excreted. However, since the chemical behavior of radium is similar to that of calcium, the blood absorbed radium from the gastrointestinal tract or lungs follows the behavior of calcium and is deposited mainly in bones [4]. Radium is the radionuclide common in the environment and is the origin of radon. Its shape is the most lethal of radionuclides because it produces alpha rays and has a very long lifespan [5]. Immediate radon precursors are radium (226Ra) which is widely spread, especially in materials made of metal products. The pioneer of radium is uranium (238U); which has a half-life of 4.47 × 109 years [6]. Over the past decade, there has been a growing interest in studying radium activity in blood samples for lung cancer patients. Since radium is a highly radioactive chemical, it is the most important source of radioactivity in a variety of blood samples. Radium is a solid radioactive element under normal temperature and pressure conditions [7,8]. Microscopic amounts of radium in the environment can lead to the accumulation of some radium in bone tissue where it decomposes from the bone marrow and can cause bone cells. Ingestion or exposure to radium can cause serious health effects including sores, anemia, bone cancer and other disorders. Radium found in the soil is taken by plants and enters the body with vegetarian / non-vegetarian food and tends to follow the calcium metabolism to become concentrated in the bones [9].

It has been reported that the average per capita of uranium in food is 1.3 $\mu g$ / day [10], 2-33 $\mu g$ / day [11] in the USA and 1.5 3 $\mu g$ / day in Japan [12].After ingestion, uranium appears rapidly in the bloodstream [13,14], where it is mainly associated with red cells [15]; a non-proliferation uranil-albumin compound is also in equilibrium with the diffusible ionic uranium hydrogen carbonate complex ($UO_2$ $HCO_3$) in the plasma. [16]. uranium subsequently accumulates in the kidneys and the skeleton, whereas little is found in the liver [14]. The skeleton is the major site of uranium accumulation [17]. It has been estimated that the total body burden of uranium in humans is 40 μg, with approximately 40% of this being present in the muscles, 20% in the skeleton and 10%, 4%, 1% and 0.3% in the blood, lungs, liver and kidneys, respectively [18].

High intake of uranium and its decay products may lead to harmful effects in human beings. According to an estimate food contributes about 15% of ingested uranium, while drinking water contributes about 85%. An exposure of about 0.1 $mg{\cdot}kg^{-1}$ of body weight of soluble natural uranium results in transient chemical damage to the kidneys [19,20,21,22]. Lung cancer, also known as lung carcinoma, is a malignant lung tumor characterized by uncontrolled cell growth in tissues of the lung. This growth can spread beyond the lung by the process of metastasis into nearby tissue or other parts of the body. Most cancers that start in the lung, known as primary lung cancers, are carcinomas. The two main types are small-cell lung carcinoma (SCLC) and non-small-cell lung carcinoma (NSCLC). The most common symptoms are coughing (including coughing up blood), weight loss, shortness of breath, and chest pains [23,24].

The aim of this study was to determine the concentrations of uranium and radium in 30 samples of blood from lung cancer patients. Measurement of uranium and radium concentrations in the samples is therefore necessary to investigate the role of radium and uranium concentration in causing various diseases, especially cancer.

## 2.Materials and Method

In this study, 30 different samples of serum lung cancer patients were examined. Samples were collected from Middle Euphrates Center. CR-39 detectors were washed with distilled water, and dried in the air. Thereafter, the CR-39 detectors was dried at 80 ° C in oven for approximately 16 hours [25]. The samples were dried, for 60 days in a cylindrical plastic container of 3.5 cm diameters and 6.5 cm depth. A piece of 500-micron CR-39 detector (American Technical Plastic, Inc.) with an area of (1 × 1) mm in the middle of the samples (α-autoradiography closed connection) is included in $mm^2$ each container. The detector records the paths of alpha particles emitted by radon from alpha decay of radium contents in the samples. After the radiation period, the bombed detector were collected and chemically etched into NaOH 6.25 M solution at 70 ° C within 8 hours [26]. After drilling, the CR-39 detectors were washed in distilled water and then dipped for a few minutes in a 3% acetic acid solution and washed again with distilled water and dried in the air.

A technique using CR-39 detectors can be used in measurements of uranium and radium [27] as shown in Figure 1. The background of the CR-39 track detectors was calculated by optical microscopy and subtracted from the readings of all detectors. The path density was calculated in the nuclear path detector using a light microscope.

