Determination of Uranium Concentration in Soil of Baghdad Governorate and its Effect on Mitotic Index Assay

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Abstract:
The aim of this work is to determine the uranium concentration in soil samples taken from the north, south, east, west and center of the city of Baghdad and measure its impact on the rate of cell division for non-smokers peoples and living in those areas and that between the ages 25-30 year.

The uranium concentration in the samples determined by using CR-39 track detector . As calculated for the ten samples of each site when irradiated by thermal neutrons from the (Am - Be) source with flux ($5x\ 10^3$ n $S^{-1}cm^{-2}$), the concentration values were calculated by a comparison with standard geological samples. The results indicate that the extent of the concentration of uranium in the soil north and east of Baghdad was 12.9 ± 0.7 in Al- Taji north of Baghdad and 12.4 ± 0.23ppm in the Diyala- Bridge area east of Baghdad and the results were recorded lower concentration of uranium in the western, central and southern Baghdad, which stood at 0.60 ± 0.21 in the Abu Ghraib area west of Baghdad, and 4.6 ± 0.7ppm in the Bab-Al-Sharqee of central Baghdad and 0.87 ± 0.7ppm in Al-Mhmodya area south of Baghdad . The mitotic index assay MI in the north and east of Baghdad was 2.3 ± 0.059 in the north and 2.43 ± 0.059 in eastern Baghdad, while the lowest rate in West and Central and South compared with the threshold level of 0.6 . Which indicates contamination north and east of Baghdad as a result of uranium wars on Iraq passed in 2003 which negatively affects the behavior of lymphocytes and on the rate of division.

Keywords: Uranium concentration , Soil , Mitotic index assay, Blood , CR-39.

تحديد تركيز اليورانيوم في تربة محافظة بغداد وتاثيرة على معدل الانقسام الخلوي

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الخلاصة:
يهدف البحث الى قياس تركيز اليورانيوم في عينات من التربة المأخوذة من الشمال والجنوب والشرق والغرب ووسط مدينة بغداد وقياس تاثيرة على معدل الانقسام الخلوي للأشخاص الغير مدخنين والساكنين في تلك المناطق والتي تتراوح اعمارهم بين 25-30 سنة . تم ايجاد تركيز اليورانيوم باستخدام كاشف الاثر النووي CR-39 حيث حسبت لعشر عينات لكل موقع عندما شععت بواسطة النيوترونات الحرارية من المصدر (Am – Be) بفيض نيوتروني حراري ($5x103nS^{-1}cm^{-2}$) ، وتم تحديد تركيز اليورانيوم بالحسابات المعتمدة مع ماتعطي النماذج الجيولوجية القياسية . تشير النتائج الى ان مدى تركيز اليورانيوم في تربة شمال وشرق

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بغداد بلغ 0.7 ± 12.9 في منطقة التاجي الواقعة شمال بغداد و 0.23ppm ± 12.4 في منطقة منطقة جسر ديالى شرق بغداد وسجلت النتائج اقل تركيز لليورانيوم في غرب ووسط وجنوب بغداد اذ بلغ ± 0.60 0.21 في منطقة ابوغريب الواقعة غرب بغداد و0.7ppm ± 4.6 في منطقة باب الشرقي وسط بغداد و0.7ppm ±0.87 في منطقة المحمودية جنوب بغداد وكذلك سجل معامل الانقسام الخلوي MI في شمال وشرق بغداد 0.059 ±2.3 في شمال بغداد و0.059 ±2.43 في شرق بغداد بينما سجل اوطا معدل في غرب ووسط وجنوب مقارنة مع مستوى العتبة 0.6 مما يدل على تلوث شمال وشرق بغداد باليورانيوم نتيجة الحروب التي مرت على العراق عام 2003 والذي يوثر سلبا على سلوك الخلايا اللمفاوية وعلى معدل انقسامها .

