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# Risk of an Excess Cancer Fatality Due to Ingestion of Uranium from Some Pharmaceuticals in Iraq

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## Abstract

In present work, uranium-238 was measured for (44) samples of medical drugs in Iraqi pharmacies. CR-39 detectors were used in the present study. Also, the "annual average internal dose" (AAIED) and "risk of an excess cancer fatality per million person" (RECFPMP) due to ingestion of these radionuclides in all samples of medical drugs were calculated. The results show that, the average of $^{238}U$ concentrations in solid samples were (0.29±0.05 ppm), while the average value of (AAIED) and RECFPMP due to ingestion of $^{238}U$ in drugs samples under study has been found (0.058±0.01μSv/y) and (0.23±0.04) respectively. All results of the value of AAIED and RECFPMP are with a world limit according to UNSCEAR and ICRP respectively. So, the intake of the studied samples of medical drugs in Iraq does due to Uranium concentrations not lead to substantial changes in the internal effective dose. Itconcludes that, the uranium concentration in the samples under study were not significant from a health hazard point of view.

**Keywords:** Cancer risk; Uranium concentrations; CR-39; Pharmaceuticals

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## Introduction

Humans around the globe are constantly exposed to radiation. Typically, the two main radiation sources humans receive can be categorized as follows: Natural and man-made radiation sources. The radiation humans receive from the outer space, cosmetic radiation or cosmetic rays, is considered the major portion of exposition. Similarly, humans receive radiation from naturally occurring radioactive elements. Approximately, all materials that are present and around us carry slightly lower of radioactive materials [1]. Based upon that, humans are exposed to low –level background radiation. However, radiation effect could be potentially passed down, or another word, inherited in later generation.Moreover, radiation pollution may contaminate soil and water, leading to entering and dissolving into the food chain [2]. A considerable contribution to the radioactivity in the human body originates from the gassy decay products of thorium radioactive series, namely (radon and thoron) and the uranium. The rocks and soildiffuse these kinds ofgases and they are also existedin readily commensurable concentrations in the atmosphere. After spreading over in the air they are inhaled by mankind during the process of decay products. Similarly, when plants and animals take up the above-mentioned gassy decay products, it will eventually be transferred to most foodstuffs leading to measurable amounts of natural radioactivity. The ordinary foods, cereals contain high radioactivity, but the situation seems quite different regarding milk products, fruit and vegetables, they contain a low content of radioactivity [3]. The elements that have radioactive properties such as uranium, radon and radiumare existed in food, water, air and soil. Therefore, the process inhaling and ingesting of these radionuclides, above normal, becomesa source ofpotential health-related hazards [4]. Directly and indirectly, several medicinal plants are utilized in the synthesis of medicines [5,6]. It is possible to obtain the radionuclides amount present in the medicines by measuring their concentrations in them. The pollution in medicinal plants because of radiation exposure contributes considerably to the increase in the internal effective dose [7]. Hence, the increase in the levels of radionuclides will affect adversely on human body, likely participate to elevate hazards of lung cancer development by emitting alpha particles. The increased exposure or intake of uranium, radon and radium in plants may have negative consequences and implications in the human body [8]. Therefore, it is extremely significant to measure the magnitude the concentrations of these radionuclides in the medicinal plant-derived pharmaceuticals to assess the amount radiation dose and to provide prevention of consumers not to expose to radiation, in all aspects, as a part of radiological protection.Overall aim of this study is to measure the uranium concentrations in samples of drugs derived from medicinal plants and collected from local pharmacies in Iraq using Solid-State Nuclear Track Detector (SSNTD) technique. Also, Estimate the annual average internal dose (AAIED) and the risk of an excess cancer fatality per million person (RECFPMP) due to ingestion of uranium-238 in in all samples under studies.

## Materials and Methods

### Sample Collection

Forty-four samples of different types of medical drugs derived from medicinal plants were collected from the local pharmacies in Iraq for the period that starts from 1/1/2019 to 1/4/2019 to measure the $^{238}$Uconcentrations. The samplesare listed in the table which designated [Table 1].

