HEAVY METALS DISTRIBUTION OF *Artemisia argyi* GROWN IN INDIGENOUS ZINC SMELTING SLAG

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Introduction

Artemisia argyi is a perennial herbaceous or slightly subshrub plant and it is good for human health. Dried *A. argyi* leaf is a commonly-used materials in traditional Chinese medicine (CPC, 2010). It has efficacy for eliminating cold to stop pain, warming meridian and collateral of hemostasis (Gao, 2012). According to the field survey, we found that *A. argyi* is one of the plants growing in indigenous zinc smelting slag. To understand the distribution and transfer of heavy metals in *A. argyi,* we collected and analyzed heavy metals of *A. argyi* (including root, stem and leaf) and their growth slag in Hezhang County. There is generally as leaf > root > stem that the order of heavy metal contents in different parts of *A. argyi*, except for Cd and Se of CZP sample, Cu of HJC, Se of JMB, and Hg of ZZC. In addition, *A. argyi* might be tolerance or slightly accumulation to heavy metals (such as As, Cd, Fe, Hg, Mn, Mo, Pb and Zn). Therefore, *A. argyi* might be a good plant selection for vegetation restoration of indigenous zinc smelting area.

Methods

Samples of the fresh *A. argyi* and indigenous zinc smelting slag were collected from the field in Hezhang County of Bijie City in Aug. of 2015. We collected the sample from four places, such as Caozaiping Village (CZP), Jiaomeiba (JMB), Hejiachong Village (HJC) and Zhaizi Village (ZZC). The plant samples where possible at least five plants were collected from each site. Then, we put their in ziploc bags and brought back to the clean lab. Stainless steel scissors separated the leaves, stems, and roots of A. argyi, and then we washed them with high-pressure tap water until all soil and other foreign substance was removed. Pre-treated samples were rinsed with the deionized water for two or three times, and dried in natural wind. The dried plant samples were ground in an agate pestle and mortar, and sieved in a nylon sieve (≤149 um). In addition, slag samples were collected at 2～20cm soil depth in each plant sample site. Slag samples (approximately 1kg each) were halved by applying the quartering method after removing foreign substances. One half of each slag sample was dried at 40 ºC until constant weight in the thermostatic air-blower-driven drying closet, then sieved in a nylon sieve (≤2 mm) for analysis of pH. We sent each plant (5g) and slag (100g) of sieved samples to an accredited laboratory (ALS Minerals ALS Chemex (Guangzhou) Co. Ltd.) for determination of their heavy metal contents by inductively coupled plasma atomic emission spectrometry (ICP-AES) and mass spectrometry (ICP-MS).

Results

There are high content of most heavy metals in *A. argyi* and indigenous zinc smelting slag, such as Fe, Mn, Pb and Zn element. In addition, the heavy metal content order of *A. argyi* are generally as leaf>root>stem, except for Cd and Se of CZP sample, Cu of HJC, Se of JMB, and Hg of ZZC (Fig. 1). Some heavy metal contents of the slag in ZZC sample were obvious lower than the other three samples, such as Ag, As, Cd, Fe, Hg, Mn, Pb and Zn. This might be the different main component in the slag (ZZC sample mainly contains coal slag, and the others mainly contains indigenous zinc smelting slag). The heavy metal contents of *A. argyi* are lower than the slag's except for the Cd, Hg and Se in leaf of ZZC. This might be a low metal bioavailability of indigenous zinc smelting slag because of its slightly acidic to neutral response. Moreover, heavy metals of *A. argyi* are high in the same with indigenous zinc smelting slag, such as Fe, Mn, Pb (except for the leaf of ZZC) and Zn. Heavy metals of *A. argyi* might be at certain of inheritance in the slag.

