Faculty of Women for, Arts, Science, and Education

Scientific Publishing Unit

# Journal of Scientific Research in Science

Basic Sciences

Volume 38, Issue 1, 2021

ISSN 2356-8372 (Online) \ ISSN 2356-8364 (print)

Journal of Scientific Research in Science 2021, 38, (1): 19-35

Contents lists available at EKB

Journal of Scientific Research in Science

Journal homepage: https://jsrs.journals.ekb.eg/

# Investigation of Radionuclides in Shisha Tobacco and Hazards Impact on the Egyptian Smokers

**Fatma Ragab*, Hanan A.S. Aly**

Physics Department, Faculty of Women for Arts, Science and Education, Ain Shams University, Cairo, Egypt.

**Abstract:**

Number of Shisha smokers has been increased drastically in the last ten years among Egyptians, and smoking shisha has become routine life style not only in popular placed but also in coffee shops and adults clubs. The World Health Organisation's (WHO) provided evidence of the potential health effects when the smokers exposed to shisha similar to a cigarette that contains nicotine, tar, carbon monoxide, heavy metals and cancer- causing chemicals. Selected samples has been investigated in two profiles wet samples (profile A) and dry sample (profile B). The average value of activity concentration for $^{238}$U, $^{226}$Ra, $^{232}$Th and $^{40}$K are 40.96, 4.52, 3.88 and 398.43 Bq/kg, respectively, for wet samples. For dry samples, the average value of activity concentration for $^{238}$U, $^{226}$Ra, $^{232}$Th and $^{40}$K are 50.19, 6.82, 4.31 and 367.07 Bq/kg, respectively. It is clear that the dry samples are little bit higher than the wet samples expect $^{40}$K concentration. Furthermore, the radon concentration values for all studied samples are lower than 300 Bq/m$^3$. The hazard parameters has been determined for two profiles of the studied samples which lower than the recommended value of worldwide.

Keywords: Shisha; Water pipe Tobacco; HPGe detector; Cancer risk; Isotopes.

## 1. Introduction:

Shisha smoking as which named in Egypt in some countries is known as hookah or Hubble bubble smoking is a method of smoking tobacco through a bowl and hose or tube, which is occasionally blended with fruit or molasses sugar [1]. Shisha tobacco is kind of flammable smoking that contains addictive nicotine and it consists of tobacco, glycerol, honey or molasses, and some antics. Furthermore, Shisha tobacco has different flavours such as apples, coconuts, mints, mangos, etc., Tobacco contains trace amounts of radioactive isotopes such as uranium and thorium series isotopes, which are radioactive carcinogens that can be found in tobacco smoke. Radioactive isotopes deposited in smokers' lungs and supplied to sensitive tissues for long periods

*Corresponding author: Fatma Ragab, Physics Department, Faculty of Women for Arts, Science and Education, Ain Shams University, Cairo, Egypt.

E-mail: fatma.ragab@women.asu.edu.eg

of time, resulting in localised radiation exposures, have the potential to cause cancer both alone and in combination with non-radioactive carcinogens [2].

Ionizing radiation causes chronic lung illnesses, acute leucopoenia, anaemia, and oral necrosis, among other health problems. Thorium poisoning can lead to malignancies of the lungs, pancreas, liver, bone, and kidneys, as well as leukaemia [3]. On waterpipe tobacco products and related accessories, there are no WHO FCTC-compliant waterpipe-specific health warning labels which the addition of health warnings on waterpipe tobacco products and accessories is likely to help global public health [4]. Currently used shisha tobacco is manually prepared in Egypt without the supervision of the Egyptian Ministry of Health on the preparation steps which leads to the manufacture of a product containing undetermined toxicity. As a result, continual monitoring of natural radioactivity concentrations and estimating gamma dose rates are critical concerns in assessing associated radiological risks. The aim of current study is investigating the activity concentration of radionuclides in Egyptian shisha tobacco that included $^{238}U$, $^{226}Ra$, $^{222}Rn$, $^{232}Th$ and $^{40}K$ in tobacco samples. Moreover, the radiological hazard parameters and cancer risk are determined for the studied samples.

## 2. Materials and methods

### 2.1. Samples descriptions:

Ten different samples of Shisha tobacco from different companies in the local market are listed in Table.1. The samples divided into two groups wet samples named profile A and dry samples named profile B. All the samples of two profiles were packaged in 200 ml Marinelli beakers.

**Table.1: Samples characteristics of Shisha tobacco from different companies.**

| Company | Sample | Flavor |
|---|---|---|
| **Elnakhla** | APP1 | Apple |
| | Pea1 | Peach |
| | Cant | Cantaloupe |
| **Danash** | APP2 | Apple |
| | Pea2 | Peach |
| | Cola | Coca cola |
| **Arab** | TOB1 | Without flavor |
| **Alborg** | TOB2 | Without flavor |
| **African** | TOB3 | Without flavor |
| **Alkhatat** | TOB4 | Without flavor |

## 2.2 Experimental Technique:

### 2.2.1. Gamma-ray spectrometry:

Gamma spectra has been recorded and analysed for different samples (wet samples profiles A & dry samples profile B), using a hyper pure germanium (HpGe) detector shielded from the background radiation and built in with integrated electronics system involved multi-channel analyser (MCA) card installed in a PC supported with MAESTRO-32 software to record and analyse the data. The relative efficiency of HPGe detector~ 50% for 3″ x 3″ NaI(TI) crystal efficiency and resolution of 1.85kev and a peak/Compton ratio of 69.9:1 at the 1.33MeV gamma ray transition of $^{60}$Co. Detector and its system were calibrated for energy to display gamma-ray photo-peaks between 52 and 3000 keV using three standard source obtained from the International

Atomic Energy Agency for the U, Th and K activity measurements: RGU-1, RGTh-1 and RGK-1 respectively [5, 6].

