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Biochemical and molecular characterization of some Papaver species from Iran, a valuable potency for producing of Morphinan alkaloids

Mohammad Reza Naghavi University of Tehran, Iran

There are 150 species in the genus of *Papaver* in the world which 28 of them are natives of Iran and five of them are endemic distributed in most part of Iran. Phytochemical evaluation of some *Papaver* species such as *Papaver bracteatum*, *Papaver somniferum* and *Papaver orientale* from Iran revealed valuable metabolites such as noscapine, morphine; codeine; thebaine and papaverine that mainly are used in medicine and pharmacy. The accumulation of morphinan alkaloids was different among organs of each species. However, we found inverse relations among various metabolites which suggest a competition among biosynthetic pathways for intermediates or organs for accumulation of final products. In addition, we found common morphinan biosynthesis pathway in different Papaver species as what reported in *Papaver* somniferum using quantitative PCR. Relative gene expression of important genes (*TYDC*, *BBE*, *SAT*, *COR*, *T6ODM*, *and CODM*) in morphinan biosynthesis pathway was highly variated depend on growth, developmental stages and alkaloid content of the species. Our results also indicated that the elicitation of *Papaver* cell culture by hormonal and nano elicitors can be a good system for enhancement the production of the alkaloids. In addition, our findings suggested that inducing the hairy roots in *Papaver* species can be used as a good source for producing commercial alkaloids.

mnaghavi@ut.ac.ir