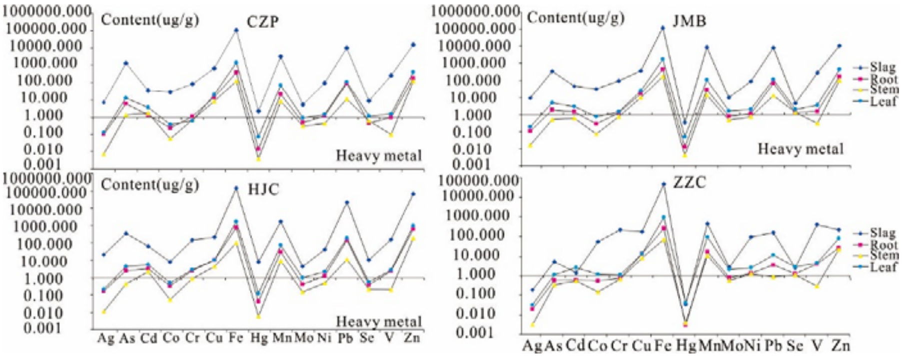

Figure 1. Distribution of heavy metal in indigenous zinc smelting slag and the different parts of *A. argyi* .

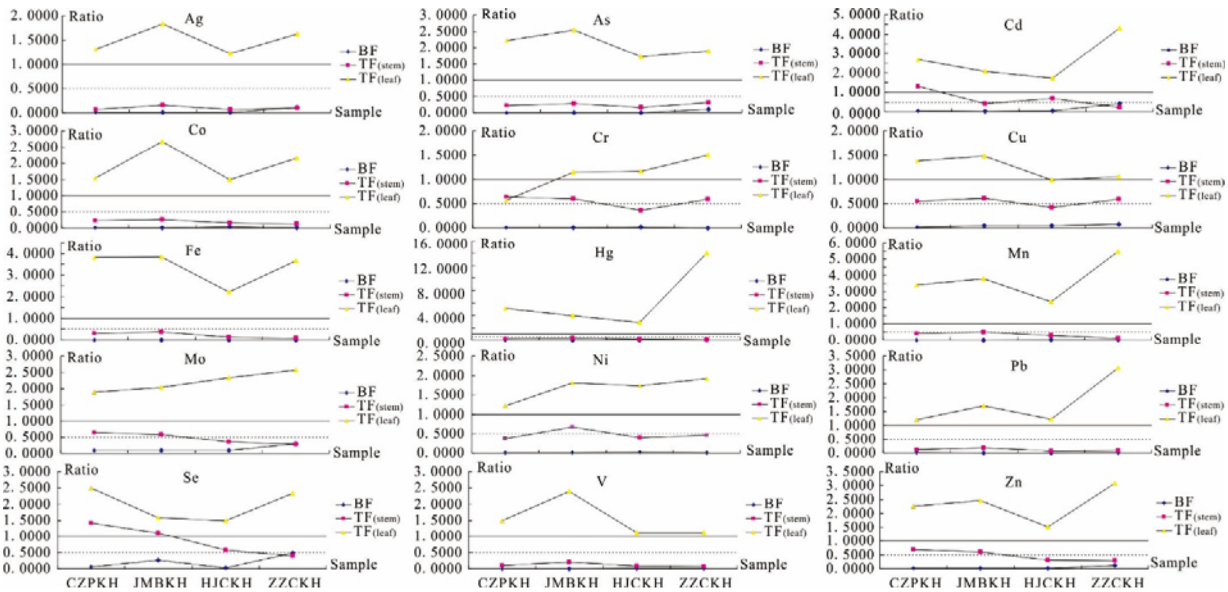

Figure 2. Accumulation and transfer in heavy metals of *A. argyi*. BF means root / slag of heavy metal. $TF_{(stem)}$ means stem / root of heavy metal. $TF_{(leaf)}$ means leaf / root of heavy metal.

