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SHORT COMMUNICATION

Characterisation and Expression Analysis of Hydroxyphenylpyruvate Reductase Derived from *Orthosiphon aristatus*

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ABSTRACT

Herbal products are getting more popular as alternative medicines and food supplements. The therapeutic effects of herbal medicines are mainly attributed to their bioactive secondary metabolites. *Orthosiphon aristatus*, locally known as 'Misai Kucing', is known for its various health benefits. One of the main chemical constituent of *O. aristatus* is rosmarinic acid, a plant polyphenol that has been proven to have antioxidant, anti-inflammatory and antimicrobial activities. Hydroxyphenylpyruvate reductase (HPPR) is one of the enzymes involved in rosmarinic acid biosynthetic pathway. Here we report the effect of UV on HPPR expression and the isolation of a full-length *hppr* cDNA from *O. aristatus* via rapid amplification of cDNA ends polymerase chain reaction. An increase in the expression was detected when the plant was exposed to UV and detected via the expression of *hppr* transcript. A 1116 bp nucleotide putative cDNA was isolated corresponding to 307 predicted amino acid. We have also isolated the 5' and 3' untranslated regions with a length of 54 bp and 123 bp, respectively. Sequence similarity analysis was performed against NCBI genebank and the BLAST result showed that the putative *hppr* cDNA isolated from *O. aristatus* exhibited high similarities with other *hppr* cDNA of the members of the Lamiaceae family such as *Perilla frutescens*, *Salvia officinalis*, *Salvia miltiorrhiza* and *Solenostemon scutellarioides*.

Keywords: Phydroxyphenylpyruvate reductase (HPPR), *Orthosiphon aristatus*, rapid amplification of cDNA ends (RACE), rosmarinic acid

Orthosiphon aristatus [syn.: *O. grandiflorus*, *O. spicatus*, *O. stamineus*] is locally known as "Misai Kucing" belonging to the family Lamiaceae. It is a perennial herb that can grow to about 0.4 to 1.5 m high. The leaves are green and simple with a lanceolate leaf blade (Jaganath & Ng, 2000). The flowers have long protruding stamens, making it look like cat's whiskers (Figure 1(a)). It has been used in Southeast Asia countries such as Malaysia, Indonesia, Thailand and Vietnam in traditional medicine for treatment of fever, epilepsy, gallstones, hepatitis, rheumatism, hypertension, syphilis, gonorrhea, tonsilitis, hepatitis, gout and diabetes (Akowuah *et al*., 2005; Kiong *et al.*, 2008).

Various ranges of scientific studies support the traditional use of the plant. Studies have showed that the plant exhibited anti-pyretic activity (Yam *et al*., 2009), radical scavenging or antioxidant (Akowuah *et al.*, 2005; Khamsah *et al*., 2006), anti-apoptotic (Abdelwahab *et al*., 2011), anti-microbial (Tong *et al*., 2011), anti-bacterial activity, anti-fungal activity (Hossain *et al*., 2008) and chemo-preventive activity (Salleh *et al*., 2011). More than 20 compounds have been isolated and identified in *O. aristatus* (Tezuka *et al*., 2000) and rosmarinic acid is one of the major constituent (Chin *et al.*, 2009). Rosmarinic acid (RA) is commonly found within the families Boraginaceae and Lamiaceae (Li *et al*., 2005) and Figure 1(b) illustrates the pathway of rosmarinic acid biosynthesis in *Coleus blumei* now known as *Plectranthus scutellarioides* (Kim *et al*., 2004). RA has been proven to have anti-microbial, anti-viral, anti-pyretic and anti-oxidant effects (Petersen & Simmonds, 2003). UV is an abiotic stimulus that has the potential to induce accumulation of secondary metabolites which in turn affect numerous physiological functions (Matsuura *et al*., 2013; Paul & Gwynn-Jones, 2003). A study by Luis *et al*. (2007) showed significant increase of rosmarinic acid concentration in rosemary when exposed to

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