INFLUENCE OF EXPOSURE METHOD ON ACCUMULATION OF HEAVY METALS IN LICHENS AND MOSSES

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Abstract: An important element in determination of the concentrations of trace elements in biological material used in active biomonitoring is the proper planning of the experiment, taking into account, inter alia, the collection and exhibition of samples, selection of analytical methods and ways of evaluation and interpretation of the results. Selected ways of exposure of the samples of mosses and lichens were tested, and the assessment of the impact of the exposure of biological material on the reliability of the results was also made. Based on the results of increments analyte concentrations (Zn, Cu, Mn, Fe and Pb) in mosses and lichens after two months of exposure, it was found that the conduct of the experiment as well as the duration of the experiment affect the level of accumulation of heavy metals in the biological material.

Keywords: mosses, lichens, biomonitoring active, heavy metals

Fig. 1. Exposure of mosses and lichens

AIM OF RESEARCH

The aim of the work was to study the influence of mosses and lichens exposure method on the measurement results, and to assess the effect of exposure method on the reliability of the results. The experiment was carried out in the area of *Collegium Biotechnologicum*, University of Opole, PL. The mosses were exposed in mesh bags (the moss bag), placed under a top of PE bottles and in a plastic box in the soil. The lichens were also placed in mesh bags, fixed under a roof box and in the soil. In experiment were also used transplants of entire larch's branches with adherent to the surface thallus lichens. The twigs were fixed at a height of 1.5 m above the ground in horizontal and vertical position.

Fig. 2. Lichens in plastic box

Fig. 3. Moss bags, lichens bags placed under the roof and transplants

Fig. 4. Mosses in PE bottles

Fig. 5. Lichens transplants horizontally

METHODS

The study used samples of *Pleurozium schreberi* mosses and lichens *Hypogymnia physodes*. The samples were collected in the clean areas of Knyszyn Forest. The biological material was exposed for a period of six months. After the first and second month of exposure in the plant samples the concentrations of heavy metals: Zn, Cu, Mn, Fe and Pb were determined using atomic absorption spectrometry. To evaluate an increase in analytes concentrations in the exposed material the relative accumulation factors *RAF* were calculated.

To determine the changes in the analyte concentrations in the exposed moss samples the Relative Accumulation Factor (*RAF*) was calculated. It is defined as follows:

$$RAF = \frac{C_{i.1} - C_{i.0}}{C_{i.0}}$$

$C_{i,0}$ - analyte concentration before exposure [mg/g d.m.]
$C_{i,1}$ - concentration of the analyte after the exposure period [mg/g d.m.]

Legend:
1 – first month
2 – second month
MS – moss in plastic box
MW – moss bag
MWD – moss bag placed under the roof
MB – moss in PE bottles
PS – lichen in plastic box
PW – lichen bag
PWD – lichen bag placed under the roof
PGZ – lichen transplants verticaly
PGL – lichen transplants horizontally

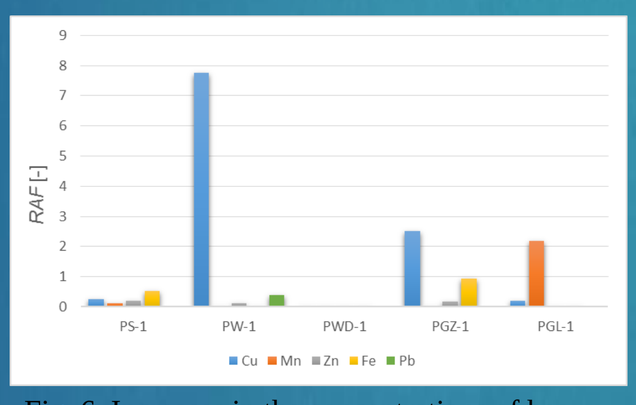

Fig. 6. Increases in the concentrations of heavy metals in lichens after the first month of exposure

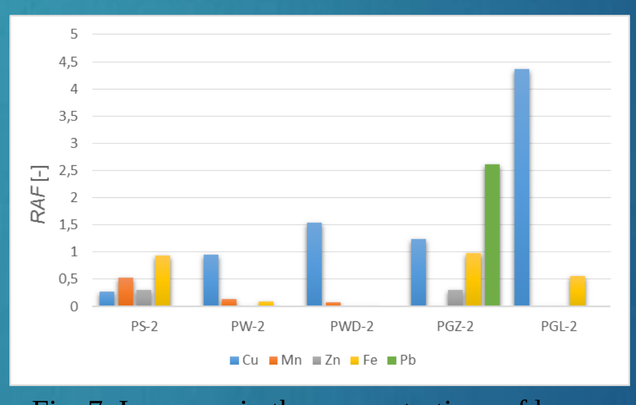

Fig. 7. Increases in the concentrations of heavy metals in lichens after the second month of exposure

