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Cadmium, Mercury and Lead in *Hypericum perforatum* L. collected in Western Serbia

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Abstract. Wild population of *Hypericum perforatum* growing in Western Serbia was analyzed for the content of important environmental pollutants cadmium, mercury and lead. Metal contents were determined by inductively coupled plasma optical emission spectrometry. Obtained results showed that levels of mercury and lead were under while cadmium concentrations exceeded limits recommended for medicinal plants. High levels of cadmium in investigated plants can be the result of soil enriched with cadmium as well as the ability of *Hypericum perforatum* to accumulate cadmium.

Key words: Hypericum perforatum, cadmium, mercury, lead, Serbia

Introduction

The use of medicinal plants in therapeutics is well known from the ancient times, but has substantially increased in the last decades (WHO, 2002). The widespread public opinion is that being naturals, the herbal medicines are harmless and so even if the expected medicinal effect is not achieved, their consumption is not dangerous. However, medicinal plants can absorb contaminants such as heavy metals from the soil, water or air. High levels of toxic metals commonly occur in plants that are grown in polluted areas i.e. near roadways, metal mining or smelting operations. In addition, high levels of metals in plants can be found when agricultural expedients are used: cadmium containing fertilizers, organic mercury or lead based pesticides, and contaminated irrigation water. Consequently, chronic use of medicinal plants, crude or in medicinal preparations containing high levels of toxic metals represents the potential risk and can cause adverse effects in humans. Chronic exposure to cadmium can cause nephrotoxicity in humans, mainly due to abnormalities of tubular reabsorption (Nordberg, 1999). Lead and mercury can cause adverse effects on the renal and nervous systems and can cross the placental barrier, with potential toxic effects on the fetus (Tong et al., 2000; WHO, 2003).

Hypericum perforatum, commonly known as St. John's wort, a medical plant used for centuries, has undergone a remarkable renaissance and become nowadays one of the most prescribed phytopharmaceuticals. In many countries, as well in Serbia *Hypericum perforatum* is traditionally used for the treatment of several diseases such as skin wounds, eczema, burns, inflammatory and psychological disorders. Furthermore, several clinical studies provide evidence that this herb is as effective as conventional synthetic antidepressants (Brenner et al., 2000; Schrader, 2000).

The aim of this work was to determine the content of 3 important environmental pollutants, cadmium, mercury and lead in wild populations of *Hypericum perforatum* growing in Western Serbia.

Materials and Methods

Trace-pure concentrated HNO_3 and H_2O_2 as well as metals standard solutions were purchased from Merck (Darmstadt, Germany). The water used in experiment was ultrapure water (conductivity < 1μS).

Herbs of investigated plant were collected during July 2010 from localities on the south slops of Sokol Mountains located in Western Serbia. Herbs were

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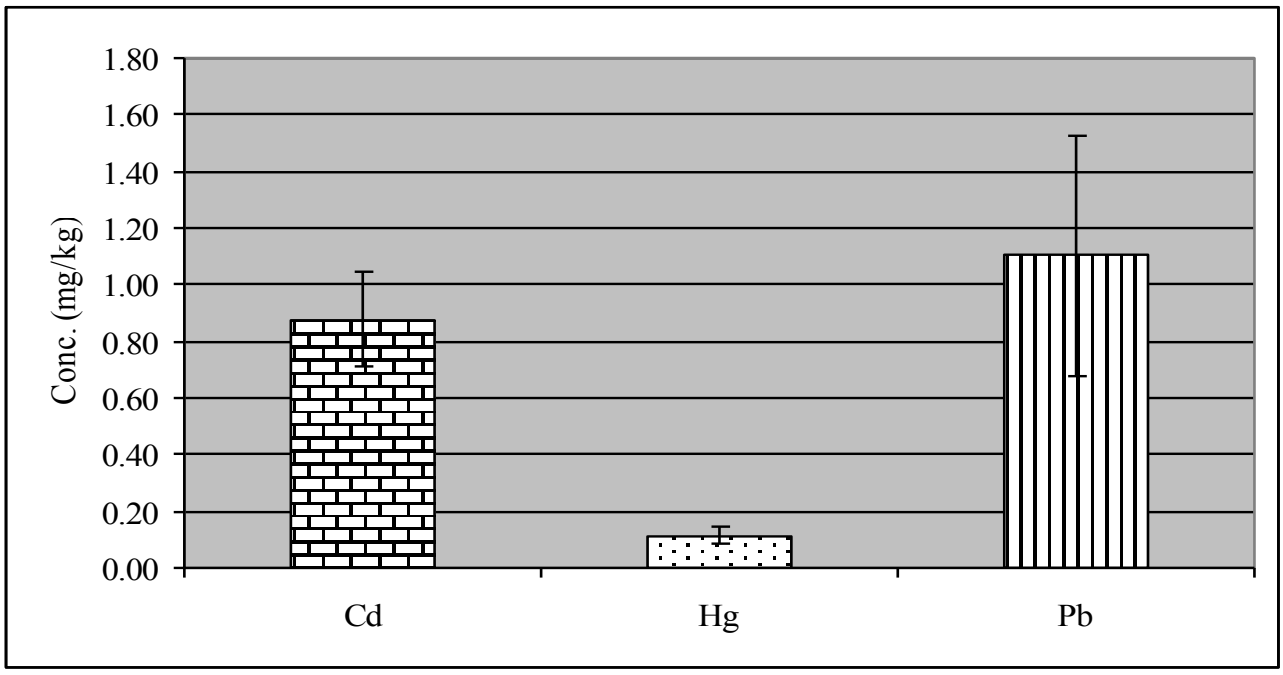

