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•*Short report*

Determination of ^{226}Ra and ^{228}Ra concentrations in foodstuffs consumed by inhabitants of Tehran city of Iran

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Background: The presence of primordial radionuclide in human habitats has always been a source of prolonged exposure. Measurement of naturally occurring radionuclides in the environment can be used as baseline to evaluate the impact of non-nuclear activities and also routine releases from nuclear installations. ***Materials and Methods:*** A total of 56 samples from 18 different foodstuff including root vegetables (beetroot, carrot, onion, potato, radish and turnip), leafy vegetables (lettuce, parsley, spinach and white cabbage) and lentil, kidney bean, Soya, eggs, rice, meat, tomato and cooking oil were purchased and analyzed by low level gamma spectrometry. ***Results:*** The ^{226}Ra concentrations from root vegetables varied from 13-62 mBqkg^{-1} with turnip of highest concentration, i.e. 62mBq kg^{-1}. Among leafy vegetables; parsley showed the maximum concentration of ^{228}Ra equal to 173 mBqkg^{-1}. ^{226}Ra and ^{228}Ra contents in the soya, 394 and 578 mBq kg^{-1} was much higher than those of other samples respectively. ***Conclusion:*** Results indicate that foodstuff consumed by Tehran inhabitants have low radium content and are safe, as far as radium concentrations is concerned. **Iran. J. Radiat. Res., 2005; 3 (3): 149-151**

Keywords: *Gamma spectrometry, naturally occurring radionuclide, Ra, Tehran.*

INTRODUCTION

Knowledge of natural radioactivity in man and his environment is important since naturally occurring radionuclides are the major source of radiation exposure to man[1]. Radioactive nuclides present in the natural environment enter the human body mainly through food and water and these measurements serve as the basic standards against which occupational exposures are assessed.

In Iran, measurement of natural and artificial radionuclides in environmental samples in normal and high-background radiation areas have been performed by some investigators[2,3], but no information are available on ^{226}Ra and ^{228}Ra in foodstuffs. Therefore we have attempted to measure ^{226}Ra and ^{228}Ra in foodstuffs of Tehran, using gamma spectrometry[4].

In this report, ^{226}Ra and ^{228}Ra contents in foodstuffs in Tehran are presented as baseline values for the estimation of the internal radiation dose.

MATERIALS AND METHODS

Diet samples were purchased from food distribution centers in Tehran city. The samples were purchased in two seasonal periods (rainy and dry seasons). The samples were washed and peeled, when necessary, dried levels was performed in air and accurately weighed for determination of fresh mass, then they were oven dried and burned for approximately 16h between 80-200°C. In some cases like meat, samples were frozen dried. After that 1-8 kg of sample fresh weight (fw) was placed in Marinnelli beaker and sealed.

Measurement have been carried out on sealed samples, after 'aging time' of at least 21 days, in order to allow the establishment of radioactive equilibrium among radium and its short-lived daughter products[5]. The measurement of natural radioactivity was done by gamma-spectrometry system using a high purity germanium (HPGe) detector with 40% relative efficiency. The detector was shielded by 10 cm lead on all sides with cadmium-copper in inner sides. The system

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was equipped with software for data acquisition and analysis. The counting time was 250,000 seconds, and the background spectra was also collected for the same period of time and subtracted from the sample spectra. Marinnelli standard mixed source (CERCA HM 395) from France was used for efficiency calibration due to its close geometry to the sample geometry. The ^{226}Ra and ^{228}Ra activities were determined indirectly via gamma line of their daughter products, ^{214}Bi (609 keV) and ^{228}Ac (911 keV) respectively. Under normal operating conditions and present counting set up, the minimum detectable activity (MDA) was approximately 12.2 and 23.4 mBq kg^{-1} (fw) for ^{226}Ra and ^{228}Ra respectively[6].

RESULTS AND DISCUSSION

The results of the determination of ^{226}Ra and ^{228}Ra in 56 samples of eighteen different foodstuffs of Tehran city are presented in table 1. As shown, the ^{226}Ra and ^{228}Ra contents in Soya, 394 and 578 mBq kg^{-1} fresh weight was much higher than those of other samples. ^{226}Ra concentration of some foodstuffs such as meat, lentil and white cabbage were considered to be the same as minimum detectable activity value.

Comparing the different activities of ^{228}Ra in the treated food samples shows that potato has much higher activity (75 mBq kg^{-1}fw) than the other root vegetables. Among leafy vegetables parsley has the maximum concentration of ^{228}Ra equal to 173 mBq kg^{-1} fw and spinach has the highest concentration of ^{226}Ra equal to 106 mBq kg^{-1} fw. Activities per kilogram fresh weight of ^{228}Ra in lentil, kidney bean and cooking oil samples were compared with each other, and the average concentration was 160 mBqkg^{-1}. In about all of the analyzed samples, the activity concentration ratios ^{228}Ra/^{226}Ra were higher than one, with potato presented the highest activity concentration ratio of approximately three.

Measured average concentrations of ^{226}Ra in root vegetables in Tehran which is 27 mBq kg^{-1} fw agree with UNSCEAR report for Asia which is 29 Bq kg^{-1} fw. Average concentration of ^{226}Ra in potato and Tehran soil is 26 mBq kg^{-1} fw and 25 Bq kg^{-1}, respectively is comparable with reported values for northern Italy which is 19 mBq kg^{-1} fw and 25 Bq kg^{-1} for potato and soil, respectively[1,7]. Our results for ^{226}Ra concentration in foodstuffs are similar to country which has the same concentration of ^{226}Ra in its soil.

Table 1. ^{226}Ra and ^{228}Ra concentrations in foodstuffs in Tehran (mBq kg^{-1} fresh).

Foodstuffs	Number of Samples	^{226}Ra min-max average	^{228}Ra min - max average
Onion	4	16 - 30 25	27 - 48 38
Potato	4	13 - 31 26	62 - 96 75
Carrot	3	29 - 49 40	40 - 70 58
radish	3	15 - 30 23	18 - 37 28
Turnip	3	21 - 62 27	47 - 77 62
Beetroot	3	19 - 50 35	25 - 60 47
Lettuce	3	25 - 63 47	30 - 72 44
Parsley	3	76 - 102 89	144 - 202 173
Spinach	3	92 - 120 106	116 - 186 151
White cabbage	3	<12	30 - 68 49
Lentil	3	<12	71 - 253 162
Kidney bean	3	40 - 80 60	114 - 208 161
Soya	3	335 - 453 394	443 - 713 578
Eggs	2	40 - 100 63	72 - 84 78
Cooking oil	3	33 - 113 73	72 - 240 156
Tomato	3	39 - 51 45	<23
Meat	3	<12	64 - 102 80
Rice	4	94 - 110 104	<23

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