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العدد الثالث والعشرون - المجلد السادس - علوم الفيزياء - نيسان 2024م
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Calculation of uranium concentrations in the blood of smokers using the CR-39 nuclear impact detector

Wasar Ibrahim Ali , Asmaa A Aziz
Department of Physics / College of Education for Pure Sciences University of Tikrit

Abstract:

Using the CR-39 nuclear impact detector, the concentration of uranium was calculated for smoking people in the city of Al-Dhuluiyah, which is located in the province of Salah Al-Din in Iraq, and the study was done on 25 samples, the number of people smoked was 12 and non-smokers 13 The results showed that the highest value of uranium concentration (1.2µg/L) for a smoker aged (65) years, while the lowest value of uranium concentration was (0.6 µg/L) for a non-smoking child aged (6) years, and this indicates that the age and condition of the person Smoking has a role in the percentage of uranium concentration in the blood of people, as smokers may have a higher absorption of uranium through the respiratory system, as smoking is associated with changes in the respiratory system and mucous membranes, which can increase the absorption of uranium in the body as well as direct exposure Smoking is an important source of direct exposure to chemicals in tobacco, including uranium. Uranium is used as an additive in the tobacco processing process, and therefore its concentration can be higher in tobacco products.

Keywords: CR-39- Smoker –Non smoker –Uranium.

حساب تركيز اليورانيوم في دم المدخنين باستخدام كاشف الأثر النووي CR-39

وسر ابراهيم علي ، اسماء عبد العزيز
قسم الفيزياء / كلية التربية للعلوم الصرفة جامعة تكريت

مستخلص:

باستخدام كاشف التأثير النووي CR-39 ، تم حساب تركيز اليورانيوم لتدخين الناس في مدينة الضلوعية ، التي تقع في مقاطعة صلاح الدين في العراق ، وتم إجراء الدراسة على 25 عينة ، كان عدد الأشخاص المدخنين 12 وغير المدخنين 13 أظهرت النتائج أن أعلى قيمة لتركيز اليورانيوم (1.2 ميكروغرام/ لتر) لمدخنة تتراوح أعمارهم بين (65) ، في حين كانت أدنى قيمة لتركيز اليورانيوم (0.6 ميكروغرام/ لتر) بالنسبة للطفل غير المدخن الذي يبلغ من العمر (6) سنوات ، وهذا يشير إلى أن عمر وحالة التدخين له دور في النسبة المئوية لتركيز اليورانيوم في الدم ، حيث أن المدخنين قد يكون لديهم امتصاص أعلى لليورانيوم من خلال الجهاز التنفسي، كما يرتبط التدخين بتغيرات في الجهاز التنفسي والأغشية المخاطية، مما يمكن أن يزيد من امتصاص اليورانيوم في الجسم بالإضافة إلى التعرض المباشر. التعرض للمواد الكيميائية الموجودة في التبغ، بما في ذلك اليورانيوم. ويستخدم اليورانيوم كمادة مضافة في عملية تصنيع التبغ، وبالتالي يمكن أن يكون تركيزه أعلى في منتجات التبغ.

الكلمات المفتاحية : CR-39– مدخن – غير مدخن – يورانيوم .

1. Introduction

Humanity is burdened by and faces an existential threat from the problem of radioactive and chemical contamination, particularly because the sources of these pollutants have assimilated into the planet's ecology. Radioactive contamination is an increase in environmental radiation brought on by human activity. the process of producing new stable elements through the emission of matter in the form of matter or radiation, such as beta, gamma, or alpha radiation.[1]

Since the beginning of life, radiation has existed in both space and on earth. Radiation is the energy that is emitted as waves or particles across a material or space medium. The natural environment and man-made environments both contain two sources of radiation [2]. External exposure to radionuclides originates through Radiation has been a part of existence since the beginning of time .Radiation has been on Earth and in space since the origin of life. The energy that travels through a substance or space medium in waves or particles is known as radiation. There are two sources of radiation in both the natural and man-made settings [2]. Human contact with soil is the source of external radionuclide exposure, as it increases blood radiation levels. Inhaling air from space and on Earth, consuming meat, seafood, plants, vegetables, tobacco products, dirt, and water can all expose a person to radionuclides like radon and uranium. The energy that travels through a substance or space medium in waves or particles is known as radiation. There are two things that both the natural and artificial worlds have. human interaction with soil, which raises the radiation content in the blood . Radionuclides such as uranium and radon enter the human body by consumption of meat, fish, plants, vegetables, cigarettes, soil, water, and inhalation of air[3, 4]

Uranium is considered a radioactive material. Uranium contains radioactive isotopes such as uranium-235 and uranium-238. When uranium is subjected to nuclear decomposition, nuclear radiation is emitted in various forms, such as alpha, beta, and gamma radiation. The radiation effect of uranium is measured in appropriate units of radiation such as Rad, Seiffert or Gray. Uranium is used in different concentrations in many applications, such as nuclear power generation in nuclear power reactors and nuclear fuel production, as well as in scientific research, medical applications, X-ray industry and other radioactive instruments [5,6].