Introduction:

CR-39 is the solid state nuclear track detectors have the capabilities for measuring concentration and spatial distribution of isotopes if they emit heavy particles, this detectors consists of short polyallyle chains, The chemical form of CR-39 is C12H18O7.The aim of this study is measure the uranium concentration in soils samples in Baghdad city and measure the effects of uranium in human cellular division in blood samples taken from the peoples whose lived in this sites because the soil is a significant part of the human environment that provides resources for food production. It is a very dynamic ecosystem of particular importance since, once contaminate, the soil acts as a potentially long-term source of environmental contamination of food, water and air. Naturally occurring radio nuclides (NOR) such as ^{238}U series, ^{232}Th series and ^{40}K are wide spread in the Earth's environment and are considered the main source of human radiation exposure. In addition to that, human activities such as the production and application of phosphate fertilizers increases the quantity of NOR and heavy metals in agricultural soil. As a result of that a long-term application of phosphate fertilizers, could be considered as a source of soil contamination. Mitotic index (MI) analysis is widely used as an indicator system that allows detection of abnormal cellular division induced by carcinogens as mutagen [1,2]. Uranium is a toxic and radioactive by product of the uranium enrichment process. It was used as ammunition by USA and UK troops in an open environment for first time in history against Iraqi civilians and military target during (1991) [2, 3]. Uranium considered a new source of radioactivity that introduced into environment ,So that the human and animals exposure to low level or radiation and effect on genetic structure DNA on lymphocytes cells because it's very sensitive to radioactivity and any changes accurse in the cells which appears from one generation to next in cellular division process [4]. CR – 39 is the one of organic detectors (polymers) and its most sensitive of the ionizing particles ,natural uranium contain three main chains (U-238,U-235,U-234) all they emits α-particles which enter from soil to human body by food and cussed different dieses such as cancer , precancerous lesion, benign tumors, cataracts, skin changes, and congenital defects [1,5].CR-39 its most sensitive of the ionizing particles ,the damage of these particles along their path is called latent track ,may become visible under an ordinary microscope after etching with chemical solution (NAOH) ,which preferentially attacked the damaged material and enlarges these original track to a size which is visible[6].

Experimental work:

Soil samples were taken from north, south, east, west, and middle of Baghdad as show in figure.1. And dried by using oven. Then 0.5g of soil powder was mixed with 0.1g of methylcellulose ($C_6H_{10}O_5$) which is used as a binder. The mixture was pressed into a pellet of 1 cm diameter and 1.5 mm thickness. It was covered with (CR – 39) detector and fixed in a plate of paraffin wax (to moderating fast neutrons) at a distance of (5 cm) from the neutron source as show in the figure.2. With flounce of thermal neutrons ($5x\ 10^3\ n\ S^{-1}cm^{-2}$) to obtain induced fission fragments [7, 8]

$$^{235}U+_0{}^1n_{thermel}===^{236}U+^{174}Kr+^{87}B+0.85MeV \quad \ldots\ldots\ldots\ldots (1).$$

After 7days (irradiation time), (CR – 39) detectors were removed from plate and etched in Normality = 6.25 NaOH solution at temperature of 60°C for (6 hours) [2]. The induced fission tracks densities were counted using the optical microscope type (Olympus) with magnification (400 x).

The uranium concentrations were measured from the relation [6].

$$C_X = C_S . [\rho_x / \rho_s] \quad \ldots\ldots\ldots\ldots\ldots (2).$$

$$C_X = \rho_x / \text{Slope} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3).$$

Where: Slope : slope of the Calibration Curve Shown in figure 3.

(C_s, C_x): Uranium concentration in standard and unknown sample (ppm).

(ρ_s , ρ_x): track density of standard and unknown sample (tracks/mm^2).