The $^{238}$U activity concentration has been determined by indirect measurements using gamma rays emitted by its daughter product ($^{234m}$Pa) represented by the 1001 keV photo-peak [7]. The radioactivity concentration of $^{226}$Ra was measured using the 186.1 keV peak from its own gamma-ray emission and take in our consideration subtract of the counting of peak corresponding to $^{235}$U recorded at 185.7 [8]. Gamma lines 295.2 keV and 351.9 eV have been used to determine radioactivity of $^{214}$Pb peaks, while $^{214}$Bi radioactivity has been determined using gamma ray of energy the 609.3 keV. The activity concentration of $^{226}$Ra-series is measured with an average value $^{226}$Ra, $^{214}$Pb and $^{214}$Bi. The activity concentration of $^{232}$Th has been demined using the 338.4 keV and 911.2 keV gamma lines of $^{228}$Ac, 583 keV and 2614.4 keV gamma lines for $^{208}$Tl and 727.3 keV gamma line for $^{212}$Bi. The activity concentration of $^{232}$Th series is measured with an average value of $^{228}$Ac, $^{212}$Bi and $^{208}$Tl. Furthermore, the radioactivity of $^{40}$K was measured directly by its own gamma radiation emitted at energy 1460.8 keV [9].

The calculation of specific activity (C) concentration in units of Bq kg$^{-1}$ for each of the isotopes in the studied samples by applying equation (1) [10]:

$$\mathrm{C(Bq\ Kg^{-1})} = \frac{C_n}{\varepsilon P_\gamma M_S} \qquad (1)$$

Where $C_n$ is the net area per second of gamma ray photo-peak corresponding to each isotope, $\varepsilon$ is the efficiency of detector for γ-ray line, $P_\gamma$ is the branching ratio of the specific γ-ray, and $M_s$ mass of the sample in kilogram.

The lowest limits of detection (LLD) has been calculated using the equation [11] & [12]:

$$\mathrm{LLD} = \frac{4.66 S_b}{\varepsilon \times I_\gamma} \qquad (2)$$

Where $S_b$ is the estimated standard error of the net background count rate in the spectrum of the radionuclide and $I_\gamma$ is the abundance of gamma emissions per radioactive decay. The LLD values obtained were 9.347, 1.307 and 1.344 Bq kg$^{-1}$ for $^{40}$K, $^{238}$U and $^{232}$Th, respectively.

**2.2.2. SSNTD CR-39:**

Selected type of Solid State Nuclear Track Detectors, (SSNTD) was CR39 due to its sensitivity for alpha particles to determine radon concentration which is comparable to alpha particles energy emitted from radon. Used CR-39 detector was in area of 1 cm x 1 cm and a thickness of 1mm. Recorded alpha track of radon emission of each sample in its two profiles has been investigated, setup up of CR-39 detector is placed on the internal cover surface of cup as presented in Fig. 1. The cup was tightly closed, and the samples were kept for one month. During this time CR-39 was exposed to alpha particles decayed from radon and its daughters in detector sensitive volume of the cup and were recorded as alpha track inside CR-39, also irradiated CR-39 detector as control detector has been used to determine the background level of radon. The detectors has been collected from the cup and chemically etched in a solution of KOH of 6.25 normality at temperature 70 ± 1 ˚C for 4 h to amplify these tracks and investigated.

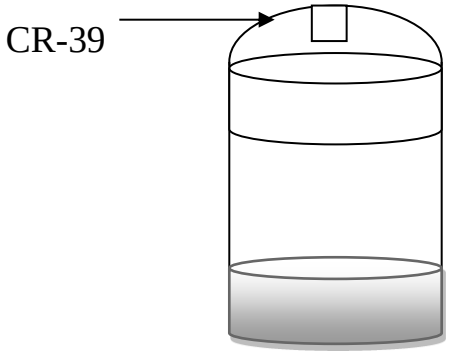


**Fig.1: CR-39 Set up in the cup**

To calculate radon concentration measurements: Alpha particles recorded tracks by CR39 have been counted manually for 100 fields which has been selected randomly, using an optical microscope at 400 times magnification. The background tracks have been counted with the same method and subtracted from track density of each sample to determine the actual tracks. The track density (tracks per $cm^2$) was determined according to area of field calculated by a stage eyepiece. The used factor of calibration is 0.163±0.002 tracks $cm^{-2}$ per Bq $m^{-3}$ d. It has been estimated from radon measurements experiment for the (CR39) track detector [13]. Radon concentration for each has been calculated by the track density using equation (3) [14]:

$$C_{Radon} = (N - B) / t\, C_{Factor} \qquad (3)$$

where, $C_{Radon}$ is the average radon concentration ($Bq/m^3$), N is the track density recorded by CR39 for each sample ( $Track.cm^{-2}$), B is the background track density recorded by virgin CR39 (Track .per $cm^2$), $C_{Factor}$ is the factor of calibration in terms of α-tracks per $cm^2$ $d^1$/ $Bqm^{-3}$ and t (hours) is the exposure time.

