

Natural Radionuclides and ^{137}Cs in Mosses and Lichen in Eastern Serbia

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The paper presents the results of radionuclides determination in mosses (*Homothecium sp.*, *Hypnum Cupresiforme sp.*, and *Brachythecium sp.*) and lichen (*Cladonia sp.*), sampled in the region of Eastern Serbia, during 1996 – 2010.

Activities of ^7Be , ^{40}K , ^{226}Ra , ^{232}Th , and ^{137}Cs were determined on an HPGe/ORTEC/Ametek detector (relative efficiency 34 %, resolution 1.65 keV at 1.33 MeV) and HPGe/Canberra detector (relative efficiency 25 %, resolution of 1.95 keV at 1.33 MeV) by standard gamma spectrometry. The average counting time was 60 000 s. The standard error of the method was 10 %. Spectral analysis was performed with the Gamma Vision 32 software package.

The majority of the ^{40}K activities measured in moss was within the range (100–500) Bq/kg dw (dry weight), while most of the ^{226}Ra and ^{232}Th activities were in the range (5–50) Bq/kg dw. The calculated "soil-to-moss" transfer factors for ^{40}K , ^{226}Ra , and ^{232}Th were 0.45, 3, and 0.3, respectively. Over the study period, the majority of the ^{137}Cs activities in moss were in the range (0–500) Bq/kg dw, with less than 10 % of the samples with the activity higher than 1000 Bq/kg dw. The spatial distribution of

the ^{137}Cs activity was highly non-uniform over the region. The variations in the content of natural radionuclides among the three most sampled moss species were not significant. Linear Pearson correlation coefficient was 0.68 for ^{226}Ra versus ^{232}Th , and 0.24 for ^{137}Cs versus ^{40}K .

The content of natural radionuclides in lichen was to some extent less than in moss, as lichen was collected from higher points (trees), and the effect of resuspension from soil was thus less pronounced. Still, the frequency pattern of activities of natural radionuclides in lichen resembled the pattern seen in moss. The ^{137}Cs activities in lichen were also less than in moss, with most of the concentrations below 300 Bq/kg dw.

The mean activities of ^7Be in moss and lichen sampled in Eastern Serbia in 2006 and 2008 were in the range (41–122) Bq/kg dw, with variations up to 71 %. The ^7Be concentrations were significantly (20–60 %) higher in 2008 than in 2006. The pronounced ^7Be variations (28–71 %) between the sites and within a year were mainly a result of its short half-life and the differences in microclimate and topology of the sites.

Keywords: mosses, lichen, radionuclides, Eastern Serbia