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Enhanced taxanes production by *Taxus x media* hairy roots in cultures supported with hybrid silica-chitosan aerogel-based materials

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Taxanes,, i.e., paclitaxel or docetaxel, are essential drugs in modern oncology. They are frontline chemotherapeutic agents for breast, ovarian, and lung cancers, and they are also used in prostate cancer and Kaposi's sarcoma. Despite their clinical success, the widespread application of taxanes is limited by a lack of natural sources or production systems. The low yield of paclitaxel production from natural sources, and the increasing global demand emphasize the necessity for innovative strategies for taxanes production. Given the metabolic complexity and low yields in natural sources, efforts to taxane biosynthesis in microbial systems, plant biomass *in vitro* bioprocessing, or cell-free platforms are recognized as crucial solutions for the efficient production of paclitaxel. Furthermore, the versatility of *in vitro* culture systems creates the possibility for enhanced metabolite production by the application of the bioengineering method. The use of hybrid chitosan-modified silica aerogels allows for simultaneous immobilization of the plant biomass and its directed elicitation, which can allow to overcome actual problems with plant-origin paclitaxel production.

The aim of the study was to investigate the influence of two various aerogels containing methyl (TMCS) and hydroxyl (TEOS) groups, and their combinations with chitosan, on *Taxus x media* transgenic roots biomass proliferation and taxanes production. Plant biomass was cultured with TMCS and TMCS-chitosan or TEOS and TEOS-chitosan aerogels. For hybrid chitosan-silica aerogels, the following concentration of chitosan for 1g of aerogel: 0.05g, 0.1g, 0.2g, and 0.4g, has been noted. The increase in the amount of plant biomass and biosynthesized taxanes was determined quantitatively.

The application of TEOS and TMCS aerogels has a slight effect on plant biomass growth and shows a noticeable influence on the production of taxanes. Supporting culture systems with chitosan-modified silica aerogel caused an increment in the production of secondary metabolites. The increase in chitosan concentration in aerogel improved the taxane concentration.

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