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A STUDY OF NATURAL RADIOACTIVITY IN SELECTED SEAWEEDS OF COASTAL KANYAKUMARI DISTRICT, TAMIL NADU, INDIA.

***P. Mary Saroja**

Department of Chemistry, Holy Cross College (Autonomous), Nagercoil.

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***Correspondence for Author**
P. Mary Saroja
Department of Chemistry, Holy Cross College (Autonomous), Nagercoil, India.

ABSTRACT

In the present study, the gross alpha, gross beta and gross gamma activities of three selected seaweeds *viz*: *Ulva lactuca* (green), *Sargassum Wightii* (brown) and *Gracillaria edulis* (red) were estimated. The selected seaweeds were collected in two seasons, pre monsoon (August 2015) and post monsoon season (December 2015) from Muttom and Kanyakumari coasts of Kanyakumari District. The gross alpha activity was measured using alpha PNC model, gross beta and gross gamma activities were measured using PNC model – 1G. Among the selected seaweeds brown algae (*S. wightii*) showed higher gross alpha activity than the other two marine macro algae (*U. lactuca* and *G. edulis*). The mean gross beta activity of *U. lactuca* (green algae) was 651.69 Bq/Kg, *G. edulis* (red algae) 104.5Bq/Kg, S. *wightii* (brown) 286.42 Bq/Kg. The mean gross alpha activities of samples collected from Muttom coast (408.83 Bq/Kg) was found to be higher than the samples from Kanyakumari coast (241.23 Bq/Kg)). All the three seaweeds under investigation recorded higher amount of gross beta activity during post monsoon season than the pre monsoon season. The mean gross beta activity of the selected seaweed samples from Kanyakumari coast was 537.04 Bq/Kg and Muttom coast was 304.51 Bq/Kg.The mean gross gamma activity in seaweed samples from Kanyakumari coast is 381.43 Bq/Kg and Muttom coast 474.00 Bq/Kg indicating locational variation.

KEYWORDS: alpha, beta, gamma, *U. lactuca*), *S. Wightii*, *G. edulis*.

INTRODUCTION

Seaweeds are a group of photoautotrophic, multicellular algae occurring in marine environments. They are good sources of proteins, carbohydrates, vitamins and minerals in human nutrition. They are nutritionally valuable as fresh or dried vegetables or as ingredients in wide prepare foods. Each atom has a nucleus and radioactive decays involve nuclear transformations until the nucleus becomes stable. The activity of the material has been shown to be the result of mainly three different kinds of radioactive emissions called alpha, beta and gamma radiations. Radiation effect can broadly be classified into natural radiation, cosmic radiation and anthropogenic radiation. Natural and anthropogenic radiations in different sources are predominant radiation factors in the marine eco-system. For instance, potassium is an essential element for all living beings either plants or humans. Potassium is used as fertilizer to augment agricultural yield and the same reaches the sea through seepage and other means.

The nature and degree of radioactivity vary in the environment due to natural as well as human causes. For instance, anthropogenic activities connected to nuclear tests, nuclear installations, nuclear power plants, nuclear reactors, etc. do contribute to the increasing emission of radioactive rays and thus causing negative impact on the environment as well as on living being. The phenomenon of biosorption of radionuclide by plant and animal species both in terrestrial and marine environment has been reported in earlier studies. The phosphate fertilizers are derived from a rock mineral named apatite containing high levels of radium and other radioactive elements ^{210}Po and ^{210}Pb and hence the cultivation of crops in soil with added chemical fertilizers increases the radionuclide concentration in vegetables. [1] Studies conducted in Turkey identified the concentrations of ^{210}Po and ^{210}Pb radionuclides in the soil and vegetable samples collected from both cultivated and uncultivated agricultural land. [2]

