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Measurement the Concentrations of Uranium in Human blood Using PM-355 Track Detector

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Abstract- The aim of this research is to measure the concentrations of uranium for twenty samples of human blood of healthy individuals and patients with leukemia and collected from some hospitals in the capital, Baghdad. Where concentrations of uranium account through detection of alpha particles using a technique reagents nuclear solid-state impact (SSNTDs) by PM-335 detector to detect alpha particles and fragments of nuclear fission and the output of the fission of uranium nuclei ^{235}U through the bombing of models thermal neutrons emitted from the source neutron Am-Be an abundance of thermal neutron ($5\times10^3 n.cm^{-2}s^{-1}$) for seven consecutive days, where the concentrations of uranium expense compared with the concentrations of uranium in the standard samples. By comparison with the standard biological samples prepared, it has been compared to the search with the permissible limits issued by ICRP and all the results for healthy people within the permissible international border results, either leukemia patients were all the results of more than the permitted international border because of increase the concentration of uranium in the blood due to many of the provinces of Iraq was militarily the scene of battles during the war of 1991and2003, where the use of depleted uranium in munitions, which have the ability to penetrate the defensive fortifications and the presence of many of the remnants of these weapons and radioactive waste left in the open air is contaminated so the soil, air and water are considered manufacturing this wastes the main cause of leukemia diseases by increasing the proportion of uranium in the environment. The concentrations of uranium for healthy from (0.077-0.216ppm) with the average value (0.121 ppm) while the concentrations of uraniumfor leukemia human were varying from (1.330- 1.960ppm) with the average value (1.671 ppm).

Keywords: PM-355, track detector, alpha particles, blood, uranium.

I. INTRODUCTION

Biological effects of radiation are typically divided into two categories; the first category consists of exposure to high doses of radiation over short periods of time producing acute or short term effects. The second category represents exposure to low doses of radiation over an extended period of time producing chronic or long term effects. High doses tend to kill cells, while low doses tend to damage or change them. High doses can kill so many cells that tissues and organs are damaged. This in turn may cause a rapid whole body response often called the Acute Radiation Syndrome (ARS) [1].

Low doses spread out over long periods of time don't cause an immediate problem to any body organ. The effects of low doses of radiation occur at the level of the cell, and the results may not be observed for many years. Besides death, there are several other possible effects of a high radiation dose [2].

Effects on the skin include erythematic reddening like sunburn, dry desquamation (peeling), and moist desquamation (blistering). Skin effects are more likely to occur with exposure to low energy gamma, x-ray, or beta radiation. Most of the energy of the radiation is deposited in the skin surface. The dose required for erythematic to occur is relatively high, in excess of 300Gy. Blistering requires a dose in excess of 1.2Gy hair loss, also called epilating, is similar to skin effects and can occur after acute doses of about 5Gy. Sterility can be temporary or permanent in males, depending up on the dose. In females, it is usually permanent, but it requires a higher dose to produce permanent sterility, dose in excess of 4Gy is required to the reproductive organs. Cataracts a clouding of the lens of the eye appears to have threshold of about 2Gy. Neutrons are especially effective in producing cataracts, because the eye has high water content, which is particularly effective in stopping neutrons. Approximately 32eV of energy is required to create an ion pair. This is independent of the type of radiation and medium, 4MeV particles create 10 ions pairs before stopping [3].

II. COLLECTION OF THE SAMPLE

Twenty samples of human blood include healthy and leukemia human were taken from the hospital to measure the concentration of uranium as shown in tables I and II.