## 3. Results and Discussions:

### 3.1. Gamma Spectroscopy Analysis:

The activity concentration of $^{238}U$, $^{226}Ra$, $^{232}Th$ and $^{40}K$ in the shisha tobacco samples (Bq $kg^{-1}$) are presented in Table 2 and 3 for wet and dry samples, respectively. The average values of activity concentration for $^{238}U$, $^{226}Ra$, $^{232}Th$ and $^{40}K$ is 40.96, 4.52, 3.88 and 398.43 Bq/kg, respectively for wet samples. In dry samples, the average value of activity concentration of $^{238}U$, $^{226}Ra$, $^{232}Th$ and $^{40}K$ were 50.19, 6.82, 4.31 and 367.07, respectively. It is obvious that the values of $^{238}U$ in two profiles are higher than the worldwide value (35 Bq $kg^{-1}$) [15]. Otherwise, the radioactive isotopes $^{226}Ra$, $^{232}Th$ and $^{40}K$ are within the permissible limits of worldwide (35, 30 and 400 Bqkg-1), respectively [16].

**Table.2 The activity concentration of $^{238}U$, $^{226}Ra$-series, $^{232}Th$- series and $^{40}K$ in wet samples (Profile A).**

| Sample | $^{238}U$ ($^{234m}Pa$) (Bq/kg) | $^{226}Ra$-series (Bq/kg) | $^{232}Th$- series (Bq/kg) | $^{40}K$ (Bq/kg) |
|---|---|---|---|---|
| APP1 | 33.99±8.91 | 3.36±1.09 | 1.74±0.68 | 177.55±3.22 |
| Pea1 | 48.06±11.79 | 5.30±0.78 | 3.27±0.80 | 268.7±5.05 |
| Cant | 56.49±18.83 | 7.05±2.14 | 4.40±0.69 | 321.86±6.96 |
| APP2 | 25.5±6.63 | 3.91±0.68 | 3.22±0.54 | 121.45±2.59 |
| Pea2 | 49.21±7.72 | 4.23±0.71 | 2.51±0.42 | 119.83±2.48 |
| Cola | 39.26±11.41 | 4.03±0.70 | 2.52±0.36 | 137.51±2.65 |
| TOB1 | 27.31±13.65 | 5.80±1.19 | 5.24 ±1.03 | 507.30±6.70 |
| TOB2 | 30.11±14.13 | 5.95±0.98 | 6.84±0.83 | 703.5±6.40 |
| TOB3 | 55.56±17.94 | 4.27±0.90 | 5.85±0.7 | 815.85±6.56 |
| TOB4 | 44.14±17.85 | 3.08±0.64 | 3.29±0.65 | 810.78±8.51 |
| Range | 25.5±6.63- 56.49±18.83 | 3.08±0.64- 7.05±2.14 | 1.74±0.68- 6.84±0.83 | 119.83±2.48- 815.85±6.56 |
| Average | 40.96±12.89 | 4.52±0.98 | 3.88±0.82 | 398.43±5.12 |

**Table.3 The activity concentration of $^{238}U$, $^{226}Ra$-series, $^{232}Th$- series and $^{40}K$ in dry samples (Profile B).**

| Sample | $^{238}U$ ($^{234m}Pa$) (Bq/kg) | $^{226}Ra$-series (Bq/kg) | $^{232}Th$- series (Bq/kg) | $^{40}K$ (Bq/kg) |
|---|---|---|---|---|
| APP1 | 40.99±10.91 | 5.36±1.4 | 2.02±0.68 | 180.55±3.19 |
| Pea1 | 53.06±14.79 | 7.63±0.91 | 3.96±0.78 | 250.7±4.05 |
| Cant | 66.49±20.83 | 10.05±2.82 | 5.08±0.5 | 204.97±3.92 |
| Pea2 | 55.21±9.72 | 6.56±0.86 | 3.19±0.42 | 100.83±1.48 |
| APP2 | 30.5±8.63 | 6.24±0.72 | 3.94±0.56 | 115.45±2.15 |
| Cola | 40.35±10.81 | 4.76±0.98 | 2.43±0.53 | 132.54±3.36 |
| TOB1 | 35.31±15.65 | 8.13 ±1.53 | 5.9±0.78 | 495.30±5.70 |
| TOB2 | 47.16±13.48 | 7.33±1.13 | 6.16±0.74 | 584.34±6.40 |
| TOB3 | 65.56±19.94 | 6.94±1.13 | 6.68±0.81 | 805.85±4.56 |
| TOB4 | 67.28±18.53 | 5.21±0.66 | 3.78±0.90 | 800.21±8.80 |
| Range | 30.5±8.63-67.28±18.53 | 4.76±0.98-10.05±2.82 | 2.02±0.68-6.68±0.81 | 100.83±1.48-805.85±4.56 |
| Average | 50.191±14.32 | 6.82±1.21 | 4.31±0.67 | 367.07±4.36 |

Figs.2&3 shows activities distributions of $^{232}Th$, $^{238}U$ series, $^{226}Ra$ and their progenies for different samples of Profiles A & B respectively, while $^{40}K$ activities are displayed in Fig.4 for the two profiles A & B. It was clear that the activity concentration of dry samples for isotopes $^{232}Th$, $^{238}U$ series, $^{226}Ra$ is higher than the wet samples. On the contrary for the activity concentration of $^{40}K$ in the wet samples were a little bit higher than in the dry samples. It is probably that the change

of activity concentration of radionuclides in two profiles might due to the fertilizer used by tobacco farmers. Whereas; the naturally occurring radionuclides are abundant in most fertilizers that follow root uptake [17]. Furthermore, it could explain the difference between the two profiles (wet and dry) may be due to the shisha tobacco in wet samples contains glycerol and honey or molasses that have higher density of the viscosity could attenuate gamma-rays. In the same context, the activity concentration of radionuclides in a different flavours is not similar that could due to the studies samples collected from different companies contains the same major ingredients of the shisha tobacco but different in minors additions according to each company. This is may explain different results in activity concentration of radionuclides.