The "can technique" proposed by Alter and Price and then developed by Simonyi. was used to calculate radium and uranium concentrations in blood samples. Radium concentration in the blood was calculated using the relationship[28,29]:

$$C_{Ra} = \rho \, h \, A / K \, T_e \, M \quad (1)$$

Where :$C_{Ra}$: Is the effective radium content of blood samples (Bq / kg), $= \rho$ : tracke density, M: is the mass of the sample (1mg), A: is the area of the cross-section of the bottle ,h: is the distance between the reagent and the highest blood sample (5 cm), K: is the working sensitivity, and Te is the effective exposure time, which is related to the actual exposure time T and the solubility constant $\lambda$ for $^{222}$Rn in relation [30].

Where K found by using the relation

$$K= \frac{1}{4} r(2\cos\theta_c - \frac{r}{R}) .$$

$$T_e = T - 1/\lambda (1- e^{\lambda T}) \quad (2)$$

$$C_u(ppm)=W_u/W_s \quad (3)$$

uranium concentrations $C_U$ in units of part per million (ppm) of blood samples has been calculated using the following equation [31]:

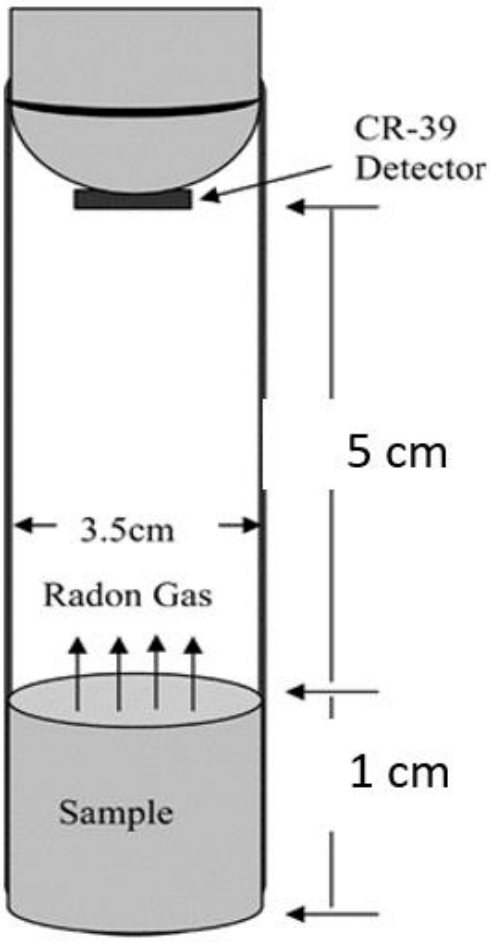


**Figure 1.** Shows a test tube technique used in the study.

where $W_S$ *is* the weight of sample (1 gm). Uranium weight ($W_U$) in sample can be calculated from the following equation [Richard and Josef, 1995] [32]:

$$W_u(gm)=N_u W_{mol} / N_{Av} \quad (4)$$

Where NU: numbers of uranium atoms, $W_{mol}$: weight of molecular uranium, $N_{Av}$: number Avogadro $6.023 \times 10^{23}$ Atoms / Mol.

### 3. Results and Discussion

The results of radium and uranium concentrations from the blood samples of lung cancer patients are shown in Table 1. Figure 2 illustrates the relationship between uranium concentration and radium concentrations, ie a positive correlation between uranium concentration and radium concentration was observed in samples from this study.

From Table (1) we observed that there were differences in uranium and radium concentration values between samples. This difference may arise due to differences in the nature of the samples and the nucleus content in healthy blood samples.

