Cinnamate-LDH hybrid for Formulation of Green pesticide

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Objectives

A green pesticide compatible with natural environment and human beings has been developed by hybridizing layered double hydroxide (LDH) with cinnamic acid, a natural antibiotic substance. As another fascinating nature-compatible approach, we have attempted to hybridize nature-compatible layered double hydroxides (LDH) with natural antibiotic substances.

Materials and Methods

Cinammic acids was dissolved in 50 ml of 1.7 M KOH aqueous ethanolic solution (volume ratio of water/ethanol = 7/3) to be 0.3 M concentration. The cinnamate-LDH hybrid (CAN-LDH) synthesized by coprecipitation route exhibited the cinnamate content of 32.3 wt % with empirical formula of $Mg_3Al(OH)_8 \cdot CAN \cdot 4.1H_2O$. Its antifungal activity was evaluated against P. capsici.

Results and Discussion

More than 80 % of intercalated cinnamate was released within 3 days from the hybrid in a simulated soil solution bubbled with air. The hybrid was effective in inhibiting growth of P. capsici above a cinnamic concentration of 150 ppm. Protective role of LDH against degradation of cinnamic acid in a cultivated soil was clearly supported by both much higher content and longer retention rate of cinnamate in the hybrid-treated soil (H-Soil) than in cinnamic acid-treated soil (C-soil).

Cinnamate-LDH hybrid exhibited high antifungal activity in vitro and controlled release of cinnamate into soil solution. Pot experiments clearly supported that cinnamate-LDH hybrid was very efficient to control root rot and blight of red pepper caused by Phytophthora capsici without any apparent harmful effects by high dose of cinnamic acid.

This study demonstrates that hybridization of natural antibiotic substances with layered double hydroxides could be a fascinating alternative for green formulation of pesticides. This unique hybrid system leads to the salient features such as safe protection of the substances against chemical and microbial degradations, controlled release, and nature-compatibility.

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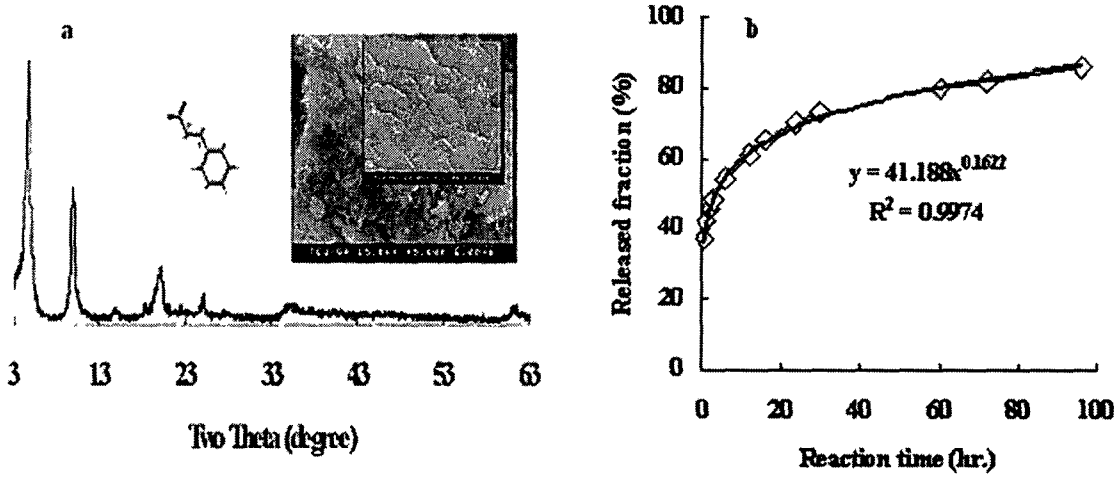

Fig. 1. Structural properties of Cinnamat-LDH (a) and release kinetic of cinnamic acid from Cinnamate-LDH (b)

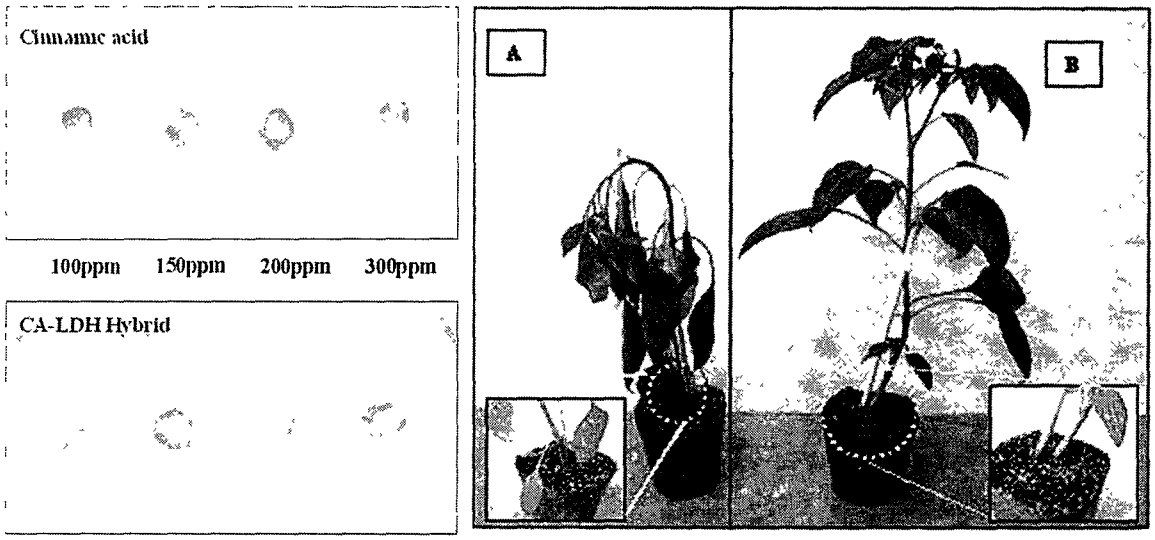

Fig. 2. Comparative antifungal activity of CA-LDH hybrid, cinnamic acid (a) and pesticidal effect of CA-LDH hybrid in soil after 7 days infested with 10^5 zoospores *phytiphthora capsci* (b).