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Determination of radioactivity in vegetable ashes at coastal areas of Kanyakumari District, Tamil Nadu

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Abstract
The mean gross alpha and beta activities in vegetables at Koottumangalam in Kanyakumari District were determined. The radioactivity studies were carried out in the Health Physics unit of BARC located in Indian Rare Earths Limited, Manavalakurichy in Kanyakumari. The vegetables such as Mango, Coconut crunch, Lady's finger, Cucumber and Brinjal were taken for alpha and beta activies determination. The average gross alpha activities for vegetable were found to be 1.25±0.019 for mango, 1.41±0.014 for coconut crunch, 0.81±0.018 for lady's finger, 1.05±0.025 for cucumber and 0.92±0.019 Bq g^{-1} for brinjal and their beta activities were 3.45±0.44 for mango, 3.75±0.014 for coconut crunch, 2.05±0.24 for lady's finger, 3.05±0.44 for cucumber, 1.97±0.44 Bq g^{-1} for brinjal. The result of the average gross alpha activities for vegetable were presented and discussed in detail.

Keywords: Gross alpha, Gross beta, vegetable, soil, leave and radioactivity

1. Introduction
The components of vegetables are essential components of human diet as they contribute starch, protein, vitamins, iron, calcium and other minerals (Thompson and Kelly, 1990) [15]. They act as a buffering agent for acidic substances secreted during digestion. Plants and vegetables grown in active area can take up a small fraction of the soil activity along with other minerals through root uptake (Eisenbud *et al*, 1997) [4]. The amount of measurement of radioactive nuclides in vegetables are well acknowledged since they have been the main concern of research conducted worldwide (Smith-Briggs and Bradley, 1984; Santos *et al*., 1993; Radhakrishna *et al*., 1996; Pietrzak-Flis *et al*., 2001; Santos *et al*., 2002; Al-Masri *et al*., 2008; Ele Abiama *et al*., 2012; Jha *et al*., 2012) [14, 9, 12, 1, 5, 7]. Accumulation and transfer of radionuclide from one environmental compartment to another through root uptake in biological systems depend upon the availability of radioactive nuclides in soil. A series of studies in high background radiation areas have revealed interesting information on accumulation in plants.

Human activities such as mining, milling and processing of uranium ores and mineral sands, smelting of metal, manufacture of fertilizers, drilling, transportation, processing and burning of fossil fuels play an important role in raising the concentrations of naturally occurring radioactive materials in the environment (Avwiri & Ebeniro, 1998; Foland, Kirland & Vinnikoov, 1995; Pujol & Sanchez- Cabeza, 2000) [2, 6, 10]. Worldwide contamination of the food chains by radionuclides produced during tests of nuclear weapons in the atmosphere has taken place during the past half century (Banzi, F.P *et al* 2000) [3]. Soil is the basic indicator of the radiological status of the environment. Because, it acts as a source of transfers of radionuclides through the food chain depending on their chemical properties and the uptake process by the roots to plants and animals (Jabbar *et al*., 2010). The measurement of any release of radioactivity to the environment is important for the protection of public health, especially if the released activity can enter the food chain.

The radiation exposure to the human population residing in Natuarl High Background Radiation Area (NHBRA) is contributed mainly by external and internal sources. The external radiation can be directly estimated by radiation measurement instrument and techniques. Therefore an attempt is made in the present investigation to studies on the natural radioactivity content in soil, leaves and vegetables collected from various coastal region of Kanyakumari district in Tamilnadu, India. Mainly gross alpha and gross beta activities of different samples were measured.

1.1 Study area
Kottumangalam coastal regions are mainly the study area which is a Naturally High Background Radiation Area (NHBRA) in the southwest coastal region of Kanyakumari district in Tamil Nadu, India.

1.2 Materials and Methods
Radiation studies were carried out in the Health Physics unit of BARC located in the campus of Indian Rare Earths Limited, Manavalakurichy in Tamil Nadu.

Vegetable sample such as Mango, Coconut crunch, Lady's finger, Cucumber, Brinjal were collected from the coastal area. The sample preparation procedures for vegetables and leaves are as follows

- Take 500 gms of Mango, 200 gms of coconut crunche, 200gms of lady's finger, 1 Kg of cucumber and 200 gms of brinjal separately
- Wash thoroughly first with demineralized water and then repeatedly with distilled water two to three times.
- Cut vegetables except coconut crunche into small pieces and then seeds of mango and cucumber were removed.
- Take the wet parts of vegetables and dry it hot air oven at a temperature of 150^0C for four hours.
- Take the samples and then cooled and powdered.
- The powered sample is taken in a nickel crucible.

- Ashed it electric Bunsen burner at a temperature 400^0C for four hours.

