

Development of Sublingual Nanofibrous Mats for Enhanced Nutrient Delivery: A Novel Approach Using Chitosan-Based Nanoparticles

Ece Guler¹, Humeyra Betul Yekeler², Sevval Gulsah Tekinalp³, Gita Parviz², Murat Dogan⁴, Ceyda Ekentok⁵, Muhammet Emin Cam^{1*}

¹ Department of Pharmacology, Faculty of Pharmacy, Istanbul Kent University, Türkiye

² Department of Pharmacology, Faculty of Pharmacy, Marmara University, Türkiye

³Health Services Vocational School, Istanbul Kent University, Türkiye

⁴ Department of Pharmaceutical Biotechnology, Cumhuriyet University, Türkiye

⁵ Department of Pharmaceutical Biotechnology, Faculty of Pharmacy, Marmara University, Türkiye

* Corresponding author: muhammet.cam@kent.edu.tr

Abstract:

There are many different types of dietary supplements that provide vital chemicals to the people they need to stay healthy. Oral administration offers convenience, yet it also presents notable drawbacks, including the hepatic first-pass effect, limited absorption, and swallowing difficulties, especially in elderly individuals, all of which must be carefully addressed. Nanosized biomaterials, which have recently come to the fore in various medical fields, have great potential to overcome current challenges. This study devised and created a drug delivery system for sublingual administration using chitosan/tripolyphosphate/polyvinylpyrrolidone (CS/TPP/PVP) nanoparticles (DNPs) loaded with β -glucan and vitamin C embedded in polyethylene oxide (PEO) nanofibrous mats (DNFs). The optimal PNP size and DNP size for sublingual administration were determined as 236 ± 1 nm and 257 ± 1 nm, respectively. The DNFs exhibited a uniform structure, with their average diameter measured at 783 ± 290 nm through scanning electron microscopy analysis. The synthesized biomaterials were thoroughly analyzed in terms of their chemical composition, 3D structure, and thermal properties. The in vitro drug release kinetics study found that 99.3% of vitamin C and 99.7% of β -glucan were released during the 15-day sustained drug release of DNP, which followed the first-order model. The 24-hour 3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide (MTT) assay in the L929 cell line revealed no significant cytotoxicity in either pure or drug-loaded samples. It has been understood that DNF nutritional supplements have the potential to be a unique supplement dosage form that is easier to use, more effective, and more bioavailable than traditional approaches.

Keywords: dietary supplement; β -glucan; vitamin C; nanoparticles; nanofibrous mats