Molecular Characterization and Expression Patterns of Shabby-Related Kinase (*Mmsk*) Gene of Mulberry (*Morus multicaulis*)

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Abstract—Shaggy-related protein kinase (SK) plays important roles in the plant growth development, signal transduction, abiotic stress and biotic stress and substance metabolism regulation. In the present paper, a cDNA sequence encoding *MmSK* (GenBank accession NO: KY348867) was cloned from the leaves of mulberry based on mulberry expressed sequence tags (EST) and homologous cloning technology using RT-PCR, which was 1705 bp in length with a full open reading frame (ORF) of 1236 bp encoding a protein of 411 amino acids. The estimated molecular weight and isoelectric point (pI) of the putative protein were 46.55 kDa and 8.61, respectively. Conservation domain structure analysis indicated that MmSK protein had typical structure of the protein kinase domain and belonged to GSK3/shaggy protein kinase family. Multiple sequence alignment and phylogenetic analysis showed that the homology between the amino acid sequences encoded by the *MmSK* gene and various species was more than 89%. Quantitative real-time PCR (qRT-PCR) analysis revealed that *MmSK* was expressed in all the tested tissues including leaf, bud, fruit, stem, phloem and xylem of the mulberry with the highest expression in the phloem. The expression level of the mRNA has changed significantly under salt, drought, cold and ABA stress treatments compared to the normal growth environment. Overall, these results showed a better understanding of the molecular basis for the signal transduction mechanism during the stress responses in mulberry trees.

Keywords: Mulberry, Shabby-related kinase (MmSK), Cloning, Characterization, Expression pattern

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