Natural Radioactivity by Alpha Particles in Human Teeth at NajafCity / Iraq

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Abstract : The rate of alpha emission from teeth in Najafcity was measured using a nuclear track detector CR-39 to determine the level of environmental contamination by radionuclides that alpha-emitting. The results were showed that the highest emission of alpha was (0.2364) mBq cm^{-2}in Najaf / Hey Al-Meladwhile the lowest emission was (0.0017)mBq cm^{-2}in Najaf / Hey Al-Wafaa.The mean of alpha emission was (0.0461±0.0046) mBq cm^{-2} , Which indicate no environmental contamination by radionuclide's which emitting alpha particles compared with the previous studies.

Key Words : Alpha, Teeth, CR-39, Natural Radioactivity, Najaf.

1. Introduction

Alpha particles emitted by decay of radionuclides such as uranium and radium which enter the human body by inhalation or ingestion, these particles are more damaged for human tissue[1], when alpha emitters enter the body through the digestive system and breathe move to the others organs by blood[2], to be deposited in bone then in teeth, as an extension of the skeleton[3]. Teeth according to many studies is a good indicator for natural exposure to radiation[4].

2. Material and Methodology

2.1 CR-39 detector:

Nuclear track detector with a chemical form $C_{12}H_{18}O_7$, most   important qualities are transparent, colorless[5], the techniques of nuclear impact detectors in the identification of the effects of radioactive materials where this effect in the form of narrow paths are generated when the passage of radiation and formed a hidden effects[6] .

2.2 Collecting the samples

Thirty-nine samples of teeth were collected from people in specialist center of dentistry in Najafat different regions from southern and northern regions in Najaf city.

2.3Preparation of samples:

Put all samples in formaldehyde solution until complete samples collection. Samples were taken to the laboratory for cutting each tooth into two halves longitudinally by engine machine and then placed in the oven for drying. As shown in Fig.(1)

Fig.(1): Samples in Oven

2.4 Natural Exposure

After each tooth has been cut into two halves, it is placed in contact with the detector in the form of sandwich. And left for 132 day during which time the emission of alpha particles from the sample to the detector to form the hidden effect, which is detected by the process of chemical etching. As shown in Fig.(2)

Fig.(2) : Natural Exposure Method

2.5 Chemical Etching

All CR-39 Detectors were etched in 6.25 N NaOH solution in 70±1 C° for 6 hours. The solution is heated by a water bath after being placed in a conical flask tightly closed to prevent evaporation of the solution during the process of etching and change its concentration. After finishing the etching process, remove the detectors from the solution by tweezers and wash with distilled water and then dry.

3. Calculation

The track density of each detector was calculated by seeing the effects by the optical microscope with magnification of 10X after connecting it to the PC and by the equation (1)[7]

$$\rho = \frac{N_{avg}}{A} \qquad (1)$$

where;
ρ= Track density
N_{avg} = average of total pits
A= area of field view
The CR-39 detector efficiency was also calculated from the equation (2)[8]

$$\varepsilon = 1 - \frac{V_B}{V_T} \qquad (2)$$

where V_B = bulk etch rate (μm h^{-1})
V_T = track etch rate (μm h^{-1})

finally, Was calculated alpha emission rate in mBq cm^{-2}, by using equation (3)[8]

$$E_\alpha = \varepsilon \frac{\rho_s - \rho_b}{T}(3)$$

whereρ_s= number of tracks in sample

ρ_b= number of tracks in background detector

T= Period of exposure=132 d

4. Results and Discussion

After the alpha emission rate was calculated for all the studied samples, it was found that the highest emission of alpha was (0.2364) mBq cm^{-2} while the lowest emission of alpha was (0.0017) mBq cm^{-2}. Fig.(3) shown the highest and lowest track density.
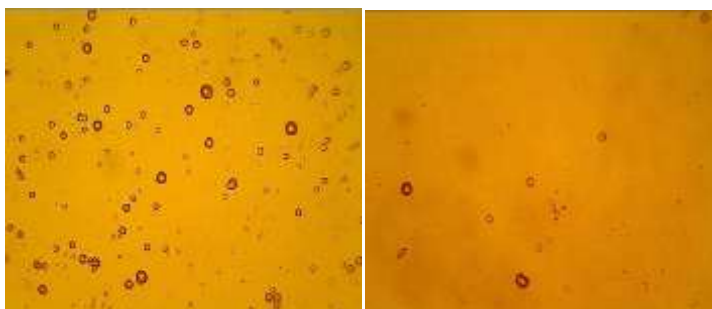
Figure(3): Highest and Lowest of Alpha Emission Rate

Generally, the mean of alpha emission rate in Najaf city was (0.0466±0.0076) mBq cm^{-2}.Table (1) represented alpha emission rate in teeth samples. Also the results shown that alpha emission rate in northern regions (0.0467±0.0103) was higher than insouthern regions (0.0459±0.0103) . Fig.(4) shown alpha emission rate in northern and southern regions in Najaf city .

