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Gross Alpha and Beta radioactivity studies in Dindigul and Erode Districts, Tamilnadu

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Abstract
In this study, the Natural radioactivity concentrations of tobacco cultivated field samples of Dindigul and Erode districts (23 stations) are measured. The Gross Alpha and Gross Beta radioactivity concentrations are investigated in the period of November 2012 to January 2013. By using an alpha counter (SP 647A) with Zns (Ag), the gross-alpha and gross-beta radioactivity of soil samples is measured. The gross-alpha and gross-beta activity concentrations in soil samples varied from 0.25 to 1.20mBq/g and 1.28 to 6.17mBq/g are observed. These results provide the baseline data for the further studies about daughter radionuclides in selected 23 stations.

Keywords: Gross Alpha, Gross Beta, Tobacco cultivated field soil

1. Introduction

The determination of radionuclides in environmental samples is a crucial task in relation to the protections of human health (Selcuk *et al*., 2009) [19] and their effects on humans are always depends on the regional geological and geographical behaviour. Presence of Radioactivity in surface soil is mainly due to the presence of radioactive elements in the Earth crust (Lide 1994) [13]. Radionuclides and their isotopes present in soil can be dissolved into the surrounding aquatic ecosystem (Bal *et al*., 2012) [1] and produced an increased background level of natural radiation in a particular ecosystem (Duenas *et al*., 1993; Canbazoglu *et al*., 2000, 2001) [5].

Radiation contamination in environment occurs due to either naturally or artificially producing radioactive substance (Patel, 1980) [16]. Radiation is part of the natural environment and approximately 80% of the human exposures are from naturally occurring radioactive materials (Brijesh patak, 2012) [4]. Human activities have contributed to the increased concentrations of some of radionuclides in the environment (Baxter 1996) [2].

The Earth crust contains small amounts of radionuclides and radioisotopes such as Uranium, Thorium, Radium and Potassium respectively. Natural contents of uranium (U) and thorium (Th) in igneous rocks are in the range 0.1-5 and 1-20 mg/kg respectively, depending on the type of rocks, Felsic rocks (Granite), usually contains more U and Th than Mafic rocks (Basalt) (Brijesh patak 2012) [4]. Enhanced levels of these naturally occurring radionuclides might be present in the soil and acts as a source of transfer 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) [11].

Among the various radioactivity research, attentions are mostly given to gamma emitter's detection and their quantification, even in an environment where it is possible to have alpha and beta emitters (Gu & Yaprak, 2010; Lu *et al*., 2012; Mehade *et al*., 2014) [8, 14, 15].

The Gross Alpha and Beta analyses are the simplest radio analytical procedures and used as the first step of a screening method. It is a very fast, safe and low cost method [5]. This present study will help to prepare baseline data for gross alpha and gross beta radioactivity in environmental sample, which will be used as fingerprint for the comparison of radioactivity level.

2. Material and Methods

2.1. Study Area and Sample Collection

The study area selected is Tobacco cultivated fields soil which covers areas of Dindigul (11 º30.870'N, 077 º57.722'E) and Erode (10 º32.256'N, 077 º57.039'E) (longitude and latitude) districts, Tamilnadu (India). 23 location sites (Figure 1 and Table 1) of these districts are used for the survey from the month of December to April. Locations are recorded in terms of degree minute second (Latitude and Longitudinal position) using hand held Global Positioning System (GPS) (Model: GARMIN GPS-12) unite and the distance between each site is 3-6 km.

2.2. Sample Preparation

For the measurement of gross alpha and gross beta activity, the tobacco cultivated field soil from each sampling stations is dried an oven at 105ºC to 110 ºC for 24 h. About 5-10 mg (for alpha) and 50-100mg (for beta) of the sample is uniformly spread over a clean background counter, Aluminium planchette (3 cm diameter) using a micro sieve and the radioactivity is The alpha spectrometric system is a (ECIL, model no.RCS 04027A) with an alpha counter (SP 647A) of ZnS (Ag) detector is used for the estimation of alpha activity of the samples (Kannan, 1983; Ganapathy, 1984) [12, 9]. The alpha

counting system employs a scintillation principle of detection, using ZnS (Ag) powder as the phosphor, which was uniformly applied on one face of the clear circular Perspex disc of 2mm thick and 5cm diameter

2.3. Calculation of gross alpha/beta activity

The Gross alpha and Gross beta activities in soil samples are calculated using the following equation (Biswas *et al*., 2015) [3].

$$DPM = NET\_CPM \times 100 / EFF \quad (1)$$

Where, DPM = alpha/beta disintegration per min, NET_CPM = N*et al*pha/beta count per min, and EFF = alpha/beta efficiency percent.

