

Studying the Natural Radioactivity in Some Tobacco Cigarettes Imported to Iraq from Unknown Origins

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Abstract

Natural radioactivity isotope in ten tobacco leaf samples presented in different cigarettes imported to Iraq from unknown origins, were determined by gamma-ray spectrophotometer.

The study revealed several naturally occurring radionuclides in these samples. Such isotopes were "Bi-214" which belongs to U-238 series and; "Pb-212, Bi-212, Ac-228" which belongs to Th-232 series, and K-40.

Furthermore, the results show that the maximum concentrations of Pb-212, Bi-214, Bi-212, Ac-228 and K-40 radionuclides were (9.13, 59.08, 17.15, 3.1 and 102.61 Bq/Kg). Such radioactive isotopes were respectively detected in Bisnuse club, Grip, again Bisnuse club, Najema and pin cigarette type.

It is concluded from the results that Iraqi cigarettes are heavily contaminated with several radioactive isotopes. This may be reflected as a major health impact among Iraqi populations.

Keywords: Tobacco; Natural radioactivity; Gamma spectrophotometer; Cancer.

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Introduction

Tobacco leaf may contain minute quantities of radioactive isotopes such as uranium series and thorium series isotopes (Pb-210, Po-210, Ra-226), that are radioactive carcinogenic and could be found in smoke from burning tobacco,¹ which pose a radiation exposure hazard to those who intentionally or passively inhale tobacco smoke. The burning temperature of a cigarette is around 700°C, radionuclides are supposed to volatilize at temperatures over 500°C.^{1,2}

The polonium isotopes are among the most radiotoxic nuclides to human beings. The concentrations of polonium-210 in cigarette tobacco are in the range of 2.8-37Bq/kg and vary with the cigarette brand, probably due to the different varieties of tobacco used and to different manufacturing procedures.³ Some results indicate that Po-210 in cigarettes is volatilized at the temperatures characteristic for burning cigarettes and inhaled into the lung along with the cigarettes smoke. It might effectively be a factor in the increased incidence of lung cancer among cigarettes smokers.⁴

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Since then, other investigators have studied both the sources and behavior of Po-210 and lead -210 in relation to smoking, and the biological effects of these on lung tissues and other organs.³ Investigators reported that Pb-210 and Po-210 are present in both gaseous and particulate phases of tobacco smoke; both radioisotopes descend from radium-226(Ra-226) and its decay product, radon-222 (Rn-222).⁵ Pb-210 decays by beta particle emission to bismuth-210(Bi-210), which then decays by beta particle emission to Po-210 emits high energy alpha particles (5.3 million eV) and gamma radiation (550,000 eV) when it decays, becoming stable lead -206(Pb-226).^{5,6}

Tobacco plants absorb radioisotopes from the soils in which they grow. In addition, tobacco plants gather naturally present Rn-222 descendants from the surrounding air. The large surface area of tobacco leaves and their hairy and sticky nature facilities enhanced deposition of radioisotopes on the leaves during the plants life.^{6,7} This provides an additional concentration of radioisotopes on leaf surfaces beyond its concentration within the whole leaf.

It's a well established that commercially grown tobacco is contaminated with radiation. The major source of this radiation is the phosphate fertilizer, which contains radioactive metals, which may persist for so many years in the soil. These radioactive metals build up in the soil, attach themselves to the resinous tobacco leaf and ride tobacco trichomes in tobacco smoke, gathering in small "hot spots" in the small-air passageways of the lungs.^{6,8}

The objective of this study was to detect the radionuclides exist in the cigarette tobacco samples and to estimate its specific activity in the most frequently smoked cigarettes imported to Iraq.

Experimental Methods

Collection of tobacco leaf: Ten different cigarette types, imported to Iraq from unknown origins -five of them are most frequently smoked

between the gays in Iraq- were collected from local markets in Baghdad. The cigarettes brands were: Coult, Miami, Grip, Pin, Denver, Nejma, Viceroy, Bisnese Club, Gold and Fisher.

Detection of Radioactivity: One hundred grams of tobacco were isolated from their papers and filters, they were homogenized and transferred to a marenilli beaker to be examined by gamma-ray spectrophotometer for a period of four hours (14400sec)and with operating voltage of (530 V) to detect the radioisotopes in the samples.

Sodium iodide thallium NaI (TI) "2×2"detector with a resolution power (8.7%) and computer assisted science system (MCA-CASSY) version (1.11) written at 1997 were be used in this research.

