Terrestrial Radio Nuclides in the Soil of Udupi District and Gamma Dose Rate for the People

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Abstract: *The paper discusses the results of detailed studies on gamma radiation levels, ^{226}Ra, ^{232}Th and ^{40}K concentrations in soils of Udupi, Kundapur and Karkala Taluks of Coastal Karnataka region of India. The gamma absorbed dose rates were measured using portable GM survey meter and soil radioactivity was by gamma spectrometry method using an HPGe detector. The results show that the ^{226}Ra concentration varies in the range 1.2 –78.0 Bq kg^{-1} with a mean of 30Bq kg^{-1}, ^{232}Th in the range of 1.6 - 166Bq kg^{-1} with a mean of 56Bq kg^{-1} and ^{40}K in the range 12 – 477Bq kg^{-1} with a mean of 189Bq kg^{-1} in the 0-5 cm soil profile. The gamma absorbed dose rates, measured using the GM survey meter, show that the dose varies in the range of 70.0 - 123.0 nGy $h^{-1.}$ These values are comparable to those reported for other normal background regions of India.*

Key Words: *Gama Radiation Dose Rates, Radio Nuclides, HPGe Detector*

Introduction

The two prominent sources of external radiation are cosmic rays and terrestrial gamma rays. Terrestrial gamma rays derive essentially from ^{40}K and the radionuclides belonging to ^{238}U and ^{232}Th series that are present in earth's crust. (Anagnostakis *et al.*, 1996; Baeza, A., Del Rio *et al.,*1992). Apart from these natural sources, modern scientific and technological activities also contribute to the radiation level in the environment, which would be significant if proper precautions are not taken.

Therefore, studies are aimed at establishing the baseline data on radiation levels and radionuclides distribution in various environmental matrices of a region is important because such a study would help to assess, in future, the impact of our scientific and technological activities on the environment. Detailed studies were carried on the background radiation levels and natural radionuclides concentration in soils of Udupi, Kundapur and Karkala Taluks of Coastal Karnataka region of India. The region, known for its splendidly beautiful environment, is now witnessing a rapid industrialisation with setting up of many major industries including Thermal Power Stations. This paper discusses the results of gamma radiation levels and ^{226}Ra, ^{232}Th and ^{40}K activities in the soil and also the gamma dose rate measurements using the survey meter.

Materials and Methods

The external gamma dose rates in air were measured in different locations of the study area using a portable GM tube based Environmental Radiation Dosimeter (model ER709, Nucleonix Systems Pvt. Ltd., Hyderabad, India). Soil samples were collected from 0-5 cm profile from 29 sampling stations. Samples were processed and concentrations of ^{226}Ra, ^{232}Th and ^{40}K were determined by gamma spectrometry using a HpGe detector (41% efficiency n-type detector, Canberra, USA) coupled to a DSA-1000 with 16K MCA. The detector was enclosed in a 10 cm thick graded lead shield (Model 747, Canberra, USA).

The ^{226}Ra activity was evaluated from the weighted mean of the activities of three photopeaks of ^{214}Bi (609.3, 1129.3 and 1764.5 keV) after subtracting the background counts and applying Compton corrections. In the case of ^{232}Th one photopeak of ^{228}Ac (911.2 keV) and two photopeaks of ^{208}Tl (583.1 and 2614.5 keV) were used in the same way. The activity of ^{40}K was derived from the 1460.8 keV gamma line of this isotope. The detector efficiency calibration was performed using the IAEA quality assurance reference materials: RG U-238, RG Th-232, RG K-1 and SOIL-6.

The Minimum Detection Levels (MDL) for the gamma spectrometer system used in the present study were 0.2 Bq kg^{-1}, 0.3 Bq kg^{-1} and 1.2 Bq kg^{-1} for ^{226}Ra, ^{232}Th and ^{40}K, respectively for a counting time of 60,000 s and a sample weight of 0.3 kg. Details of the measurements technique were published elsewhere (Karunakara, *et al.* 2001).

Results and Discussion

The results of measurement of ^{226}Ra, ^{232}Th and ^{40}K activities in surface soils of Udupi, Kundapur and KarkalaTaluks are presented in Table 1. The activity of ^{226}Ra is in the range 1.2 to -78.0 Bq kg^{-1} with a mean value of 34.4 Bq kg^{-1}, ^{232}Th in the range 1.6 to -118Bq kg^{-1} with a mean value of 45.3 Bq kg^{-1} and that of ^{40}K in the range 11.8 to - 323Bq kg^{1} with a mean value of 198.6 Bq kg^{-1} in the surface (0-5cm) soils. These values are comparable to those reported for other normal background regions of India (Kamath *et al.*, 1996) and the world (UNSCEAR, 1993).

