Determination Of Trace Elements In Epiphytic Lichens From Bandar Baru Bangi, Selangor Using INAA Method

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Abstract. Lichens have been used as effective biomonitors of atmospheric pollutants as they can take up nutrients and pollutants directly from the atmosphere. In this study, trace element contents in epiphytic lichens were determined using INAA method. Samples were collected from 7 sampling locations around Bandar Baru Bangi, Selangor. The elements detected were As (1.73±0.85 mg/kg), Ce (3.65±1.91 mg/kg), Co (0.29±0.12 mg/kg), Cr (5.92±3.54 mg/kg), Cs (0.92±0.25 mg/kg), Eu (0.03±0.02 mg/kg), Fe (1280±760 mg/kg), Hf (0.37±0.18 mg/kg), La (1.52±0.89 mg/kg), Rb (27.7±4.8 mg/kg), Sc (0.33±0.19 mg/kg), Sm (0.28±0.16 mg/kg), Th (1.21±0.62 mg/kg) and Zn (116±27 mg/kg). Comparisons were then made between the elemental concentrations obtained and the baseline data from literature. Results showed that most of the elements were within the concentration range of the baseline data. Enrichment factors (EF) of the trace element in lichens showed that most of the elements were within the range of the baseline data except for As which was found to be slightly enriched (EF: 13.2 - 28.5). Regression analysis indicated significant correlation ($p<0.05$) with Sc for most of the elements which signifies crustal input except for Cs and Rb. The poor correlations of Cs and Rb with Sc may be due to the mobility of these elements. In summary, trace element data obtained using INAA were very useful and demonstrated that lichens were suitable biomonitors for identifying potential trace element pollutants in ambient air around the sampling area.

Keywords: Epiphytic lichens, trace elements, biomonitoring, instrumental neutron activation analysis
PACS: 82.33.Tb, 92.60.Sz, 82.80.-d

INTRODUCTION

Biomonitoring uses living organisms to monitor the area where it can react to the changes of the chemical composition in the atmospheric environment. Lichens have been used to monitor elemental composition in various geographical area and situation throughout the world[1][2][3][4][5]. In Malaysia, the use of lichens as biomonitor is still lacking and it can serve as air pollution indicator.

Lichens can be used as active or passive monitor as it fulfill the criteria of a biomonitor [4][5]. Active monitoring refers to the transplant method[3][6] which lichens from unpolluted area were implanted into the study area. In passive monitoring, the lichens were directly collected from the study area[2][7]. Lichens were well known for their effective absorption and accumulation of trace elements compared to other botanical materials such as bark substrate, mosses and fern[8]. Slow growth rate, able to accumulate to a higher degree of various toxicants and poikilohydric properties are the reasons of its universal indicator for biomonitoring purposes[1][3][4]. Relative large exposed surface area and lack of cuticle and stomata make them easy to trap the metals and accumulate it. The mechanism of uptake and immobilization of the elements were variable in different species[9][10]. The quantities of accumulated metals were influenced by its growth form and the distributions of elements in lichens were able to indicate the emission sources and the dispersion range of these elements[3][4]. The elemental composition in lichen thallus does not only depend on the elements mobility in the environment but other parameters such as temperature, moisture condition and substrate characteristic [11].

Trace elements in lichens are useful indicators for identifying potential pollutants and the data largely reflects the levels of these elements in the atmosphere around a study area. The elemental composition in the lichens can be analyzed using several analytical methods with or without chemical treatment such as neutron activation analysis (NAA), atomic absorption spectrometry (AAS), and inductively coupled plasma-mass spectrometer (ICP-MS). Proper quality control using selected standard reference materials (SRM) is vital during the analysis of trace elements in lichen samples[5][7]. The results obtained usually interpreted using comparative analysis and statistical method such as regression analysis or factor analysis[5][12]. Enrichment factor (EF) can be calculated for verifying the origin of the accumulated elements contained in the lichens[1][12] because windblown soil dust can be potential source of trace elements in lichens.

Advancing Nuclear Research and Energy Development
AIP Conf. Proc. 1584, 235-239 (2014); doi: 10.1063/1.4866137