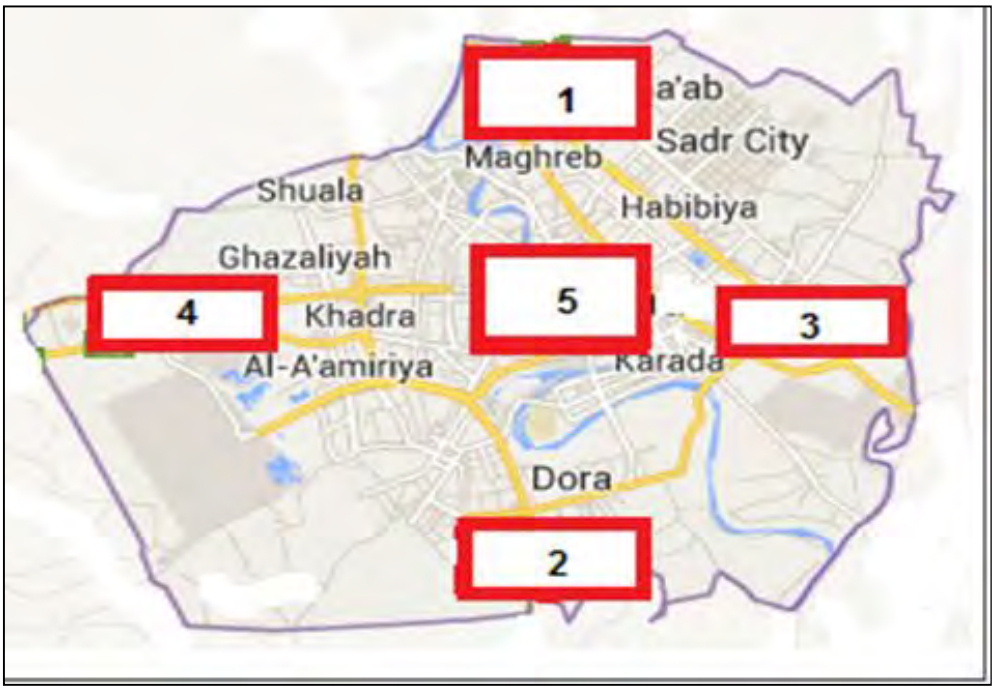

Figure 1- Entries figures on the map shows locations samples for the city of Baghdad.

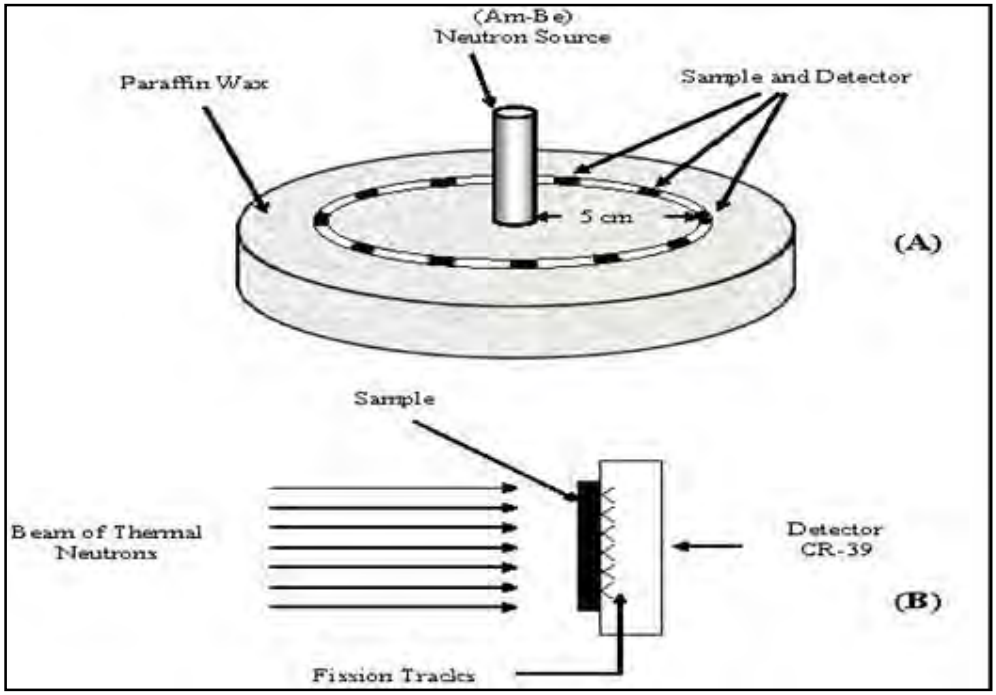

Figure 2- The iradation of detector and samples of the neutrons source [6].