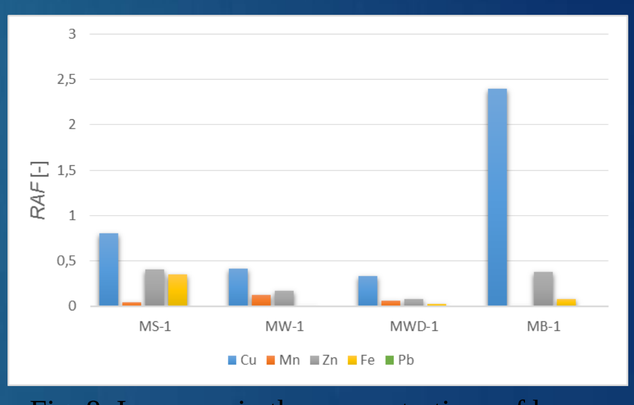

Fig. 8. Increases in the concentrations of heavy metals in moss after the first month of exposure

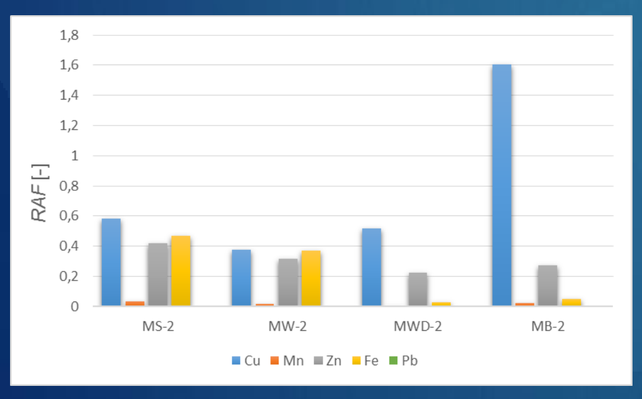

Fig. 9. Increases in the concentrations of heavy metals in moss after the first month of exposure

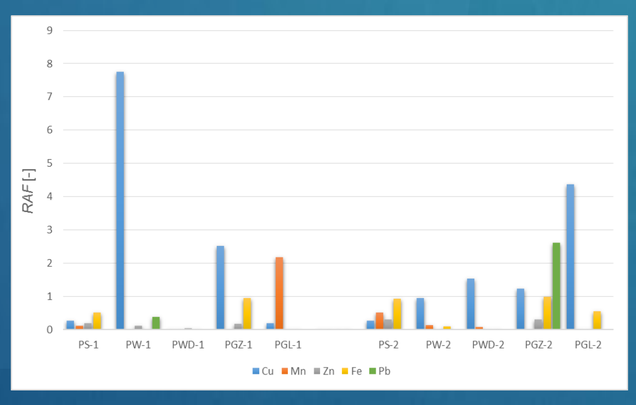

Fig. 10. Comparison of RAFs in lichens after the first and second month of exposure

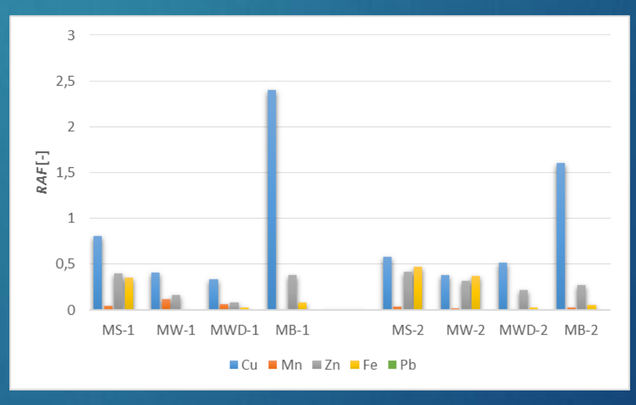

Fig. 11. Comparison of RAFs in moss after the first and second month of exposure

Fig. 12. Lichen bags

CONCLUSIONS

Analysis of the results after two months of experiment showed a significant influence of the exposure method on the heavy metal accumulation in the biological material. The highest concentrations of analytes were determined in the lichen samples, transplanted with the horizontally aligned larch branches. In contrast, the highest heavy metal accumulation occurred in mosses placed in boxes embedded in the soil. This phenomenon could be a result of secondary enrichment with atmospheric aerosol or soil dust. Partial cover of the exposed samples with roofs caused increase in the analytes concentration occurring not earlier than after two months of exposition.