Table 1: Radium and uranium concentrations in healthy blood samples.

| Code | Age(year) | Track density($Tr.cm^{-2}$) | $C_{Ra}$(Bq/kg) | Cu(ppb) | Wu(gm) |
|---|---|---|---|---|---|
| N1 | 84 | 40 | 0.579 | 20.24422561 | 2.02442E-08 |
| N2 | 80 | 89 | 1.288 | 45.04340198 | 4.50434E-08 |
| N3 | 70 | 31 | 0.449 | 15.68927485 | 1.56893E-08 |
| N4 | 65 | 109 | 1.578 | 55.16551479 | 5.51655E-08 |
| N5 | 60 | 122 | 1.766 | 61.74488811 | 6.17449E-08 |
| N6 | 52 | 23 | 0.333 | 11.64042973 | 1.16404E-08 |
| N7 | 50 | 22 | 0.318 | 11.13432409 | 1.11343E-08 |
| N8 | 48 | 127 | 1.838 | 64.27541631 | 6.42754E-08 |
| N9 | 40 | 30 | 0.434 | 15.18316921 | 1.51832E-08 |
| N10 | 45 | 41 | 0.593 | 20.75033125 | 2.07503E-08 |
| N11 | 37 | 52 | 0.753 | 26.31749329 | 2.63175E-08 |
| N12 | 35 | 220 | 3.184 | 111.3432409 | 1.11343E-07 |
| N13 | 31 | 23 | 0.333 | 11.64042973 | 1.16404E-08 |
| N14 | 30 | 168 | 2.432 | 85.02574756 | 8.50257E-08 |
| N15 | 28 | 170 | 2.461 | 86.03795884 | 8.6038E-08 |
| N16 | 25 | 31 | 0.449 | 15.68927485 | 1.56893E-08 |
| N17 | 24 | 39 | 0.565 | 19.73811997 | 1.97381E-08 |
| N18 | 23 | 41 | 0.593 | 20.75033125 | 2.07503E-08 |
| N19 | 22 | 177 | 2.562 | 89.58069832 | 8.95807E-08 |
| N20 | 20 | 35 | 0.507 | 17.71369741 | 1.77137E-08 |
| N21 | 46 | 86 | 1.245 | 43.52508506 | 4.35251E-08 |
| N22 | 43 | 85 | 1.230 | 43.01897942 | 4.3019E-08 |
| N23 | 41 | 68 | 0.984 | 34.41518354 | 3.44152E-08 |
| N24 | 39 | 116 | 1.679 | 58.70825427 | 5.87083E-08 |
| N25 | 34 | 223 | 3.228 | 112.8615578 | 1.12862E-07 |
| N26 | 32 | 123 | 1.780 | 62.25099375 | 6.2251E-08 |
| N27 | 29 | 55 | 0.796 | 27.83581021 | 2.78358E-08 |
| N28 | 27 | 44 | 0.637 | 22.26864817 | 2.22686E-08 |
| N29 | 26 | 11 | 0.159 | 5.567162043 | 5.56716E-09 |
| N30 | 21 | 121 | 1.751 | 61.23878247 | 6.12388E-08 |

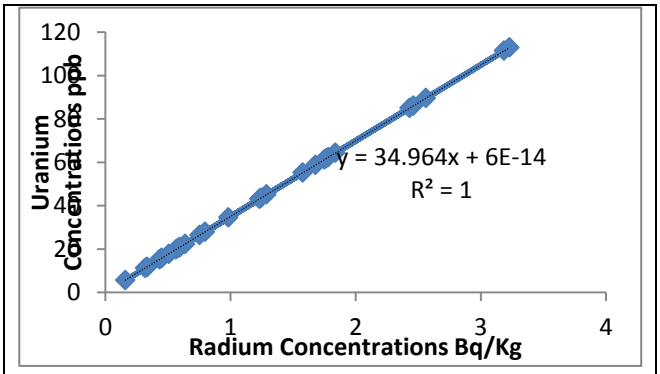


Figure2 : Showing the correlation between radium and uranium concentration of blood samples for healthy human.

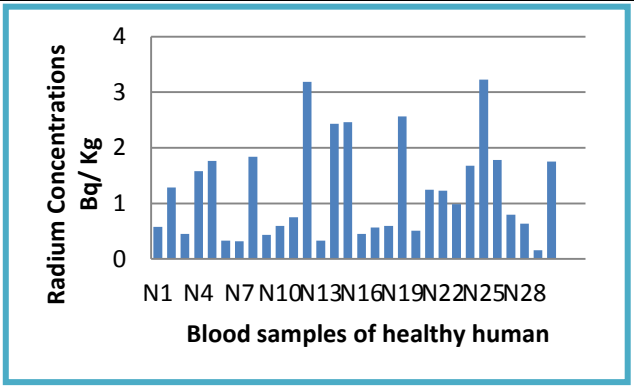


Figure 3: Radium concentrations in thirty blood samples of control human.

