SIIC003

APPLICATION OF ARTIFICIAL NEURAL NETWORK TO SIMULATE PHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY DURING SPONTANEOUS FERMENTATION OF *CARICA PAPAYA* LEAF

Nur Syahira Mohammad[1], Mohamad Sufian So'aib[2]
[1]Faculty of Chemical Engineering, Universiti Teknologi MARA Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang Malaysia
[2] Faculty of Chemical Engineering, Universiti Teknologi MARA Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang Malaysia

**corresponding author: sufian5129@uitm.edu.my*

Abstract:
Artificial Neural Network (ANN) was used to simulate the phenolic content and antioxidant activity during spontaneous fermentation of *Carica papaya* leaf. The aim of the present research project is to develop ANN models for prediction of phenolic content and antioxidant activity of *Carica papaya* leaf during spontaneous fermentation and to compare the statistical performance of different ANN architecture for the prediction of phenolic content and antioxidant activity. Data used to derive and validate the model was obtained from the experiment. The input of the ANN model is volume and day of fermentation, while the output is the phenolic content and antioxidant activity. Trial and error method were used to develop the ANN model. The transfer function used in this research project was hyperbolic tangent sigmoid with the Levenberg-Marquadt algorithm training function. The ANN architecture was the multilayer feed-forward structure with backpropagation training algorithm used for computing biases and weights. The performance of ANN model was being evaluated by correlation coefficient (R) and mean square error (MSE). The neural network model with minimum MSE and maximum R value was considered to be the best ANN. The best topology for Antioxidant activity of *Carica Papaya* leaf is 2-12-12-1 with low MSE value which is 0.0044367. The best topology for Phenolic content of *Carica Papaya* leaf is 2-11-11-1 with low MSE value which is at 0.00024449.

***Keywords*:**
Artificial Neural Network; Phenolic Content; Antioxidant Activity; Transfer Function, Spontaneous fermentation

Objectives:

- To develop ANN models for prediction of phenolic content and antioxidant activity of Carica papaya leaf during spontaneous fermentation.
- To compare the statistical performance of different ANN architecture for the prediction of phenolic content and antioxidant activity of *Carica papaya* leaf during spontaneous fermentation.

Methodology:

Data encoding and modelling

The first data was encoded in a manner suitable for ANN processing for ANN modelling. 5L volumes is encoded as 1, 50L volumes was encoded as 2 and days of fermentation was encoded with intervals from 0 to 100, respectively. The number of samples available from the experimental data for training, testing and validating of the neural network for the phenolic content and antioxidant activity output variables were set. Analysis results and facilitate training was being process separately. The technique that has been used to train the net was backpropagation technique and weights and biases were determined using Levenberg-Marquadt algorithms. Mean Square Error (MSE) method was chosen for the performance assessment. Each of network was created with two input (volume, days of fermentation) and one output, for each variable is separately. The number of hidden neurons varies, as this was trial and error method to develop the ANN model.

The transfer function that has been used was the Hyperbolic tangent sigmoid. Each of network was created with two input (volume, days of fermentation) and one output, for each variable is separately. The number of hidden neurons was varying from 1 to 20 with 1 and 2 hidden layers, as this was trial and error method to develop the ANN model. For each run, the MATLAB scripts will random select the samples. 70% of the samples was for training, 15% of samples for testing and finally for another 15% of samples was for validation of subsets. Artificial neural network learns to predict the phenolic content and antioxidant activity with very high accuracy, approximating the experimental data with a very small error. Training was performed based on experimental data. Even so, it is clear from the results that the neural network was able to abstract an accurate model.

Results:

Activity	Neural Network Architecture	Regression			MSE	Average Relaticve Errors
		Training	Validation	Testing		
Antioxidant activity	2-12-12-1	0.98435	0.99315	0.99263	0.0044367	0.946397
Phenolic content	2-11-11-1	0.99814	0.99925	0.99858	0.00024449	1.173506

Conclusion:

The complexity of the fermentation process does not enable easy description of the phenomenon through simple mathematical equations. However, ANN prove to be efficient tools both for predicting antioxidant activity and phenolic content of *carica papaya* leaf during spontaneous fermentation. ANN is a stochastic modelling tool which is able to model complex linear and non-linear relationships by reasoning, using simple computational element. Various types of neural network-based technique exist for predictive modelling, but the feed-forward ANN based model was designed and trained using the backpropagation algorithm for performing prediction of the antioxidant activity and phenolic content for this study. As demonstrated on the testing subset of data, the prediction capability is very good, since relative errors are less than 10%. The ANN is efficient instrument in computing these values and consequently it may bring important savings of experimental costs. Result of this study reveal the utility of the ANN developed model aspects hidden in the experimental data. The distribution data points for neural network model almost similar and close to the actual experiment data with correlation coefficient (R) in the range of 0.9-1.0. The developed neural network models are reliable and able to predict antioxidant activity and phenolic content performance parameter with reasonable accuracy.