Measurement of the Uranium Concentration in Different Types of Tea Used in Iraqi Kitchen

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Abstract
Tea is one of the important liquids that people drink. In Iraq, tea is the main beverage after water. The tea plant is known scientifically as Camellia sinensis, when planting and during growth needs to fertilizers, which contents remarkable amounts of Uranium. So it became important to study the concentrations of uranium found in tea. Eight samples of tea had been taking, which represent the most important species used in the Iraqi kitchen, and the Uranium concentrations were measured. The results showed that the average concentration of uranium for all samples were**1.005** ***mg/L,*** while the average of the annual effective dose was **0.221** ***mSv/y***. The results also indicated that green tea possesses small concentration of Uranium compared with other species.
Keywords: Uranium, Tea.

قياس تركيز اليورانيوم في انواع مختلفة من الشاي المستخدم في المطبخ العراقي

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الخلاصة
يعتبر الشاي من السوائل المهمة التي يتناولها العالم. ففي العراق يعد الشاي المشروب الرئيسي بعد الماء. ونبات الشاي المعروف علميا بأسم كميليا، عند زراعته واثناء نموه يحتاج الى الأسمدة والتي يدخل في تركيبها اليورانيوم. لذلك اصبح من المهم دراسة تراكيز اليورانيوم الموجودة في الشاي وال منتقلة اليه من الأسمدة في التربة. لقد تم اخذ ثمانية عينات من الشاي والتي تمثل اهم الأنواع المستخدمة في المطبخ العراقي وتم قياس تراكيز اليورانيوم فيها. اوضحت النتائج ان معدل تركيز اليورانيوم لكل العينات كان **1.005** ***mg/L*** بينما كان معدل الجرعة الفعالة بحدود **0.221** ***mSv/y*** . وأوضحت النتائج ايضا ان الشاي الأخضر يمتلك تركيز يورانيوم قليل مقارنة مع الأنواع الأخرى.

1:- Introduction

There are several methods and techniques were used in the literature to measure the concentration and activity of the radioactive isotopes such as Uranium in the environmental samples. Depending on the type of the detected radiation, these methods can be classified into three spectroscopes: gamma, alpha, and beta. The choice of any one of these spectroscopes must be dogged according to the physical type of the sample, mass of the sample, and the importunity of the sample (if the sample is important, then nondestructive method can be used). Solid State Nuclear Track Detectors (SSNTDs)

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[1] method can measure concentration of any charged particles such as alpha particles, then one can classify it as alpha spectroscopy in the radioactive contamination field. There are many researchers [1-2] used it to estimate the concentration of Uranium in the environmental samples. Environmental samples which ingested into human body represent the most important samples because the resulted effective dose increases rabidly with increasing the concentration or activity of these samples. However, with the passage of time the technique of SSNTD (in spite of its simplicity) became a powerful scientific tool [1]. Not only this technique system is simple, inexpensive, employs very little electronics, is portable but also it has found some unique applications in almost all scientific fields. On the other hand, after water, tea is the most widely consumed beverage in the world [3]. It has a cooling, slightly bitter, and astringent flavor that many people enjoy [4]. In Iraq, the daily average consumption of tea, spatially black tea is about 0.5 litters while for drinking water is about 2 litters. Therefore, one must be gave attention to the tea.

Tea, like any plant, planted in soil which must be contained fertilizers to obtain a good plant and tasty. A fertilizer, in it's made, contains some amount of Uranium which can be transfer to the tea plant and accumulated in it.

However, in this paper different types of tea, which widely utilized from the public of Iraq, are measured against Uranium Concentration (UC) using CR-39 as SSNTD technique.

2:- Tea

Tea is an aromatic beverage commonly prepared by pouring hot or boiling water over cured leaves of the tea plant, Camellia sinensis [5].

Tea has historically been promoted for having a variety of positive health benefits, and recent human studies suggest that green tea may help reduce the risk of cardiovascular disease and some forms of cancer, promote oral health, reduce blood pressure, help with weight control, improve antibacterial and antivirasic activity, provide protection from solar ultraviolet light [5], increase bone mineral density, and have "anti-fibrotic properties, and neuro protective power".

Consumption of tea is associated with a lower risk of diseases that cause functional disability, such as "stroke, cognitive impairment, and osteoporosis" in the elderly [4].