### Samples of Preparation

In this study, after collecting medical drugs samples from various local pharmacies inIraq were packed in labeled polyethylene bags and then sentto the radiation detection and measurement laboratory in the physics department, faculty of science, University of Kufa. The purpose of preparationthe samples is conductthe required analysis by drying and keeping them moisture-free by placingthem for 8 hours in an oven at 70℃. To reachan appropriate homogeneity, the samples are mechanically grounded, by using the electric mill. Also, the samples were sieved through of 0.8 mm pore size diameter. The respective net weights are measured and recorded with a highly sensitive digital weighing balance with a percent of ±0.01%. Next, the samples were placed in the plastic cup diameter (3.8 cm), length (7 cm) and volume (130 ml). All samples were stored for about one month before they were counted, to allow secular equilibrium to be obtained between $^{222}$Rn and its parent $^{226}$Ra in uranium chain [9].

### Samples of Measurement

It is used the integrated passive dosimeter to measure alpha particles in medical drugs samples in this study from variouslocal pharmacies of Iraq, which included solid stated detectors CR-39for measuring uranium concentrations with dimensions of (1x1) cm$^2$. CR-39 detector weremade in USA (charleswater.co.un, vermason.co.un, IEC61340-5-1) and a thickness 100 μm. Each detector was put directly on samples of containers.Then sealed at room temperature for 62 daysexposure time.

Uranium concentrations ($C_U$) were measured by a theoretical estimate proposed by ISLAM et al. using SSNTDs (CR-39), as following [9-11]:

$$C_U\,(ppm) = \frac{952.\rho_t}{R_\alpha \rho N_A \left(8\lambda_{238} + \frac{7\lambda_{235}}{140}\right).10^{-6}} \quad (1)$$

where, $C_U$ is uranium concentrations (ppm), $N_A$ is the Avogadro's number, ρ is the sample density, $\rho_t$ is the track density on the detector surface, $R_\alpha$ the mean alpha particle range which equal 48 μm in soil for 4–8 MeV energy range [12], 7 and 8 are alpha particle number for $^{235}$U and $^{238}$U decay chains respectively, and 1/40 is the ratio of the isotopic abundances of $^{238}$U and $^{235}$U in natural uranium.

The annual average internal dose AAIEDby an ingestion of radionuclides has been calculated according to the equation 2 [13,14]:

$$\mathrm{AAIED}\left(\frac{nSv}{y}\right) = C_u\left(\frac{Bq}{kg}\right) \times I^m\left(\frac{kg}{y}\right) \times C^f\left(\frac{nSv}{Bq}\right) \quad (2)$$

where $I^m$ represents the rate of consumption from the medicine intake for an individual within a year(kg/y), and $C^f$ represents the effective dose conversion factor of the radioactive element (nSv/Bq). Through the process of evaluation, the AAIED due tothe ingestion of radionuclides from the intake of medicines, the calculations were based on assuming two times a day, where 500 mg for each medicine were consumed [13,14]. While, the effective dose conversion factor for uranium ingestion by people as 45 nSv/Bq [15].

The risk of an excess cancer fatality per million person (RECFPMP) due to ingestion of radon, radium, and uranium from pharmaceuticals has been calculated according to the equation 3:

$$RECFPMP = AAIED \times DL \times RF \quad (3)$$

Where DL represents the duration of life (70 yr) and RF is the risk facto r(0.055Sv-1) recommended by the ICRP [16].

**Table 1:** Name and sample code of samples under study.

| Sample code | Name sample | Sample code | Name sample |
|---|---|---|---|
| **H1** | Eucarbon | **H23** | Gentaplex |
| **H2** | Trilac | **H24** | Acaiberry |
| **H3** | Urologicaprobiakut | **H25** | Speman |
| **H4** | Aspin | **H26** | Prostamed |
| **H5** | Senade | **H27** | Ab slim extra |
| **H6** | Vitalacticb | **H28** | Fat burner |
| **H7** | Swiss microlactin | **H29** | Digestives |
| **H8** | Uriclar | **H30** | Ginseng |
| **H9** | Allohol | **H31** | Pilex |
| **H10** | Magnesiumdragees | **H32** | Colon cleanse |
| **H11** | Dizyme blend | **H33** | liv.52 |
| **H12** | Asmasam | **H34** | brewer,s yeast |
| **H13** | Kellagon | **H35** | Agiolax |
| **H14** | Glucose powder | **H36** | Green tea |
| **H15** | Trizyme | **H37** | Corn silk |
| **H16** | Slimtol extra | **H38** | Natmucil |
| **H17** | Proxnal | **H39** | Anise |
| **H18** | Cardixin | **H40** | Chamomile |
| **H19** | Chicoridin | **H41** | Borage |
| **H20** | Legalon forte | **H42** | Harntee 400 tadin |
| **H21** | Actiloba plus | **H43** | Linaza |
| **H22** | Bran | **H44** | Eliminex plus |

