DETERMINATION OF NATURAL RADIOACTIVITY LEVELS IN MYRTUS COMMUNIS PLANT

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Abstract

In this study are presented the first results on determination of natural and artificial radioactivity levels in Myrtus Communis plant (commonly known as Mërsina). Plants are collected from Spille bay on the Adriatic sea, central part of Albania. The determination of activity concentration in plant and soil samples is performed by using High Purity Germanium (HPGe) gamma-ray spectrometry. The average activity concentration in soil samples is found to be 203.56 ± 7.3 Bq kg^{-1} for ^{40}K, 10.52 ± 0.71 Bq kg^{-1} for ^{226}Ra and 13.20 ± 0.44 Bq kg^{-1} for ^{232}Th. On the other hand the average activity concentration in Myrtus Communis plant is found to be 235.96 ± 10.51 Bq kg^{-1} for ^{40}K, 6.64 ± 0.65 Bq kg^{-1} for ^{226}Ra and MDA for ^{232}Th. The activity concentrations of ^{40}K and ^{226}Ra in Myrtus Communis plant are found to be comparable to those in soil. Regarding ^{232}Th the activity concentration in the soil was found to be relatively low, resulting in MDA (Minimum Detectable Activity) values for the activity concentration in plants, which is reasonable considering the low mobility of thorium in the environment. The activity concentration of the artificially produced radionuclide of ^{137}Cs was found to be 7.74 ± 0.48 Bq kg^{-1} in soils and MDA in all plant samples. This research work provides baseline data for the radiological hazard assessment due to the use of medicinal plants in Albania.

Key words: Natural radioactivity, Myrtus Communis, radiological hazard.

Introduction

In recent times, emphasis on plant research is increased to show the substantial potential of medicinal plants used in different traditional systems all over the world. The use of medicinal plants for treating diseases is probably the oldest existing method that humanity has used to cope with illnesses. According to the International Food Safety Authorities Network (INFOSAN, 2011), plants used as food commonly have ^{40}K, ^{232}Th and ^{238}U and their progenies. It is expected that similarities would be found in plants used for medicinal purposes since plants are the primary pathway of natural radionuclides entering into the human body through the food chain. In a variety of concentrations, Naturally Occurring Radioactive Materials (NORMs) have

always been present in every part of the earth and in the tissue of all living beings. Natural radionuclides such as ^{228}U, ^{232}Th and ^{40}K can be found almost everywhere; in soil, public water supplies, oil and atmosphere thereby subjecting human beings to reasonable exposure (R.L. Njinga et al., 2015). Myrtle (*Myrtus communis)* is a naturally occurring, highly drought-tolerant, evergreen shrub or small tree that is widely distributed within the Mediterranean basin. It is classified as an aromatic species because of the essential oil compounds of the leaves and fruits. Myrtle is commercially used for perfume and liquor production, and the harvest comes mainly from wild plants (Sirca, C., et al., 2008). The therapeutic effect of these medicinal plants for the treatment of various diseases are based on the organic constituent (such as essential oil, vitamins, glycosides, etc.) present in them (Desideri, D., Meli, M. A., & Roselli, C. 2010). This paper focused on determining the activity concentration of natural and artificial radionuclides in the leaves of Myrtle plant known as Mërsina in Albanian name and in the soil of rooting area of the plant.

Materials and methods

In the site shown in Figure 1 were collected ten samples of Myrtle plant. From the rooting area of the plants were also collected ten soil samples. Each sampling point was marked using global positioning system (GPS) as shown in Table 2. Plants are collected from Spille bay on the Adriatic sea, central part of Albania The plant samples were first air dried, and then, dried in an oven at temperature 80^0C for 24 hours at the laboratory. The soil samples were dried for 24 hours at temperature of 110^0C. Then crushed to fine powder and filtered with a sieve so as to obtain uniformly homogenous sample matrix. The samples are then filled into the plastic container of 1000 ml volume.