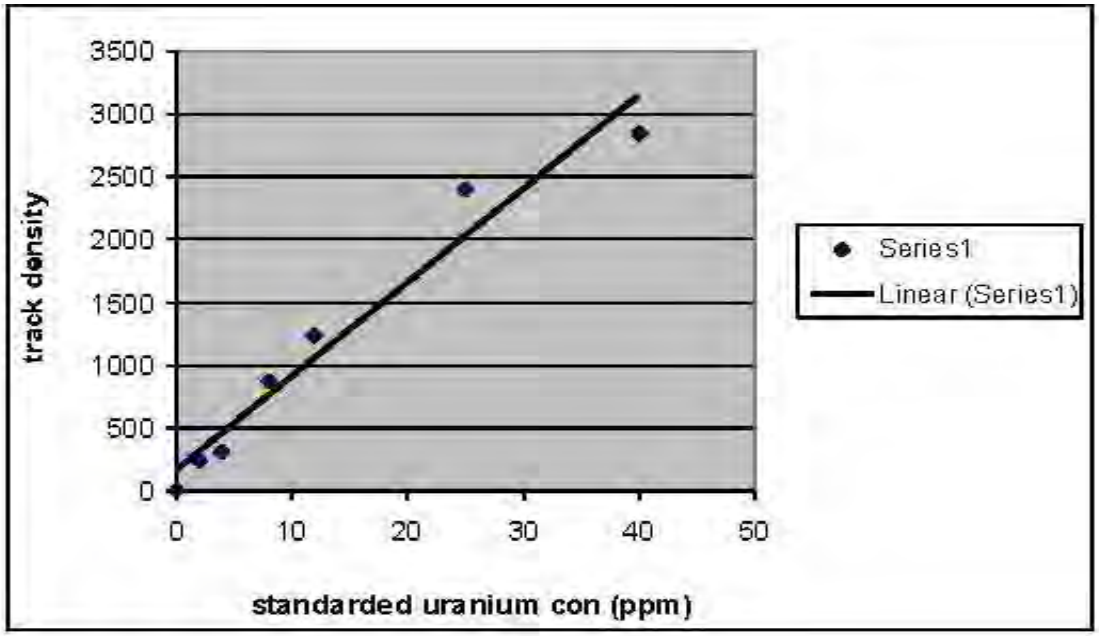

Figure 3- Track density and uranium concentration for standards geological samples [6].

Blood samples were collected from the peoples who are living in the study zones and exclusively for non-smokers, aged between 25-30 years, and cultured inside laminar airflow to prevent the contamination. each tube contain 4.5 ml. of RPMI – 1640 culture medium, 0.5 ml of whole blood was in these tubes and 0.2 ml of PHA was added to each tube. Tubes were then tightly closed by a screw cap and were incubated in incubator at 37°C for 72 hours. The tubes were frequent shaking for one time at least every 24 hours, at the end of 71 hours of the incubation period the cell were treated with colchicines to arrest them in the metaphase stage by adding 0.1 ml of colchicines to each tube with mild shaking and transferred back to the incubator to incubate for 1 hour to complete the period of incubation (72 hours) at 37°C. Culture tubes were removed from the incubator and centrifuged at 1500 rpm for 10 min. The cells were settled at the bottom of the tubes and the supernatant was clear, by using pastor pipette, the supernatant was gently removed and the pellet was left in the bottom of tube with small amount of culture medium, the pellet was well shaken by using vortex and re – suspended in approximately 5 – 10 ml of hypotonic solution with continuously shaking ,the tubes were centrifuged at 1500 rpm for 10 min then the supernatant was discarded by using the vortex the pellet was mixed and 5ml of freshly made fixative solution (Methanol acetic acid 3:1 volume/ volume) was added drop by drop with initial mixing. to get a good fixation, one ml of the fixation liquid was added to the cells after the last wash. The cells were re-suspended and then dropped on the slides (2-3) from a suitable high then dried at room temperature for one day, and stained with Geimsa stain, where the slides covered with the stain and left for ten min and then washed with distilled water, at finally The slides were examined by using optical microscopic with magnification 400X to determine the number of mitosis cells. to determined mitotic index assay MI by Eq.(4) [9].