Fig. 1. Cadmium, mercury and lead concentrations in herbs of *Hypericum perforatum* L.

collected around Soko Monastery where the local residents collect the medical plants.

The samples (approximately 100 g) were collected in the paper bags and kept at room temperature until analyzed. After drying at room temperature, plant material was homogenized and sifted through a sieve. Mineralization was carried out by wet digestion, using advanced microwave digestion system „Milestone ETHOS-1 lab station". Each sample (0.2 g) was transferred into teflon vessel with addition of 5 ml HNO_3 and 2 ml H_2O_2. Samples were digested in accordance with program recommended by manufacturer. After cooling, samples were transferred into plastic flasks and diluted to 25 mL with ultrapure water. Metals concentrations were measured using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES spectrometer, Spectro-Arcos, Germany). The accuracy of the ICP-OES analyses was validated with reference samples from the LGC standards (IC-INTC-TL-1 Tea leaves-Trace elements).

Results and Discussion

The obtained results are presented in Figure 1. Mercury levels in investigated samples were between 0.068 and 0.136 mg/kg. The highest concentration of mercury, as total mercury, found in this study was 0.136 mg/kg and is much lower than the limit of 0.5 mg Hg/kg recommended for drugs (Caldas et al., 2004). All samples of Hypericum had concentration of lead under the limit of 10 mg/kg recommended for medicinal plants (WHO, 1999). However, results of this study indicate high concentrations of Cd in herbs of Hypericum perforatum collected from location of Sokol Mountains. Cd concentrations in Hypericum herb were in range of 0.731 to 1.121 mg/kg dry plant material with average value of 0.878 mg/kg. These values are very high, three to almost four times higher than value proposed by WHO-0.3 mg Cd/kg dry material (WHO, 1999). The obtained levels of Cd appear to be of health concern.

The potential contamination of raw medicinal plants with toxic metals depends on many complex factors like species, cultivation, processing, harvesting time, level and duration of contaminant exposure, topography, geographical origin, storage. The degree to which plants are able to take up Cd depends on its concentration in the soil and its bioavailability, modulated by the presence of organic matter, pH, redox potential, temperature and concentrations of other elements.

In the present study, plant materials were collected from parts of Western Serbia. This area is with low, if any, antropogenic pressure. Thus the presence of high levels of Cd derives probably from its high content in soil resulting from rock mineralization processes. The geological composition of the Soko Mountains is calcareous and siliceous, but no detailed analysis of this geological area has been done. Furthermore, Hypericum species are characterized as Cd accumulators (Schneider and Marquard 1996).

Conclusion

Since the use of *Hypericum perforatum* in both crude and prepared forms has greatly increased in recent years, it is necessary to ensure the safety, quality and efficacy for their consumption by public. Present study indicates that

Hypericum plants from wild population of Western Serbia contain high levels of cadmium. These plants should not be used for oral Hypericum preparation.

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