Error is the difference between a measured value and the true value of a quality or attribute. Thus, it is the factor that limits the precision and accuracy of the result of a measurement. The term net count rate associated with the activity measurement is the difference between the gross count rate of the sample (which is the summation of background count rate and sample count rate) and the background count rate. Each count rate includes standard deviation expressed as,

$$\sigma = \pm\sqrt{\frac{As}{Ts} + \frac{Ab}{Tb}} \quad (2)$$

Where, σ = standard deviation, As = sample count rate in c.p.s., Ab = background count rate in c.p.s., Ts = sample count time, Tb = background count time. The measurement errors represent one- sigma uncertainties.

2.4. Statistical Analysis

Statistical analysis is performed for the obtained results by using SPSS (17.0 version). The data was expressed as a mean percent change from the control group ± standard deviation. Skewness, kurtosis, frequency distribution, histogram parameters are used to analyse the results.

3. Result and Discussion

Terrestial radiation varies from place to place depending upon on variation of radionuclide concentration in soil. Natural radioactive elements are transferred and cycled through natural processes and between the various environmental compartments by entering into ecosystems and human food chains (Shanthi *et al*., 2009) [18]. The gross alpha and beta radioactivity concentrations in soil samples obtained from locations in Dindigul and Erode districts of Tamilnadu are respectively presented in Table 1-2 and Figure 1-2.

Understanding natural radioactivity will enable us to check or limit the toxicity and hence risk to the individual and society of such exposed (Sarojini *et al*., 2015) [17]. The gross alpha radioactivity concentration in soil varies between 0.25 and 1.20 mBq/g and the gross beta radioactivity concentration varies between 1.28 and 6.17 mBq/g. The sample S5 has the highest gross alpha radioactivity concentrations while the sampling station S12 contains the lowest gross alpha radioactivity concentrations. The S6 sampling station has the highest gross beta radioactivity concentrations while the sampling stations S12 showed lowest gross beta radioactivity concentrations.

Natural soil, water and vegetables are not completely free from radioactive isotopes due to the presence of beta and alpha emitters from the natural decay series of uranium, thorium and actinium and other single isotopes such as 40K. The main alpha emitters are 238U, 234U, 232Th, 226Ra and 210Po and the main beta emitters are 40K, 228Ra, 210Pb that can be present in environmental samples in different concentrations (Biswas *et al*., 2015) [3]. It is interesting that the soil sample station of S6 has high concentrations both in gross alpha and gross beta radioactivity when compared to other sampling stations. This is resulted from the geological structure of the locations from which the sample is obtained. As shown in the Figure 1 and Figure 2 respectively the soil samples have higher gross alpha and gross beta radioactivity such a result may due to the location of the stations from which soil samples are obtained which is situated on the Tobacco cultivated soil samples are the radon existence is relatively high.

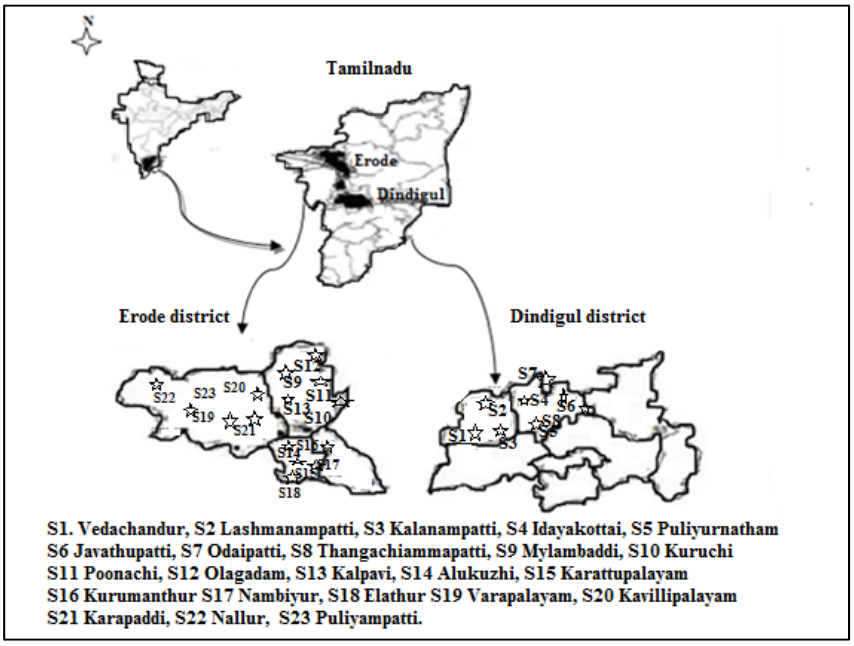

Fig 1: Study area: Soil sampling locations in of Dindigul and Erode Districts are shown in the map

