Predicting the optimum compositions of a transdermal nanoemulsion system containing an extract of Clinacanthus nutans leaves (L.) for skin antiaging by artificial neural network model

ABSTRACT

A nanoemulsion-based formulation containing leaf extracts of Clinacanthus nutans Lindau (C. nutans) was prepared for therapeutic use and optimized by artificial neural network (ANN). The model was applied to optimize the particle size of the transdermal nanoemulsion system containing an extract of C. nutans leaves for skin antiaging. Five universal learning algorithmsð incremental back propagation, batch back propagation, quick propagation, genetic algorithm, and Levenberg-Marquardtð were used in the ANN to achieve the optimum topologies. The optimum topologies were selected among the learning algorithms trained with lowest root mean square values. Genetic Algorithm-5-13-1 was found to be the optimum topology for the final model to predict the optimum particle size. Under these conditions, the actual particle size of the optimum nanoemulsion compared well with the predicted values with the residual standard error of less than 1.5%. The final formulation was observed to be stable against phase separation under an accelerated stability study and during storage at room temperature and 45℃ for 90 days. The dermal irritation assay demonstrated that the developed nanoemulsion was found to be compatible with human skin and could be classified as nonirritant. In vivo ultrasound attributes of the skin study showed that the collagen content increased significantly with the application of the C. nutans nanoemulsion among all 21 volunteers during the 21 days of the treatment period. Hence, ANN was found to be an effective tool for optimizing the nanoemulsion containing C. nutans leaves extract with efficacy to protect collagen from breakdown.

Keyword: Artificial neural network; Dermal irritation; Formulation; Optimization; Multivariate method; Skin antiaging