

Potential Cross-Protection Roles of Chitooligosaccharide in Alleviating Cd Toxicity in Edible Rape (*Brassica rapa* L.)

Authors : Haiying Zong, Yi Yuan, Pengcheng Li

Abstract : Cadmium (Cd), one of the toxic heavy metals, has high solubility and mobility in agricultural soils and is readily taken up by roots and transported to the vegetative and reproductive organs which can cause deleterious effects on crop yield and quality. Excess Cd in plants can interfere with many metabolic processes, such as photosynthesis, transpiration, respiration or nutrients homeostasis. Generally, the main methods to reduce Cd accumulation in plants are to decrease the concentration of Cd in the soil solution through reduction of Cd influx into the soil system, site selection, and management practices. However, these approaches can be very costly and consume a lot of energy. Therefore, it is critical to develop effective approaches to reduce the Cd concentration in plants. It is proved that chitooligosaccharide (COS) can enhance the plant's tolerance to abiotic stress including drought stress, salinity stress, and toxic metal stress. However, so far little information is known about whether foliar application with COS modulates Cd-induced toxicity in plants. The metal detoxification processes of plants treated with COS also remain unclear. In this study, edible rape (*Brassica rapa* L.), one of the most widely consumed leafy vegetables, was selected as an experimental model plant. The effect of foliar application with COS on reducing Cd accumulation in edible rape was investigated. Moreover, Cd subcellular distribution pattern in response to Cd stress in the rape plant sprayed with COS was further tested in order to explore the potential detoxification mechanisms in plants. The results demonstrated that spraying COS at different concentrations (25, 50, 100 and 200 mg L⁻¹) possess diverse functions including growth-promoting, chlorophyll contents-enhancing, malondialdehyde (MDA) level-decreasing in leaves, Cd²⁺ concentration-decreasing in shoots and roots of edible rape under Cd stress. In addition, it was found that COS can also dramatically improve superoxide dismutase (SOD) activity, catalase (CAT) activity and peroxidase (POX) activity of edible rape leaves. The relieving effect of COS was related to the concentration and COS with 50-100 mg L⁻¹ displayed the best activity. Further, the experiments results exhibited that COS could decrease the proportion of Cd in the organelle fraction of leaves by 40.1% while enhance the proportion of Cd in the soluble fraction by 13.2% at the concentration of 50 mg L⁻¹. The above results showed that COS may have the potential to improve plant resistance to Cd via promoting antioxidant enzyme activities and altering Cd subcellular distribution. All the results described here open up a new way to study the protection role of COS in alleviating Cd tolerance and lay the foundation for future research about the detoxification mechanism at subcellular level.

Keywords : chitooligosaccharide, cadmium, edible rape (*Brassica rapa* L.), subcellular distribution

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