Table I
The blood samples for healthy human

Code of Sample	Gender	Age Year	Region
B1	male	40	Gazalia
B2	male	36	Baya'a
B3	female	25	Mansur
B4	male	60	Rahmaniya
B5	female	32	Huriya
B6	female	26	Baghdad aljadida
B7	female	45	Hay ala'amil
B8	female	44	Sha'ab
B9	male	60	Yarmook
B10	male	45	Taji

Table II
The blood samples for leukemia human

Code of Sample	Gender	Age (Years)	Region
B11	male	38	Washash
B12	male	40	Taji
B13	female	27	Falluja
B14	male	55	Hay ala'amil
B15	female	35	Diyala
B16	male	24	Altalibiya
B17	female	40	Thawra
B18	female	42	Sha'ab
B19	male	57	Yarmook
B20	female	43	Ramadi

III. IRRADIATION OF BLOOD SAMPLES

By taking the special data in all samples and relate by (gender ,age and region) and probability exposure to uranium or not , all samples are heated at (300 ^{o}C) for (6 hr) to dry it and oxidize organic material and re-concentration of samples, then powdered of (0.5g) and pressed into a pellet of (1cm) diameter,(1mm) thickness. The standard blood samples of different uranium concentration were prepared.

The pellets covered with PM-355track detectors on both sides and put in a plate of paraffin wax at a distance of 5cm from the neutron source Am-Be with thermal flux (5000 n.cm^{-2}.s^{-1}), as shown in fig.1, obtain the fission fragments from these equations [4,5]:

$$^{235}U + {}^{1}_{0}n_{\ thermal} \longrightarrow \text{fission fragments + energy} \ \ldots. (1)$$

$$^{9}Be + {}^{4}_{2}He \longrightarrow {}^{12}C + {}^{1}n + 5.76\ MeV \ \ldots.. (2)$$

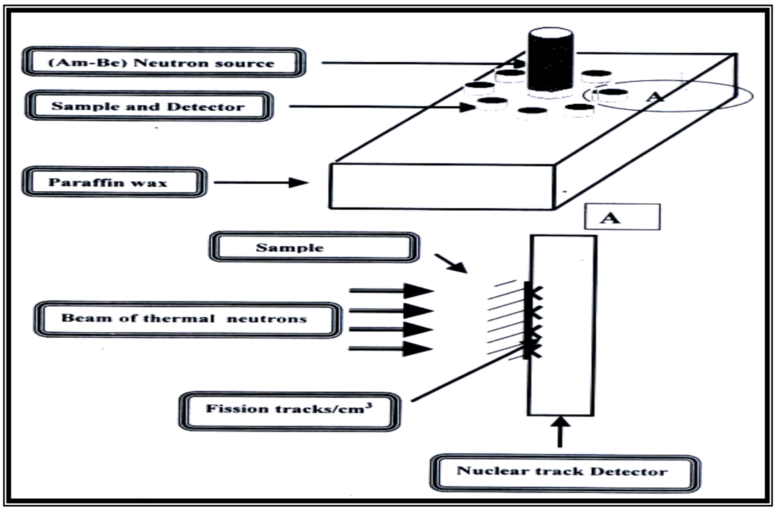

Fig.1 Irradiation of the detectors and samples to the neutron source

IV. CALCULATIONS OF URANIUM CONCENTRATIONS

PM-355 detectors were etched in (6.25N) of NaOH at temperature of (6^{0} ^{o}C) for (5 hr). The induced fission tracks density was recorded using an optical microscope for determine uranium concentration by comparative method from these equations [6]:

$C_x = C_s.\ \rho_x / \rho_s$ ……………….(3)

$I_s / I_x = R_s / R_x$ ……………..(4)

Where:

C_x : uranium concentration for unknown samples.

C_s : uranium concentration for standard samples.

ρ_x : induced fission tracks density for unknown samples.

ρ_s : induced fission tracks density for standard samples.

I_x : ratio between abundance of uranium (^{283} U / ^{235} U) for unknown samples.

I_s : ratio between abundance of uranium (^{283}U /^{235}U) for standard samples.

R_x : the range of fission fragments of unknown samples.

R_s : the range of fission fragments of standard samples.