Teas can generally be divided into categories based on how they are processed. There are at least six different types of tea: white, yellow, green, oolong (or wulong), black, and post-fermented tea of which the most commonly found on the market are black, white, green, and oolong. Some varieties, such as traditional oolong tea and Puerh tea, a post-fermented tea, green tea, can be used medicinally [6].

After picking, the leaves of Camelliasinensis soon begin to wilt and oxidize, unless they are immediately dried. The leaves turn progressively darker as their chlorophyll breaks down and tannins are released. This enzymatic oxidation process, known as fermentation in the tea industry, is caused by the plant's intracellular enzymes and causes the tea to darken. In tea processing, the darkening is stopped at a predetermined stage by heating, which deactivates the enzymes responsible. In the production of black teas, the halting of oxidization by heating is carried out simultaneously with drying.

Without careful moisture and temperature control during manufacture and packaging, the tea may become unfit for consumption, due to the growth of undesired moulds and bacteria. At minimum, it will make the taste unpleasant.

3:- Materials and Methods

Iyar is one of the pioneers in SSNTD field and in his paper proved that the best method for preparing and sampling any sample was done by made it soluble [2]. Then the SSNTD putt in the solution sample to get homogenous distribution of tracks, therefore, the read of these tracks by some numbers of microscope field view became sufficient to estimate the concentration comparing with the hall detector if one used solid sample. On the other hand, for all tea samples, and to simulate the reality, the dried tea samples were putt in boiling water over 15 minutes. After that, the tea solution centrifuged with 4000 round per minutes centrifuge to get a dense tea solution. Finally, the CR – 39 with $1\times 1cm^2$ area butted in this dense solution with 3cm radius plastic cup. Then, all cups lifted one month to get good irradiation of alpha particles of the CR – 39 films. The exposed films were etched in a NaOH solution at optimal conditions, ensuring good sensitivities of the SSNTDs and a good reproducibility of the registered track density rates with 6.25N at 70 °C for 7 hours for the CR-39 detectors [1].

4:- Results and Discussion

The calibration of the Uranium concentration was done by measured the density of tracks in the CR – 39 films which had putted for one month in standard samples of Uranium taken from Ref. [7]. Figure (1) - illustrated the calibration curve and from curve fitting, one can deduce equation (1) which used to estimate the results of the Uranium concentration in tea samples.

$$Concentration of Uranium\left({}^{mg}/_{L}\right) = \frac{\rho\left({}^{tracks}/_{cm^2.h}\right) - 5.186}{66.95} \quad \text{.....(1)}$$

Eight tea samples, which used in Iraqi kitchens, were tested against UC. The overall results illustrated in table (1) and showed that the maximum, minimum, and the overall average concentration of Uranium are 1.946, 0.169 and 1.005 ${}^{mg}/_{L}$ respectively. Comparing with allowed concentration of Uranium in drinking water 10 ${}^{\mu g}/_{L}$, which gave by several works [8 – 12], UC in tea samples larger than the UC in drinking water about thousand times. The daily intake of tea for Iraqi costumers is about 0.5 litters per day which is quarter of water intake (2 litter per day), therefore, one can expect that the UC in tea samples is very high against allowed limits. On the other hand, the results demonstrate that the green tea sample (sample with label S8) has value 0.169 ${}^{mg}/_{L}$ very small comparing with other samples (which represent black tea). This remark pushed us to repeat the procedure of UC measurements for five times for all samples but the results appeared the same with negligible differences. Therefore, one can conclude that the green tea absorbed small amount of U from the planted soil and fertilizer, which contain U with noticeable concentrations, and for costumers one can highly recommend the use of green tea in addition to health useful of it [6].

However, the annual committed effective dose (E_{Ui} in $Sv.y^{-1}$) to the adult members of the population due to the ^{238}U, ^{235}U and ^{234}U radionuclides, originated from the ingestion of drinking tea is given by [10]:

$$E_{Ui} = I_{Ui} \cdot e(g)_{Ui} \quad \text{.....(2)}$$

where I_{Ui} represents the annual intake in $Bq.y^{-1}$ for U with its three isotopes I_{U-238}, I_{U-235} and I_{U-234}, respectively, and $e(g)_{Ui}$ are the ingestion dose coefficients of ^{238}U,^{235}U and ^{234}U which have the values; 4.50E-08, 4.70E-08 and 4.90E-08 Sv/Bq as shown in Table (2). E_{Ui} was estimated for each isotopes of Uranium by calculated I_{Ui} and $e(g)_{Ui}$ then summed the three E_{Ui} to obtain E_U (Annual committed effective dose of the natural Uranium).