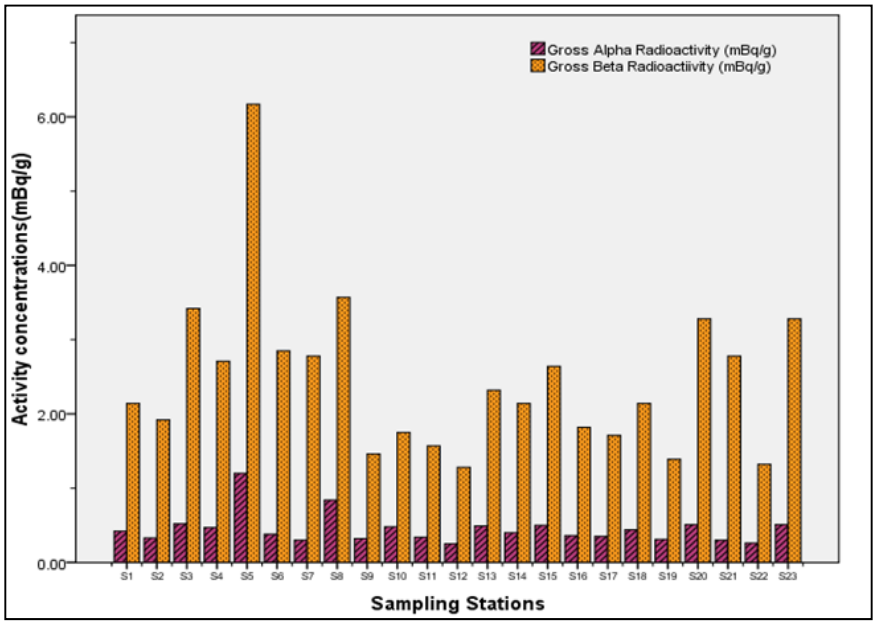

Fig 2: The Gross alpha and gross beta radioactivity Concentration of the soil samples

