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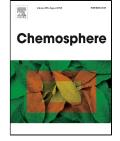
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Extractive recovery and valorisation of arsenic from contaminated soil through phytoremediation using *Pteris cretica*

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8 9 **Abstract**

10 Contamination of ground water and soil by arsenic poses serious environmental challenges globally. A possible solution to this problem is through phytoremediation using hyper-accumulating plants. This 11 study investigates phytoremediation of soil containing $200 \pm 3 \text{ mg kg}^{-1}$ of arsenic using *Pteris cretica* 12 ferns, and the strategies for arsenic extraction from the ferns biomass and subsequent conversions to 13 valuable arsenic products. The Pteris cretica ferns achieved maximum arsenic accumulations of 4427 14 \pm 79 to 4875 \pm 96 mg of arsenic per kg dry biomass after 30 days. Extraction efficiencies of arsenic in 15 the ferns fronds were $94.3 \pm 2.1\%$ for ethanol-water (1:1 v/v), $81.5 \pm 3.2\%$ for 1:1(v/v) methanol-16 water, and $70.8 \pm 2.9\%$ for water alone. Molybdic acid process was used to recover $90.8 \pm 5.3\%$ of the 17 18 arsenic, and $95.1 \pm 4.6\%$ of the phosphorus in the biomass extract. Quantitative precipitation of $Mg_3(AsO_4)_2$ and $Mg_3(PO_4)_2$ occurred on treatment of the aqueous solutions of arsenic and phosphorus 19 after stripping at pH of 8 – 10. The efficiencies of $Mg_3(AsO_4)_2$ and $Mg_3(PO_4)_2$ precipitation were 96 ± 20 21 7.2% and 94 \pm 3.4%, respectively. Arsenic nanoparticles produced from the recovered Mg₃(AsO₄)₂, using two-stage reduction process, had average particle diameters of 45.5 ± 11.3 nm. These 22 nanoparticles are potentially valuable for medical applications, while the Mg₃(AsO₄)₂ could be 23 converted to more valuable forms of arsenic or used as a pesticide, and the $Mg_3(PO_4)_2$ in fertiliser. 24 Recovery of these valuable products from phytoremediation biomass would incentivise and drive 25 26 commercial industries' participation in remediation of contaminated lands.

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Keywords: Phytoremediation, hyper-accumulator, *Pteris cretica*, solvent extraction, molybdic acid
process, arsenic nanoparticles.

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