The study found that average alpha particle concentrations are lower in non-smokers' blood than in smokers' blood [7]. The amount of radon in a person's body increases as more individuals smoke in close quarters, and some radon gets transferred from the lungs to the blood and other organs [8]. According to studies, smoking has poisonous, genotoxic, fatal, carcinogenic, and dangerous consequences on the healthy. An rise in uranium and radon levels has been linked to smoking's increased risk to human health, according to past studies[9] .

2.Pratical part

2.1. location of study

The city of Dhuluiya, which is in the Salah al-Din province in central Iraq, is home to roughly 55,000 people. It is situated on the eastern bank of the Tigris River, about 80 km north of Baghdad, and on a longitude of 43.35 east of the Greenwich line and a latitude of 34.27 north of the equator.

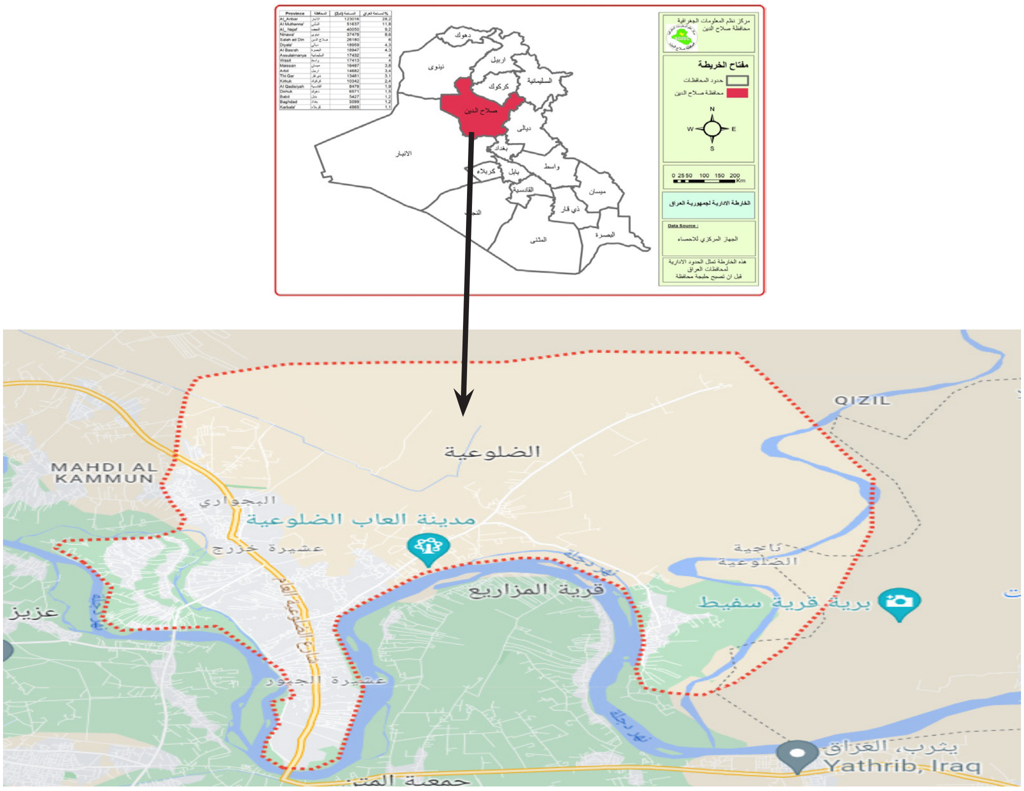

Figure 1: Map of the city of Dhuluiya.

2.2 Biological Samples

The biological samples were collected during the months of October and November 2022 and the samples were divided into two groups: the first group, smokers, who number 12 people, while the second group represents non-smoking people, who number 13 people. Using a micropipette, two drops of blood (µL75) were placed on a square piece of the CR-39 nuclear trace detector with an area of (1.5 x 1.5) cm2. After the sample dried at room temperature, another layer of the reagent was placed on the surface of the sample for the purpose of making it in the form of a pair, and so on for the rest. Figures (2a and 2b) shows the process of preparing the Samples to be ready for irradiation with the neutron source.

