

Hairy roots of *Hypericum perforatum* L.: a promising system for xanthone production

Research Article

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Abstract: *Hypericum perforatum* L. is a common perennial plant with a reputed medicinal value. Investigations have been made to develop an efficient protocol for the identification and quantification of secondary metabolites in hairy roots (HR) of *Hypericum perforatum* L. HR were induced from root segments of *in vitro* grown seedlings from *H. perforatum*, after co-cultivation with *Agrobacterium rhizogenes* A4. Transgenic status of HR was confirmed by PCR analysis using *rolB* specific primers. HR had an altered phenolic profile with respect to phenolic acids, flavonol glycosides, flavan-3-ols, flavonoid aglycones and xanthones comparing to control roots. Phenolics in control and HR cultures were observed to be qualitatively and quantitatively distinct. Quinic acid was the only detectable phenolic acid in HR. Transgenic roots are capable of producing flavonol glycosides such as quercetin 6-C-glucoside, quercetin 3-O-rutinoside (rutin) and isorhamnetin O-hexoside. The HPLC analysis of flavonoid aglycones in HR resulted in the identification of kaempferol. Transformed roots yielded higher levels of catechin and epicatechin than untransformed roots. Among the twenty-eight detected xanthones, four of them were identified as 1,3,5,6-tetrahydroxyxanthone, 1,3,6,7-tetrahydroxyxanthone, γ -mangostin and garcinone C were *de novo* synthesized in HR. Altogether, these results indicated that *H. perforatum* HR represent a promising experimental system for enhanced production of xanthones.

Keywords: *Agrobacterium rhizogenes* A4 • Phenolic acids • Flavonol glycosides • Flavan-3-ols • Flavonoid aglycones • Xanthones

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1. Introduction

Hypericum perforatum L. (Saint John's wort) is a medicinal plant considered as an important natural source of secondary metabolites with a wide range of pharmacological attributes. It contains naphthodianthrone, acylphloroglucinols, flavonoids, biflavones, phenylpropanes, xanthones and an essential oil rich in sesquiterpenes [1]. Flavonoids,

naphthodianthrone and phloroglucinols are distributed in the aerial parts of the plant, whereas xanthones are mainly produced in the roots [2]. Flavonol derivatives, naphthodianthrone and phloroglucinols are used for the treatment of mild and moderate depression [3]. Xanthones are a class of polyphenolics that exhibit well-documented pharmacological properties, such as monoamine oxidase inhibition, and antioxidant, antimicrobial,

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