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Estimation of Uranium Concentration in Blood Samples of Kidneys Failure Patients in Al- Muthanna Governorate

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Abstract. Precise the measurement of uranium concentration in human blood is quite important in assessment of occupational and public exposure to uranium. In the present work, the fission track technique was used to determine uranium in blood of Kidneys Failure Patients in Al- Muthanna Governorate. The uranium concentration values in blood samples of Kidneys Failure Patients ranged between 0.119 p.p.m to 0.31 p.p.m, while Healthy group results were ranged 0.117 p.p.m to 0.199 p.p.m. Some parameters used to explain the results of uranium concentration. Results showed that the concentration of uranium in the blood increases in kidney failure patients.

Keywords. Uranium concentrations, Blood samples, Fission Track technique

INTRODUCTION

Uranium is a naturally occurring radioactive element. In its pure form, it is a silver-white, lustrous, dense and weakly radioactive metal [1,2]. Metallic uranium has a high density about 19 g/cm3. It is present in the outside layer of earth at an average concentration of 2 ppm [3]. Because all isotopes unstable and half-lives varied between 159,200 years and 4.5×10^{9} years the uranium is weakly radioactive. Naturally occurring uranium consists of three isotopes (^{234}U , ^{235}U , ^{238}U), all of which decay by gamma emission and alpha emission [4]. Uranium trace determinations in the blood samples give a genuinely decent gauge of the quantity of heavy elements within distinct body tissues. Uranium is widespread in nature, being available in a wide variety of gaseous, solid, and liquid compounds [5]. There are diverse conceivable ways by which uranium can reach the human body either direct way by breathing in uranium-bearing residue particles or by drinking water which is dirtied by uranium, or in an indirect path from the fruitful soil layer by means of the food chain [6]. Solubility of uranium varies depending upon the specific compounds and the dissolvable, and this solvency decides how rapidly and proficiently the body ingests them from the lung and the digestive organs, separately [7]. Uranium kept during the bones and different organs is in this manner discharged once again into the circulation system, which causes a few medical issues running from cancer to kidney failure, respiratory disorders, congenital abnormalities, skin diseases, and other obscure unknown diseases [8,9]. The destiny of uranium in the human body that enters the systemic tissues and circulation system can't be effectively estimated or watched. In this way, models are utilized to speak to the development of material around the body. These models can be utilized to compute radiation doses to the tissues and to predict the retention and excretion of the element [10].

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The aim of this study is to determine the concentration of uranium in the blood samples for the people in Al-Muthanna Governorate using CR-39 nuclear track detector, and to study the relationship between the Uranium concentration in blood and kidney failure.

EXPERIMENTAL METHOD

The experimental technique of uranium concentration in blood samples is the same as reported somewhere else [9,11]. In this study, 26 blood samples of individual volunteers (21 patients and 5 healthy), male and female, were taken from Al- Muthanna Governorate. The volunteers had no previous history occupational exposure to (^{235}U). They completed a comprehensive questionnaire about demographic information such as age and gender. The droplet method was used to determine the concentration of uranium in blood samples. I injected the blood with a size of (30µL) on each detector using a micropipette. The area of the detector ($1cm^2$) After placing the blood sample and after it dried, another detector was placed on top of it as shown in (figure 1). In this technique, the blood samples were irradiated with thermal neutrons from (Am-Be) neutron source for seven days so as to make inert harm to the detector due to ^{235}U (n, f) reaction. The total neutrons flounce was ($3 \times 10^5\ n\ cm^{-2}$). The process of irradiating samples was carried out in (Department of Physics, College of Education for Pure Sciences / Ibn Al-Haitham, Baghdad University, Baghdad, Iraq), The induced fission fragments were obtained according to the following (n, *f*) reaction:

$$^{235}_{92}U + \ ^{1}_{0}n \rightarrow ^{236}_{92}U^{*} \rightarrow ^{141}_{56}Br + ^{92}_{36}Kr + 3^{1}_{0}n \text{--------(1)}$$

After the irradiation, the CR-39 detectors were etched in (NaOH) solution with normality (N= 6.25) at a temperature of 60 °C for 5 h. The induced fission tracks densities were recorded using optical microscope with magnification of 400×. The fission track densities were measured on surfaces showing uniform distribution of uranium.