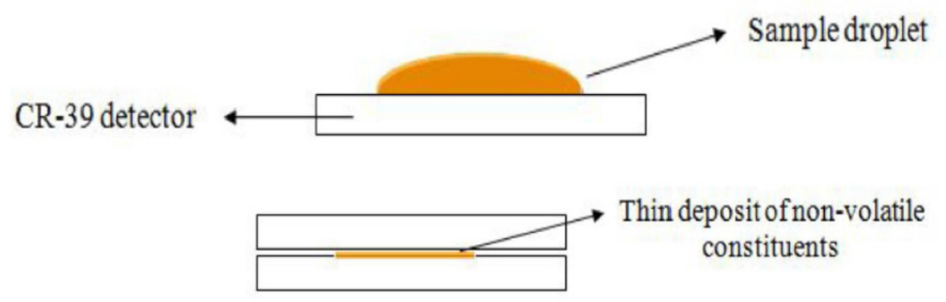

Figure (2a): samples preparing

After that, cover the detector with transparent adhesive tape on both sides, leaving small spaces between each sample and another, and place sticky sheets next to each sample that contain numbers indicating the data of the sample. Thus, it is in the form of a straight tape placed around the neutron source.

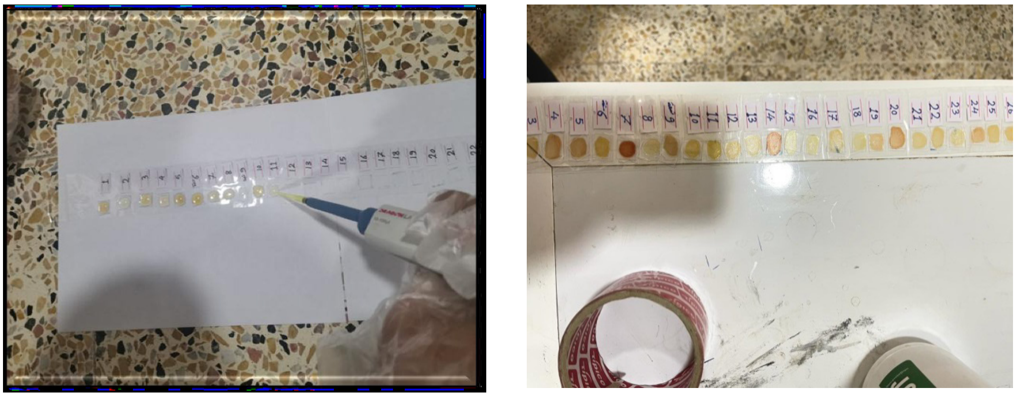

Figure (2b): adding blood to the detector

2.3.Nuclear track detector (CR-39)

Per shore Molding Ltd.UK CR-39 detector with a thickness of 500 mm was used to record the effects of fission fragments. The detector sheets were cut into small pieces of area of each piece (cm 1.5 * cm 1.5). These pieces were kept at room temperature.

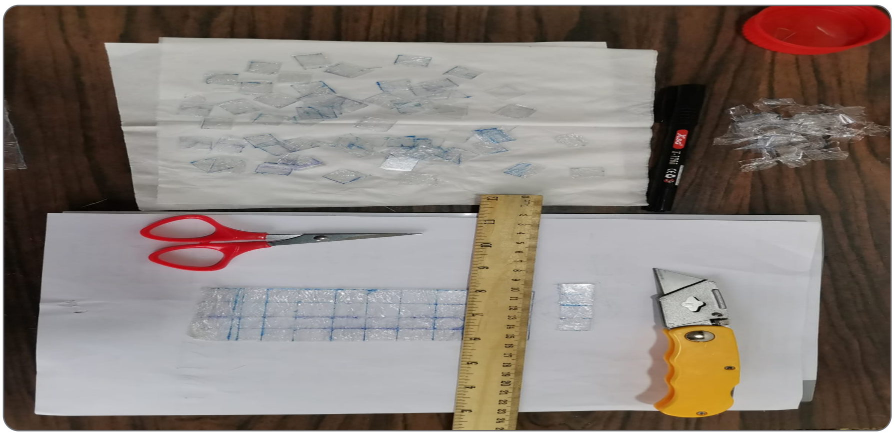

Figure 3: Reagent shredder process

2.4 Calculations of Uranium Concentrations

The uranium concentrations in the study's blood samples were ascertained by comparing the levels of uranium in unknown (unknown) samples to the density of traces recorded for standard blood samples (after subtracting the effects with the empty detector). This was done by comparing the intensity of the effects obtained through the CR-39 nuclear trace detector for blood samples. The levels of uranium chain formed in standard blood samples are 0.81 ppb. Standard blood samples were prepared using natural uranium samples that were recommended by the International Atomic Energy Agency (IAEI) to find the calibration completed to analyze the fission trajectory(s) to determine the uranium concentration in biological samples[10].

