

Mass Propagation of Medicinal Plant Tissues through Bioreactor Technology

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ABSTRACT

The production of high-value secondary metabolites from medicinal plants has gained significant attention due to their pharmaceutical and therapeutic importance. This study explores the use of bioreactor systems for the large-scale propagation and metabolite production from various tissue types of selected medicinal plants, including *Catharanthus roseus*, *Vinca minor*, *Tanacetum cinerariifolium* (pyrethrum), and other economically important species. Explants such as leaves, callus, roots, hairy roots, suspension cultures, and synthetic seeds were cultured using a range of media formulations supplemented with specific plant growth regulators (auxins, cytokinins, and elicitors) to induce and maintain desired tissue morphogenesis. Optimization of bioreactor conditions—such as aeration, agitation, pH, and nutrient supply—enabled efficient biomass accumulation and enhanced production of bioactive compounds. Hairy root cultures, in particular, demonstrated superior stability and metabolite yield, while suspension cultures facilitated rapid cell division and metabolite extraction. Synthetic seed technology also showed potential for long-term preservation and large-scale regeneration of elite lines. The bioreactor-based scale-up approach presents a sustainable and controlled alternative to traditional field cultivation, offering consistent quality and yield of plant-derived compounds such as vincristine, vinblastine, and pyrethrins. This study underscores the potential of integrating plant tissue culture techniques with bioreactor technologies for the industrial production of phytochemicals from medicinal plants.