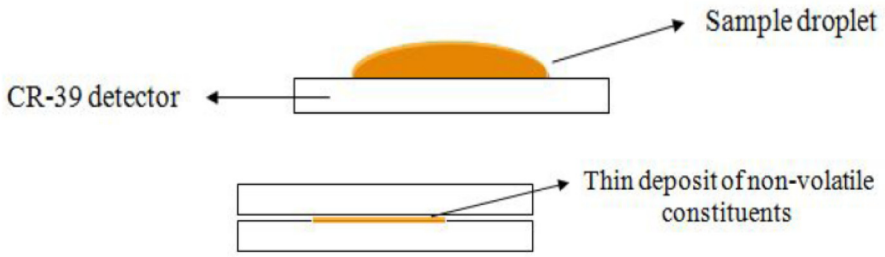

FIGURE 1. Preparation of blood samples to determine the uranium content.

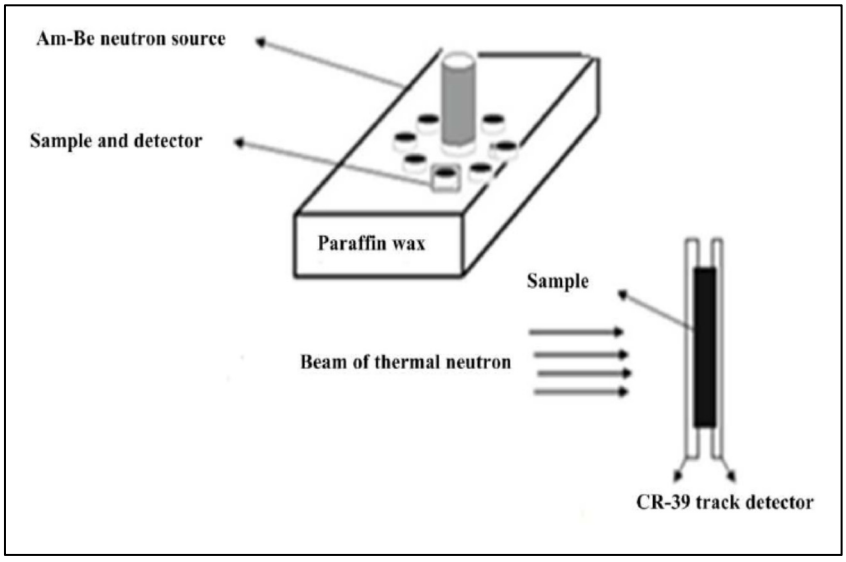

FIGURE 2. The irradiation of the samples and detectors to the neutron source.

CALCULATIONS OF URANIUM CONCENTRATIONS

Uranium concentration in the blood samples was measured by comparison between track densities registered on the detector of blood samples and that of the standard samples by (Eq. 1) [11].

$$CX = CS. (\rho X / \rho S) \ldots\ldots\ldots\ldots\ldots (2)$$

Where ρX and ρs are the induced fission track density for unknown sample and standard sample in (tracks/mm2), Cx and Cs denote the uranium concentration for unknown sample and standard sample in (ppm).