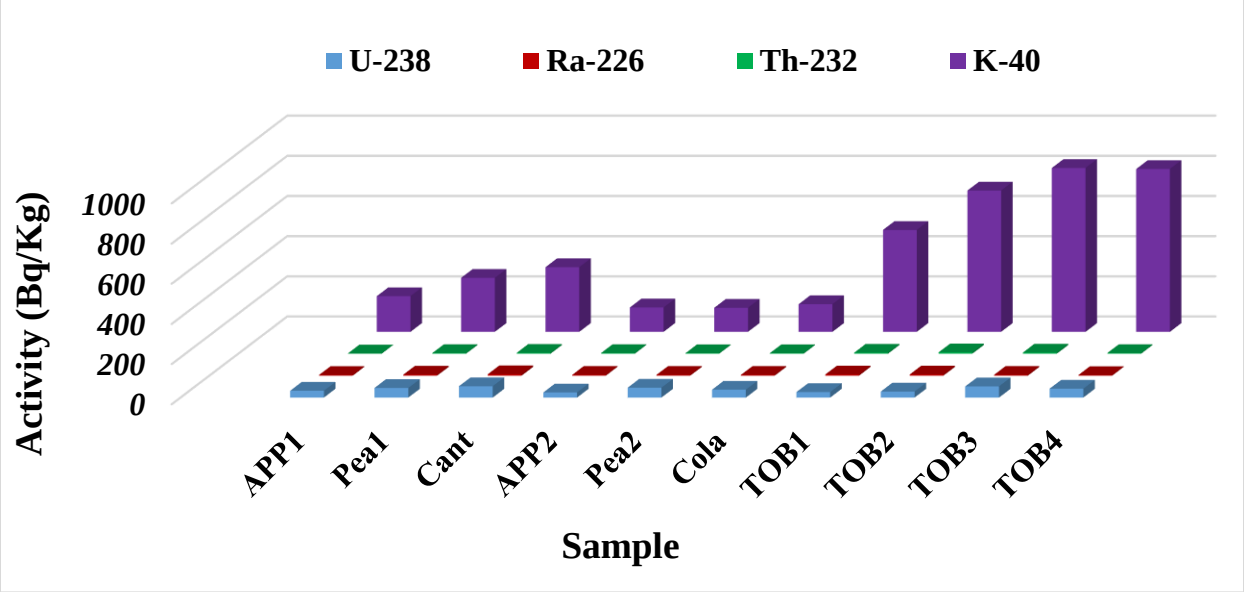


**Fig.2 Activity distribution of $^{238}$U, $^{226}$Ra-series, $^{232}$Th- series and $^{40}$K for different samples in profile A**

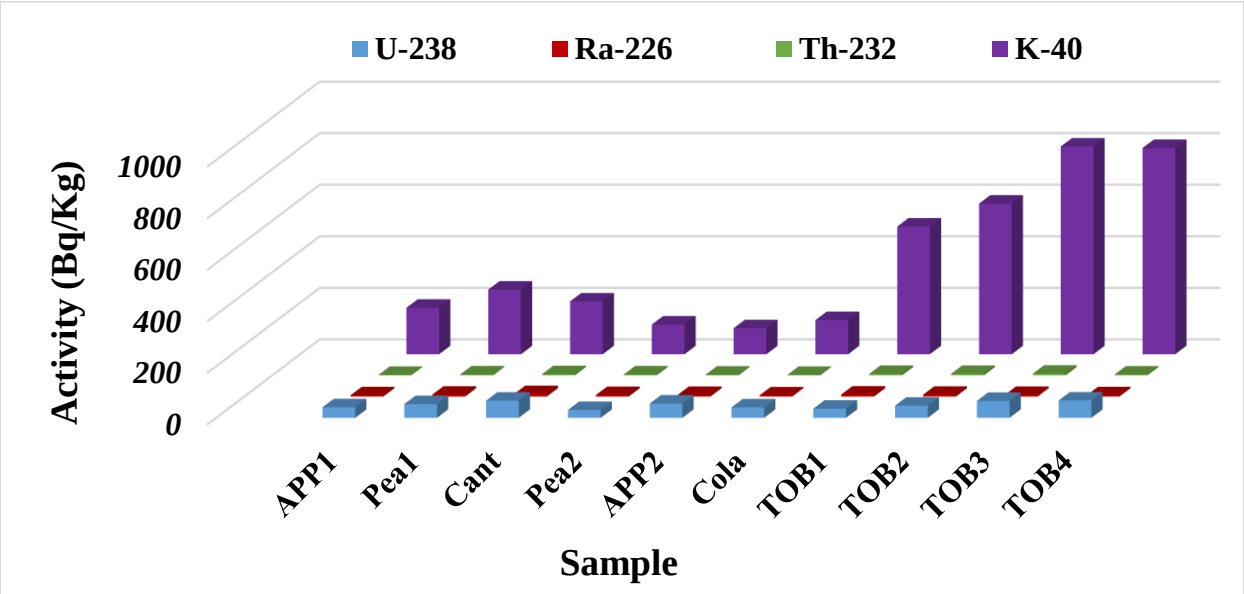


**Fig.3 Activity distribution of $^{238}U$, $^{226}Ra$-series, $^{232}Th$- series and $^{40}K$ for different samples in profile B**

