Study of Some Radiological Parameters in Tobacco leaves of Iraq

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Abstract:

In present work radioactivity measurements of radionuclides to (^{226}Ra,^{232}Th and ^{40}K) and Some Radiological Parameters of (14) tobacco leaves samples that available in Iraq markets was determined using NaI (TI). The results showed the average specific activity for ^{226}Ra, ^{232}Th and ^{40}K have been found (4.299) Bq/Kg, (4.729) Bq/Kg and (1029.147) Bq/Kg. while the average values of annual effective dose^{226}Ra, ^{232}Th and ^{40}K were (0.101) mSv/y, (0.796) mSv/y and (0.035) mSv/y.

Keywords: Radio activity, Tobacco leaves, NaI detector.

قياس بعض متغيرات الاشعاعية لأوراق التبغ في العراق

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الخلاصة:

في هذه الدراسة تم حساب نشاط الاشعاعي لنويذات (^{226}Ra و ^{232}Th و ^{40}K) و بعض المتغيرات الاشعاعية ل (١٤) نمودج من الاوراق التبغ المتوفره في الاسواق العراقية باستخدام كاشف يوديد الصوديوم NaI (TI). لقد وجدة معدل الفعالية النوعية لكل من(^{226}Ra و ^{232}Th و ^{40}K) هي (4.299) Bq/kg و (4.729) Bq/kg وBq/kg (1029.147) على التوالي. بينما معدل قيم جرع السنوية لكل من (^{226}Ra و ^{232}Th و ^{40}K) هي (0.101) mSv/y و (0.796) mSv/y و (0.035). mSv/y

الكلمات المفتاحية: النشاط الاشعاعي, أوراق التبغ ,كاشف (NaI (TI)..

1. Introduction

Natural radioactive decay series such as ^{238}U and ^{232}Th as well as singly occurring radionuclides such as ^{40}K exist in the earth curst and atmosphere in varied levels. The radioactivity present on air or in the agricultural land and in soil may transfer to the crops grown on it. It happens; however, that an amount of some radioactive elements find their way into human bodies [1]. The specific metabolic character of the plant species may lead to accumulation of radio-nuclides in their organs, which may further depend upon the physical-chemical characteristics of the soil [2]. The radionuclides present in the environment are transferred to plants by

two ways first indirect method uptake from soil through roots [3]. Second, it is direct method absorption through aerial parts of the plants. Presence of radioactivity in plant organs has been reviewed by various workers [2]. Tobacco is an agricultural product processed from fresh leaves of plants in the genus Nicotania. It contains minute quantities of radioactive isotopes that pose a radiation exposure hazard to those who internationally or passively inhale it [4].

2. Materials and Method:

2.1. Collection Sample and Preparation

Fourteen types of Tobacco leaves (domestic and importer) are collected from market of Iraq. We divided these samples into (7) groups according to the producing country as shown in table (1). The Tobacco samples have been dried, ground homogenization and sieved. The samp les are dried before radioactivity measurement for (2-4) days at a temperature of (42-44)^{o}C. The dried tobacco were have been ground and milled using a blender to obtain an equal size particles. Later, equal weight (0.25) kg of each tobacco sample (using a high sensitive digital weighting balance with a percent of ±0.01%). The samples are sealed for about (4) weeks in the Marnelli beakers (with size 1L) to reach secular equilibrium between the isotopes of natural decay series. Then they have been brought in front of the detector for counting to about 18000 seconds.

Table (1): Show Tobacco Samples according to the producing country

No.	Groups	Samples Code	Origin
1	G1	T1	IRAQ
2		T2	IRAQ
3	G2	T3	FRANCE
4		T4	FRANCE
5	G3	T5	ITALY
6		T6	ITALY
7	G4	T7	BULGARIA
8		T8	BULGARIA
9	G5	T9	TURKEY
10		T10	TURKEY
11	G6	T11	EUROPEAN
12		T12	EUROPEAN
13	G7	T13	EGYPT
14		T14	EGYPT

2.2. Radioactivity Measurements in the Samples

2.2.1. Radioactivity Counting

The scintillation detector is illustrated in fig (1). Our detector has a (3 × 3) inch cylindrical NaI scintillation crystal which is activated with thallium impurities [5]. The Uranium–238 and Thorium–232 activities were determined indirectly through the activities of their daughter products. Following calibration of detection system performance and determining the minimum detectable activity of system, quantitative analysis of prepared samples was performed. Photo-peak efficiency for each of the peaks with the mentioned energy can be calculated using the following equation [6]:

$$\text{Efficiency } (\%) = \frac{N_P}{I_\gamma T_0 C} \times 100\% \ldots . (1)$$

Where:

N_p: Net photo-peak area (count/ sec) at E_γ,

I_γ: Intensity of emitted gamma ray (%),

T_o: Time of counting (sec.)

C: activity of standard source in (Bq).