V. RESULTS

The concentrations ofuraniumin blood for healthy human shows in table III and fig.2. The concentrations ofuranium in blood for leukemia human shows in table IV and fig.3. The concentrations of uranium inall human blood samples are shown in fig.4

Table III

Concentration of uranium in blood for healthy human

Code of Sample	Gender	Age Years	Region	*track density* $\rho *10^5$ *track.mm*$^{-2}$	*Cx ppm*
B1	male	40	Gazalia	11.0 ± 1.71	0.090
B2	male	36	Baya’a	13.5± 2.20	0.129
B3	female	25	Mansur	12.1± 2.03	0.113
B4	male	60	Rahmaniya	12.6 ±2.12	0.119
B5	female	32	Huriya	15.9 ±2.47	0.168
B6	female	26	Baghdad aljadida	9.5 ± 1.11	0.077
B7	female	45	Hay ala’amil	9.8 ±1.32	0.080
B8	female	44	Sha’ab	13.1±1.79	0.127
B9	male	60	Yarmook	11.5±1.82	0.093
B10	male	45	Taji	20.0±3.02	0.216
					Average =0.121

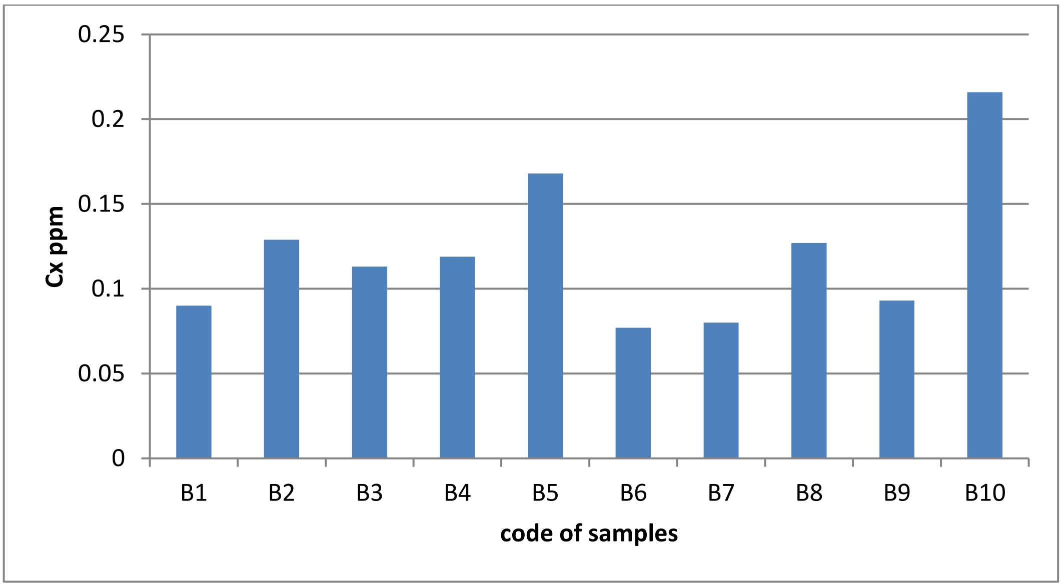

Fig.2 Concentrations of uranium in blood for healthy human

Table IV
Concentration of uranium in human blood for leukemia human

Code of Sample	Gender	Age Years	Region	*track density* $\rho *10^5$ *track.mm*$^{-2}$	*Cx ppm*
B11	male	38	Washash	105.5± 10.05	1.522
B12	male	40	Taji	145.33 ± 14.0	1.850
B13	female	27	Falluja	201.67± 20.9	1.960
B14	male	55	Hay ala'amil	110.0 ±13.72	1.610
B15	female	35	Diyala	159.67 ± 15.5	1.900
B16	male	24	Altalibiya	85.67±8.38	1.330
B17	female	40	Thawra	95.33 ±12.38	1.449
B18	female	42	Sha'ab	90.67± 10.7	1.403
B19	male	57	Yarmook	130.33 ±13.28	1.805
B20	female	43	Ramadi	194.0 ±19.33	1.932
					average=1.671