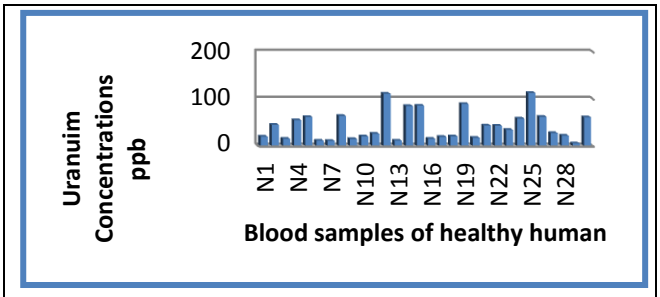


Figure 4: Uranium concentrations thirty blood samples of healthy human.

From figure (2) we found the correlation linearly between radium and uranium concentration of blood samples for healthy human ,figure(3) Illustrates Radium concentrations in thirty blood samples of control human and figure(4) that show Uranium concentrations thirty blood samples of healthy human.

From Table 2, we observed that there were differences in uranium and radium concentration values between samples. This difference may arise due to differences in the nature of the samples and the nucleus content in blood samples for lung cancer patients.

Table 2. Radium and uranium concentrations in blood samples for lung cancer patients.

| Code | Age(year) | Track density(Tr.cm$^{-2}$) | $C_{Ra}$(Bq/kg) | Cu(ppb) | Wu(gm) |
|---|---|---|---|---|---|
| T1 | 85 | 104 | 1.505 | 52.63499 | 5.26E-08 |
| T2 | 82 | 74 | 1.071 | 37.45182 | 3.75E-08 |
| T3 | 81 | 134 | 1.940 | 67.81816 | 6.78E-08 |
| T4 | 80 | 18 | 0.261 | 9.109902 | 9.11E-09 |
| T5 | 78 | 26 | 0.376 | 13.15875 | 1.32E-08 |
| T6 | 76 | 27 | 0.391 | 13.66485 | 1.37E-08 |
| T7 | 75 | 122 | 1.766 | 61.74489 | 6.17E-08 |
| T8 | 73 | 124 | 1.795 | 62.7571 | 6.28E-08 |
| T9 | 72 | 51 | 0.738 | 25.81139 | 2.58E-08 |
| T10 | 70 | 67 | 0.970 | 33.90908 | 3.39E-08 |
| T11 | 68 | 123 | 1.780 | 62.25099 | 6.23E-08 |
| T12 | 67 | 109 | 1.578 | 55.16551 | 5.52E-08 |
| T13 | 66 | 144 | 2.084 | 72.87921 | 7.29E-08 |
| T14 | 65 | 133 | 1.925 | 67.31205 | 6.73E-08 |
| T15 | 64 | 134 | 1.940 | 67.81816 | 6.78E-08 |
| T16 | 63 | 115 | 1.665 | 58.20215 | 5.82E-08 |
| T17 | 62 | 117 | 1.694 | 59.21436 | 5.92E-08 |
| T18 | 61 | 46 | 0.666 | 23.28086 | 2.33E-08 |
| T19 | 60 | 57 | 0.825 | 28.84802 | 2.88E-08 |
| T20 | 59 | 70 | 1.013 | 35.42739 | 3.54E-08 |
| T21 | 58 | 51 | 0.738 | 25.81139 | 2.58E-08 |
| T22 | 52 | 38 | 0.550 | 19.23201 | 1.92E-08 |
| T23 | 51 | 37 | 0.536 | 18.72591 | 1.87E-08 |
| T24 | 50 | 59 | 0.854 | 29.86023 | 2.99E-08 |
| T25 | 44 | 53 | 0.767 | 26.8236 | 2.68E-08 |
| T26 | 42 | 80 | 1.158 | 40.48845 | 4.05E-08 |
| T27 | 41 | 82 | 1.187 | 41.50066 | 4.15E-08 |
| T28 | 39 | 161 | 2.330 | 81.48301 | 8.15E-08 |
| T29 | 24 | 227 | 3.286 | 114.886 | 1.15E-07 |
| T30 | 23 | 147 | 2.128 | 74.39753 | 7.44E-08 |

Determination of radium and uranium concentrations in blood samples is very important We found that the uranium content in blood samples was high and important from a health risk perspective. Figure 3 and Figure 4 illustrate the distribution of radium and uranium concentrations, respectively, for different blood samples.

