Development and Evaluation of an SGLT2 Inhibitor-Loaded Nanoformulation for the Treatment of Breast Cancer

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Abstract

Canagliflozin (CANA), a sodium–glucose cotransporter 2 inhibitor, has potential anticancer activity, but its poor aqueous solubility presents a formulation challenge. This study aimed to develop and evaluate a peppermint oil-based canagliflozin-loaded nanoemulsion (PO CANA-NE) for potential application in breast cancer treatment. Solubility screening guided excipient selection, and the nanoemulsion was prepared using probe ultrasonication. Formulation variables were screened to optimize particle size, polydispersity index, and zeta potential. The optimized formulation was evaluated for morphology, drug content, viscosity, transmittance, in vitro release, and storage stability. Anticancer activity was investigated in MCF-7 breast cancer cells using MTT viability, Annexin V/propidium iodide apoptosis, and reactive oxygen species assays. The formulation exhibited a drug content of 98.56 ± 1.37%, viscosity of 1.31 ± 0.43 cP, and transmittance of 97.19 ± 0.98%. PO-CANA-NE showed greater cytotoxic activity than free CANA, with IC_{50} values of 9.61 and 19.38 µg/mL, respectively. Increased apoptosis and reactive oxygen species production were also observed with PO-CANA-NE. These findings support further investigation of the formulation as a potential anticancer delivery system. Additional preclinical studies are required to establish safety, selectivity, and in vivo efficacy.