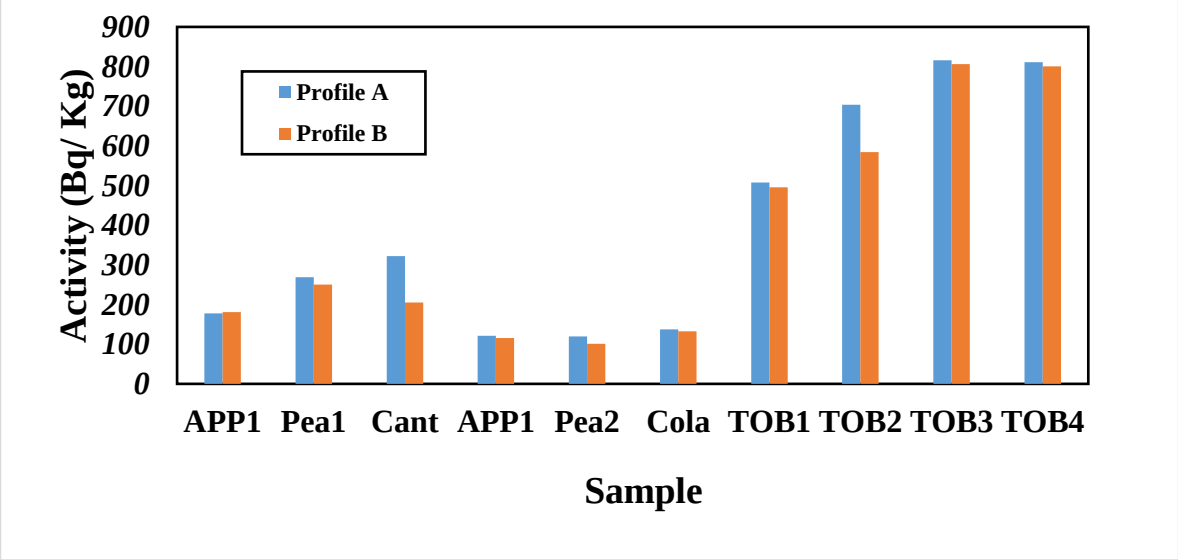


**Fig.4 Activity distributions of $^{40}K$ for different samples of profiles A&B**

### 3.2. Radon Concentration

The calculated radon concentrations for different samples in the two profiles are represented in Table4. It is obvious that the radon concentration values for all studied samples are lower than 300 Bq/$m^3$ [18] as shown in Fig.5.

**Table.4 Radon concentration for different wet & dry samples of the two Profiles A & B.**

| Sample | Rn Concentration (Bq/ $m^3$ ) | |
|---|---|---|
| | wet samples Profile A | dry samples Profile B |
| APP1 | 69.87 | 97.36 |
| Pea1 | 107.26 | 120.27 |
| Cant | 131.4 | 149.89 |
| APP1 | 51.87 | 68.66 |
| Pea2 | 104.48 | 125.23 |
| Cola | 91.16 | 91.45 |
| TOB1 | 62.43 | 79.56 |
| TOB2 | 64.76 | 107.23 |
| TOB3 | 123.19 | 144.38 |
| TOB4 | 95.11 | 157.13 |

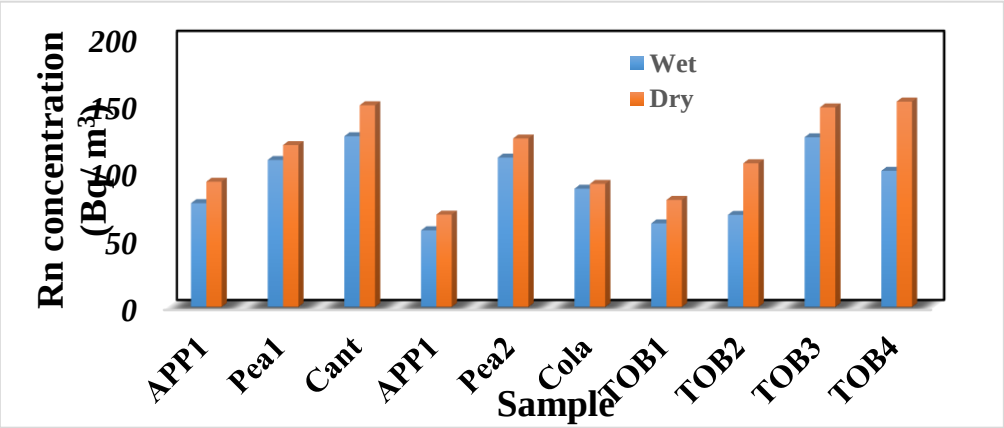


**Fig.5 Radon concentration for different samples of profiles A&B**

Figs.6&7 display the correlation between radon ($^{222}$Rn) and $^{238}$U that show good correlation ~ ($R^2$=0.98) for wet samples (profile A) and ~ $R^2$= (0.99) for dry samples. Otherwise, there is no correlation found between radium and uranium (0.018 for wet) and (0.01 for dry). This may due to the solubility of uranium and radon and per contra in radium insolubility of radium. After smoking, radon is the second biggest cause of lung cancer. Furthermore, radon and smoking interact to cause lung cancer, putting smokers at a higher risk of radon poisoning [19].