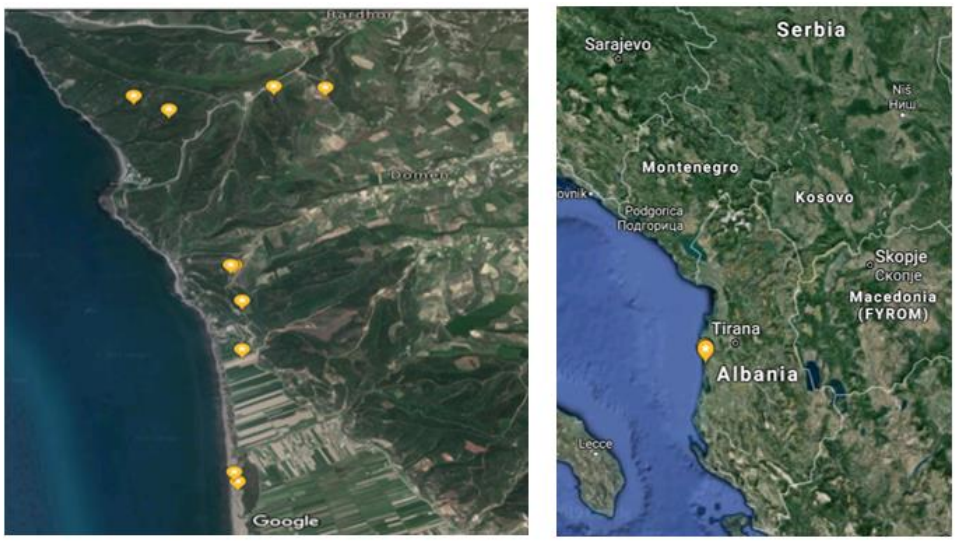

Figure 1. The location of Myrtle samples

The Marinelli beakers were sealed with PVC (polyvinyl Chloride) tape and carefully labelled. After at least 4 weeks, the radioactive equilibrium between ^{226}Ra and their daughter products can be reasonably assumed as restored and samples are measured using high-resolution gamma-ray spectrometry technique. The analysis of the activity concentrations of sand samples was performed by using a p-type coaxial HPGe (high purity germanium) detector with 40% relative efficiency and an energy resolution of 1.8 keV at 1332.5 keV (^{60}Co).The detector was placed inside a lead well lined with copper-cadmium foils in order to reduce the environmental background. The absolute efficiency curve for different matrices was simulated using Laboratory Sourceless Object Calibration Software (LabSOCS) (Shyti, M., 2019). Each sample was counted for 24 hours in the set geometry. The photopeaks used for ^{214}Pb are 295 and 351.9 keV, for ^{214}Bi are 609.3 keV and 1020.3 keV. The concentration of ^{40}K and ^{137}Cs was found by measuring the activity of their peak at 1460.8 and 661.6 keV respectively.

Results and discussions

The activities of ^{226}Ra, ^{232}Th, ^{40}K, and ^{137}Cs in the plant of Myrtle and in the soil samples collected from the corresponding sampling locations are presented in Table 1 and 2. The activity concentrations of ^{226}Ra in the plant of the study area vary from 2.27 ± 0.48 to 9.87 ± 0.84 Bq kg^{-1} with a mean value of 6.64 ± 0.65 Bq kg^{-1}. The activity concentrations of ^{232}Th and artificial radionuclide of ^{137}Cs in the plant is found to be MDA (Minimum Detectable Activity). The activity concentrations of ^{40}K in the plant of Myrtle vary from 171.42 ± 7.89 to 281.06 ± 12.47 Bq kg^{-1} with a mean value of 235.96 ± 10.51 Bq kg^{-1}. On the other hand the activity concentrations of ^{226}Ra, ^{232}Th, ^{40}K and ^{137}Cs vary in the soil from 7.23 ± 0.52 to 17.06 ± 1.10 Bq kg^{-1} with a mean value of 10.52 ± 0.71 Bq kg^{-1} for ^{226} Ra; 7.50 ± 0.27 to 25.10 ± 0.77 Bq kg^{-1} with a mean value of 13.20 ± 0.44 Bq kg^{-1} for ^{232}Th; 138.36 ± 5.41 to 346.57± 8.57 Bq kg^{-1} with a mean value of 203.56 ± 7.3 Bq kg^{-1} for ^{40}K and 0.28 ± 0.03 to 35.49 ± 2.14 Bq kg^{-1} with a mean value of 7.74 ± 0.48 Bq kg^{-1} for ^{137}Cs respectively.