A. argyi might be a heavy metal tolerant plant, such as As, Cd, Fe, Hg, Mn, Mo, Pb and Zn. It might be mainly through the transfer of the heavy metal to leaves to reduce the effects of heavy metal stress. The figure two shows that BF of heavy metals in *A. argyi* is below at 0.5. Although there is not high that the enrichment in the root of *A. argyi*, all parts of *A. argyi* still contains a high content of heavy metals (such as Fe, Mn, Pb and Zn) because their content of the slag are very high. $TF_{(stem)}$ of heavy metals in *A. argyi* are less than 1, and some are less than 0.5. This illustrates many heavy metals are generally difficult to accumulate in the stems of *A. argyi*. $TF_{(leaf)}$ of heavy metals in *A. argyi* are higher than 1, and some are higher than 2 such as Fe, Hg and Mn. The heavy metals in the root might be not difficult to transfer to the leaves of *A. argyi* that is the reason why *A. argyi* might be tolerance or slightly accumulation to heavy metals. $TF_{(leaf)}$ or $TF_{(stem)}$ of an element in the plant are >1 characteristic of accumulator, whereas for they are <1 suggesting excluder (Baker, 1981). Tolerant plant describes that the plant can survive and reproduce with heavy metal stress. They generally confronted heavy metal stress with two strategies: avoidance is protected externally from the effects of the stress and tolerance survives the influences of internal stress(Baker, 1987). Therefore, *A. argyi* might be tolerance or slightly accumulation to heavy metals, and it probably mainly survives the effects of heavy metal stress through transferring the heavy metals to leaves. This might be the reason why *A. argyi* could survive in indigenous zinc smelting slag with many high heavy metals stresses. Moreover, *A. argyi* might be a good plant selection for vegetation restoration of indigenous zinc smelting area. In contrast, phytoremediation is a better solution to the problem of the toxic heavy metals contamination in soils and waters (Hazrat et al., 2013). They suggest native herbaceous plants growing in metal-contaminated sites have phytoremediation potential after analyzing heavy metals of native herbaceous plants in an antimony mine(Xue et al., 2014). People might used excluder for phytostabilizating mining or smelting slag and accumulators for phytoextracting metal-contaminated area(Wójcik, et al., 2014).

Conclusion

There are high content of most heavy metals in *A. argyi* and indigenous zinc smelting slag, such as Fe, Mn, Pb and Zn. The heavy metal content order of *A. argyi* are generally as leaf>root>stem. *A. argyi* might be tolerance or slightly accumulation to heavy metals, such as As, Cd, Fe, Hg, Mn, Mo, Pb and Zn. Moreover, it probably mainly survives the effects of heavy metals stress through transferring the heavy metals to their leaves. *A. argyi* might be a good plant selection for vegetation restoration of indigenous zinc smelting area. In addition, although local people generally do not use *A. argyi* as a Chinese medicinal material, we still recommend that we should pay attention to the medicinal plant growth environment when we choose some medicinal plants (especially in *A. argyi*) as a Chinese medicinal material. They also suggest that medicinal plants used for medicinal materials should be collected from an unpolluted natural habitat(Khan, et al., 2008).

References

Baker, A. J. M. (1981). Accumulators and excluders-strategies in the response of plants to heavy metals Journal of Plant Nutrition, 3(1-4), 643-654.

Baker, A. J. M. (1987). Metal tolerance. New Phytologist, 106(s1), 93–111.

Chinese Pharmacopoeia Commission (CPC) (2010). Pharmacopoeia of the People's Republic of China, Part 1. Beijing: China Medical Science Press.

Gao X. M. (2012). Illustrated Handbook of Color Chinese Medicinal Herbs (Vol. 3): Beijing: Chinese Medicine Ancient Book Press.

Khan, S. A., Khan, L., Hussain, I., Marwat, K. B., & Akhtar, N. (2008). Profile of heavy metals in selected medicinal plants. Pakistan Journal of Weed Science Research, 14(1-2), 101-110.

Hazrat, A., Ezzat, K., & Muhammad Anwar, S. (2013). Phytoremediation of heavy metals--concepts and applications. *Chemosphere, 91*(7), 869-881.

Wójcik, M., Sugier, P., & Siebielec, G. (2014). Metal accumulation strategies in plants spontaneously inhabiting Zn-Pb waste deposits. Science of the Total Environment, 487, 313-322.

Xue, L., Liu, J., Shi, S., Wei, Y., Chang, E., Gao, M., Chen, L., Jiang, Z. (2014). Uptake of heavy metals by native herbaceous plants in an antimony mine (Hunan, China). CLEAN–Soil, Air, Water, 42(1), 81-87.

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