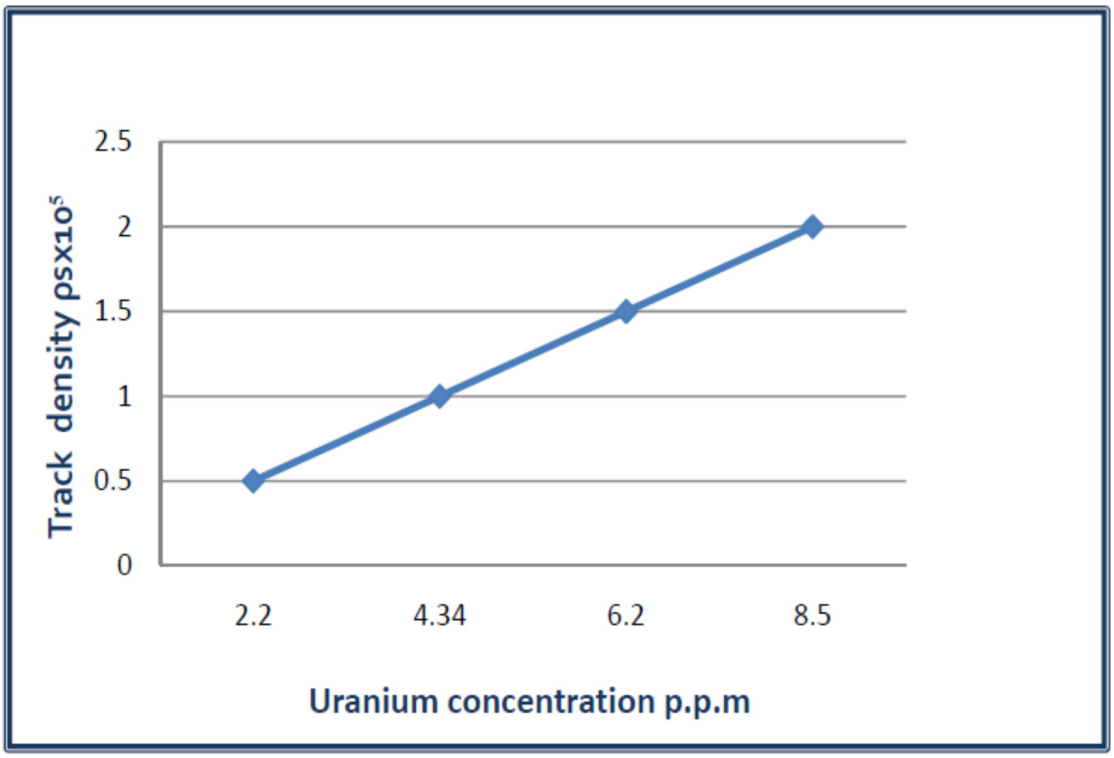

FIGURE 3. The relation between track density and uranium concentration in (ppm) for standard samples [Tawfiq, 2011].

RESULTS AND DISSECTION

Uranium concentrations in blood samples of individual volunteers in Al- Muthanna Governorate are summarized in Table 1, from this table the uranium concentration in blood samples of kidney Failure Patients ranged from 0.119 p.p.m to 0.31 p.p.m, with the average value of uranium concentration was 0.243 p.p.m, and this finding is higher than reported data of other researchers [9, 12, 13]. The uranium concentration in blood samples of healthy group ranged from 0.117 p.p.m to 0.199 p.p.m, with the average value of uranium concentration was 0.137 p.p.m.

From this table, the average value of uranium concentration in blood samples of kidney Failure Patients is higher than those of healthy group.

The reason behind such results can be credited to the fact that in Al- Muthanna Governorate was the center of military activities during the Gulf Wars I and II, and the disposed of weapons are still lying around in this region. This indicates that the people living in Al- Muthanna Governorate exposed to the uranium levels higher than those living in other cities. The concentration of uranium in the blood determined by the (ICRP) is estimated to be 0.115 p.p.m. The results obtained for healthy people were within the internationally tolerable limits when compared with the results of healthy group concentrations of uranium

TABLE 1. Range and average of uranium concentration (ppm) in blood samples Kidneys Failure Patients in Al- Muthanna Governorate.

Sample code	Gender	Age year	Uranium concentration p.p.m
S1	male	34	0.0136 ± 0.119
S2	male	74	0.0246 ± 0.296
S3	female	53	0.0216 ± 0.171
S4	female	53	0.0193 ± 0.25
S5	male	62	0.0204 ± 0.203
S6	male	71	0.0302 ± 0.201
S7	male	36	0.0606 ± 0.16
S8	female	69	0.0125 ± 0.248
S9	female	35	0.0346 ± 0.147
S10	male	67	0.0173 ± 0.217
S11	female	44	0.0152 ± 0.187
S12	male	64	0.02712 ± 0.30
S13	male	68	0.0255 ± 0.238
S14	female	20	0.0242 ± 0.298
S15	male	48	0.0321 ± 0.31
S16	female	50	0.0421 ± 0.28
S17	female	73	0.026 ± 0.31
S18	female	55	0.0689 ± 0.282
S19	male	49	0.019 ± 0.21
S20	female	57	0.034 ± 0.31
S21	female	19	0.025 ± 0.30

TABLE 2. Range and average of uranium concentration (ppm) in blood samples Healthy group in Al- Muthanna Governorate

Sample code	Gender	Age year	Uranium concentration p.p.m
S1	male	35	0.117 ± 0.0106
S2	female	30	0.199 ± 0.0272
S3	male	50	0.129 ± 0.0119
S4	female	33	0.118 ± 0.0173
S5	female	27	0.12 ± 0.015

CONCLUSIONS

The uranium concentration in blood samples of kidneys failure patients group were higher than the value from the healthy group. The uranium concentration in the blood samples of the groups of study increased with increasing number of year's age. The average of uranium concentration for females for patients and healthy were higher than for males. Results show that the uranium concentration in the blood of healthy group is close the allowed limit from ICRP agency (0.115 ppm).

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