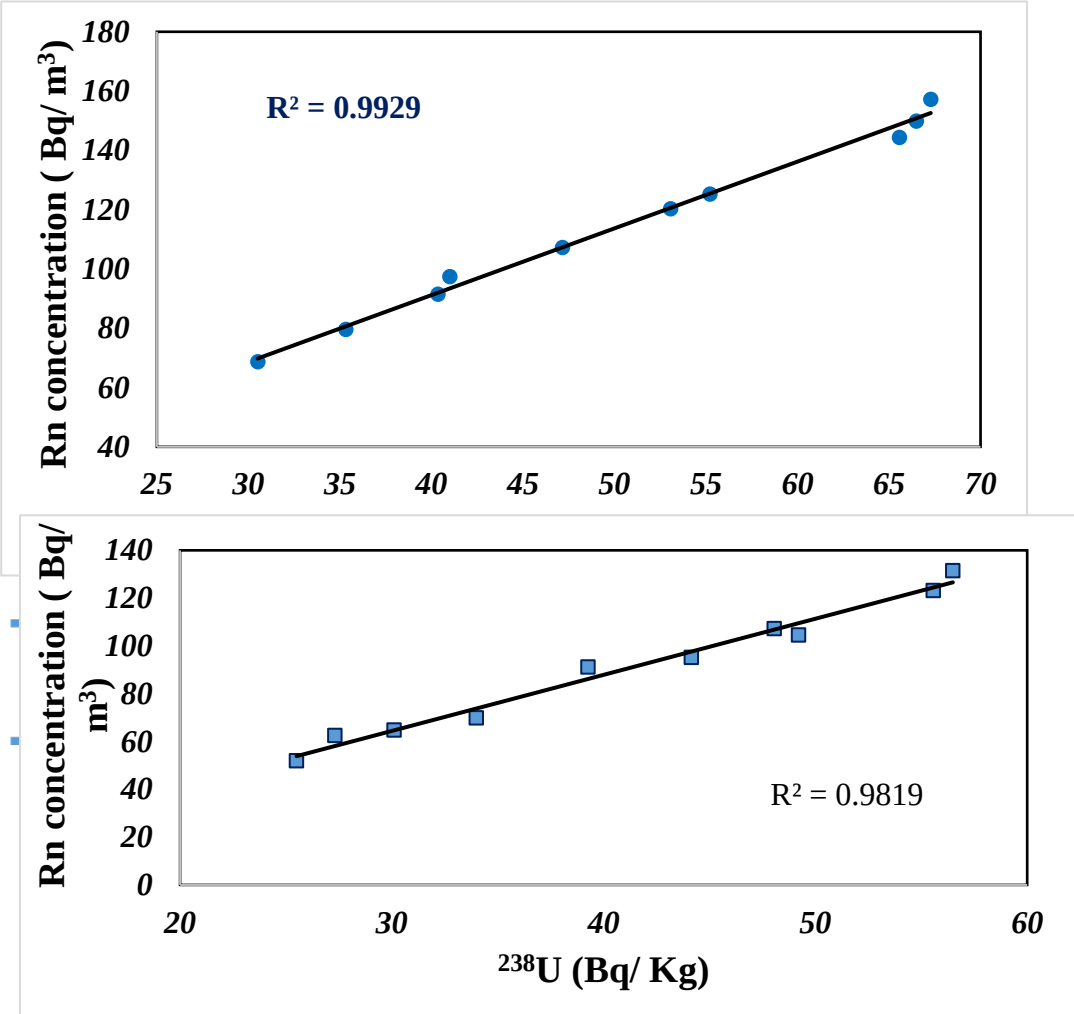


**Fig.7 Rn – U activity concentration for different dry samples**

### 3.3. Hazard indices:

The radiological hazard indices are radium equivalent activity ($Ra_{eq}$), internal hazard ($H_{ex}$) and excess lifetime cancer risk factor (ELCR) that determined according to the relevant equations in table 5.

**Table.5 Hazard indices, equations**

| Hazard index | Equation | Reference |
|---|---|---|
| Radium equivalent activity(Bq $kg^{-1}$) | $Ra_{eq}= C_{Ra} +1.43\ C_{Th} +0.077\ C_K$ | **[20]** |
| Internal hazard index ($H_{in}$) | $H_{in}=\frac{C_{Ra}}{185}+\frac{C_{Th}}{259}+\frac{C_K}{4810}$ | **[21]** |
| Excess lifetime cancer risk factor (ELCR) | ELCR=AED×DL×RF | **[22]** |

$C_{Ra}$ , $C_{Th}$ , $C_K$ are the concentrations of $^{226}Ra$ , $^{232}Th$ and $^{40}K$ respectively.

AED is the annual effective dose, DL and RF are the duration of life (70 year) and risk factor 0.05 $Sv^{-1}$.

Tables 6 and 7 show that the $Ra_{eq}$ ranged from 15.36 to 82.86with an average value of 42.12 Bq/kg in wet samples and from 18.56 to 84.9 with an average value of 46.22Bq/kg in dry samples which is lower than the recommended value of 370 Bq/kg [20]. The internal hazard index values for all samples are less than the unity so negligible hazardous effects to respiratory organs [23]. The range of ELCR in the wet and dry samples are 0.3 $x10^{-3}$ to 1.12$x10^{-3}$with an average value of 1 $x10^{-3}$and from 0.4 $x10^{-3}$ to 1.11 $x10^{-3}$ with an average value of 1 $x10^{-3}$, respectively. The average value of ELCR was in agreement with the world's average value of Cigarette (1.16 $x10^{-3}$) [20].

