

# Isolation of antofine from *Cynanchum atratum* BUNGE (Asclepiadaceae) and its antifungal activity against *Penicillium digitatum*

Zhitong Xin, QiuliOu Yang, Chunpeng Wan, Jinxin Che, Lu Li, Jinyin Chen and Nengguo Tao

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## Abstract

The present study describes the isolation of the alkaloid “antofine” from *Cynanchum atratum* BUNGE as well as its anti-fungal potential against the citrus postharvest pathogen *Penicillium digitatum*. Antofine, which was extracted using an ultrasonic-assisted method and identified by  $^1\text{H}$ ,  $^{13}\text{C}$ -NMR, and LC/MS analysis, showed strong antifungal activity against *P. digitatum*, with an observed minimum inhibitory concentration (MIC) and a minimum fungicidal concentration (MFC) of  $1.56 \times 10^{-3}$  and  $1.25 \times 10^{-2} \text{ g L}^{-1}$ , respectively. *In vivo* assays showed that antofine could significantly reduce the incidence of green mold. Furthermore, the total lipid and ergosterol contents of *P. digitatum* decreased after antofine treatment, indicating the disruption of membrane integrity. In addition, antofine caused a significant reduction of the intracellular adenosine triphosphate (ATP) content during the entire exposure period. These results suggest that the antifungal activity of antofine against *P. digitatum* can be attributed to the disruption of the cell membrane integrity and energy metabolism.