Gamma energy spectrum Background of the laboratory environment have been determined by using empty Marenilli beaker putted on the NaI(TI) detector with the same period and operating voltage used for determination of samples energy spectra. As shown in fig(1)

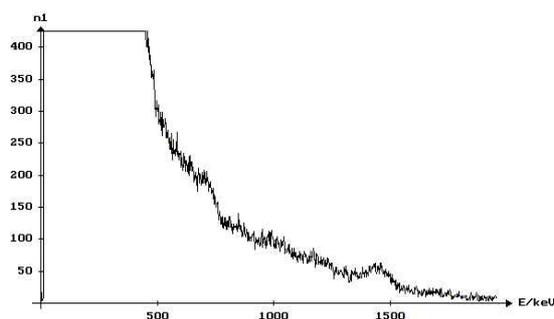


Fig. (1): Background spectrum using Na(Tl).

Energy and efficiency calibrations were performed by Cs-137, CO-60, and Na-22 sources. The specific activity concentrations of these detected samples were calculated from equation:
Specific activity = net area under the peak / W × I% × Eff. % × T ---- 1

Where: **W**: weight of the sample (kg), **I**: relative intensity of the gamma emission at energy considered, **Eff.**: Absolute efficiency and **T**: measuring time in (sec)

Results and Discussion

Experimental results are shown in table (1) that Several (5) radionuclides have been detected in the examined tobacco leaf samples they are; Bi-214 (U-238 series), Pb-212, Bi-212, Ac-228 (Th-232 series) and k-40, ranging between (3-4) nuclides in each sample.

Figure from (2-12) showing the gamma ray spectrums of each sample.

Some of them are displayed by two figures to clear all the energy peaks.

The concentrations of interest radionuclides were determined by selected intense gamma lines. These lines are 238 KeV for Pb-212, 703 KeV for Bi-214, 727 KeV for Bi-212, 969 KeV for Ac-228, and 1462 KeV for K-40.⁹

Table (1): The examined cigarette types, the detected radionuclides, Specific activity and the average of specific activity of each nuclide.

Isotopes	Pb-212	Bi-214	Bi_212	Ac_228	K-40	
Energy (keV)	238	703	727	969	1460	
intensity	44.6	0.47	7.59	16.6	10.7	
Cigarette Samples	Specific activity(Bq/Kg)					No.
<i>Court</i>	7.360	—	—	—	74.018	2
<i>Miami</i>	7.630	43.518	—	—	62.691↓	3
<i>Grip</i>	7.761	59.083	—	—	67.495	3
<i>Pin</i>	7.109↓	53.562	—	—	102.616↑	3
<i>Denver</i>	7.459	—	7.822↓	—	68.102	3
<i>Najema</i>	8.664	—	—	3.102	71.214	3
<i>Viceroy</i>	6.437	—	12.111	—	83.925	3
<i>Bisnuse club</i>	9.133 ↑	—	17.153↑	—	73.925	3
<i>Gold</i>	7.613	—	9.849	0.383	77.850	4
<i>Fisher</i>	8.136	—	13.619	—	70.841	3
Average	7.730	52.543	12.122	1.742	75.267	

From this table we can see that:

1. K-40 having the highest average specific activity (75.267Bq/Kg) while Ac-228 having the lowest (1.742 Bq/Kg).
2. Some nuclides appeared in some samples and absent in another.
3. Bisnuse clube type which is a Virginia blended tobacco and made under the authority of England has the highest specific activity in two of its detected nuclides (Pb-212and Bi-212).
4. comparing with other similar studies¹ we can see that Bi-214 and K-40 have been detected as in these studies but with lower specific activity, while Pb-210, Ra-226 and Po-210 haven't detected because the first two nuclide has a small energy 46.52KeV, 186 KeV respectively which lies within Compton scattering area of our using detector, while the second nuclide has a very low intensity (0.0012). In other studies they detect it by alpha spectrometer not gamma as in our research.^{2,4}
5. In general, some tobacco samples contain much higher levels of radionuclides compared to others, that's because some countries tobacco farmers use more commercial phosphate fertilizers derived from apatite rock which is naturally radioactive. For example, American cigarettes have 500% higher radiation levels than Indian tobacco.¹⁰ Therefore, we can see significant differences between tobaccos from different countries depending on the dominant farming methods.