The monazite deposits occur throughout the erstwhile South Travancore region of India, comprising parts of Kerala and Kanyakumari district, Tamil Nadu.[3] Kanyakumari district and the southwest coast of India are naturally high background radiation area with the monazite content in the soil varying from 0.3% to 6% and the average annual effective dose is reported upto 20mSvyr^{-1}.[4] The Valliyar river with its origin at the Western Ghats and destination at Kadiapattinam, which serves to transport mineral from the weathering rocks of the Western Ghats, thereby constitutes the major source of the highly radioactive mineral.[5]

Akil and Yusof (2007) stated that the metals and radio nuclides are absorbed by the sea organisms through water, food and sediment.[6] Goodard and Jupp (2001) compared the activity concentration in seaweed and fish around the coast of oman.[7] Soma Giri *et al*., 2007 reported that the dilution following monsoon has a dominant role in deciding the fate of radio nuclide in the surface water system.[8] Hence the present study was undertaken to estimate the gross alpha activity, gross beta activity and gross gamma activity in the selected seaweeds collected from the Muttom and Kanyakumari coasts and to know the impact of seasons and locations on the natural radioactivity of selected seaweeds.

MATERIALS AND METHODS

a) Area of study

In the present study, the selected coastal villages are Muttom and Kanyakumari which are located in the Kanyakumari district, Tamil Nadu, India. This district is the southernmost tip of India which lies between 77^{o} 15' and 77^{o} 36' of the eastern longitude and 8^{o} 35' and 8^{o} 35' of the northern latitude.

b) Collection and Processing of Samples

The selected seaweed samples namely *Ulva lactuca* (green), *Sargassum Wightii* (brown) and *Gracillaria edulis* (red) were collected in two seasons, pre monsoon (August 2015) and post monsoon season (December 2015). About 50 g of each species were collected and the samples were thoroughly washed with distilled water to remove dirt particles, debris and other epiphytes followed by shade-drying. The shade dried sample was further dried using hot air oven at 110ºC. It was then heated in silica crucibles at 590ºC using muffle furnace for 6 h to obtain dry ash. The colourless ash obtained was used to measure gross alpha, gross beta and gross gamma activities.

c) Estimation of gross alpha activity

About 0.02g of ash was crushed into fine powder using agate motar and spread as a fine layer on a aluminium planchet and its gross alpha activity was measured using alpha PNC model whose efficiency was 29.36%. The period of counting was 5000 seconds. From the measured count rate, the gross alpha activity was calculated using the formula:

$$\text{Activity} = \frac{\text{Net counts}}{T} \times \frac{100}{E} \times \frac{1}{w}$$

Net counts = Sample counts – Background counts

T = Time in seconds = 5000 sec

w = Weight of the sample in g

E = Efficiency

d) Estimation of gross beta activity

About 0.035g of ash was weighed and grind into fine powder using agate motar and spread uniformly on an aluminium planchet and its gross beta activity was measured using PNC model – 1G. From the measured count, gross beta activity was calculated using the above formula. The period of counting was 500 seconds whose efficiency was 19.95%.

e) Estimation of gross gamma activity

About 0.05g of ash was weighed and grind into fine powder using agate motar and spread uniformly on a aluminium planchet and its gross gamma activity was measured using PNC model – 1G. From the measured count, gross gamma activity was calculated using the above formula. The period of counting was 1000 seconds whose efficiency was 19.95%.

RESULTS AND DISCUSSION

a) Gross Alpha Activity

The seasonal variation of gross alpha activity in three selected seaweeds namely *U. lactuca*, *G. edulis* and *S. wightii* collected from Kanyakumari coast is presented in Table I. The gross alpha activity in *U. lactuca* was found to be 119.20 Bq/Kg in pre monsoon and 340.59 Bq/Kg in post monsoon season. It was observed that the gross alpha activity was less during pre monsoon season. Similarly for *S. wightii*, the gross alpha activity was recorded as 306.50 Bq/Kg during pre monsoon and 408.70 Bq/Kg in post monsoon season. In *G. edulis* the gross alpha activity was 102.10 Bq/Kg during pre monsoon season and 170.29 Bq/Kg in post monsoon season. Except *U. lactuca*, *S. wightii* and *G. edulis* recorded higher amount of alpha activity during post monsoon seasons. Among the selected seaweeds brown algae (*S. wightii*) showed higher mean gross alpha activity than the other two marine macro algae (*U. lactuca* and *G. edulis*).

