Determination of Uranium concentration in males and females teeth in Samawa city using Lexan Detector

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Abstract: The uranium concentrations in teeth samples were determined using a Lexan nuclear track detector and a fission tracks registration methodology for 25 samples of teeth, each weighing (0.7) grams and measuring (2) mm in thickness, Teeth were collected from private clinics and government hospitals in different areas in the city of Samawa for both males and females. Thermal neutron bombardment of (U) from a (^{241}Am-Be) neutron source with a flux of ($5x10^{3}$.n.cm^{-2}.s^{-1}) for one week. The outcomes obtained showed that the highest value of uranium concentrations was in a woman, a 33-year-old, and the lowest uranium concentration was in a 7-year-old child. Uranium concentration results vary according to the person's location, gender and age. The findings revealed that the uranium concentration was high in females was higher than the concentration of uranium in males by an average of (81.13%).

***Keywords*:** Uranium concentration, Lexan detector, etching time, neutron source.

1. Introduction (12 bold)

Uranium is one of the hardest naturally occurring elements and all its isotopes are radioactive. Radiotoxicity and chemical toxicity (nephrotoxicity) are well documented [1]. U is found in trace amounts in a variety of foods, including tap and mineral water, as well as vegetables. The average daily uranium intake was 1.6 ng from air and 0.11 g from foods. From water and 1.14µg from food, achieving a total average value of 1.25 µg/d per person [2]. The uranium isotopes that are normally measurable in nature are ^{234}U, ^{235}U, and ^{238}U with abundances (%) of 0.0055, 0.7200, and 99.27 respectively, used during nuclear power application [3].

Uranium is a naturally occurring element with a wide distribution. It can be in the form of a gas, a liquid, or a solid substance. [4, 5]. Exposure for uranium occurs through mining, milling, and chemical processing. Uranium can enter the body by breathing, food digestion, or drinkable water. The uranium absorbed by human the skeleton, kidneys, and liver are examples of body systems) and after that excreted, in part, It is only faintly absorbed in the gastrointestinal system during urination [6, 7], and the urine removes the majority of what is received [8]. Because of the relevance of the subject in terms of health and the environment, several studies have been conducted on uranium concentration in urine. Uranium has a high potential for contaminating the environment and causing major difficulties, particularly in areas exposed to uranium weaponry, as was the case in the southern Iraq region after the Gulf Wars (1991-2003) [9, 10]. Several studies have found a link between uranium levels and cancer patients [9–11]. The volatility of uranium largely depends on the compound, and this solubility impacts how quickly and effectively the body absorbs them through the lungs and intestines. Uranium that has accumulated in the bone and other organs is eventually released into the blood, causing a range of health problems ranging from cancer to kidney failure to skin ailments [10].

The technique of measuring the number of particles by observing their track in certain organic or inorganic materials has been used for the study of phenomena in Nuclear track detectors are one of the most common detectors used to analyze the nature of damage products produced by extensively ionized radiation such as alpha particles or fission fragments in subjects as diverse as geology. Astrophysics, and nuclear physics. Astronomy and nuclear physics are two fields of study. So because technique is based on the damage caused in a solid along the route of a severely ionizing particle, it is a fairly basic technique that can be simply used in the field of studies [12, 13].

This study investigates the concentration of uranium in the dental bones in Samawa City for males and females.

2. Methodology(Experimental Procedure)

2.1.**Teeth sample collection:**

Twenty five tooth samples were collected from different areas in Al-Samawa city. Each tooth was ground to a fine powder. The weight of the sample (0.7 gm) and (2 mm) in thickness. The teeth samples were covered with a 1x1 cm piece of Lexan detector and put in front of the neutron source.

2-2. Irradiation of the detectors:

The pellets with a 1x1 cm (teeth of sample) were cover with a Lexan detectors and placed in a paraffin wax plate at a distance of 5cm from the neutron source ^{241}Am-Be, with thermal neutron flux ($5x10^3$ n cm($^{-2}$) S($^{-1}$) for 7 days, as shown in Fig (1)

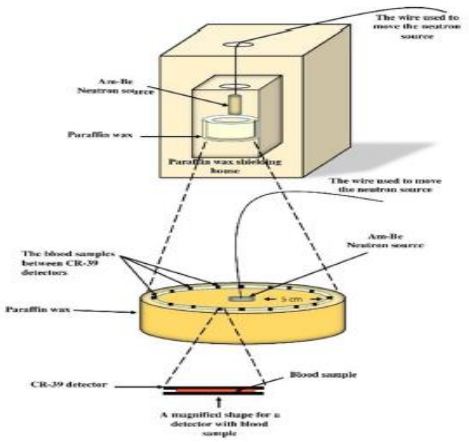

Figure 1 Neutron source with (Lexan and samples) [14].

