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Uptake of arsenate and arsenite by two *Pteris vittata* ecotypes

Xiaoming Wan[1], Mei Lei*[1], Guangdong Zhou[1], Iida Atsuo[2]
[1]Institute of Geographic Sciences and Natural Resources Research, CAS, Beijing 100101, China
[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

Introduction

Arsenic (As) contamination has received focused attention in China. Phytoextraction technology using hyperaccumulators, represented by *Pteris vittata*, has been confirmed as a feasible and economic method for As contaminated soils [1].

During the phytoextraction practice in Southern China, we have found that adopting different *P. vittata* could lead to several folds remediation efficiency variances. Reason behind this phenomenon is not clear yet, which may be partly attributed to the varied capacity of *P. vittata* to transform As.

As in soil exists mainly as inorganic arsenate (As(V)) and arsenite (As(III)), which could transform into each other under certain conditions [2]. The two forms of As behaved differently in soils and plants. However, *P. vittata* could efficiently accumulate both speciations.

This study investigated the uptake of As(V) and As(III) by different *P. vittata* ecotypes, aiming to understand the hyperaccumulation mechanisms from the aspect of ecotypic differences in As transformation.

Materials and Methods

Mature *P. vittata* sporophytes were exposed to As(V) and As(III) in hydroponic systems for 7 days. Nutrient solutions were refreshed every 12 hours without air pumping, to prevent the transformation of As(III) to As(V) in the nutrient solution. Leafs, stems and roots were separately collected, freeze-sectioned and then freeze-dried.

The micro As K-edge (11867 eV) X-ray absorption spectra (μXANES) were obtained at the X-ray microbeam station on beamline 4A of the Photon Factory at the High Energy Accelerator Research Organization, Tsukuba, Japan.

Results and Discussions

As uptake by two ecotypes

GX ecotype could uptake more As(III) than As(V) while YN ecotype showed no obvious difference in removing two As species. The As(III) accumulating ability was higher while the As(V) absorption capacity was slightly weaker in GX. For GX ecotype, the As concentration in different tissues were leaf>stem>root while for YN ecotype, the order were leaf>root>stem.

Table 1 As concentration in *P. vittata* (mg/kg)

	GXAs(III)	YNAs(III)	GXAs(V)	YNAs(V)
Root	426(70)	339(67)	350(43)	322(70)
Stem	627(93)	332(88)	464(126)	254(937)
Leaf	2721(661)	2533(339)	2341(349)	2561(259)

Note: GX and YN indicate two ecotypes from Guangxi province and YN province, respectively. Values are presented in the form of mean(standard deviation).

As speciation in two ecotypes

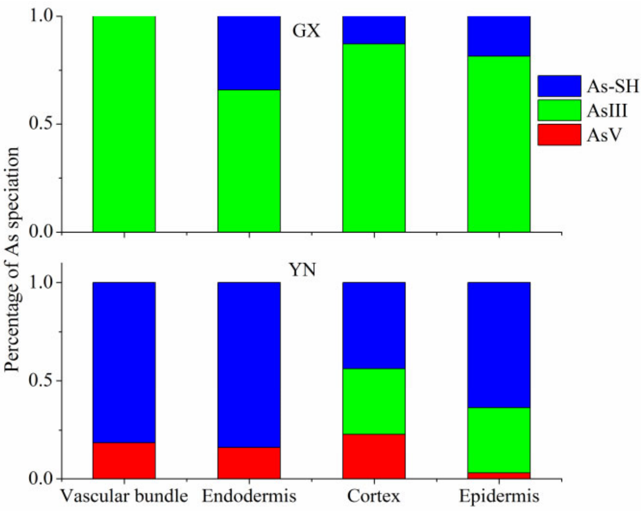

Fig. 1 As speciation in the roots (As(III) added)

When supplied with As(III), two ecotypes showed obviously different As transformation behavior. In GX ecotype, which could accumulate more As(III), most As in the vascular bundle was As(III) while in YN, As-SH dominated in the vascular bundle. Since it has been considered that As-SH was much more difficult to be transferred to aboveground parts [3], this may be the reason for the higher As(III) accumulating ability of GX ecotype. Another interesting phenomenon is that YN ecotype showed the oxidation ability of As(III) while GX had no such ability.

References

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