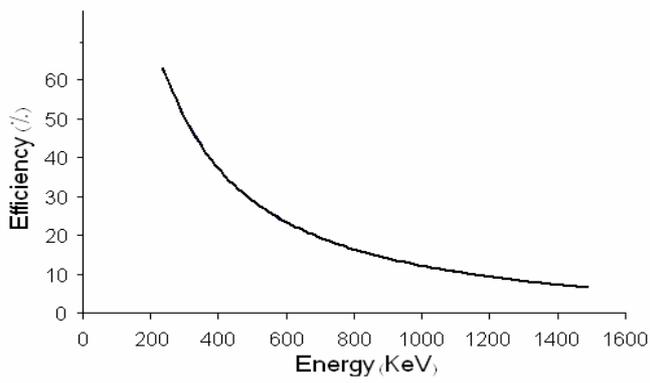


Fig. (2): Efficiency curve of Na(Tl)detector.

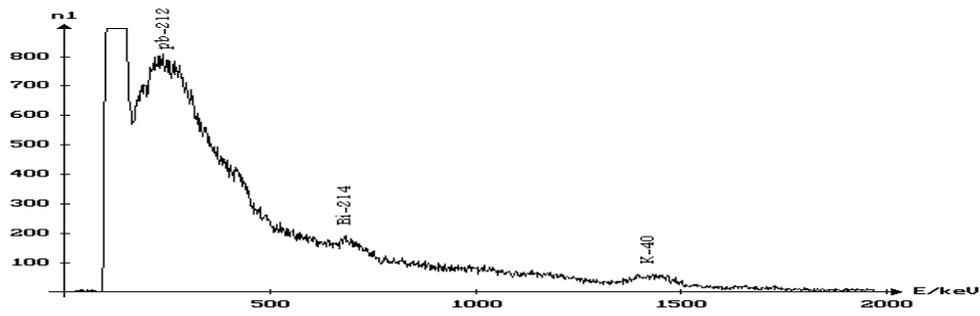
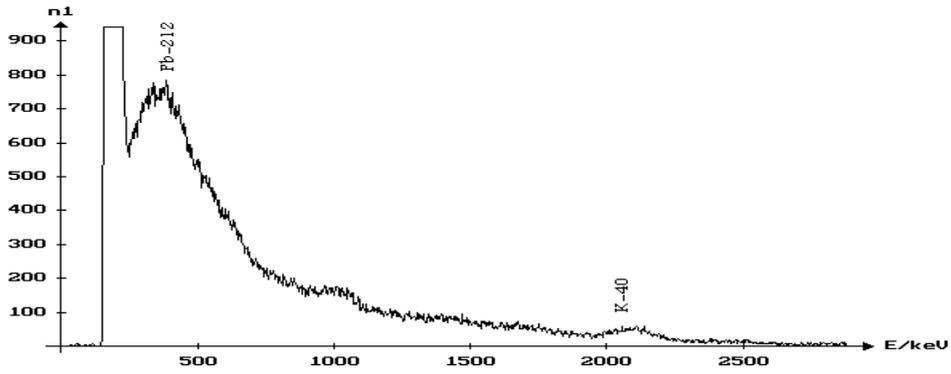


Fig. (3): Court.

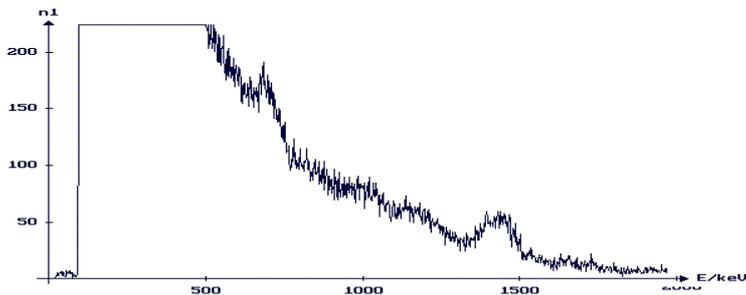


Fig. (4): Miam.

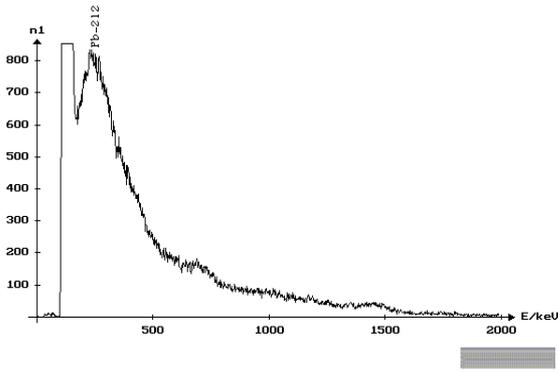


Fig. (5): Grip.