We can found the flux (**φ**) from the equation:

$$\varphi = A_c / 4 \pi r^2 \ldots\ldots\ldots (2)$$

2.3. Chemical etch and scanning with a microscope:

The Lexan detectors (1 x 1 cm) were removed after one week of irradiation and etched in a 6.25 N aqueous solution of NaOH at 60°C for 5 hours [16]. The detectors were cleaned in distilled water before being dried in the open air. The developed fission track were large and view with an optical microscope Novel type model (N-200M), equipped with a digital camera name ToupCame 2.0, model UCMOS00350KPA, manufactured by Hangzhou ToupTek Photonic. The number of the tracks in the detectors was count by computing a mean number of 10 visions. The track density for each case was calculated by dividing the mean fission tracks by the field of view of the camera ($0.052 mm^2$). The following relationship was used to calculate the density of the tracks ρ_x in the detector:

$$\rho_x = \frac{N_{ave}}{A} \ldots\ldots\ldots\ldots (1)$$

Where that:
ρ_x: Density of tracks / mm^2.
N_{ave}: the average of all tracks
A: field of view area

2.4. Concentration of uranium:

The uranium concentration in the teeth samples was determined using the fission tracks technique, which involved comparing track densities detected on the detectors of the sample and the standard sample. The formula was used to determine the uranium concentration of an unknown sample [17]:

$$\frac{Cx}{\rho_x} = \frac{Cs}{\rho_s} \ldots\ldots\ldots\ldots (2)$$

Where
C_s, C_x: Uranium concentration (ppm) for both the standard and the samples.
P_s, ρ_x: tracks density (track/mm^2) for standard and unknown samples respectively.

And

$$C_x = C_s \frac{\rho_x}{\rho_s} \ldots\ldots\ldots\ldots (3)$$

Y = mx + c

= 148.9x + c

Slope = 148.9x

Five hours etching

Samples Code	Gender	Age	Track density ρ_x Track/mm^2)(	Uranium concentration C_x (ppm)	S.A The specific activity (Bq/ Kg)
1	M	37	680.89	1.27	**15.70**
2	M	55	848.32	1.58	**19.56**
3	M	34	598.32	1.12	**13.79**
4	M	66	315.73	0.59	**7.28**
5	F	33	1136.78	2.12	**26.20**
6	F	45	989.34	1.85	**22.81**
7	M	24	854.73	1.60	**19.70**
8	F	43	766.16	1.43	**17.66**
9	F	55	641.19	1.20	**14.78**
10	M	7	213.7	0.40	**4.93**
11	F	33	759.98	1.42	**17.52**
12	F	32	875.24	1.63	**20.18**
13	M	24	560.57	1.05	**12.92**
14	F	40	986.1	1.84	**22.73**
15	F	34	877.57	1.64	**20.23**
16	M	23	543.79	1.01	**12.54**
17	M	55	819.32	1.53	**18.89**
18	F	56	989.9	1.85	**22.82**
19	F	43	1051.66	1.96	**24.24**
20	F	33	651.88	1.22	**15.03**
21	F	67	729.92	1.36	**16.83**
22	M	32	883.43	1.65	**20.36**
23	F	22	433.42	0.81	**9.99**
24	F	43	1083.99	2.02	**24.99**
25	F	45	1124.21	2.10	**25.91**
Max			**1136.78**	**2.12**	**26.20**
Min			**213.7**	**0.40**	**4.93**
Mean			**776.64**	**1.45**	**17.90**

Fig. (2) show that the relationship between the track density and uranium concentration when (slope = 148.94x) for etching time five hours.

Table1: Uranium concentration for teeth samples and specific activity.

3. Results and discussion:

Table 1 shows that the tracks density, concentration of uranium and the specific activity for (25) samples in one week irradiation, result showed that the mean track density was (776.64#/mm^2), uranium concentration (1.45 ppm) and specific activity (17.90 Bq / Kg) for etching time five hours and These results disagree with the observation of (Alyaa A. Abd Al-Jabar, 2015)[18], and (Nidhala H.Kadhim,2011)[19] They both found the concentration of uranium in dental samples by neutron activation is (0.071 ppm),(*0.*18 ppm) respectively and These results agree with the observations of (Auday Tariq Al-Bayati)[20] and (Thaer Muhammad, 2019)[21] who study uranium concentrations in water and soil.