The Specific activity concentrations in the samples were obtained using the expression [7]:

$$C\left(\frac{Bq}{Kg}\right) = \frac{N_P}{\varepsilon\, t\, I_\gamma\, M_s} \dots\dots\dots\dots\dots (2)$$

Where:

C is the Specific activity of the radionuclide in the sample.

N_P is the net photo-peak due to each radionuclides.

ε is the detector efficiency of the specific gamma ray.

t is the time exposure.

I_γ is the absolute transition probability of the specific gamma ray.

M_s is the mass of the sample (kg).

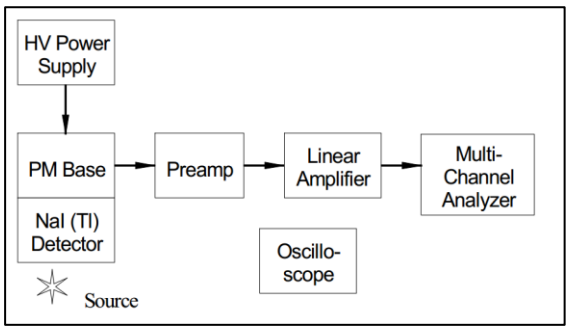

Figure (1): Block diagram for a scintillation detector system [5]

2.2.2. Annual Effective Dose

To estimate the annual effective doses (H_E), we have assumed 0.82 g of tobacco per cigarette and a smoker is smoking 30 cigarettes (one and a half packs) per day or (24.6) g of tobacco per day, and then the annual consumption of tobacco by cigarettes is estimated to be (8.985) kg/y. The fraction of the radionuclide activity concentration that is recovered from cigarette tobacco to cigarette smoke is 0.75, as on the average, about 75 % of the radioisotope in the cigarette tobacco is contained in the cigarette smoke, which is partially inhaled and deposited in the lung tissues and about 25 % is retained in the cigarette filter. Then the derived for the annual effective dose, H_E (Sv/y), is due to inhalation for adults (smokers), according to the equation [8].

H_E = 0.75 x MT x A x F----------(3)

where MT (kg/y) refers to the annual amount (in mass) of tobacco consumed, A (Bq/Kg) refers to the concentration of the, and F (Sv/Bq) refers to the dose conversion factor[8].

3. Results and Discussions:

Table (2) shows the specific activity of ^{226}Ra, ^{232}Th, and ^{40}K of the collected Tobacco leaves samples which it in Iraq markets. The specific activity of radionuclide of collected samples under study ranges from (0.934) Bq/Kg to (10.07) Bq/Kg for ^{226}Ra, (1.036) Bq/Kg to (18.253) Bq/Kg for ^{232}Th and from (594.299) Bq/Kg to (1459.976) Bq/Kg for ^{40}K. There is a variation in the specific activity of radionuclides in different Tobacco leaves samples, for example (T4) which is FRANCE has lowest ^{226}Ra concentration, while (T10) which is TURKEY has the maximum value, (T11) EUROPEAN has the lowest ^{232}Th concentration while the maximum is (T6) ITALY, and the lowest ^{40}K concentration is (T2) which is IRAQ and the maximum is (T6) which is ITALY as shown in fig(2), fig(3) and fig(4) From the specific activity of ^{226}Ra, ^{232}Th, and ^{40}K of Tobacco samples, the annual effective dose is calculated and the results are ranges from (0.022) mSv/y to (0.237) mSv/y for ^{226}Ra,

form (0.174) mSv/y to (3.075) mSv/y for ^{232}Th and from (0.020) mSv/y to (0.049) mSv/y for ^{40}K presented in table (3). The table (4) showed specific activity concentration in tobacco leaves for some countries.

Table (2): Specific Activity of ^{226}Ra, ^{232}Th and ^{40}K in Tobacco Samples

No.	Groups	Samples Codes	Specific Activity(Bq/kg)		
			A(^{226}Ra)	A(^{232}Th)	A(^{40}K)
1	G1	T1	3.010	2.925	863.143
2		T2	5.295	1.401	**594.299**
3	G2	T3	6.021	1.706	976.144
4		T4	**0.934**	6.521	985.946
5	G3	T5	5.295	8.593	1054.561
6		T6	7.890	**18.253**	**1459.976**
7	G4	T7	1.038	13.499	1093.330
8		T8	2.595	3.870	778.228
9	G5	T9	3.530	4.113	886.602
10		T10	**10.070**	5.028	1169.214
11	G6	T11	3.426	**1.036**	715.670
12		T12	1.349	2.986	1185.735
13	G7	T13	1.038	3.413	955.879
14		T14	8.409	15.937	1088.484
	Min		**0.934**	**1.036**	**594.299**
	Max		**10.07**	**18.253**	**1459.976**
	Ave		**4.299**	**4.729**	**1029.147**