Table (1): Alpha Emission Rate in Teeth Samples

No.	Sample code	Location	Eα (mBq cm^{-2})
1	CR-250	Northern regions/ Hey Al-Melad	0.1015
2	CR-164	Northern regions/ Hey Al-Jemaeya	0.0258
3	CR-365	Northern regions/ Hey Al-Neser	0.0122
4	CR-221	Northern regions/ Hey Al-Neser	0.0465
5	CR-223	Northern regions/ Hey Al-Jemaeya	0.0264
6	CR-388	Northern regions/ Hey Al-Melad	0.1164
7	CR-336	Northern regions/ Hey Al-Rahma	0.0324
8	CR-224	Northern regions/ Hey Al-Rahma	0.0149
9	CR-317	Northern regions/ Hey Al-Jazera	0.0138
10	CR-220	Northern regions/ Hey Al-Jazera	0.0445
11	CR-200	Northern regions/ Hey Al-Wafaa	0.0049
12	CR-148	Northern regions/ Hey Al-Wafaa	0.0016
13	CR-170	Northern regions/ Hey Al-Aladala	0.0337
14	CR-417	Northern regions/ Hey Al-Furat	0.0536
15	CR-198	Northern regions/ Hey Al-Jemaeya	0.0333
16	CR-314	Northern regions/ Hey Al-Muhandsen	0.0931
17	CR-278	Northern regions/ Hey Al-Melad	0.2364
18	CR-222	Northern regions/ Hey Al-Melad	0.0451
19	CR-269	Northern /regions/ Hey Al-Askary	0.0050
20	CR-415	Northern regions/ Hey Al-Macramé	0.0211
21	CR-311	Northern regions/ Hey Al-Macramé	0.0867
22	CR-151	Northern regions/ Hey Al-Nidaa	0.0083
23	CR-247	Northern regions/ Hey Al-Nidaa	0.0609

| 24 | CR-149 | Northern regions/ Hey Al-Neser | 0.0037 |
25	CR-169	Northern regions/ Hey Al-Neser	0.0453
26	CR-312	Southern regions/ Street city	0.0473
27	CR-338	Southern regions/ Al-Hera	0.0388
28	CR-218	Southern regions/ Hey Al-Zahraa	0.0053
29	CR-418	Southern regions/ Hey Al-Qadiseya	0.0874
30	CR-166	Southern regions/ Hey Al-Ansar	0.1201
31	CR-173	Southern regions/ Hey Al-Quds	0.0043
32	CR-145	Southern regions/ Hey Al-Ansar	0.1206
33	CR-337	Southern regions/ Hey Al-Quds	0.0544
34	CR-225	Southern regions/ Street city	0.0153
35	CR-199	Southern regions/ Hey Al-Emammahde	0.0066
36	CR-274	Southern regions / Hey Ansar	0.0450
37	CR-195	Southern regions / Hey Ansar	0.0276
38	CR-196	Southern regions / Hey Ansar	0.0410
39	CR-191	Southern regions / Hey Ansar	0.0294
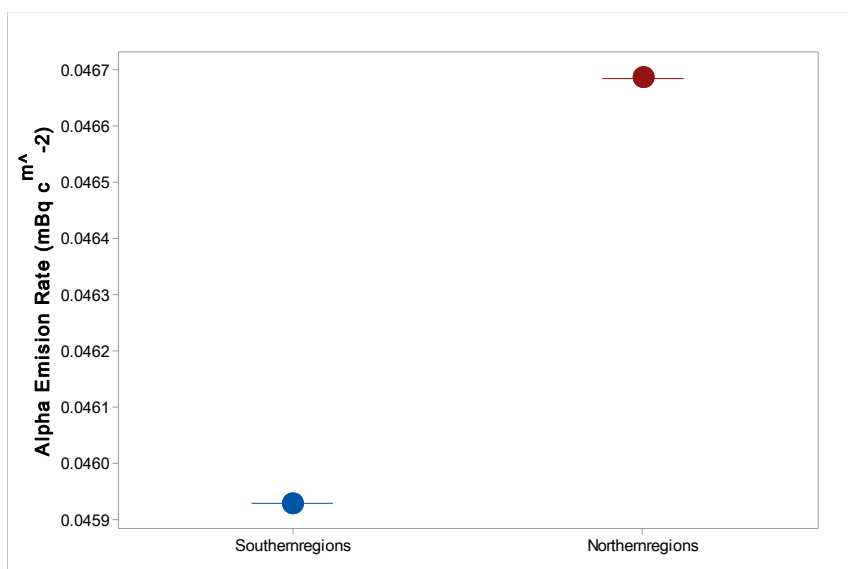
Fig.(4): Alpha Emission Rate in Northern and Southern Regions in Najaf City

5. Conclusions

The data showed that:

- Alpha Emission Rate in Najaf City was (0.0461 ± 0.0046)mBq cm^{-2} which was within the limits allowed globally compared to previous studies.
- Alpha Emission Rate innorthern regions was higher than in southern regionswhich indicate no environmental contamination by radionuclide's which emitting alpha particles compared with the previous studies.

6.Acknowledgement

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