Structure and expression profiling of a novel calcium-dependent protein kinase gene, CDPK3a, in leaves, stems, grapes, and cell cultures of wild-growing grapevine Vitis amurensis Rupe.

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Abstract

Key message VaCDPK3a is actively expressed in leaves, stems, inflorescences, and berries of Vitis amurensis and may act as a positive growth regulator, but is not involved in the regulation of resveratrol biosynthesis.

Abstract Calcium-dependent protein kinases (CDPKs) are known to play important roles in plant development and defense against biotic and abiotic stresses. It has previously been shown that CDPK3a is the predominant CDPK transcript in cell cultures of wild-growing grapevine Vitis amurensis Rupe., which is known to possess high resistance against environmental stresses and to produce resveratrol, a polyphenol with valuable pharmacological effects. In this study, we aimed to define the full cDNA sequence of VaCDPK3a and analyze its organ-specific expression, responses to plant hormones, temperature stress and exogenous NaCl, and the effects of VaCDPK3a overexpression on biomass accumulation and resveratrol content in V. amurensis calli. VaCDPK3a was actively expressed in all analyzed V. amurensis organs and tissues and was not transcriptionally regulated by salt and temperature stresses. The highest VaCDPK3a expression was detected in young leaves and the lowest in stems. A reduction in the VaCDPK3a expression correlated with a lower rate of biomass accumulation and higher resveratrol content in calli of V. amurensis under different growth conditions. Overexpression of the VaCDPK3a gene in the V. amurensis calli significantly increased cell growth for a short period of time but did not have an effect on resveratrol production. Further subculturing of the transformed calli resulted in cell death and a decrease in expression of the endogenous VaCDPK3a. The data suggest that while VaCDPK3a acts as a positive regulator of V. amurensis cell growth, it is not involved in the signaling pathway regulating resveratrol biosynthesis and resistance to salt and temperature stresses.

Keywords Calcium-dependent protein kinase · Gene expression · Vitis amurensis · Plant cell cultures · Resveratrol · Salt and temperature stress

Abbreviations

ABA Abscisic acid
BA 6-Benzylaminopurine
CDPK Calcium-dependent protein kinases
NAA α-Naphthaleneacetic acid
RT-PCR Reverse transcription PCR
SA Salicylic acid

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