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Diversity in cadmium accumulation and resistance associated with various metallothionein genes (type III) in *Phytolacca americana* L.

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Abstract

Metallothioneins (MTs) are known for their heavy metal detoxification during phytoremediation. To estimate their roles in the cadmium (Cd) hyperaccumulator *Phytolacca americana* L., three MT genes, *PaMT3-1*, *PaMT3-2* and *PaMT3-3*, belonging to the MT3 subfamily were cloned. They separately encoded 63, 65 and 65 amino acids, respectively, containing 12, 10 and 11 cysteines, respectively. Each gene was individually transformed and expressed in *Escherichia coli* cells. A Cd-resistance assay showed that the recombinant strains had enhanced survival rates, especially those containing *PaMT3-1* and *PaMT3-3*. Additionally, the recombinant strains were high Cd accumulators, with the recombinant *PaMT3-1*'s maximum accumulation being 2.16 times that of the empty vector strains. The numbers of cysteines and the structures of MT proteins were associated with the Cd enrichment and resistance capabilities. *PaMT3-1* could be an effective gene resource in future plant Cd remediation-related breeding programs.

Keywords: metallothionein; *Phytolacca americana* L.; prokaryotic expression

1. Introduction

Metallothionein (MT) is a low molecular weight, cysteine-rich protein that ubiquitously exists in eukaryotes and cyanobacteria [1,2]. It can bind heavy-metal ions by coordinate bonds to form nontoxic or minimally toxic complexes [3,4], and also act as an antioxidant to protect plants from oxidative damage [5,6]. MT, therefore, plays an important role in improving the heavy-metal resistance of plants [7]. To date, MT and MT-like genes have been widely identified from a variety of plants and their

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