## Results and Discussion

The results of arithmetic for $^{238}$U concentrations in samples of medical drugs in the present study have been given in Table 2. From Table 2, the lower value of uranium concentration and specific activity were for sample H31 (0.001 ppm) and (0.05 Bq/kg), while the higher value was found in pharmaceutical H4 (1.73 ppm) and (21.35 Bq/kg) with an average value of (0.29±0.05 ppm) and (3.56±0.67) respectively.

Table 3 shows the annual average internal effective dose (AAIED) and danger of an excess cancer fatality per million person (RECFPMP) due to ingestion of uranium-238 from samples of medical drugs derived from medical plants. From Table 3, it is found that, the average value of AAIED by ingestion of uranium-238 in samples under study are ranged from (0.001 μSv/y) to (0.351 μSv/y) with an average (0.058±0.01 μSv/y). The value of RECFPMP ranged between (0.003) and (1.35) with an average value of (0.23±0.04).

The variation in the uranium concentrations can be attributed to the numerous components of these pharmaceuticals because they were of plant origin. The pollution that occurred by radiation can be also directly caused by the absorption of radionuclides from the atmosphere. The uptake of radionuclides by plant varies relying on the soil crust, the plant itself and the fertilizer. Consequently, the radiation pollution of the plant is highly anticipated. However, the specific activity of uranium for all the researched pharmaceuticals was less than accepted lower limit of the action level, which is 33 Bq/kg [17]. The AAIED in all samples of the medical drugs studied in the current

**Table 2:** Uranium concentrations in samples under study.

| Sample code | Uranium concentrations (ppm) | Specific activity of Uranium (Bq/kg) | Sample code | Uranium concentrations (ppm) | Specific activity of Uranium (Bq/kg) |
|---|---|---|---|---|---|
| **H1** | 0.37 | 4.61 | **H23** | 0.34 | 4.25 |
| **H2** | 0.75 | 9.31 | **H24** | 0.11 | 1.32 |
| **H3** | 0.11 | 1.38 | **H25** | 0.09 | 1.14 |
| **H4** | 1.73 | 21.35 | **H26** | 0.02 | 0.23 |
| **H5** | 0.08 | 1.04 | **H27** | 0.28 | 3.52 |
| **H6** | 0.14 | 1.7 | **H28** | 0.09 | 1.12 |
| **H7** | 0.27 | 3.3 | **H29** | 0.42 | 5.13 |
| **H8** | 0.46 | 5.68 | **H30** | 0.01 | 0.18 |
| **H9** | 0.28 | 3.4 | **H31** | 0.001 | 0.05 |
| **H10** | 0.11 | 1.4 | **H32** | 0.03 | 0.37 |
| **H11** | 0.19 | 2.33 | **H33** | 0.09 | 1.14 |
| **H12** | 1.65 | 20.42 | **H34** | 0.06 | 0.76 |
| **H13** | 0.17 | 2.13 | **H35** | 0.02 | 0.3 |
| **H14** | 0.03 | 0.41 | **H36** | 0.15 | 1.84 |
| **H15** | 0.15 | 1.79 | **H37** | 0.33 | 4.12 |
| **H16** | 0.17 | 2.08 | **H38** | 0.13 | 1.58 |
| **H17** | 0.4 | 4.89 | **H39** | 0.11 | 1.35 |
| **H18** | 0.23 | 2.83 | **H40** | 0.78 | 9.62 |
| **H19** | 0.28 | 3.47 | **H41** | 0.74 | 9.14 |
| **H20** | 0.45 | 5.58 | **H42** | 0.25 | 3.11 |
| **H21** | 0.1 | 1.26 | **H43** | 0.04 | 0.45 |
| **H22** | 0.21 | 2.57 | **H44** | 0.24 | 2.91 |
| **Average±S.E:**Uranium concentrations (ppm): 0.29±0.05<br>Specific activity of Uranium (Bq/kg): 3.56±0.67 | | | | | |