$$CX = CS \, . \, (\rho X / \rho S) \quad ………. (1)$$

Where: The value of C_x represents the uranium concentration of unknown samples (ppm).

The C_S value represents the concentration of uranium in standard samples (ppm).

The value of $\rho\rho_x$ represents the density of traces in samples of unknown concentration (tracks/mm2).

The value ρρs represents the density of the effects in standard samples (tracks/mm2).

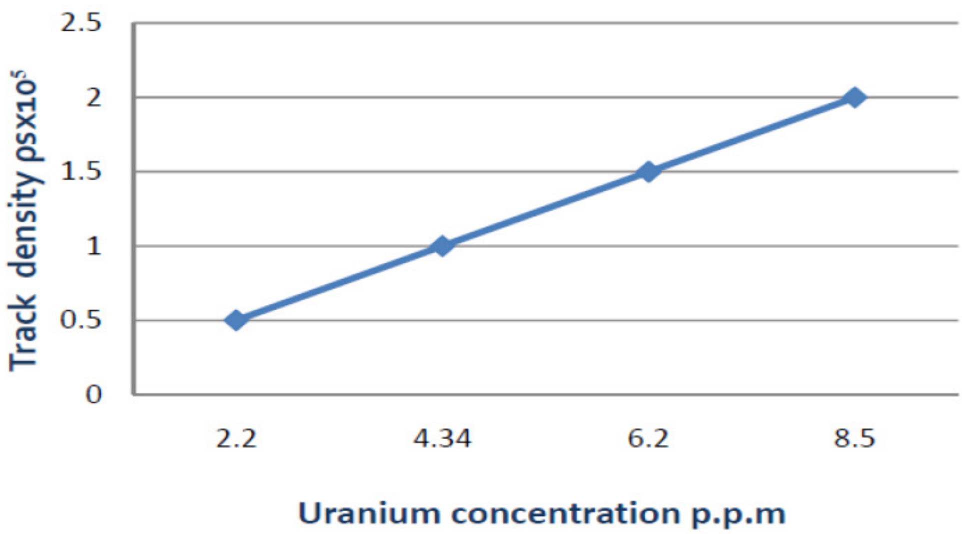

Figure 4 shows how the concentration of uranium in standard blood samples relates to the density of the route [11].

The final equation that was used to measure uranium concentrations in blood samples of unknown concentration can be expressed as follows::

$$C_x = \left(\frac{\rho_x}{Slope}\right) ------ (2)$$

3.Results and discussion

Table (1) shows the concentrations of uranium for blood samples of healthy people, as the study was conducted on (25) people, the number of smokers was 12 people and non-smokers were 13. The highest uranium concentration value was (1.2µg/L) for a 65-year-old smoker, while the lowest uranium concentration value was (0.6 µg/L) for a 6-year-old non-smoker, and this indicates that the person's age and smoking status have a role in the percentage of uranium concentration in people's blood.

Table (1) displays the findings of the uranium concentration in healthy individuals' blood samples.

Cod Sample	age (years)	gender	State smoking	Uranium concentration (µg/L)
C1	16	female	non	0.81
C2	30	female	non	0.84
C3	26	female	non	0.82
C4	40	male	smoker	0.95
C5	33	female	non	0.86
C6	17	male	non	0.81
C7	40	male	smoker	0.96
C8	28	male	non	1.09
C9	23	female	non	0.88
C10	29	male	smoker	0.9
C11	65	male	smoker	1.2
C12	6	male	non	0.6
C13	22	female	non	0.95
C14	52	male	smoker	1.1
C15	41	female	non	1.06
C16	26	female	non	0.91
C17	30	male	smoker	0.98
C18	35	male	smoker	1.10
C19	33	male	smoker	1.03
C20	28	male	smoker	0.88
C21	25	male	smoker	0.84
C22	27	male	non	0.92
C23	22	male	smoker	0.93
C24	27	male	smoker	0.95
C25	30	male	non	1.05
Mean ± Std. Error				0.9368 ± 0.1255560