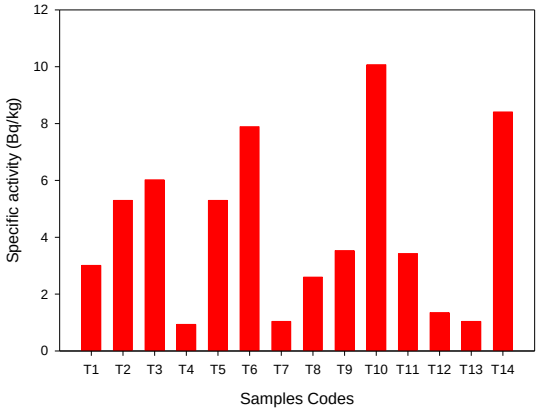

Figure (2): Represent values of Specific Activity of ^{226}Ra in Tobacco samples

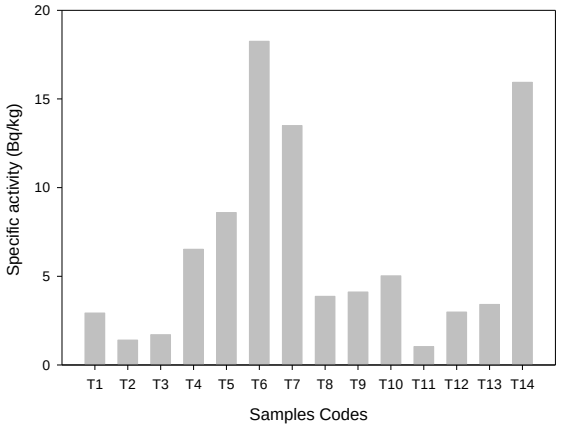

Figure (3): Represent values of Specific Activity of ^{232}Th in Tobacco samples.

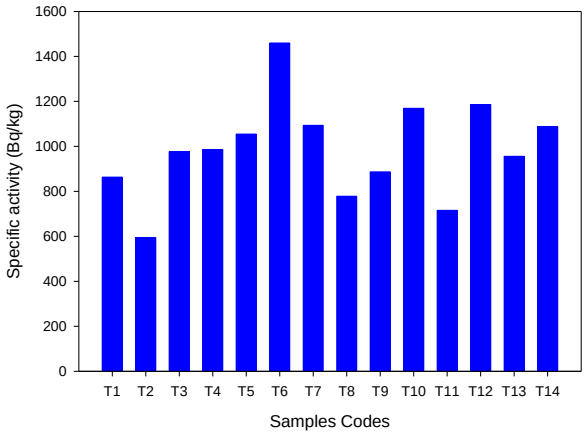

Figure (4): Represent values of Specific Activity of ^{40}K in Tobacco samples.

Table (3): Represent annual effect dose for ^{226}Ra, ^{232}Th and ^{40}K in Tobacco samples.

No.	Groups	Samples Codes	Annual Effective Dose(mSv/y)		
			^{226}Ra	^{232}Th	^{40}K
1	G1	T1	0.070993	0.492771	0.02949
2		T2	0.124886	0.236025	0.020305
3	G2	T3	0.142009	0.287408	0.03335
4		T4	0.022029	1.098585	0.033685
5	G3	T5	0.124886	1.447652	0.03603
6		T6	0.186091	3.07506	0.049881
7	G4	T7	0.024482	2.27416	0.037354
8		T8	0.061205	0.651974	0.026589
9	G5	T9	0.083257	0.692912	0.030291
10		T10	0.237507	0.847061	0.039947
11	G6	T11	0.080804	0.174534	0.024451
12		T12	0.031817	0.503048	0.040511
13	G7	T13	0.024482	0.574984	0.032658
14		T14	0.198332	2.684886	0.037189
	Min		**0.022029**	**0.174534**	**0.020305**
	Max		**0.237507**	**3.07506**	**0.049881**
	Ave		**0.101408**	**0.796693**	**0.035161**

Table (4): Specific Activity of ^{226}Ra, ^{232}Th and ^{40}K in Tobacco samples for some countries using Gamma spectroscopy

Country	^{226}Ra (Bq/kg)	^{232}Th (Bq/kg)	^{40}K (Bq/kg)	Ref
India	61 to 153	28 to 42	750 to 2232	11
Yemen	57.8 to 69.4	46.8 to 77.6	660 to 1091	12
Iraq	59.08	3.1	102.61	13
Present Study	0.934 to 10.07	1.036 to 18.253	594.299 to 1459.976	

4. Conclusions

1. The minimum value of specific activities concentrations for ^{226}Ra and ^{232}Th nuclides, has been found in (FRANCE and European) tobaccos. While minimum value of specific activity for ^{40}K has been recoded in Iraq's tobaccos.
2. The maximum value of specific activities concentrations for ^{232}Th and ^{40}K nuclide, has been found in Italian's tobacco. While maximum value of ^{226}Ra nuclide has been found in Turkish tobacco's.
3. The value of specific activities in all samples under study have been found lower than values of specific activities measured in some countries according table (4).
4. There is no danger of radiation healthy in measured models.

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