环境科学学报
ACTA SCIENTIAE CIRCUMSTANTIAE

研究论文

王晓丽,韦朝阳,冯人伟,涂书新.白玉凤尾蕨与印度芥菜对不同形态锑的富集与转化特征[J].环境科学学报,2014,34(3):720-727

白玉凤尾蕨与印度芥菜对不同形态锑的富集与转化特征

The accumulation and transformation of antimony characteristics in *Pteris cretica* and *Brassica Juncea*

关键词：白玉凤尾蕨 印度芥菜 三价锑 五价锑 甲基锑

基金项目：国家自然科学基金（No.40971264，10979052）

作 者 单位

王晓丽 1. 中国科学院地理科学与资源研究所, 北京 100101;2. 华中农业大学资源与环境学院, 武汉 430070

韦朝阳 中国科学院地理科学与资源研究所, 北京 100101

冯人伟 农业部环境保护科研监测所, 天津 300191

涂书新 华中农业大学资源与环境学院, 武汉 430070

摘要：以白玉凤尾蕨和印度芥菜为实验材料，采用温室水培方法研究两种植物在人工添加不同形态（三价无机锑、五价无机锑和三甲基锑）与不同水平锑（白玉凤尾蕨为30和50 mg · L^{-1}，印度芥菜为5和20 mg · L^{-1}）处理条件下的生长状况.以不加锑处理作为对照，同时分析锑在两种植物不同部位的富集与形态转化.结果表明，白玉凤尾蕨与印度芥菜对3种形态的锑均可出现显著的吸收富集，白玉凤尾蕨地上部和根部锑含量最高分别达到816 mg · kg^{-1}和6065 mg · kg^{-1}，印度芥菜地上部和根部锑含量最高分别达到322 mg · kg^{-1}和2663 mg · kg^{-1}；两种植物对不同形态锑的富集能力均为三价锑（Sb（Ⅲ））>五价锑（Sb（Ⅴ））>甲基锑（TMSb），且主要富集于根部.Sb（Ⅴ）处理下，白玉凤尾蕨与印度芥菜地上部80%以上转化为Sb（Ⅲ），反映两种植物均具有很强的将Sb（Ⅴ）转化为Sb（Ⅲ）的能力；Sb（Ⅲ）处理下，白玉凤尾蕨与印度芥菜对Sb（Ⅲ）的转化较少，地上部与根部只有不到5%的Sb（Ⅲ）转化为Sb（Ⅴ）；白玉凤尾蕨可直接吸收TMSb，并有31%~46%被转化为无机的Sb（Ⅲ）和Sb（Ⅴ），而印度芥菜则100%将TMSb转化为无机的Sb（Ⅲ）和Sb（Ⅴ）.植物对有机锑直接吸收转运并将其转化为三价锑的能力可能是植物对锑富集的重要机制.

Abstract：Antimony (Sb) toxicity and contamination have become a growing concern in recent years. Remediation of Sb contamination using plants may be an effective approach. One set of hydroponic trials was conducted using *Pteris cretica* and *Brassica Juncea*. Plants were grown for 2 weeks in nutrient solution containing different rates (*P. cretica*: 30 and 50 mg · L^{-1}; *B. juncea*: 5 and 50 mg · L^{-1}) and different speciation of Sb, with no Sb added as the control, to investigate the characteristics of plant uptake, accumulation, and transformation of Sb. The results showed that *P. cretica* and *B. juncea* can greatly accumulate Sb, in the treatments of Sb(Ⅲ), Sb(V), and TMSb, and the highest concentrations in the aboveground parts and roots of *P. cretica* were 816 mg · kg^{-1} and 6065 mg · kg^{-1}, respectively; while those were 322 mg · kg^{-1} and 2663 mg · kg^{-1} for *B. juncea*. The accumulation and transfer ability of Sb followed an order of Sb(Ⅲ)> Sb(V)>TMSb in both plants. Sb(V) was mostly transformed into Sb(Ⅲ), with above 80% of transformation rates in the aboveground parts of the two plants when treated with Sb(V). Sb(Ⅲ) was mostly taken up in its original species, with only 5% of Sb(Ⅲ) being transformed into Sb(V) in the plants. When treated with TMSb, *P. cretica* could take up and transfer more than 50% of TMSb from roots to aboveground parts without changing the species, with remaining 31%~46% TMSb being transformed into Sb(Ⅲ) and Sb(V), mainly Sb (Ⅲ); while in *B. juncea* no TMSb was detected due to the complete transformation into inorganic Sb. We suggest that the ability to direct uptake, accumulate and transfer TMSb without species transformation may probably be involved in the mechanism of antimony accumulation in plants.

Key words：*Pteris cretica* *Brassica Juncea* Sb(Ⅲ) Sb(V) TMSb