The average uranium concentration in the blood of smokers and non-smokers is displayed in Table (2) since it is clear from the data and Figure (4) that smoking increases the amount of uranium in the smoker's body. If you discover that the group of smokers has a greater uranium content than the group of non-smokers, there may be a number of reasons why this could be the case, including[12,13]

1. Direct exposure Smoking is an important source of direct exposure to chemicals found in tobacco, including uranium. Uranium is used as an additive in the tobacco processing process and therefore its concentration can be higher in tobacco products.
2. Cold smoke deposition, which occurs when smoke is slowly cooled and deposited on surfaces, can contain elevated concentrations of uranium. Smokers are likely to experience higher levels of cold deposition due to persistent smoking.
3. Smokers may have a higher absorption of uranium through the respiratory tract. Smoking is associated with changes in the respiratory tract and mucous membranes, which can increase the absorption of uranium in the body.
4. Smoking affects the metabolism of minerals in the body, including uranium. Smoking may lead to changes in the process of absorption and distribution of uranium in the body and thus increase its concentration.

Table (2) demonstrates the relationship between smokers' and non-smokers' average uranium concentration.

Gander	No of Subject	Mean ± Std. Error
Smoker	12	0.985±0.104
No Smoker	13	0.892±0.125

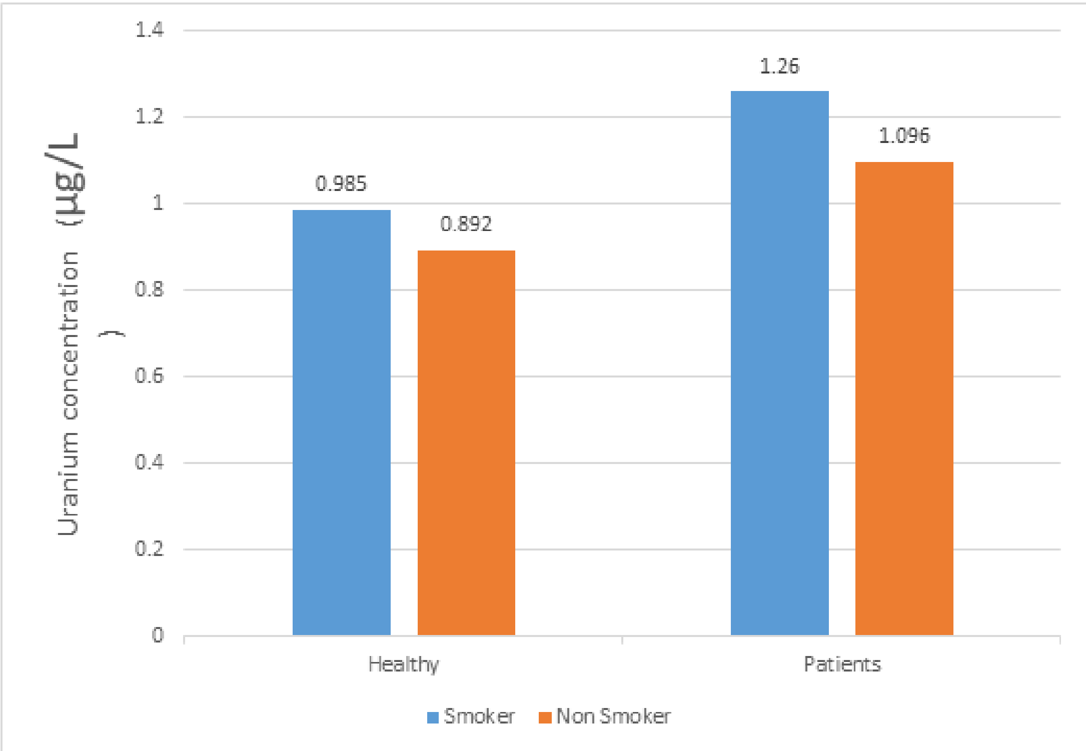

Figure 4 shows a diagram of the average concentration of uranium as a function of the state (smoker and nonsmoker)

4. Conclusions

The highest value of uranium concentration was (1.2µg/L) for a smoker aged (65) years, while the lowest value of uranium concentration was (0.6 µg/L) for a non-smoking child aged (6) years, and this indicates that the person's age and smoking status have a role in the percentage of uranium concentration in the blood of people Direct exposure Smoking is an important source of direct exposure to chemicals in tobacco, including uranium. Uranium is used as an additive in the tobacco processing process and therefore its concentration can be higher in tobacco products.

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