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ORIGINAL ARTICLE

Exogenous phenylalanine and ultrasound treatments improved Taxol biosynthesis in hazelnut cell culture

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Abstract

Hazelnut, one of the most important nut plants, has recently been suggested as a potential alternative and sustainable source of Taxol. Taxol is one of the most widely prescribed chemotherapy drugs for various types of cancers. In the present study, the effect of phenylalanine (0, 5, 7.5 and 12.5 mg L^{-1}) and ultrasonic treatment (UT: for 0, 30, 45, 60 and 90s) were investigated on cell proliferation, growth, Taxol content and the production other secondary metabolites in a completely randomized designed experiment. Expression of taxadien-5α-ol-O-acetyltransferase (*TDAT*) gene was also studied in cultured hazelnut cells. The results showed that UT treatment of up to 45s, increased both fresh (Fm) and dry (Dm) matters. Quantitative analysis of secondary metabolites revealed the positive effect of phenylalanine and UT and the highest flavonoids (TFC) level (1.95 mg g^{-1}) was observed in samples grown under 12.5 mg L^{-1} phenylalanine supplementation. Moreover, our result showed that, both treatments had a positive and significant effects on the production of Taxol in hazelnut cell suspension. Particularly, the phenylalanine treatment at a concentration of 7.5 mg L^{-1} and UT treatment at 45s resulted in the highest Taxol content (192.72 and 208.41 ppm, respectively). Expression of the *TDAT* gene was induced by both treatments, with the highest upregulation detected under the 12.5 mg L^{-1} phenylalanine treatment and the 90s UT treatment. Overall, these findings indicate that the utilization of phenylalanine, as a precursor in the Taxol biosynthesis pathway, along with UT treatment as a stimulant for growth and secondary metabolites biosynthesis, enhanced the expression of the key *TDAT* gene of the Taxol biosynthesis pathway. This enhancement, in turn, led to an increase in the Taxol content of hazelnut cell suspension cultures. Therefore, the applied treatments can be considered as effective stimulants for Taxol production in vitro.

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