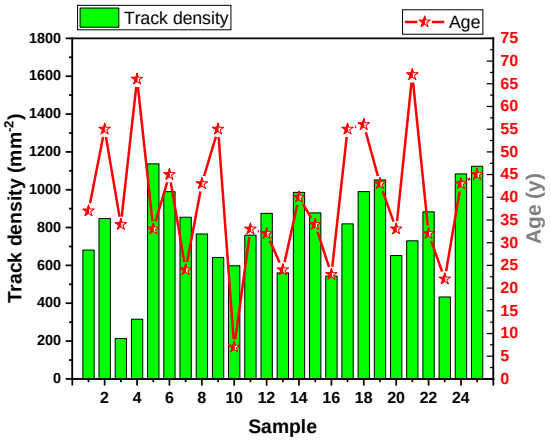

Fig. (3) The relation between sample, Track density and Age.

Figure 3 shows the all patients age and samples number and the track density for both gender (male and female).

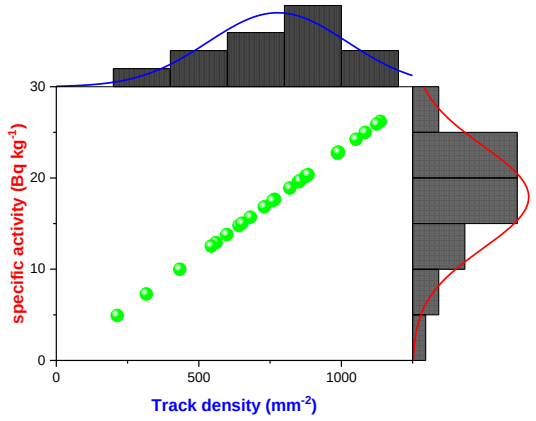

Fig. (4) The relationship between tracks density and specific activity.

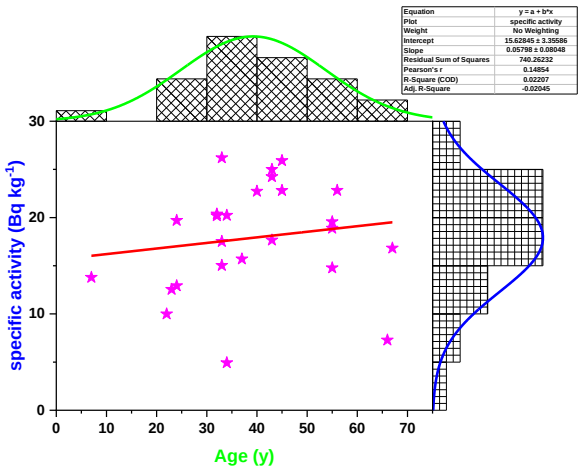

Fig. (5) The relation between Age patient and specific activity.

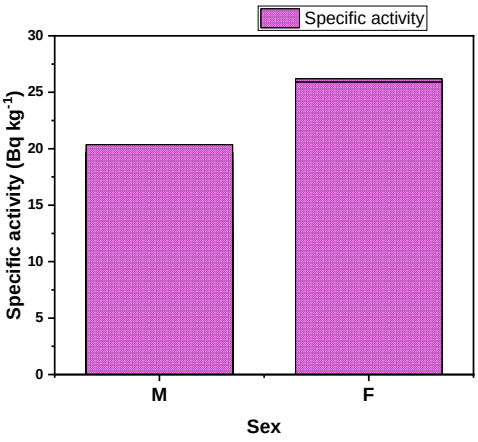

Fig. (6) The relation between Sex and specific activity.

Fig. 6 showed that uranium concentration and specific activity for female higher than uranium concentration and specific activity for male, this is also consistent with previous research conducted on the city of Samawa and this is consistent with the results of researcher Muayad Muhammad Abd (The mean value of concentration in blood sample and urine samples of the healthy group were 0.266 ppm and 1.20 µg/L, respectively. The results showed that the uranium concentrations in the group of kidney failure patients were higher compared to the uranium concentrations in the healthy group. Uranium concentration in blood sample of females are higher than in males) [22].Also, the research presented by Dr. Nada Fadel shows that the city of Samawah has the highest concentrations of uranium [23].

5. CONCLUSION

1- Uranium concentration the females is higher than that of males in Samawa city.

2- There is a clear relationship between age and uranium concentration. A 7-year-old child (deciduous teeth) has the lowest concentration of uranium (0.40 ppm), and the highest uranium concentration is (2.12 ppm) for a 34-year-old woman.

3- The concentration of uranium is higher than the permissible limit according to (the International Committee for the Protection of Radioactive), especially in females, and it may be due to the low blood percentage compared to males or because of the nature of cell division in females.