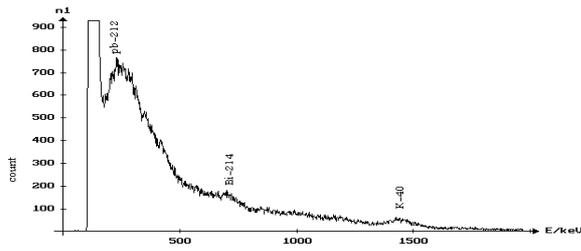
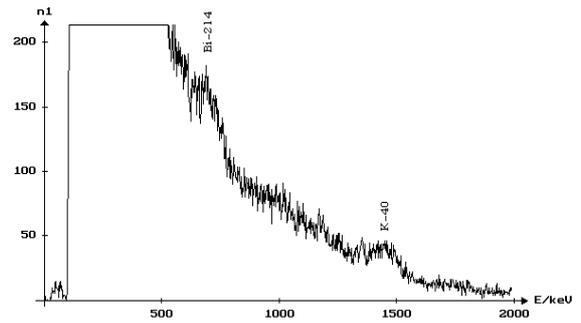


Fig. (6): Pin.

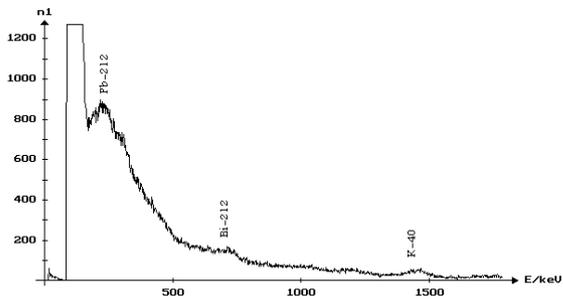
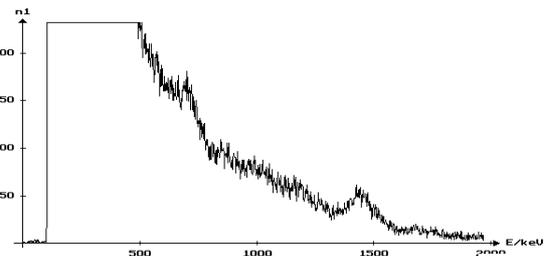


Fig. (7): Denver.

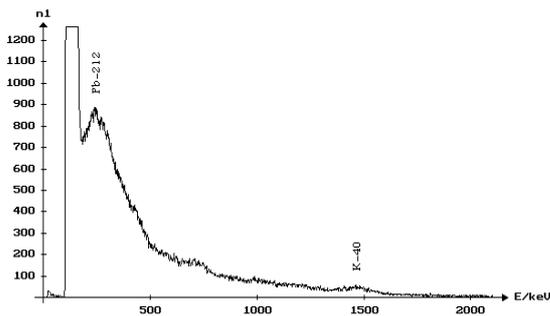
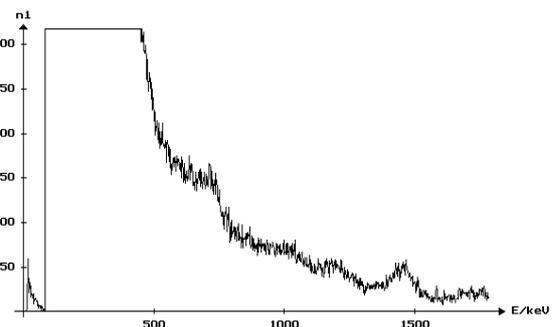
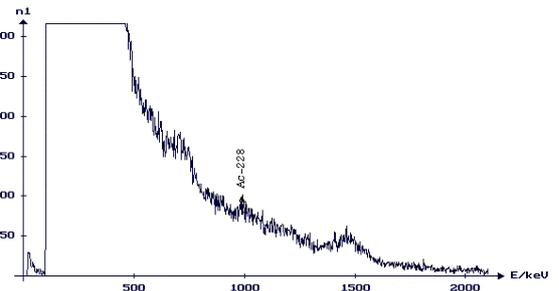


Fig. (8): Nejma.