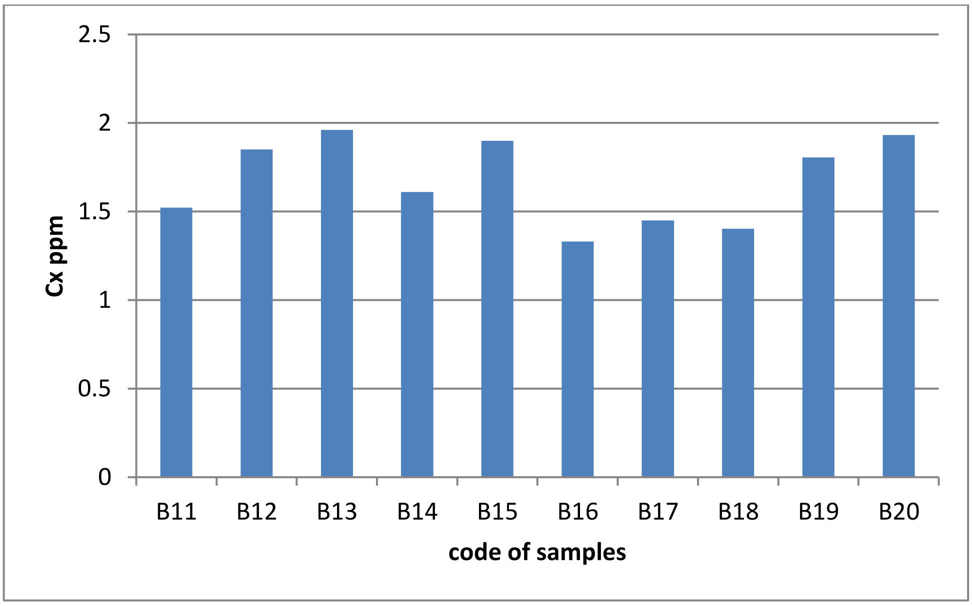

Fig.3 Concentrations of uranium in blood for leukemia human

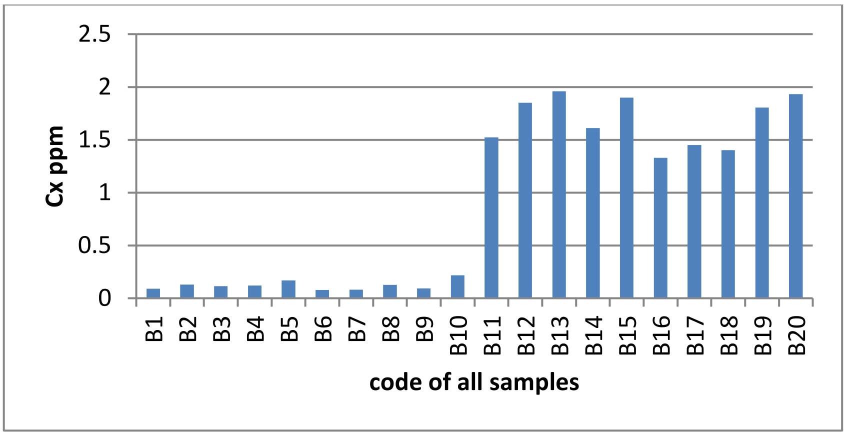

Fig.4 Concentrations of uranium inall human blood samples

VI. CONCLUSIONS

Fig. 3 shows the concentrations of uranium for healthy human were varying from 0.077-0.216 ppm with the average value 0.121 ppm ,the lowest concentration of uranium was found in B6 sample (female, 26 year ,Baghdad aljadida) and equal to 0.077 ppm, but the highest concentration of uranium 0.216 ppm was found in B10 sample (male, 45year ,Taji) ,these results were less the allowed limit 0.810 ppm from ICRP [7,8]. Fig.4 shows the concentrations of uranium for leukemia human were varying from1.330-1.960 ppm with the average value 1.671 ppm ,the lowest concentration of uranium 1.330 ppm was found in B16 sample (male,24year, altalibiya) ,the highest concentration of uranium 1.960ppm was found in B13 sample (female,27year, falluja)These results were more than the allowed limit 0.810 ppm from ICRP [7,8] because many of cities in Iraq were military practices theater through 1991and 2003 war and the weapons waste in still being in these regions that explain the depleted uranium has great reason to cases leukemia diseases as well as the existence of natural environment. Fig.5 shows all the concentrations of uranium for leukemia human samples that are higher than all concentrations of uranium for healthy human samples.

VII. REFERENCES

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