

Application of Nuclear and ICP-AES analytical techniques in atmospheric deposition study

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Abstract: Neutron activation analysis (NAA) is a multi-element non-destructive method, characterized for good detection limits for most of the elements, and a matrix-independent method with the absence of the analytical blank that makes it very useful in environmental studies. NAA shows high accuracy, low systematic error, and low detection limits during the quantitative analysis that makes it very efficient in trace analysis of the elements in environmental samples such as soil, water, biota, and air samples. ENAA and ICP-AES analysis in combination with the moss biomonitoring were used to assess the air quality in Albania. Air pollution is a global problem that may cause undesirable consequences to human health and environmental ecosystems. It is responsible for the increase of the greenhouse effect in the atmosphere, global warming, climate change, and acid rain.

The analysis of 54 elements in moss samples of Albania was determined by INAA method in Frank Laboratory of Neutron Physics Joint Institute for Nuclear Research, Dubna, Russian Federation. ICP-AES analysis of was performed in the Institute of Chemistry, Faculty of Science, Ss. Cyril and Methodius University, Skopje, North Macedonia. Moss biomonitoring survey in Albania started on 2010 and continued on 2015, in the same period with the European moss survey for trace metals in atmospheric deposition. Due to the isolation from the global Covid-19 pandemic, the sampling of 2020 moss survey is postponed to the summer 2021. Toxic metals that present high risk to human health via different exposure pathways and to the environment, as well as the metals derived from soil dust mineral particles in the atmosphere are discussed in this study. Moss biomonitoring of atmospheric deposition involves the content of the metals in the green and/or green-brown parts of the moss tissues that represents the 3–5 years of moss growth period. In such a way, it represents the spatial and temporal trend of the integral survey of the deposition, and the exposure concentrations should be representative as a long-term average.

Significant differences were found onto the concentrations of Al, As, Cd, Cr, Co, Ni and Pb in moss samples, followed with various distribution patterns for different elements that present diverse geographical variability in the moss metal concentrations and metals atmospheric deposition. The anthropogenic emission sources and soil dust associated with the windblown fine mineral dust particles are pointed as possible local emitting sources of trace metals atmospheric deposition. The median values of the carcinogenic risk CR_{2010} and CR_{2015} are compared with the carcinogenic target risk value (1×10^{-6}), and the CR unacceptable value ($CR > 1 \times 10^{-4}$). Recent studies onto air pollution are discussing the relationship between the Covid-19 mortality and air pollution from all anthropogenic sources. A reasonable correlation between the number of Covid 19 infected people and the air PM content of European countries is suggested in this study.

Keywords: Neutron activation analysis, ICP-AES analysis, trace metals, air pollution, moss biomonitoring, health effects, Albania