MI= (No .of dividing cells/1000 cell) ×100%..... (4).

Results and Discussion:

In this paper, the use of soil samples for parties Baghdad governorate and central to see how this pollution areas of uranium by the war and its aftermath, as well as measuring the impact of such concentrations on the rate of mitotic index assay MI of the people living in those areas were calculated the concentrations of uranium and the coefficient of mitotic index assay MI, As shown in tables 1,2,3,4,5,and 6.

Table1-Uranium concentration in soil samples and mitotic index Assay in the north of Baghdad.

No. of Sample	Location	Concentration of Uranium C_X (ppm) ±SD	Gender	Age of Persons (years)	Mitosis /1000cell±SD
1.	North of Baghdad (Taji)	12.90 ± 0.7	Female	(25—30) years	2.00±0.068
2.			Female		2.31±0.07
3.			Female		2.22±0.063
4.			Male		3.0 ±0.07
5.			Male		2.5±0.068
6.			Male		2.31±0.061
7.			Female		2.20±0.088
8.			Male		2.99±0.060
9.			Male		2.31±0.021
10.			Female		2.11±0.023
					Average=2.3±0.059

Table 2- Uranium concentration in soil samples and mitotic index assay in the South of Baghdad.

No. of Sample	Location	Concentration of Uranium C_X (ppm) ±SD	Gender	Age of Persons (year)	Mitosis /1000cell±SD
1.	South of Baghdad (Mhmodya)	0.870 ± 0.7	Male	(25—30) years	0.21±0.068
2.			Female		0.11±0.023
3.			Female		0.19±0.051
4.			Female		0.19±0.07
5.			Female		0.18±0.068
6.			Female		0.19±0.068
7.			Male		0.21±0.062
8.			Male		0.22±0.023
9.			Male		0.25±0.068
10.			Male		0.29±0.055
					Average=0.20±0.1

Table 3- Uranium concentration in soil samples and mitotic index assay in the East of Baghdad.

No. of Sample	Location	Concentration of Uranium C_X (ppm) ±SD	Gender	Age of persons(year)	Mitosis /1000cell±SD
1.	East of Baghdad (Diyala-Bridge)	12.40 ± 0.23	Female	(25—30) years	2.00±0.051
2.			Female		2.02±0.07
3.			Male		3.00±0.063
4.			Male		3.00 ±0.07
5.			Female		2.00±0.068
6.			Female		2.31±0.061
7.			Female		2.20±0.088
8.			Male		2.90±0.060
9.			Male		2.51±0.021
10.			Male		2.22±0.023
					Average=2.43±0.05

Table 4- Uranium concentration in soil samples and mitotic index assay in the West of Baghdad.

No. of sample	Location	Concentration of Uranium C_X (ppm) ±SD	Gender	Age of Persons (year)	Mitosis /1000cell±SD
1.	West of Baghdad (Abo-Greeb)	0.60 ± 0.21	Female	(25—30) years	0.11±0.018
2.			Male		0.21±0.016
3.			Female		0.19±0.011
4.			Male		0.2±0.017
5.			Male		0.29±0.060
6.			Female		0.18±0.032
7.			Female		0.18±0.012
8.			Male		0.3±0.022
9.			Female		0.17±0.052
10.			Male		0.23±0.061
					Average=0.20±0.3

Table 5- Uranium concentration in soil samples and mitotic index assay in the Middle of Baghdad.

