

Improvement of Artemisinin Production by *P. indica* in Hairy Root Cultures of *A. annua* L.

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Abstract : Malaria is a major health problem in many developing countries. The parasite responsible for the vast majority of fatal malaria infections is *Plasmodium falciparum*. Unfortunately, most *Plasmodium* strains including *P. falciparum* have become resistant to most of the antimalarials including chloroquine, mefloquine, etc. To combat this problem, WHO has recommended the use of artemisinin and its derivatives in artemisinin based combination therapy (ACT). Due to its current use in artemisinin based-combination therapy (ACT), its global demand is increasing continuously. But, the relatively low yield of artemisinin in *A. annua* L. plants and unavailability of economically viable synthetic protocols are the major bottlenecks for its commercial production and clinical use. Chemical synthesis of artemisinin is also very complex and uneconomical. The hairy root system, using the *Agrobacterium rhizogenes* LBA 9402 strain to enhance the production of artemisinin in *A. annua* L., is developed in our laboratory. The transgenic nature of hairy root lines and the copy number of trans gene (*rol B*) were confirmed using PCR and Southern Blot analyses, respectively. The effect of different concentrations of *Piriformospora indica* on artemisinin production in hairy root cultures were evaluated. 3% *P. indica* has resulted 1.97 times increase in artemisinin production in comparison to control cultures. The effects of *P. indica* on artemisinin production was positively correlated with regulatory genes of MVA, MEP and artemisinin biosynthetic pathways, viz. *hmgr*, *ads*, *cyp71av1*, *aldh1*, *dxs*, *dxr* and *dbp2* in hairy root cultures of *A. annua* L. Mass scale cultivation of *A. annua* L. hairy roots by plant tissue culture technology may be an alternative route for production of artemisinin. A comprehensive investigation of the hairy root system of *A. annua* L. would help in developing a viable process for the production of artemisinin. The efficiency of the scaling up systems still needs optimization before industrial exploitation becomes viable.

Keywords : *A. annua* L., artemisinin, hairy root cultures, malaria

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