Modeling the effect of composition on formation of aerosolized nanoemulsion system encapsulating docetaxed and curcumin using D-optimal mixture experimental design

ABSTRACT

The synergistic anticancer effect of docetaxel (DTX) and curcumin (CCM) has emerged as an attractive therapeutic candidate for lung cancer treatment. However, the lack of optimal bioavailability because of high toxicity, low stability, and poor solubility has limited their clinical success. Given this, an aerosolized nanoemulsion system for pulmonary delivery is recommended to mitigate these drawbacks. In this study, DTX- and CCM-loaded nanoemulsions were optimized using the D-optimal mixture experimental design (MED). The effect of nanoemulsion compositions towards two response variables, namely, particle size and aerosol size, was studied. The optimized formulations for both DTX- and CCM-loaded nanoemulsions were determined, and their physicochemical and aerodynamic properties were evaluated as well. The MED models achieved the optimum formulation for DTX- and CCM-loaded nanoemulsions containing a 6.0 wt% mixture of palm kernel oil ester (PKOE) and safflower seed oils (1:1), 2.5 wt% of lecithin, 2.0 wt% mixture of Tween 85 and Span 85 (9:1), and 2.5 wt% of glycerol in the aqueous phase. The actual values of the optimized formulations were in line with the predicted values obtained from the MED, and they exhibited desirable attributes of physicochemical and aerodynamic properties for inhalation therapy. Thus, the optimized formulations have potential use as a drug delivery system for a pulmonary application.

Keyword: D-optimal; Mixture experimental design; Aerosol; Curcumin; Docetaxel; Nanoemulsion; Pulmonary delivery