Table I: Natural Radioactivity of selected seaweeds from Kanyakumari coast during the study period August (pre monsoon season) and December (post monsoon season) 2015.

Species	Seasons	Gross alpha activity Bq/Kg	Gross beta activity Bq/Kg	Gross gamma activity Bq/Kg
U. lactuca	Pre monsoon	119.20	501.24	111.1
	Post monsoon	340.59	801.99	111.1
G. edulis	Pre monsoon	102.10	200.49	888.8
	Post monsoon	170.29	973.85	666.6
S. wightii	Pre monsoon	306.50	257.78	177.7
	Post monsoon	408.70	486.92	333.3

The seasonal variation of gross alpha activity in three selected seaweeds from Muttom coast is provided in Table II. The gross alpha activity in *U. lactuca* was found to be 510.80 Bq/Kg in pre monsoon and 306.50 Bq/Kg in post monsoon season. It was observed that the gross alpha activity was less during post monsoon season. Similarly for *S. wightii*, the gross alpha activity was recorded as 408.70 Bq/Kg during pre monsoon and 442.70 Bq/Kg in post monsoon season. In *G. edulis* the gross alpha activity was 681.00 Bq/Kg during pre monsoon season and 102.10 Bq/Kg in post monsoon season. Except *S. wightii*, *G. edulis* and *U. lactuca* recorded higher amount of gross alpha activity during pre monsoon season. This showed the seasonal influence on the gross alpha activity of the seaweeds. In general the mean gross alpha activities of samples collected from Muttom coast (408.83 Bq/Kg) was found to be higher than the samples from Kanyakumari coast (241.23 Bq/Kg)). This investigation is in accordance with the findings of radioactivity in food crops from the high background radiation areas in Kanyakumari district of southwest India indicated higher levels than in the food crops at low background radiation areas. [9] The mean gross beta activity of *U. lactuca* (green algae) was 651.69 Bq/Kg, *G. edulis* (red algae) 104.5Bq/Kg, S. *wightii* (brown) 286.42 Bq/Kg.

Table II: Natural Radioactivity of selected seaweeds from Muttom coast during the study Period August (pre monsoon season) and December (post monsoon season) 2015.

Species	Seasons	Gross alpha activity Bq/Kg	Gross beta activity Bq/Kg	Gross gamma activity Bq/Kg
U. lactuca	Pre monsoon	510.80	429.64	777.70
	Post monsoon	306.50	515.57	666.60
G. edulis	Pre monsoon	681.00	102.10	299.90
	Post monsoon	102.10	206.90	222.20
S. wightii	Pre monsoon	408.70	257.78	666.60
	Post monsoon	442.70	315.07	211.00

b) Gross Beta Activity

The seasonal variation of gross beta activity in three selected seaweeds collected from Kanyakumari coast namely *U. lactuca*, *G. edulis* and *S. wightii* is provided Table I. The gross beta activity in *U. lactuca* was found to be 501.24 Bq/Kg in pre monsoon and 801.99 Bq/Kg in post monsoon season. It was observed that the gross beta activity was less during pre monsoon season. Similarly for *S. wightii*, the gross beta activity was 257.78 Bq/Kg during pre monsoon and 486.92 Bq/Kg in post monsoon season. In *G. edulis* the gross beta activity was 200.49 Bq/Kg during pre monsoon season and 973.85 Bq/Kg in post monsoon season. All the three seaweeds under investigation recorded higher amount of gross beta activity during post monsoon season than the pre monsoon season. This accounts for the seasonal impact on the activity concentration of gross beta.

