



## **Heavy metals uptake by plants from family Lamiaceae growing in the polluted soils**

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The researches, carried out in the last few years, showed a serious disturbance of the ecological equilibrium in a number of intensive agricultural regions. It was ascertained that in the regions near the enterprises of the ferrous and non-ferrous industry the contents of heavy metals in the soil and the agricultural produce considerably exceeded the maximum permissible concentrations. In the vicinity of the Non-Ferrous-Metal Works (NFMW) near Plovdiv, more than 2100 ha have been polluted by heavy metals. The data analysis from the NFMW emissions showed that the main source of environmental pollution with lead, zinc, cadmium and sulfur dioxide are the technological and ventilation gases released from lead production. The second important pollution sources are the gases from Roller workshops and drying furnaces in zinc plants. Another environment-pollution threat is posed by the shaft furnace in the periods of its starting and stopping, as well as in regimes of break-down operations, when the purification installations are turned off and the dust-gas mixture is directly released into the atmosphere. During the last few years, as a result of the precautions, taken from the NFMW, for limiting the throwing out of emissions of dust and sulphur oxide, a tendency towards limiting their quantity in the atmosphere was observed. However, the heavy metals accumulated from the previous years remained in the surface layer of the soil. An extended period of time is needed for their extraction and during that period a special attention should be paid on the right choice of the grown agricultural crops. Finding some heavy metal tolerant crops which final products is not contaminated could be one alternative for solving the problem. However, little information is available about the extent of tolerance and phytoextractability of the plant species from family Lamiaceae. This gave us the grounds to carry out a comparative research, which to allow us to (i) determine the quantities and the centers of accumulation of Pb, Zn and Cd in the vegetative organs of plants from family Lamiaceae - lavender

(*Lavandula vera* L.) and basil (*Ocimum basilicum* L.), as well as in their products, and (ii) evaluate the extent of tolerance and phytoextractability of the selected plant species from family Lamiaceae. On reaching flowering stage, the plants were gathered and the contents of Pb, Zn, and Cd in their different parts - roots, stems, leaves and inflorescences - were determined. Under laboratory conditions we extracted essential oil from the inflorescences of lavender and above-ground parts of basil by means of steam distillation. The contents of heavy metals (Pb, Zn and Cd) in the plant material (roots, stems, leaves and inflorescences) and in the essential oils of lavender and basil were determined by the method of the dry mineralization. To determine the heavy metal content in the samples, inductively coupled emission spectrometer was used. A clearly distinguished species peculiarity existed in the accumulation of heavy metals in lavender and basil vegetative organs. Basil accumulates heavy metals from the soil through the root system, and a great part of the heavy metals is inhibited by the roots and only a small quantity moves to the surface sections. However, in lavender only a small part of the heavy metals is inhibited by the roots, and the great part of them is accumulated in the above-ground parts (stems, leaves and inflorescences). The obtained results show that basil, as well as lavender can be planted successfully on areas, polluted by heavy metals. The studied crops represent a good compromise, where lower potential of toxic metal accumulation is compensated by the possibility of processing of contaminated biomass. On one hand, it can reduce the risk to use such areas for agriculture. On the other hand, the selective accumulation of Pb, Zn and Cd in the stems, leaves and inflorescences makes lavender extremely suitable for phytoremediation purposes. Favorable is also the fact that heavy metals do not influence the development of the studied crops, as well as on the quality and quantity of the oils obtained from them. The possibility of further industrial processing will make lavender and basil economically interesting crops for farmers of phytoextraction technology.