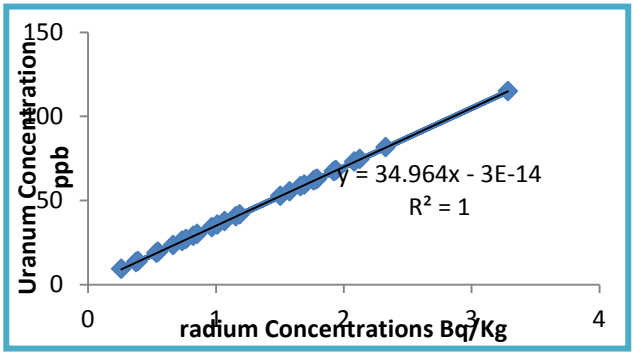


Figure 5: Showing the correlation between radium and uranium concentration for thirty blood samples of Lung Cancer.

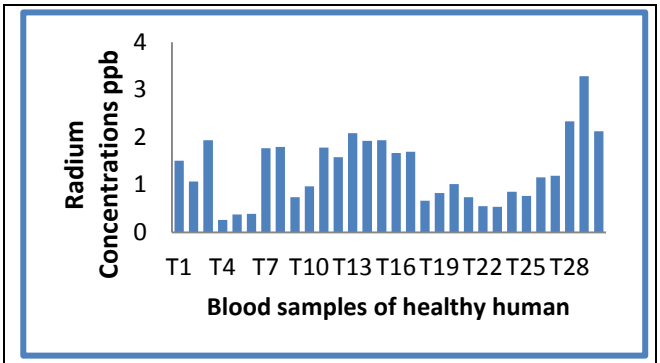


Figure 6: Radium concentrations thirty blood samples of Lung Cancer of human.

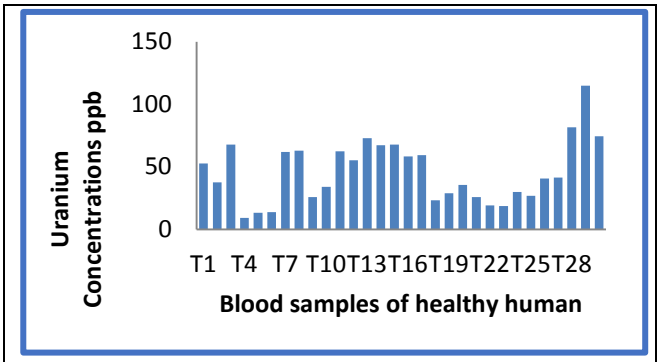


Figure 7: Uranium concentrations in thirty blood samples of lung cancer of human.

From figure (5) we found the correlation linearly between radium and uranium concentration of blood samples for healthy human ,figure(6) Illustrates Radium concentrations in thirty blood samples of control human and figure(7) that show Uranium concentrations thirty blood samples of healthy human

The result of uranium concentration of blood samples is high compared to the limit (11.7 ppm) [33].In Egypt, Abraham et al. (2007) the results are listed in Table 2. It was found that the maximum level of 226Ra was 2.11 B 0.01 Bq / kg was detected, while the lowest level of <0.32 Becquerel The effective radium content values in this paper were detected for blood samples less than those reported by Ibrahim et al. (2007). In India, Shanthi et al. (2009) [34] shows that the concentration of 226Ra activity for blood samples ranges Between 0.064 ± 0.03 (tomato) and 1.227 ± 0.24 Bq / kg (drum stick) The maximum values of the effective radium content in the samples studied are lower than the maximum reported by Shanthi et al. 2009, while the minimum value in the samples is higher than the values for the same study.

## 4.Conclusions

Radium and uranium concentrations were measured using firefighting technique. The results showed that the mean values concentration of radium and uranium in the samples for health human was smaller than patients with lung cancer .

The radium distribution was found to be heterogeneous since the radium content in the samples varied from one sample to another. The results revealed that the samples were maybe not safe with respect to the effects of health risks. A positive relationship was observed between radium content and uranium concentrations in blood samples.

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