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Uranium estimation in some toothpaste collected from national market in Iraq

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ABSTRACT

To protect radiation infrastructure in Iraq, the uranium concentration in toothpastes of national market in Iraq has been measured. Five samples of toothpastes collected from market in Baghdad, for this purpose, which isAnper(from Iraq), Sensodyen(from England), crest (from Germany), Sanino(from Algebra) and Signal (from Egypt), which represent the most used in national market in Iraq. These samples due analyzed using nuclear track detectors technique type lexan detector. The measured values of uranium content found to vary from (1.07-3.57) ppm, which is equivalent in exposer dose in unit mSv were (0.113-0.3795) mSv. The value of uranium concentration is considering low and not harmful, especial the International Commission for Radiological Protection (ICRP) annual effective dose limit of 1 mSv as a general public.

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Introduction

In most countries radionuclidesare the largest contributors of radiation dose to human. These radionuclides reach the human body through the food chain, materials that used from human and it is causing radiation damage in respective organs [1].

Uranium pose both chemical and radiological problems, the element uranium is very widely distribution throughout the crust of the earth [2, 3]. Public radiation exposure from uranium mainly occurs through the surface and ground water pathway and contamination of foodstuffs and materials which used by human as toothpaste or cleaning materials, building materials or any materials in environmental [4].

Toothpastes consist of various agents as polishing or abrasive materials, binders, dears sweetening, flavoring a surfactants fluoride and water. There are minerals inorganic and organic matters present in the toothpastes, generally contaminated with minor amounts of uranium [4].

There have been achievement studies about uranium concentration in materials which used from human in several countries, most of these studies about food and a little about cleaning materials, Surrender Singh at al [4] who reported a uranium concentration in toothpastes and fruit juices in India found the uranium concentration in toothpastes (0.91-3.56)ppm for different toothpastes used in market.

In this research, we usedsolid state unclear track detectors (SSNIDs), which is convenient technique for low active measurement since it is low cost, a simple operation and it has high registration sensitivity and possibility of use for long period exposures without any fading [5].

Experimental

Theoretical approach

The uranium content in toothpaste samples was calculated by using a theoretical estimate proposed by the Abdus Salam international linter for theoretical physics (1998) [6] using nuclear tracts detector (Lexan). Decay chain of U-238 and U-235 feature 8 and 7 α's, respectively. The ratio of the isotopic abundances of U-238 and U-235 in natural uranium is taken as 1/140. If the toothpaste powders sample has Cu ppm of uranium and density ρ, it follows.

$$Na^{238+235} = \rho C_U N_A \frac{10^{-6}}{238}\left[8\lambda_{238} + \frac{7\lambda_{235}}{140}\right] \ldots\ldots\ldots(1)$$

ás per cm^3

Where N_A is the Avogadro number of nuclear of alpha particles entering the detector in contact with the sample and can be calculated as a function of the average range with R_α, the mean alpha particle average is found to be 48 μ_m in powder (toothpaste powder) and 4-8 MeV energy range [7], than ρ_t the track density on the detector formed by alphas coming from alayer is given by:

$$\rho_t = \frac{1}{2}\alpha_{total}\int_o^{R_\alpha}\left(1 - \frac{r}{Rx}\right)dr = \alpha_{total}\frac{R_\alpha}{4} \ldots\ldots(2)$$

$or\ \alpha_{total} = \frac{4\,\rho_t}{R_\alpha}$Inserting into Eq. (1) yields

$$Cu = \frac{952.\rho_t}{R_\alpha \rho N_A\left(8\lambda_{238} + \frac{7\lambda_{235}}{140}\right)10^{-6}} \ldots\ldots\ldots..(3)$$

Methods:

Five toothpastes samples (Anper, Sensodyne, Crest, Sanino and Signal) collected from national market in Baghdad. Toothpastes are dense solution, therefor to change it powder, we are melting toothpastes in water and quitting until drying and collected the powder of toothpastes.

About 120 gm of each sample was placed in plastic bottles of 6.5 cm radius and 6 cm length. Squared 500µm thick pieces (2×2) cm^{2}of four detectors type lexan, density 1.36gm/cm^3 made in Germany has been used for each sample. The detectors placed direct contact on the top of the powder of samples and kept for 16 days and then the exposed detectors collected and etched with 6N NaOH and 70C^o for 8 hours [8]. They were washed thoroughly in running water for 5 minutes and then in distilled water for another 5 minutes. The track density (track/cm^2) was counted by optical microscope type Pro. way made in china. It's

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capable of giving magnification by an objective (4x, 10x, 40x and 100x) and two eye pieces (10x) to measure the number of track density. Digital video camera cons cope model HDCE-50 B made in Canada. It's special for microscope with 5MB resolution it is connected with personal computer. Special program used with digital camera of microscope. Ithas complete components of image processing filtering, counting and converting. This program has been used to calibrate the picture dimension using a scaled slide to calculate the area of field view.

The results of track density were converted in uranium concentration by using equation (3).