For the purpose of evaluationg radionuclide pickup by food crops, soil upto a depth 30 cm has to be collected from in and around the plant. The collection and the procedure of soil samples are

- Collected soils were taken in polythene bags for analysis.
- Take one Kg of soil free from all mud wastes.
- Stone and other particles were removed.
- Dried samples in hot air oven at a temperature of 150^0C for four hours.
- Take the sample and then to cool.
- Then 5 gms of the sample with the help of a riffle splitter.
- The sample is powered with the help of agate mortar.

1.3 Estimation of Gross alpha/ beta activity of the samples

- Take approximately 0.00050 gm of powered sample in the previously cleaned aluminum planchet and uniformly spread.
- The sample along with a planchet is kept in a drawer assembly of the alpha/beta counting system.
- Counted for 1000 seconds.
- The background of the counting system was also determined in a similar way by counting the empty planchet for 1000 seconds.
- The net count obtained is found out by subtracting the background counts from the sample counts.
- From the measured count rate the gross alpha/beta activity was calculated using the formula

$$Gross\ alpha/beta = \frac{Net\ counts}{T} X \frac{100}{Efficiency\ of\ the\ counter} X \frac{1}{W}\ Bq/g$$

Net counts = Sample counts - Background counts
W = Weight of the sample in grams.
T = Time in seconds.

1.4 Estimation of Monazite content in soil samples

1. Take 300 gms of soil sample with a help of the riffle splitter in the sample bottle upto the mark
2. Sample bottle was kept in the ionization chamber
3. Counted for 1000 seconds for two to three times
4. The standard is also counted for 1000 seconds
5. The background of the counting system is also determined ina similar way by 1000 seconds
6. The net count obtained was found out by subtracting the gross sample count and standard count
7. From the measured count rate the percentage of monazite was calculated using the formula

$$\%\ of\ monazite = \frac{W \text{ X } S \text{ X } R}{w \text{ X } r}$$

W = weight of the standard sample
S = Known monazite % of Standard substance
R = Net count for standard reading
W = weight of the sample
R = Net count of sample reading

2. Result and Discussion

The gross alpha and beta activities in soil, leaves and vegetables are shown in Table 1 to 5. Gross α and gross β activities in vegetables such as mango, coconut crunches, lady's finger, cucumber and brinjal are shown in Fig 1. Fig 2 describes monazite % in different soil samples.

Table 1: Relative radioactive content in soil, leaves and mango samples

S. No	Specification	Weight (g)	Activity (Bq g^{-1})		Monazite %
			Gross α	Gross β	
1	Mango	0.0062	1.25	3.45	-
2	Leaves 1	0.0057	0.80	1.75	-
3	Soil 1	0.0080	8.22	29.40	01.25

Table 2: Relative radioactive content in soil, leaves and coconut samples

S. No	Specification	Weight (g)	Activity (Bq g^{-1})		Monazite %
			Gross α	Gross β	
1	Coconut	0.0050	1.41	3.75	-
2	Leaves 2	0.0049	1.00	1.85	-
3	Soil 2	0.0072	10.25	31.40	1.30

Table 3: Relative radioactive content in soil, leaves and Lady's finger samples

S. No	Specification	Weight (g)	Activity (Bq g^{-1})		Monazite %
			Gross α	Gross β	
1	Lady's finger	0.0061	0.81	2.05	-
2	Leaves 3	0.0058	0.51	1.05	-
3	Soil 3	0.0049	7.71	21.45	0.71

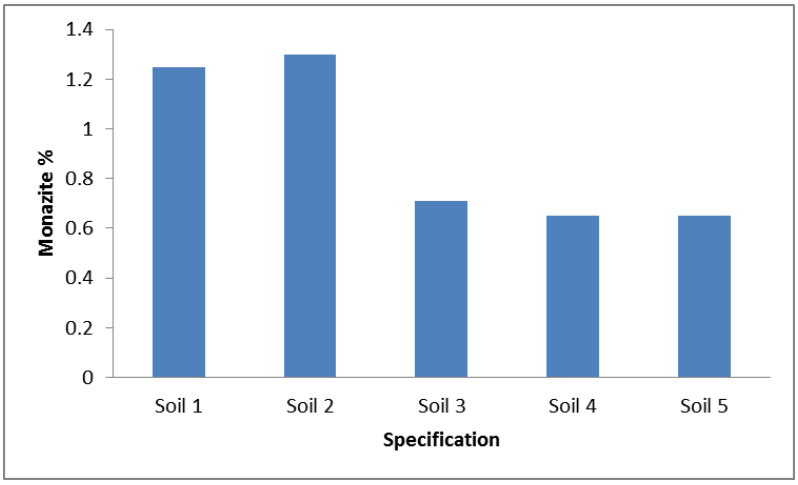

Fig 2: Monazite % in soil

Table 4: Relative radioactive content in soil, leaves and Cucumber samples

S. No	Specification	Weight (g)	Activity (Bq g^{-1})		Monazite %
			Gross α	Gross β	
1	Cucumber	0.0050	1.05	3.05	-
2	Leaves 4	0.0060	0.95	2.75	-
3	Soil 4	0.0520	10.05	31.45	0.65