**Table.6 Hazard parameters for different wet samples Profile A.**

| Hazard index | Range | Average |
|---|---|---|
| Raeq(Bq/kg) | 15.36±3.22-82.86±4.08 | 42.12 ± 3.65 |
| $H_{in}$ | 0.041±0.002-0.22±0.01 | 0.11 ± 0.007 |
| ELCR | $0.3 \times 10^{-3} \pm 0.0003$ -$1.12 \times 10^{-3} \pm 0.0002$ | $1 \times 10^{-3} \pm 0.00025$ |

**Table.7 Hazard parameters for different dry samples Profile B.**

| Hazard index | Range | Average |
|---|---|---|
| Raeq(Bq/kg) | 18.56±2.1 -84.9±4.12 | 46.22±3.16 |
| $H_{in}$ | 0.05±0.001 -0.23±0.02 | 0.13±0.01 |
| ELCR | $0.4 \times 10^{-3} \pm 0.0005$-$1.11 \times 10^{-3} \pm 0.0003$ | $1 \times 10^{-3} \pm 0.0004$ |

## 4. Conclusions:

Shisha tobacco use is harmful in a variety of ways, with serious health, economic, and social implications. Despite the fact that natural radioactivity in shisha tobacco may be one of the main causes of tobacco smoking's negative health effects. The present work intended to investigate the shisha tobacco in two kind of profiles (wet and dry) of different companies' common used by Egyptians smokers. The assessment of natural radionuclides and the radiological hazards in Shisha tobacco has been carried out using gamma spectrometry (HpGe detector) and radon radiometry (CR-39 detector). The average values of activity concentration for $^{226}$Ra, $^{232}$Th and $^{40}$K in two profiles are lower than the recommended value but the average values of activity concentration of $^{238}$U is a little bit higher than the guideline value. Furthermore, there is good correlation between $^{238}$U and $^{222}$Rn for the two profiles. The detected level of radon activities in the studied tobacco samples are within the permissible values of most of organisations. Although, the level of radon is within the recommended value but the mechanism of shisha smoking starts by burning the tobacco and inhaling its smoke by the smoker through a pipe, this may increase the process of breathing

radon gas which enters to the person lung that ma in long run will cause cancer. On the same context, the radiological hazard indices are lower than their respective recommended limit. The excess lifetime cancer risks values estimated were agree with the guideline values of Cigarette. The study revealed that the organizations health should awareness the public with health-risks of the shisha tobacco of smokers and non-smokers people in public area.

**References:**

[1] British Heart Foundation UK: https://www.bhf.org.uk/informationsupport/risk.

[2] N. Abd El-Aziz, A.E.M. Khater, H.A. Al-Sewaidan, "Natural radioactivity contents in tobacco". International Congress Series, 1276: (2005) 407– 408

[3] H. A. Shousha, F. Ahmed, "Lifetime Cancer Risk of Gamma Radioactivity Results from Smoking". Journal of Cancers Review, 3: (2016) 1-9.

[4] J. Khalil, L. H. Robin, T. N. Rima, A.A. Rema, "The Tobacco Health Nexus? Health Messages in Narghile Advertisements." Tobacco Control, 18: (2009) 420-21.

[5] IAEA, "Preparation and Certification of IAEA Gamma Spectrometry Reference Materials, RGU-1, RGTh-1 and RGK-1". International Atomic Energy Agency. Report-IAEA/RL/148 (1987).

[6] R.M. Anjos, R. Veiga, T. Soares, A.M.A. Santos, J.G. Aguiar, M.H.B.O. Frasca, J.A.P. Brage, D. Uzˆeda, L. Mangia, A. Facure, B. Mosquera , C. Carvalho, P.R.S. Gomes, "Natural radionuclide distribution in Brazilian commercial granites". Radiat. Meas. 39: (2005) 245–253.

[7] M. Tawfeek, W. El-Gammal , H.M. Abu-Zied , A. Nada , Z.F.K. Hassan, F. Ragab, " Characterization of Pu-bearing materials by non-destructive spectrometric approach: relevance for nuclear forensics ". J. Sci. Res. Sci., 37: (2020) 61-72.

[8] H. Ramebäck, A. Vesterlund, A. Tovedal, U. Nygren, L. Wallberg, E. Holm, C. Ekberg, G. Skarnemark, "The Jackknife as an Approach for Uncertainty Assessment in Gamma Spectrometric Measurements of Uranium Isotope Ratios". Nuclear Instruments and Methods in Physics Research, 268: (2010) 2535-2538.

[9] K. Szkliniarz, A. Walencik-Łata, J. Kisiel, K. Polaczek-Grelik, K. J¸edrzejczak, M. Kasztelan , J. Szabelski , J. Orzechowski, P. Tokarski, W. Marszał,M. Przybylak, K. Fuławka, S. Gola, "Characteristics of Natural Background Radiation in the Polkowice-Sieroszowice Mine, Poland". Energies, 14: (2021) 1-13

[10] N. F. Salih, " Measurement the natural radioactivity concentration levels of radionuclides in selected vegetables collected from Kirkuk, Iraq using HPGe detector". International Journal of Environmental Analytical Chemistry, 27: (2021)1-20

[11] N.N. Jibiri, S.O. Bankole, "Soil radioactivity and radiation absorbed dose rates at roadsides in high-traffic density areas in Ibadan Metropolis, south western Nigeria". Radiat Prot Dosimetry, 118: (2006) 453–458.