Table (1) showed the results of the E_U of the tea samples which had the maximum and minimum values as 0.037 and 0.428 mSv/y with overall average about 0.221 mSv/y. The allowed effective dose for all ways of intake (such as ingestion and inhalation) and for all radiation exposures (such as Radon or Cosmic rays) for publics is about 1mSv/y, as given by National Conical on Radiation Protection (NCRP) [12], which is distributed as shown in figure (2) for USA. Figure (2) demonstrated that costumer's exposure is about 2% whereas from the results of this work (for Iraqi costumers), the E_U for tea samples is about only 25% from total effective dose. Therefore, one can conclude that for Iraq the allowed effective dose must be determined and estimated for all sources of radiation exposures.

5:- Conclusions

Tea is highly intakes by Iraqi publics, so, the measurements of the UC are very important to healthy live. The maximum, minimum, and the overall average UC in tea samples are 1.95, 0.66, and 1.12 ${}^{mg}/_{L}$ respectively. Also, the results demonstrated that the tea have a one thousand UC more than the water. Finally, the results strongly suggested that the green tea is recommended to use instead the usual one (black tea) in Iraqi kitchens.

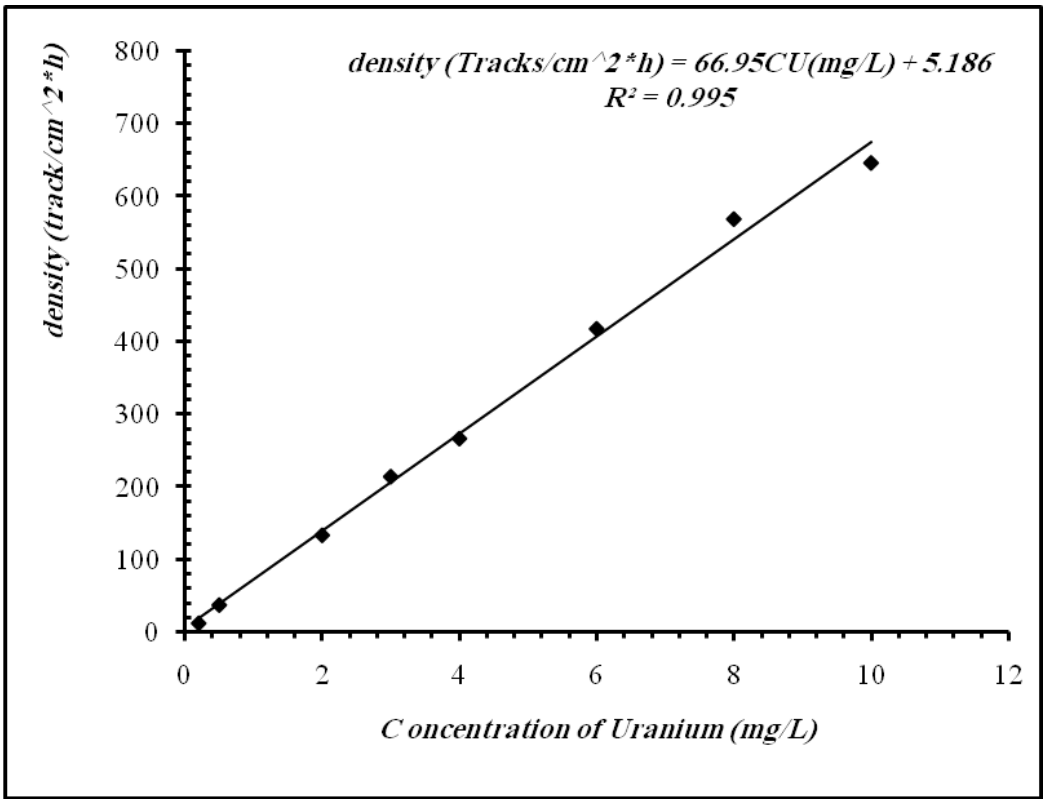

Figure 1- the calibration curve of the CR-39 SSNTD for Uranium.