Detector efficiency was calculated with in measured the etching rate along diameter of the track (V_B) and the etching rate general (V_T) by used the relationship between the etching time and change of diameter (ΔD) to calculated (V_B) and the relationship between the etching time and the change of weight (ΔM) to calculated (V_T). Efficiency was determined by used equation (4)[8]

$$\eta = 1 - \left\{\frac{V_B}{V_T}\right\} \dots \dots \dots (4)$$

Result and discussion:

Figure (1) and (2) explain the rate of weight change with etching time as well as the diameter change with etching time. The result shows that mass decreases with increasing etching time as well as the diameter of tracks increasing with increasing etching time, this is corresponding with the scientific literature this side [9].By using equation (4) we have calculated the efficiency of detector, which is found to be (0.15); it is quality good [10].

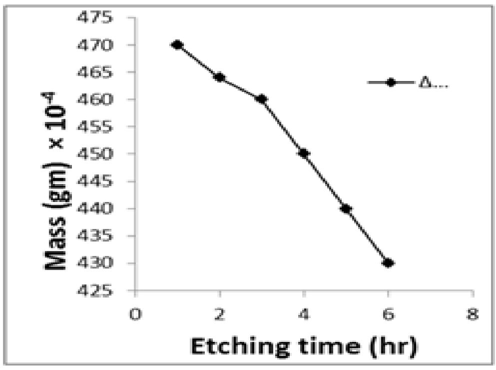

Figure 1. Shows the relationship between the change in weight and etching time.

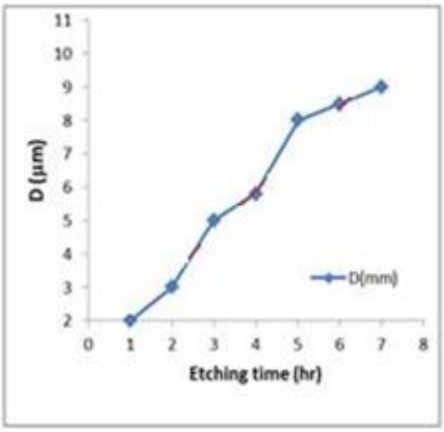

Figure 2. Shows the relationship between the diameter and etching time

Table 1. Indicate to the uranium content of various toothpastes

Sa. cod	N. of toothpaste	Manufacturing agency	Track density (t./cm^2)	Ura. Con.Ppm
S1	Anper	Iraq	33.334$\pm$0	1.07
S2	Sensodyne	England	99.123$\pm$0.188	3.20
S3	Crest	Germany	112.281$\pm$4.716	3.57
S4	Sanino	Algebra	38.597$\pm$5.069	1.24
S5	Signal	Egypt	52.632$\pm$0	1.64

Table 2. Uranium concentration and effective dose in toothpastes samples

Sample No.	Uranium concentration in ppm	Uranium effective in Bq/kg	Equivalent dose in mSv/yes
S1	1.07$\pm$0$\pm$0.0074	11.37439 $\pm$0.71648	0.11374$\pm$0.0071
S2	3.20$\pm$6x10^{-3}	34.0168$\pm$0.0637	0.3401 $\pm$6x10^{-5}
S3	3.57$\pm$0.2339	73.9518$\pm$2.4864	0.3795$\pm$0.0248
S4	1.24$\pm$0.1628	13.18154$\pm$1.6772	0.1318$\pm$0.0167
S5	1.64$\pm$0 $\pm$0.06855	17.4336 $\pm$0.7268	0.1743$\pm$0.0072

Table (1) represented the samples of toothpaste and manufacture countries and number of track.Table (2) represented the uranium content in unit ppm and Bq/Kg and mSv. The uranium content of various toothpaste calculated by using equation (3), and figure (3) represented histogram of results. The uranium content has been forward vary from (1.07-3.57)ppm, which represented in dose unit (0.113-0.3795) mSv, where anper toothpaste manufacture by Iraq has a minimum uranium content (1.07)ppm, whereas rest has yielded a maxim content (3.57)ppm so the paste type sensodyne was has (3.2)ppm. High value uranium in kerst and sensdyne pastes may be due to the presence of minerals from the plant sources.

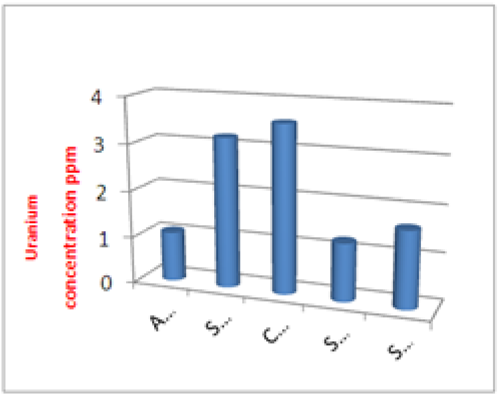

Figure 3. Represent histogram of the value of uranium

This dose of the chose toothpastes low than the international commission for Radiological protection (ICRP) annual effective dose limited of 1 mSv for general public [1, 11].

Conclusions:

The obtained uranium concentration explain the krest paste is higher uranium content was (3.57)ppm and too sansoden was (3.2)ppm, where the anper past is lowest (1.07)ppm and sanio past which reach to (1.24)ppm

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