Table 5: Relative radioactive content in soil, leaves and Brinjal samples

S. No	Specification	Weight (g)	Activity (Bq g^{-1})		Monazite %
			Gross α	Gross β	
1	Brinjal	0.0052	0.92	1.97	-
2	Leaves 5	0.0057	0.55	0.95	-
3	Soil 5	0.0063	6.45	19.25	0.65

Tables 1 to 5 provide the relative radioactive content in the vegetable, soil and leaves. It can be seen from the tables that radioactive content in the soil samples are maximum, their gross alpha activities are 8.22±0.074 for mango, 10.25±0.042 for coconut crunch, 7.71±0.038 for lady's finger, 10.05±0.038 for cucumber and 6.45±0.052 Bq g^{-1} for brinjal and their gross beta activities are 29.40±0.48 for mango, 31.40±3.24 for coconut crunch, 21.45±3.69 for lady's finger, 31.45±3.95 for cucumber, 19.25±2.15 Bq g^{-1} for brinjal. The corresponding monazite contents were determined to be 01.25% for mango, 1.30% for coconut crunch, 0.71% for lady's finger,0.65% for cucumber, 0.65% for brinjal. In the leaves samples, the average gross alpha activity was found to be 0.80±0.012 for mango, 1.00±0.026 for coconut crunch, 0.51±0.022 for lady's finger, 0.95±0.055 for cucumber and 0.55±0.034 Bq g^{-1} for brinjal and their average gross beta activities were found to be 1.76±0.38 for mango, 1.85±0.19 for coconut crunch, 1.05±0.21 for lady's finger, 2.75±0.42 for cucumber and 0.95±0.36 Bq g^{-1} for brinjal.

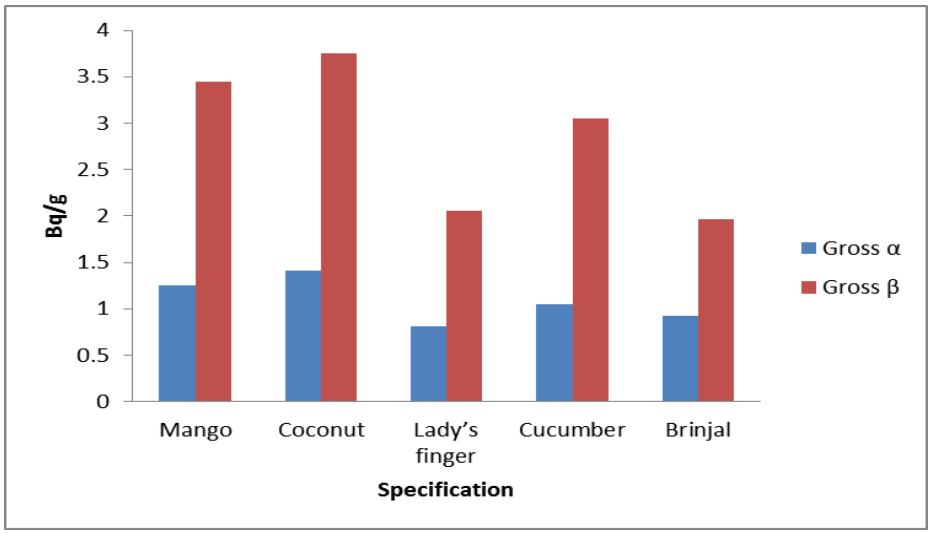

Fig 1: Gross α and gross β activities (Bq/g) in vegetables

The average gross alpha activities for vegetable were found to be 1.25±0.019 for mango, 1.41±0.014 for coconut crunch, 0.81±0.018 for lady's finger, 1.05±0.025 for cucumber and 0.92±0.019 Bq g^{-1} for brinjal and their beta activities were 3.45±0.44 for mango, 3.75±0.014 for coconut crunch, 2.05±0.24 for lady's finger, 3.05±0.44 for cucumber, 1.97±0.44 Bq g^{-1} for brinjal. The lower content of radioactivity in the leaves as compared to vegetables can be attributed to the lesser life period of leaves. As the leaves are having a weathering period roughly one or two months, so the concentration it is expected to be less. Longer life period of coconut leads to greater accumulation of radioactivity when compared to other vegetables.

3. Conclusion

The gross alpha and beta activities reported from soil, leaves and vegetables in kanyakumari district at different places are found to be within limit. Understanding natural radioactivity will enable us to check or limit the toxicity. The result shows that there is no appreciable change in the activities of vegetable samples such as mango, coconut crunch, lady's finger, cucumber and brinjal collected from the Natural High background areas.

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