ID	Lat. N	Long. E	^{40}K	Unc.^{40}K	^{137}Cs_MDA	^{226}Ra	Unc.^{226}Ra	^{232}Th_MDA
P.GJ.1. Plant	41.13333	19.46428	239.58	10.58	0.48	9.42	0.84	1.91
P.GJ.2. Plant	41.13336	19.46044	246.51	10.77	0.45	8.05	0.63	1.71
P.GJ.3. Plant	41.11892	19.45747	243.27	10.86	0.53	9.87	0.79	2.14
P.GJ.4. Plant	41.11892	19.45722	176.32	8.15	0.53	3.46	0.54	2.07
P.GJ.5. Plant	41.13269	19.45000	227.45	10.09	0.48	4.45	0.49	1.89

P.GJ.6. Plant	41.13158	19.45265	227.86	10.05	0.47	4.35	0.55	1.84
Spille 1 Plant	41.11203	19.45803	171.42	7.89	0.51	9.65	0.76	2.00
Spille 2 Plant	41.10114	19.45772	281.06	12.47	0.59	8.03	0.73	2.28
Spille 3 Plant	41.10191	19.45749	281.05	12.47	0.50	2.27	0.48	2.04
Spille 4 Plant	41.11603	19.45805	265.04	11.76	0.56	6.84	0.72	2.16
		Min	**171.42**	**7.89**	**0.45**	**2.27**	**0.48**	
		Max	**281.06**	**12.47**	**0.59**	**9.87**	**0.84**	
		Average	**235.96**	**10.51**	**0.51**	**6.64**	**0.65**	

Table1. Activity concentration of radionuclides in Myrtle plant

Table 2. Activity concentration of radionuclides in the soil

ID	Lat. N	Long. E	^{40}K	Unc. ^{40}K	^{137}Cs	Unc. ^{137}Cs	^{226}Ra	Unc. ^{226}Ra	^{232}Th	Unc. ^{232}Th
P.GJ.1. Soil	41.13333	19.46428	204.87	8.02	5.98	0.37	7.74	0.53	8.53	0.30
P.GJ.2. Soil	41.13336	19.46044	138.36	5.96	0.28	0.03	7.23	0.52	8.37	0.31
P.GJ.3. Soil	41.11892	19.45747	172.42	7.40	9.01	0.56	9.41	0.64	10.78	0.39
P.GJ.4. Soil	41.11892	19.45722	199.68	8.48	35.49	2.14	11.78	0.77	15.84	0.51
P.GJ.5. Soil	41.13269	19.45000	165.68	7.03	0.56	0.05	10.20	0.67	7.50	0.27
P.GJ.6. Soil	41.13158	19.45265	346.57	5.41	10.43	0.64	17.06	1.10	25.10	0.77
Spille 1 Soil	41.11203	19.45803	209.15	8.05	2.20	0.14	10.44	0.69	11.25	0.38
Spille 2 Soil	41.10114	19.45772	194.43	8.57	1.09	0.08	8.95	0.61	11.63	0.39
Spille 3 Soil	41.10191	19.45749	177.44	7.68	2.97	0.19	7.93	0.55	10.10	0.35
Spille 4 Soil	41.11603	19.45805	226.97	6.40	9.37	0.57	14.47	0.96	22.91	0.71
		Min	**138.36**	**5.41**	**0.28**	**0.03**	**7.23**	**0.52**	**7.50**	**0.27**
		Max	**346.57**	**8.57**	**35.49**	**2.14**	**17.06**	**1.10**	**25.10**	**0.77**
		Average	**203.56**	**7.30**	**7.74**	**0.48**	**10.52**	**0.71**	**13.20**	**0.44**

Conclusions

Natural and artificial radioactivity levels of Myrtle plant were investigated using gamma-ray spectrometry. The results of the analysis indicated an average activity for ^{226}Ra, ^{232}Th, ^{137}Cs, ^{40}K to be: 6.64 ± 0.65 Bq kg^{-1}, ^{232}Th (MDA), ^{137}Cs (MDA) and 235.96 ± 10.51 Bq kg^{-1} for ^{40}K. This study may also help in forming a framework of environmental safety regulations related to radiological healthcare in medicinal plants. The study evaluated the levels of ^{137}Cs contamination in the leaves of Myrtle plant resulting MDA.

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