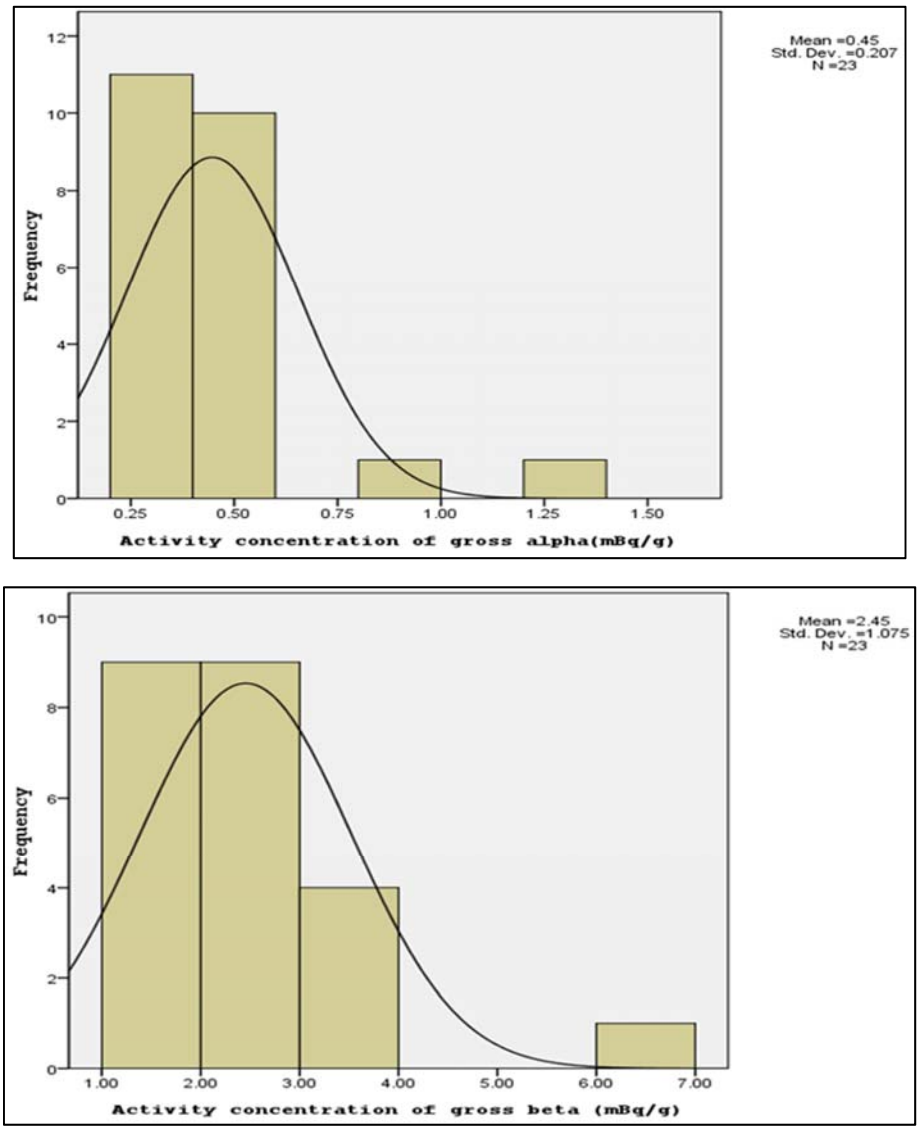

Fig 3: Activity concentration of Gross Alpha and Gross beta in soil

Table 1: Location of the sampling sites

Site No	Location	Latitude	Longitude
S1	Vedachandur	077°57.039'E	10°32.256'N
S2	Lashmanampatti	077 ° 57.582'E	10°32.740'N
S3	Kalanampatti	077°57.988'E	10°32.730'N
S4	Idayakottai	077°53.523'E	10°31.436,N
S5	Puliyurnatham	077°50.025'E	10°32.002'N
S6	Javathupatti	077° 51.053'E	10°31.350'N
S7	Odaipatti	077°47.095'E	10°35.232'N
S8	Thangachiammapatti	077°42.025'E	10°29.232'N
S9	Mylambaddi	077°40.722'E	11° 30.870'N
S10	Kuruchi	077°41.564'E	11°34.031'N
S11	Poonachi	077°39.397'E	11°36.294'N
S12	Olagadam	077°41.633'E	11°33.740'N
S13	Kalpavi	077°38.471'E	11°34.151'N
S14	Alukuzhi	077°21.379'E	11°26.751'N
S15	Karattupalayam	077°21.353'E	11°26.906'N
S16	Kurumanthur	077°20.874'E	11°24.815'N
S17	Nambiyur	077°19.313'E	11°21.679'N
S18	Elathur	077°18.430'E	11°23.293'N
S19	Varapalayam	077°13.958'E	11°22.344'N
S20	Kavillipalayam	077°13.885'E	11°23.186'N
S21	Karapaddi	077°12.057'E	11°22.741'N
S22	Nallur	077°08.377'E	11°30.870'N
S23	Puliyampatti	077°57.039'E	10°32.256'N

Table 2: The Gross alpha and Gross Beta Radioactivity in Tobacco Cultivated field soil samples

Site No.	Sampling Stations	Gross Alpha Activity(mBq/g)	Gross Beta Activity(mBq/g)
S1	Vedachandur	0.42	2.14
S2	Lashmanampatti	0.33	1.92
S3	Kalanampatti	0.52	3.42
S4	Idayakottai	0.47	2.71
S5	Puliyurnatham	1.20	6.17
S6	Javathupatti	0.38	2.85
S7	Odaipatti	0.30	2.78
S8	Thangachiammapatti	0.84	3.57
S9	Mylambaddi	0.32	1.46
S10	Kuruchi	0.48	1.75
S11	Poonachi	0.34	1.57
S12	Olagadam	0.25	1.28
S13	Kalpavi	0.49	2.32
S14	Alukuzhi	0.40	2.14
S15	Karattupalayam	0.5	2.64
S16	Kurumantur	0.36	1.82
S17	Nambiyur	0.35	1.71
S18	Elathur	0.44	2.14
S19	Varapalayam	0.31	1.39
S20	Kavillipalayam	0.51	3.28
S21	Karapadi	0.30	2.78
S22	Nallur	0.26	1.32
S23	Puliyampatti	0.51	3.28
Range		0.25-1.20	1.28-6.17
Mean ±SD		0.45 ±0.20	2.45±1.07
Skewness		2.57	1.90
Kurtosis		7.94	5.54
Frequency distribution		Leptokurtic	Leptokurtic

Conclusion

Natural radioactivity forms a significant part of the total activities in the environment whereas anthropogenic activities have introduced significant amounts and usually their influence is limited to the near locality of their introduction. This work is framed to determine the natural radioactivity in the tobacco cultivated soil samples of Dindigul and Erode districts by determining gross alpha and gross beta radioactivity concentrations and it is found to be within limits.

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