•*Short report*

Estimation of annual effective dose from ^{226}Ra and ^{228}Ra due to consumption of foodstuffs by inhabitants of Ramsar city, Iran

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Background: ^{226}Ra and ^{228}Ra contents in foodstuffs of Ramsar which is a coastal city in the northern part of Iran were determined by gamma spectrometry. Measurement results together with food consumption rates were used to estimate annual effective dose from ^{226}Ra and ^{228}Ra, due to consumption of food stuffs by inhabitants of Ramsar city. **Materials and Methods:** A total of 33 samples from 11 different foodstuffs including root vegetables (beetroot), leafy vegetables (lettuce, parsley and spinach) and tea, meat, chicken, pea, broad bean, rice, and cheese were purchased from markets of Ramsar city and were analyzed for their ^{226}Ra and ^{228}Ra concentration. 1-8 kg of fresh weight sample was placed in Marinnelli beaker and sealed. The measurement of natural radioactivity levels as performed by gamma-spectrometry system, using a high purity germanium (HPGe) detector with 40% relative efficiency. **Results:** The highest concentrations of ^{226}Ra and ^{228}Ra were determined in tea samples with 1570 and 1140 mBq/kg, respectively, and the lowest concentration of ^{226}Ra was in pea, cheese, chicken, broad bean, and beetroot. **Conclusion:** The maximum estimated annual effective dose from ^{226}Ra and ^{228}Ra due to consumption of foodstuffs were determined to be 19.22 and 0.71 mSv from rice and meat samples respectively, where as, the minimum estimated annual effective dose for ^{226}Ra was 0.017, 0.018 and 0.019 mSv from beetroot, cheese and pea samples respectively. **Iran. J. Radiat. Res., 2005; 3 (1): 47-48**

Keywords: *Gamma spectrometry, ^{226}Ra and ^{228}Ra, annual effective dose, Ramsar.*

INTRODUCTION

Knowledge of natural radioactivity in man and his environment is important since naturally occurring radionuclides are the major sources of radiation exposure to man(1). Radioactive nuclides present in the natural environment enter the human body mainly through food and water. Besides, measurement of naturally occurring radionuclides in the environment can be used not only as a reference when routine releases from nuclear installation or accidental radiation exposures are assessed, but also as a baseline to evaluate the impact caused by non-nuclear activities.

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 has been available on ^{226}Ra and ^{228}Ra in foodstuffs. Therefore, we have started measurements of ^{226}Ra and ^{228}Ra in foodstuffs of Ramsar city using low level gamma spectrometry measurement system(4), and estimating annual effective dose due to consumption of foodstuffs by Ramsar city residents.

MATERIALS AND METHODS

Diet samples were purchased from food distribution centers in Ramsar city. The samples were washed and peeled, when necessary, dried in air and accurately weighed for determination of fresh mass, and then they were oven dried and burned for approximately 16h between 80-200 °C. In some cases like meat, samples were freeze dried. Then, 1-8 kg of fresh weight sample was placed in Marinnelli beaker and sealed.

Measurements have been carried out on sealed samples, after 'aging time' of at least 21 days, in order to allow the establishment of radioactive equilibrium between radium and its short-lived daughter products(5). The measurement of natural radioactivity levels performed by gamma-spectrometry system, using a high purity germanium (HPGe) detector with 40% relative efficiency. The

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detector was shielded by 10 cm lead on all sides with cadmium-copper in inner sides. The system was equipped with software for data acquisition and analyzing. The counting time was 250,000 seconds and background spectra was also collected for the same period of time and subtracted from sample spectras. Marinnelli standard mixed source (CERCA HM 395) from France was used for efficiency calibration due to its close geometry to the sample geometry(6). 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(7). Under normal operating conditions and present counting set up, the minimum detectable activity (MDA) was approximately 12.2 and 23.4 mBq/kg (fw) for ^{226}Ra and ^{228}Ra respectively(8).

RESULTS AND DISCUSSION

The annual food consumption (kg), annual intake (Bq) and estimated annual effective dose from ^{226}Ra and ^{228}Ra (mSv) due to consumption of foodstuffs by Ramsar city residents are presented in table 1.

As seen in table 1, the maximum estimated annual effective dose from ^{226}Ra due to consumption of foodstuffs was 19.220 mSv from rice sample and the maximum estimated annual effective dose from ^{228}Ra was determined to be 0.713 mSv from meat sample. The minimum estimated annual effective doses for ^{226}Ra were estimated to be 0.017 mSv from beetroot sample.

Among leafy vegetables, spinach has the maximum ^{226}Ra and ^{228}Ra annual effective doses equal to 0.645 and 0.552 mSv, respectively Analysis showed that concentrations of ^{226}Ra and ^{228}Ra in tea samples was the highest, and the lowest concentration of ^{226}Ra were in pea, cheese, chicken, broad bean and beetroot.

Table 1. Annual effective dose (mSv) from ^{226}Ra and ^{228}Ra due to consumption of food stuffs by Ramsar city residents.

Foodstuffs	No. Of Samples	Annual Consumption (Kg)	Annual ^{226}Ra Intake (Bq)	Annual ^{228}Ra Intake (Bq)	^{226}Ra Annual Effective dose (µSv)	^{228}Ra Annual Effective dose (µSv)
Beetroot	3	7.1	0.086	0.410	0.017	0.124
Lettuce	3	8.6	0.353	0.430	0.071	0.129
Parsley	3	2.7	2.040	0.371	0.408	0.112
Spinach	3	10.0	3.220	1.840	0.645	0.552
Chicken	3	12.7	0.154	1.524	0.030	0.457
Meat	3	29.0	0.519	2.378	0.104	0.713
Rice	3	72.3	96.120	1.690	19.220	0.507
Cheese	3	7.6	0.092	0.831	0.018	0.249
Tea	3	1.4	2.180	1.582	0.436	0.475
Pea	3	7.4	0.093	0.844	0.019	0.253
Broad bean	3	13.7	0.167	0.321	0.033	0.096

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