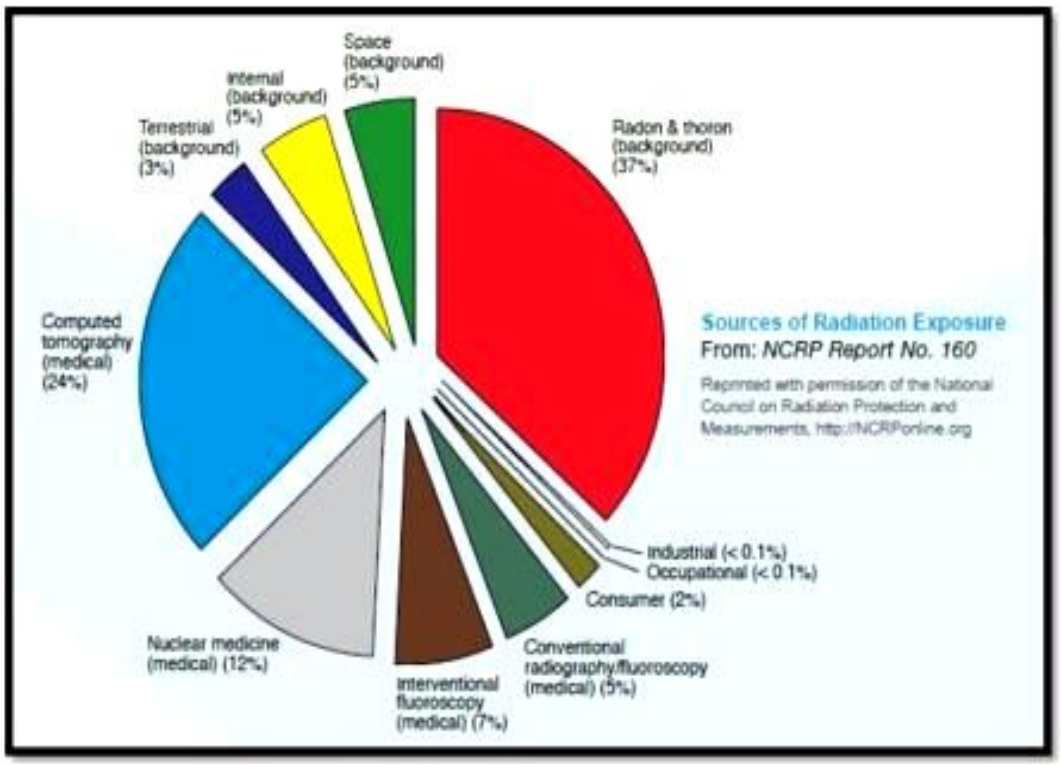

Figure 2- Sources of Radiation Exposure [12].

Table 1- The overall results of the tea samples

Samples Trade market	Tracks No.	Density $\left(Tracks/_{cm^2 * h}\right)$	CU $\left(mg/_L\right)$	S.A $\left(Bq/_L\right)$	Eff. Dose $\left(mSv/_y\right)$
S1 Apple Tea (Dubai)	**16800**	**135.36**	**1.946**	**49.842**	**0.428**
S2 Wasa Tea (Dubai)	**6600**	**62.04**	**0.850**	**21.767**	**0.187**
S3 Tea supplied to Iraqi costumers from Iraqi Trade Ministry	**13400**	**125.96**	**1.805**	**46.243**	**0.397**
S4 Barari Tea (Dubai)	**7700**	**66.81**	**0.921**	**23.596**	**0.203**
S5 Ahmed Tea (London)	**7000**	**65.8**	**0.906**	**23.208**	**0.199**
S6 Chehan Tea	**6300**	**49.01**	**0.655**	**16.779**	**0.144**
S7 Mahmood Tea	**6700**	**58.14**	**0.791**	**20.274**	**0.174**
S8 Alokozay Green Tea (Celan)	**1830**	**16.51**	**0.169**	**4.337**	**0.037**
The overall average	**8291.25**	**72.45**	**1.005**	**25.756**	**0.221**

Table 2- Radiological properties of natural uranium [10].

Isotope	Specific activity for Uranium	Mass fraction (%)	Ingestion dose coefficients eg_{Ui}
U-238 (Bq/mg)	12.44	99.2745	4.50E-08
U-235 (Bq/mg)	80	0.72	4.70E-08
U-234 (Bq/mg)	230700	0.0055	4.90E-08
U Total (Bq/g)	25400	-	-

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