[12] M.E. Ibrahim, N. Walley El-Dine, A. EL-Shershaby, S.M. EL-Bahi, N. Ali, "Assessment of the Natural Radioactivity and its Radiological Hazards in Stream Sediments at Gulf of Al Aqaba, Sinai, Egypt". J. Sci. Res. Sci., 32: (2015) 62-75.

[13] A.J. Khan, R. Varshney Parsed, R.K. Tyagi , T.V. Ramachandran, "Calibration of (CR39) plastic track detector for the measurement of radon and its daughters in dwellings". Nucl Tracks Radiat Measure, 17: (1990) 497–502.

[14] A.B. Tanner, "Radon migration in the ground: A supplementary review. Proceedings of Natural Radiation Environment III". Springfield, US DOE Report CONF-780422, 1: (1980) 5- 56.

[15] UNSCEAR, United Nations Scientific Committee on the Effects of Atomic Radiation, Report to the General Assembly: Sources and Effects of Ionizing Radiation, (1989), New York

**A.** R. Ali, A. H. Hasan, "Cancer Risk Due to the Natural Radioactivity in Cigarette Tobacco". Scientific Research Publishing, 4: (2016) 54-65

[16] J. Abdul, A. Waheed, S. B. Arshad, S. A. Syed, R. Saeed-Ur, · I. A. Muhammad, " Measurement of soil radioactivity levels and radiation hazard assessment in mid Rechna interfluvial region, Pakistan, J Radio anal". Nucl. Chem. (2010) 283:371–378 DOI 10.1007/s10967-009-0357-3.

[17] ICRP Lung Cancer Risk from Radon and Progeny & Statement on Radon. ICRP Publication 115, Ann. ICRP 40: (2010) 1.

[18] UNSCEAR, Sources and Effects of Ionizing Radiation. United Nations Scientific Committee on the Effect of Atomic Radiation, Report to the General Assembly annexes, United Nations, (2000), New York. USA.

[19] F. C. Akinyose, P. Tchokossa, M. M. Orosun, S. O. Oluyde, M. Umakha, K. K. Ochommadu, T. A. Olaniyan, O. A. Ajibade, "Radiological Impacts of Natural Radioactivity in Locally Produced Tobacco Products in Ibadan, Oyo State, Nigeria". Momona Ethiopian Journal of Science, 10: (2018) 59-75.

[20] S. M. Darwish, N. Walley El –Dine, T. Ibrahim, H. Emad, "Assessment of natural radioactivity levels in phosphate rocks from Wadi Qena and AbuTartor mine in Egypt". J. Sci. Res. Sci., 32: (2015) 20-38

[21] G.O. Avwiri, C.P. Ononugbo, I.E. Nwokeoji, "Radiation hazard indices and excess lifetime cancer risk in soil, sediment and water around mini-okoro/oginigba creek, Port Harcourt, Rivers State, Nigeria". Comprehensive J. Environment and Earth Sciences, 3: (2014) 38-50.

[22] P. Sola, U. Injarean, R. Picha, C. Kranrod, C. Kukusamude, S. Tokonami, "Measurement of NORM in Building Materials to Assess Radiological Hazards to Human Health and Develop the Standard Guidelines for Residents in Thailand: Case Study in Sand Samples Collected from Seven North eastern Thailand Provinces". Atmosphere, 1024: (2021) 1-12

# التحقيق من النويدات المشعة في تبغ الشيشة وتأثير المخاطر على المدخنين المصريين

**فاطمة الزهراء محمد رجب- حنان علي**

قسم الفيزياء, كلية البنات للاداب والعلوم والتربية, جامعة عين شمس, القاهرة مصر

**الملخص**

زاد عدد مدخني الشيشة بشكل كبير بين المصريين في السنوات العشر الماضية، وأصبح تدخين الشيشة أسلوب روتيني ليس فقط في الأماكن الشعبية ولكن أيضًا في المقاهي والنوادي المخصصه للكبار. قدمت منظمة الصحة العالمية ما يثبت ان الشيشة مثل السيجارة لها الآثار الصحية المحتملة عندما يتعرض المدخنون لها والتى تحتوى على النيكوتين والقطران وأول أكسيد الكربون والمعادن الثقيلة والمواد الكيميائية المسببة للسرطان. تم فحص العينات المختارة في ملفين عينات رطبة (أ) وعينات جافة (ب). وجد ان متوسط تركيزات النويدات المشعة اليورانيوم-238، الراديوم-226 ، الثوريوم-232 والبوتاسيوم- 40 هي 40.96 و 4.52 و 3.88 و 398.43 بيكريل / كجم على التوالي للعينات الرطبة. بالنسبة للعينات الجافة فإن متوسط تركيزات النويدات المشعة اليورانيوم-238، الراديوم-226 ، الثوريوم-232 والبوتاسيوم- 40 هي 50.19 و 6.82 و 4.31 و 367.07 بيكريل / كجم على التوالي. من الواضح أن العينات الجافة (ب)اعلى قليلاً من العينات الرطبة باستثناء البوتاسيوم- 40.علاوة على ذلك، كانت قيم تركيز الرادون لجميع العينات المدروسة أقل من 300 بيكريل/م $^3$. تم تحديد معلمات الخطر لكل العينات المدروسة والتي وجد انها تقل عن القيمة الموصى بها في جميع أنحاء العالم.