Evaluation of the Effective Electrospinning Parameters Controlling Kefiran Nanofibers Diameter Using Modelling Artificial Neural Networks

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ABSTRACT

Objective(s): This paper investigates the validity of Artificial Neural Networks (ANN) model in the prediction of electrospun kefiran nanofibers diameter using 4 effective parameters involved in electrospinning process. Polymer concentration, applied voltage, flow rate and nozzle to collector distance were used as variable parameters to design various sets of electrospinning experiments for production of electrospun kefiran nanofibers.

Methods: The Scanning Electron Microscopy (SEM) was used to investigate the morphology and evaluate the size of the nanofiber. Data set was drawn using k fold cross-validation method, which was the most suitable scheme for the volume of the data in this work. Data were partitioned into the five series and trained and tested via ANN method.

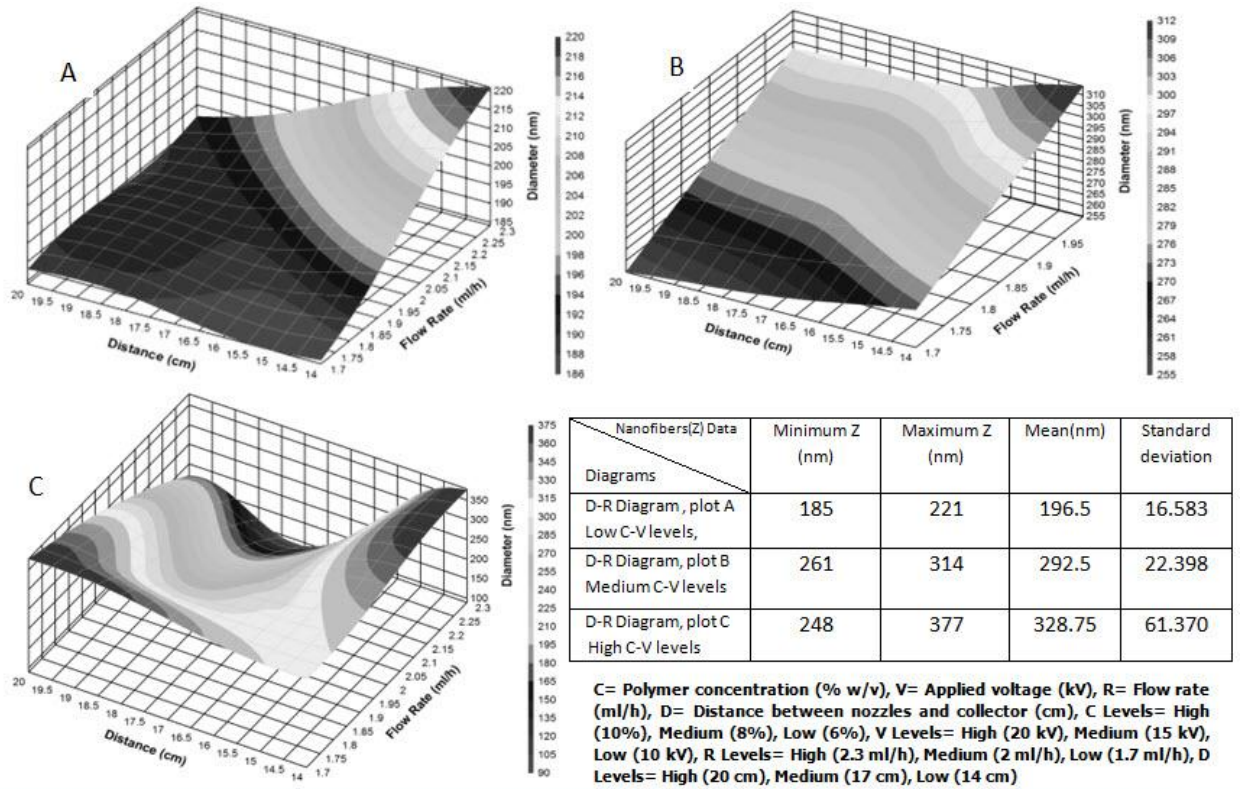
Results: The Scanning Electron Microscopy (SEM) images of the generated nanofiber samples were confirmed that all of the samples were fine and defect-free. Our results indicated that the network including four input variables, three hidden layers with 10, 18 and 9 nodes in each layer, respectively, and one output layer obtained the highest efficiency in the testing set. The mean squared error (MSE) and linear regression (R) between observed and predicted nanofibers diameter were 0.0452 and 0.950, respectively.

Conclusions: The results demonstrated that the proposed neural network was appropriately performed in assessing the input parameters and prediction of nanofibers diameter.

Keywords:

Kefiran, Nanofibers , Electrospinning, ANN, Modeling

Supplementary Information



Nanofibers(Z) Data / Diagrams	Minimum Z (nm)	Maximum Z (nm)	Mean(nm)	Standard deviation
D-R Diagram , plot A Low C-V levels,	185	221	196.5	16.583
D-R Diagram, plot B Medium C-V levels	261	314	292.5	22.398
D-R Diagram, plot C High C-V levels	248	377	328.75	61.370

C= Polymer concentration (% w/v), V= Applied voltage (kV), R= Flow rate (ml/h), D= Distance between nozzles and collector (cm), C Levels= High (10%), Medium (8%), Low (6%), V Levels= High (20 kV), Medium (15 kV), Low (10 kV), R Levels= High (2.3 ml/h), Medium (2 ml/h), Low (1.7 ml/h), D Levels= High (20 cm), Medium (17 cm), Low (14 cm)

Fig. 8s. The data and 3 D plots of nanofibers diameter predicted by ANN fixed in mentioned levels (D-R Diagrams)