**Table 3:** Uranium concentrations in samples under study.

| Sample code | AAIED (µSv/y) | RECFPMP | Sample code | AAIED (µSv/y) | RECFPMP |
|---|---|---|---|---|---|
| **H1** | 0.076 | 0.29 | **H23** | 0.07 | 0.27 |
| **H2** | 0.153 | 0.59 | **H24** | 0.022 | 0.08 |
| **H3** | 0.023 | 0.09 | **H25** | 0.019 | 0.07 |
| **H4** | 0.351 | 1.35 | **H26** | 0.004 | 0.01 |
| **H5** | 0.017 | 0.07 | **H27** | 0.058 | 0.22 |
| **H6** | 0.028 | 0.11 | **H28** | 0.018 | 0.07 |
| **H7** | 0.054 | 0.21 | **H29** | 0.084 | 0.32 |
| **H8** | 0.093 | 0.36 | **H30** | 0.003 | 0.01 |
| **H9** | 0.056 | 0.22 | **H31** | 0.001 | 0.0003 |
| **H10** | 0.023 | 0.09 | **H32** | 0.006 | 0.02 |
| **H11** | 0.038 | 0.15 | **H33** | 0.019 | 0.07 |
| **H12** | 0.335 | 1.29 | **H34** | 0.012 | 0.05 |
| **H13** | 0.035 | 0.13 | **H35** | 0.005 | 0.02 |
| **H14** | 0.007 | 0.03 | **H36** | 0.03 | 0.12 |
| **H15** | 0.029 | 0.11 | **H37** | 0.068 | 0.26 |
| **H16** | 0.034 | 0.13 | **H38** | 0.026 | 0.1 |
| **H17** | 0.08 | 0.31 | **H39** | 0.022 | 0.09 |
| **H18** | 0.046 | 0.18 | **H40** | 0.158 | 0.61 |
| **H19** | 0.057 | 0.22 | **H41** | 0.15 | 0.58 |
| **H20** | 0.092 | 0.35 | **H42** | 0.051 | 0.2 |
| **H21** | 0.021 | 0.08 | **H43** | 0.007 | 0.03 |
| **H22** | 0.042 | 0.16 | **H44** | 0.048 | 0.18 |
| **Average±S.E**:AAIED (µSv/y): 0.058±0.01<br>RECFPMP: 0.23±0.04 | | | | | |

work was less than even the lower limit of the recommended range (3-10 mSv/y) which is recommended by International Commission on Radiological Protection and the action level of 0.29 mSv/y recommended by UNSCEAR in regard with the ingestion exposure that occurred by natural sources [18]. The values of the risk of an excess cancer fatality per million person (RECFPMP) due to the ingestion of uranium values were less than the lower limit of the range (170-230) per million people recommended by the International Commission on Radiological Protection [18]. Therefore, the values of RECFPMP are very little, so, it may be decided that the risk of cancer is negligible. At last, it is found that the uranium concentration in the samples under study was low and not significant from a health hazard point of view.

## Conclusion

The specific activity of uranium in all 44 samples of medical drugs derived from medicinal plants in Iraqi pharmacies was much smaller than the average world level according to UNSCEAR 2008. The annual internal effective doses from uranium due to the ingestion of all samples in the present study were lower than the action levels recommended byICRP and UNSCEAR. The results of RECFPMP in all samples under study have been found lower than the regulatory standard recommended according to ICRP, therefore, it may be decided that the risk of cancer in negligible. Because of uranium-238, the intake of the current medical drugs derived from medicinal plants in Iraqi pharmacies does not result in significant changes in the internal radiation dose and do not constitute a health hazard to those who use these drugs.

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