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DETERMINATION OF Br, Rb, Cs, Sc AND Na IN VARIOUS PLANT LEAVES LOCATED IN AN URBAN PARK BY NEUTRON ACTIVATION ANALYSIS

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In order to determine the effect of airborne emission of trace elements, e.g. Br, Rb Cs, Sc and Na on roadside ecosystem, concentrations were determined in different species of plants from an urban park at Lahore. For monitoring purpose attention was paid to the leaves of *Sapindus mukorossis*, *Alstonia scholaris* and *Diospyros embryopteris*. Different varieties of tissues were found to have different concentration of trace elements when compared among themselves. The concentration of trace element deposition was compared with the values reported in literature. Significant pollution was observed.

INTRODUCTION

Motor vehicles are a major source of pollutant emission. Vehicle emissions of gaseous oxides of nitrogen, carbon monoxide and particulate pollutants contribute significantly to the atmospheric burdens. These are rapidly and widely dispersed and disturb roadside ecosys-

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tem. The metals from motor vehicle emissions are also dispersed in the atmosphere and deposited close to the highway, causing their elevation in soil and vegetation. The determination of bromides /Br/ in the atmosphere has received considerable interest due to association between vehicle-emitted lead and bromide concentration of atmospheric particulates. It is important to evaluate the concentration of vehicle emission in air and their effect on different types of biological materials. Three leaf samples of plants, namely *Sapindus mukorossis*, *Alstonia scholaris* and *Diospyros embryopteris* were taken from a National Park /Bagh-e-Jinnah/ at Lahore which is surrounded by roads from all sides. The prevailing wind which changes its directions over the year can thus increase the levels of trace elements on tree leaves from all directions. In the present study the neutron-activation method is employed for the evaluation of Br, Rb, Cs, Sc and Na in various plant leaves of the selected trees in the National Park in continuation of our work[1] on evaluation of trace elements and aerosols in air and their effect on urban environment of the Punjab area in Pakistan.

EXPERIMENTAL

A set of three samples of leaves were collected for each species of plant at different locations in the same sampling area. The leaves after washing in deionized water were freeze-dried overnight at 0.02 mbar atmospheric pressure using freeze-drier Model Christ Beta A. Each sample was groud to powder and stored in a sealed glass vessel.

In order to carry out neutron-activation analysis the samples were sealed in duplicate in quartz ampoules along-

with the standard samples. The standards were IAEA Soil-7 and IAEA lake sediment SI-1. These ampoules were further cold welded in an aluminium capsule made of special alcon alloy. The aluminium capsule was then irradiated for 5 h in the core of Pakistan Research Reactor /PARR/ at a thermal neutron flux of 2×10^{13} n $cm^{-2} sec^{-1}$. The irradiated samples after cooling for 10-12 d were transferred to preweighed polyethylene capsules and counted for 1800-6150 sec on pre-calibrated detecting system. The counting setup of this detecting system consisted of an intrinsic germanium crystal detector with 17.6 cm^2 active area, a number of amplifiers and 4096-multichannel analyz CANBERRA Series 85. The selected radionuclides and their γ-ray photopeak energies /keV/ used in the present work were ^{82}Br: 826, 775, 696.7, 618.5 and 554, ^{134}Cs: 568, 604 and 795, ^{46}Sc: 888.1 and 1119.9, ^{86}Rb: 1077.2 and ^{24}Na: 1368.

RESULTS AND DISCUSSION

The average values of $\bar{X}$ for Br, Rb, Sc, Cs and Na are given in Table 1 and the distribution pattern of these elements is given in Fig. 1. All the results discussed here are on dry weight basis. The respective concentrations of Rb and Br in *Alstonia scholaris* were 7.63 ppm and 19.3 ppm and in *Sapindus mukorossis* these were 7.5 ppm and 24.13 ppm. The respective values of 35.4 ppm and 43.4 ppm of these two elements found in *Diospyres embryopteris* are, however, higher than those accumulated in the first two species. The concentration of Cs in *Alstonia scholaris, Sapindus mukorossis* and *Diospyros embryopteris* was found 1.41 ppm, 0.863 ppm, and 1.066 ppm, respectively, while that of Na in the same species was 2.66 mg, 0.62 mg, and 1.23 mg, resp.