The seasonal variation of gross beta activity in three selected seaweeds from Muttom coast is given in Table II. The gross beta activity in *U. lactuca* was found to be 429.64 Bq/Kg in pre monsoon and 515.57 Bq/Kg in post monsoon season. Similarly for *S. wighti*, the gross beta activity was 257.78 Bq/Kg during pre monsoon and 315.07 Bq/Kg in post monsoon season. In *G. edulis* the gross beta activity was recorded as 102.1 Bq/Kg during pre monsoon season and 206.9 Bq/Kg in post monsoon season. *U. lactuca*, *G. edulis* and *S. wightii* recorded higher amount of gross beta activity during post monsoon season. It showed that the activity concentration of gross beta vary in different seasons due to environmental factors. The mean gross beta activity of the selected seaweed samples from Kanyakumari coast was 537.04 Bq/Kg and Muttom coast was 304.51 Bq/Kg. Thus the beta activity is varied between the two selected locations.

c) Gross Gamma Activity

The seasonal variation of gross gamma activity in three selected seaweeds namely *U. lactuca*, *G. edulis* and *S. wightii* from Kanyakumari coast is presented in Table I. The gross gamma activity in *U. lactuca* was found to be 111.1 Bq/Kg in pre monsoon and 111.1 Bq/Kg in post monsoon season. It was observed that the gross gamma activity does not change in both the seasons indicating that it is independent of seasons. Similarly for *S. wightii*, the gross gamma activity was 177.7 Bq/Kg during pre monsoon and 333.3 Bq/Kg in post monsoon season. The gross gamma activity of *G. edulis* was 888.8 Bq/Kg during pre monsoon season and 666.6 Bq/Kg in post monsoon season. *G. edulis* recorded higher gross gamma activity during the post monsoon season while *S. wightii* showed higher gross gamma activity during the pre

monsoon season.This indicated that inter species variation in gamma activity is observed in seaweeds which is also influenced by the seasons.

The seasonal variation of gross gamma activity in three selected seaweeds namely *U. lactuca*, *G. edulis* and *S. wightii* from Muttom coast is presented in Table II. The gross gamma activity in *U. lactuca* is found to be 777.7 Bq/Kg in pre monsoon and 666.6 Bq/Kg in post monsoon season. It is observed that the gross gamma activity is low during post monsoon season when compared with pre monsoon season. Similarly for *S. wightii* the gross gamma activity is 666.6 Bq/Kg during pre monsoon and 211.0 Bq/Kg in post monsoon season. In *G. edulis*, the gamma activity is recorded as 299.9 Bq/Kg during pre monsoon season and 222.2 Bq/Kg in post monsoon season. *U. lactuca* and *G. edulis* recorded high activity concentration of gross gamma activity during pre monsoon than the post monsoon season. The mean gross gamma activity in seaweed samples from Kanyakumari coast is 381.43 Bq/Kg and Muttom coast is 474.00 Bq/Kg indicating locational variation. The variation of natural radioactivity levels at different sampling sites is due to the variation of concentrations of radioactive elements in the geological formations.[10] In general the natural radioactivity in terms of alpha and beta activity is found maximum during post monsoon season. Similar observation was reported for the natural radioactivity of *G. edulis* from four locations on the coast of Tamil Nadu.[11]

CONCLUSION

In the present study, it can be concluded that the selected seaweeds brown algae (*S. wightii*) showed higher gross alpha activity than the other two marine macro algae (*U. lactuca* and *G. edulis*).The mean gross beta activity of *U. lactuca* (green algae) was 651.69 Bq/Kg, *G. edulis* (red algae) 104.5Bq/Kg, S. *wightii* (brown) 286.42 Bq/Kg. The mean gross alpha and gamma activities of samples collected from Muttom coast were found to be higher than the samples from Kanyakumari coast while mean gross beta activity of the selected samples was found to be higher for the samples from Kanyakumari coast.The mean alpha and beta activities are found to be the highest in post monsoon season for the samples from Kanyakumari coast. The mean gross gamma activity of the selected seaweed samples from Kanyakumari coast is 381.43 Bq/Kg and Muttom coast 474.00 Bq/Kg indicating locational variation. The variation of natural radioactivity levels at different sampling sites is due to the variation of concentrations of radioactive elements in the geological formations.

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