No.of sample	Location	Concentration of Uranium C_X (ppm) ±SD	Gender	Age of Persons(year)	Mitosis /1000cell±SD
1.	Middle of Baghdad (Bab-Al-Sharqee)	4.60 ± 0.7	Male	(25—30) years	0.71±0.018
2.			Male		0.88±0.022
3.			Female		0.25±0.051
4.			Female		0.18±0.01 77
5.			Male		0.38±0.060
6.			Male		0.29±0.064
7.			Female		0.22±0.011
8.			Female		0.12±0.021
9.			Male		0.35±0.058
10.			Female		0.22±0.044
					Average=0.335±0.03

Table 6- Uranium concentration in soil samples and mitotic index assay in the (North, South, East, West, and Middle) of Baghdad.

No. of Location\	Location	City	Concentration of Uranium	Age of Persons	Mean(Mitosis/1000cell)±SD
1	North	Taji	12.90 ± 0.7	(25—30) years	2.3±0.059
2	South	Mhmodya	0.870 ± 0.7		0.20±0.1
3	East	Diyala-Bridge	12.40 ± 0.23		2.43±0.05
4	West	Abo-Greeb	0.60 ± 0.21		0.20±0.3
5	middle	Bab-Al-Sharqee	4.60 ± 0.7		0.335±0.030

The concentration of uranium in the west, middle and south of Baghdad be (0.60 ± 0.21, 4.6 ± 0.7 and 0.87 ± 0.7) ppm, respectively, and the results indicated that these sites are within the allowable level of international for the concentration of uranium (11ppm) [5]. Results also indicate that the maximum concentration of uranium was in Diyala bridge and the Taji area, as it is located in the east

and north of Baghdad, which recorded (12.40 ± 0.23 ppm, 12.90 ± 0.7ppm), this is a proof of contamination that areas since 2003, uranium or radioactive contamination in those areas in the 2003 war, which cause pollution of the environment in those areas of uranium and its impact, which remains for a long time such as half-life of $4.5x10^9$years[9], and there was a relationship between the rate of cell division MI and the concentration of uranium as shown in figure.4., where the highest percentage of these divisions in those areas (2.43 ± 0.05, 2.30 ± 0.59) respectively, compared with threshold level (0.6) [6]. This confirms that the radiation occurs ionization in water molecules, which is most abundant in living cells leading to the formation of a number of ions are highly reactive called free radicals, these radicals composition of toxic compounds such as hydrogen peroxide to harm the components of the cell [10]. As indicated most of the empirical research on the impact of radiation on living cells and what they're toxic compounds such as hydrogen peroxide to harm the components of the cell, such as chromosomes, where the cell is the unit constructivism in the body of the organism and therefore the impact of radiation cause either cell death or events mutations or increase in the rate of cell division and that what has get it from the search results. As well as the risks of uranium toxicity is leading to the emergence of diseases and phenomena such as infertility, infections, cataracts, and growth retardation and muscles, nerves, skin and combine.

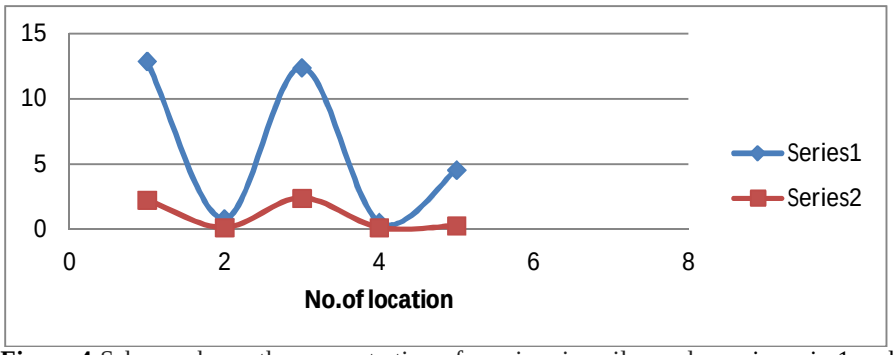

Figure 4-Scheme shows the concentration of uranium in soil samples as in series1 and mitotic index assay for blood samples as in series 2.

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