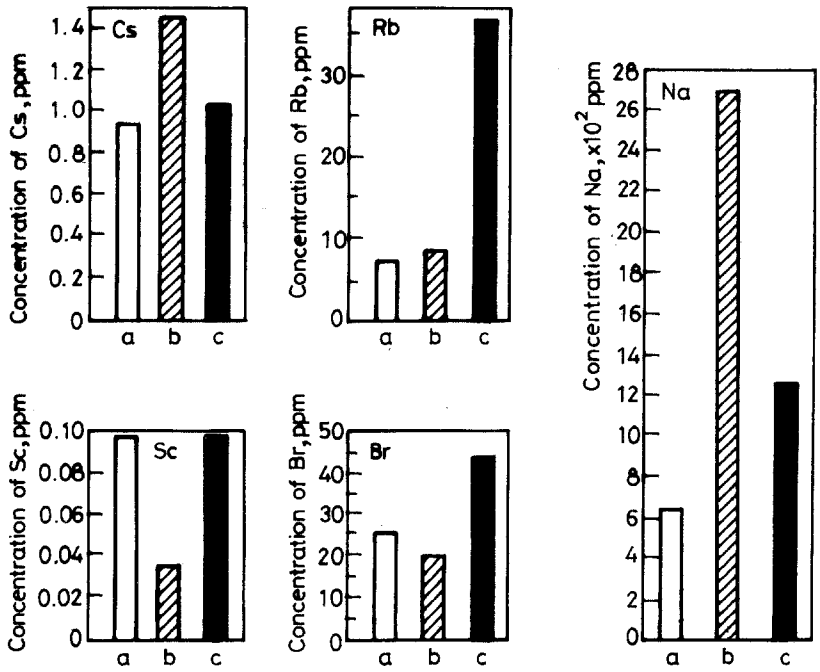

Fig. 1. a - *Sapindus mukorossis*, b - *Alstonia scholaris*, c - *Diospyros embryopteris*

In this case the concentration of Cs and Na in *Alstonia scholaris* is higher than that found in the other two species. A lower amount of 43.3 ppb of Sc was, however, observed in *Alstonia scholaris* as compared to respective concentration of 95 ppb and 90 ppb of this element in *Sapindus mukorossis* and *Diospyros embryopteris*.

The concentration of Rb, Br and Sc in various plants was determined by Tran Van and Teherani[2] by using neutron-activation analysis. The concentration of Rb in *Imperata cylindrica* /Grams/ was reported 0.4 ppm,

TABLE 1

Concentration of trace elements in various plants μg/g* /Dry weight basis/

Elements	*Sapindus mukorossis*	*Alstonia scholaris*	*Diospyros embryopteris*
	$\bar{X} \pm s$	$\bar{X} \pm s$	$\bar{X} \pm s$
Cs	0.863 ± 0.05	1.41 ± 0.07	1.066 ± 0.05
Rb	7.5 ± 0.47	7.63 ± 0.47	35.4 ± 1.4
Sc	0.095 ± 0.011	0.0433 ± 0.003	0.09 ± 0.005
Br	24.13 ± 1.26	19.13 ± 1.13	43.4 ± 2.4
Na	620 ± 3.6	2666 ± 15	1233 ± 6

*Average of 9 determinations.

in *Mimosa pudica* plant it was 2.99 ppm and in rice it was 1.78 ppm. The concentration of Br in *Imperata cylindrica* was found to be 10.28 ppm, in *Mimosa pudica* it was 5.59 ppm and in rice its concentration was 4.07 ppm. Similarly 0.04 ppm of Sc was reported in *Imperata cylindrica*, 0.09 ppm in *Mimosa pudica* and 0.02 ppm in rice. Qureshi et al.[3] evaluated concentration of Br in various brands of tea leaves and cigarette tobacco leaves. In tea leaves Br concentration was in the range of 5.18 ppm to 6.58 ppm, while in different brands of cigarette in the range of 3 ppm to 137 ppm. On the average the concentration of Br was 6.09 ppm in different brands of tea leaves and 47.8 ppm in tobacco leaves.

The concentrations of Rb, Br, Sc, Cs and Na in the plants of *Sapindus mukorossis*, *Alstonia scholaris*, and *Diospyros embryopteris* have been determined for the first time in urban areas. These values are compared with the data given for other plants. Although variation in

concentration is expected due to the difference in species and location yet the values of Rb, Br, Sc and Cs were found to be considerably higher. Our values are about 7 times higher for Rb, 4 times higher for Br and 1.4 times higher for Sc as compared to the values reported by Tran Van and Teherani[2]. Our values for Br are 4.7 times higher than the average values of tea leaves reported earlier[3]. However, the values for Br were comparable with the average values of tobacco leaves. The unusually higher background level of Br was explained by Thompson and Hussain[4] with reference to trace elements in aerosol along Island Express way in New York City Long Island area. They concluded that Br in the form of $C_2H_4Br_2$ is used as a lead scavenger, in leaded gasoline. Actually tetraalkyl lead is added to petrol as an anti-knock agent, which during combustion reacts with ethylene-dihalide "scavengers" and predominantly Pb and halogens are emitted. The authors reported that there was an apparent Br enrichment in downwind of the roadway. Even upwind Br was highly enriched over rural concentrations by a factor of about 200 and at the 25-m downwind station the enrichment factor was about 2000. Hence downwind enrichment apparently results from direct automobile emission of Br on the expressway. It has been reported[5] that Sc is present only in the backgrond and resuspended particulates. Our values for Sc are comparable to the values of mimosa plant reported earlier[2]. Therefore, Sc has not been considered as a serious toxic element emitted through vehicle exhaust.

The present study has revealed that heavy metals are present in vehicle exhaust, as a result of wear and tear, when released they contaminate the roadside ecosystem. A difference in the uptake of trace elements by different plants is observed. Since considerable amount

of elements, such as Br, Rb and Cs is observed in the urban park, regular monitoring of the trace element levels in leaves of plants located in city environment should be carried out in view of possible health hazards.

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