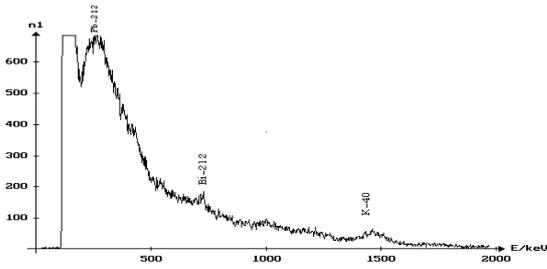


Fig. (9): Viceroy.

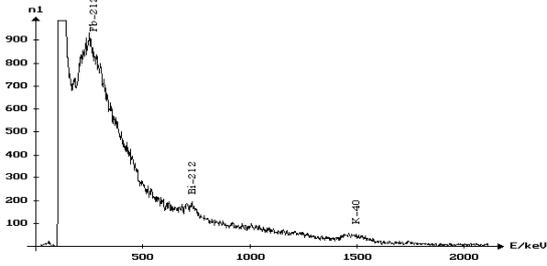
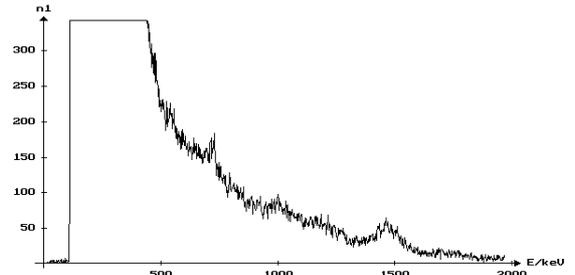


Fig. (10): Bisnes clube.

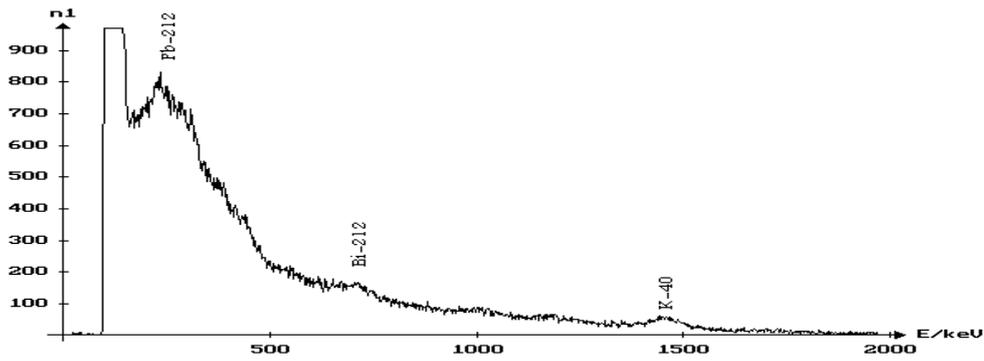
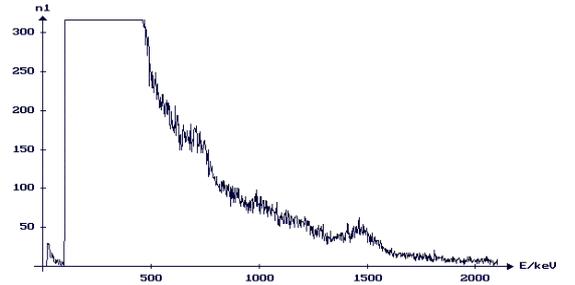


Fig. (11): Gold.

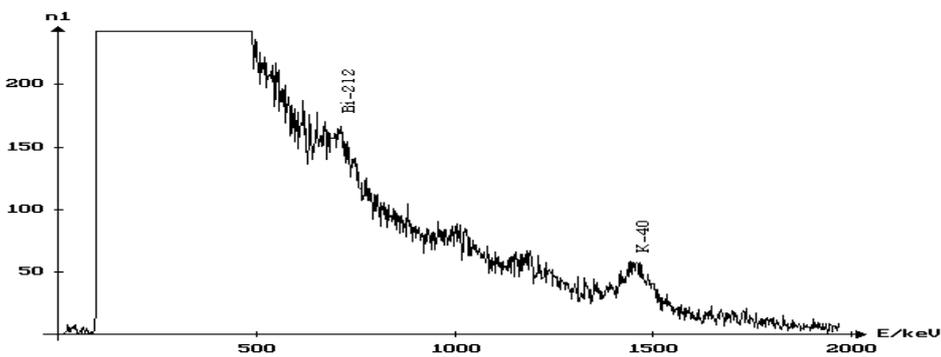


Fig. (12): Fisher.

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