Place	K-40 BqKg^{-1}	Th-232 Bqkg^{-1}	Ra-226 BqKg^{-1}	Gamma Dose Rate nGyh^{-1}
1. Kodavoor	73.0	26±1.0	34.9±0.0	79
2. Cherkady	219.2	44.9±1.2	26.1±0.9	79
3. Kakkunje	128.8	43.6±1.3	42.9±1.1	105
4. Karje	493.5	14.8±0.8	6.1±0.7	105
5. Kukke Halli	108.6	24.8±0.9	19.7±0.7	105
6. Dupadakatte	124.5	51.7±1.3	44.2±1.0	88
7. Kemmannu	366.5	18.9±0.9	12.83±0.7	96
8. Brahmavar Sugar Factory	89.9	25.28±0.9	29.4±0.8	88
9. Kallianpur	190.5	49.9±1.2	54.8±1.1	105
10. Pamboor	199.5	41.3±1.2	34.7±0.9	114
11. Shivally	183.8	38.9±1.1	55.1±1.1	123
12. Nejar	194.8	51.4±1.3	63.5±1.1	96
13. Tenkanidiyur	222.6	26.9±0.9	17.9±0.8	79
14. Hebri (Near Karje)	202.3	79.3±1.7	48.6±1.2	70
15. Yedthady	137.0	21.3±0.9	21.4±0.8	114
16. Kukkehalli North	119.7	28.1±0.9	23.0±0.7	123
17. Kokkarne	72.9	29.3±0.8	15.1±0.6	105
18. Hebri Nisargadama	254.1	47.2±1.2	30.8±0.9	105
19. Perampalli	92.8	40.7±1.2	48.9±1.0	123
20. Herror	105.1	27.0±0.8	43.5±0.8	88
21. Cherkady	256.6	53.4±1.4	26.2±1.0	79
22. Malpe Sand	231.7	2.31±0.5	2.6±0.4	70
23. Hoode sand	84.3	88.8±1.6	41.1±1.0	70
24. Nandikoor	171.1	6.9±1.6	21.8±1.0	88
25. Nakre	213.9	118.9±1.8	38.9±1.0	114

Place	K-40 $BqKg^{-1}$	Th-232 $Bqkg^{-1}$	Ra-226 $BqKg^{-1}$	Gamma Dose Rate $nGyh^{-1}$
26. Ajekar	323.1	166.2±2.2	78.0±1.4	112
27. Karkala	230.6	60.9±1.3	53.9±1.3	114
28. Bailur	477.1	47.0±1.2	33.8±1.0	114
29. Nitte	190.6	37.1±1.1	28.4±0.9	70
30. Maravanthe Beach	57.4	1.6±0.6	1.2±0.5	53
31. Byndoor Beach	155.5	62.1±0.3	19.7±0.9	61
32. Kambadakone	127.1±4.9	28.8±0.9	22.7±0.8	79
33. Tallur	179.3±5.6	48.3±1.1	46.9±0.9	79
34. Gangolli	119.3±4.5	18.6±0.8	18.6±0.7	114
35. Byndoor Hill	11.8±2.9	14.9±0.8	13.8±0.6	96

The average dosage rate people receive is quite normal. Only at Yedthady, Mandarthi and miraculous pond of Attur church, the activity is slightly high but at normal rate. The higher activity could be due to the presence of thorium in the granite. Dosage rate at the beaches of Udupi district is quite low compared to hilly region. So there is no possibility of thorium content like Kerala or Ullal beach.

Radio Nuclide K-40 is present in all the soil samples in good amount and this radio nuclide is the main source which contributes for the dose rate that the people of Udupi district receive. The value is quite high in Kemmannu and Karje area. In Nandikoor, presence of radio nuclides and dose rate is found to be normal.

The study has established the baseline data on ^{226}Ra, ^{232}Th and ^{40}K in the soils of Udupi Kundapur and Karkala Taluks. The database would help in assessing, in future, the environmental impact of operation of major industries, including Thermal Power Stations that are coming up in the region. The activities of these radionuclides in soil and the gamma absorbed dose delivered by these radionuclides to the population of the region are comparable to those reported for other normal background regions of India and the world.

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