http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 13 (7): 1443-1446, 2014
ISSN 1812-5638 / DOI: 10.3923/itj.2014.1443.1446

Artificial Neural Network Modeling of Extract from Lotus Seed Liquor Lees of Furfural Content

[1,2]Libin Xu, [1,2]Yan Liu, [1,2]Xia Zhu, [1,2]Yong Shi and [1,2]Dongsheng Li
[1]Key Laboratory of Fermentation Engineering (Ministry of Education),
HuBei University of Technology, WuHan, 430068, China
[2]Research Center of Food Fermentation Engineering and Technology of HuBei,
WuHan 430068, China

Abstract: In the present study, a multi-layer perception neural network and Radial Basis Function (RBF) network were used to model of extract form lotus seed liquor lees of furfural content. Artificial neural network were used to model extract furfural from lotus seed liquor lees and comparison with the results obtained from a regression analysis. Owing to the furfural in lotus seed liquor was easy to mix with organic matter in any proportion. The appropriate extraction conditions guaranteed the maximum extract from lotus seed liquor lees. This study provided a theoretical basis for the production of liquor.

Key words: Artificial neural network, a multi-layer perception neural network, radial basis function network, lotus seed liquor lees, furfural

INTRODUCTION

The Chinese herb `Lian-Zi' which is the seed of the nymphaeaceae aquatic herb. It has been used for medicinal purposes, such as an astringent, tonic and sedative in oriental cultures (Yen *et al*., 2005). Recently, it has been indicated that lotus seed has an anti-aging effect and enhances immunity. The embryo of the lotus seed has multiple medicinal purposes, such as invigoration of the spleen, anti-diarrhea, kidney tonic, heart tonic and astringent. it has been recorded as a traditional Chinese drug in the Chinese Pharmacopoeia. Lotus seeds contain substantial amounts of embryos which is not only including phospholipids, proteins, amino acids, vitamins. (Xu, 1992; Zheng *et al*., 2003). Lotus seed liquor used the Hunan red lotus powder which were wipe off the lotus seed as wine accessories. the active material are dissolved into the liquor, which can improve the health care performance of liquor and add the value of lotus seed.

Considerable effort is spent worldwide to characterize and control foodstuff, in order to ascertain their composition and safety. The role of furfurals in food has been highlighted for different kinds, such as honey, coffee, concentrated grape juice, baby food, balsamic vinegar.

Owing to the furfural was easy to mixed with organism in any proportion. The appropriate extraction condition was not only guaranteed the maximum extract from lotus seed liquor lees, but also provided a theoretical basis for the extract from lotus seed liquor lees by methanol. This study was used to optimize the conditions of furfural extraction.

Artificial Neural Network (ANN) is considered as a biological neural network which is a mathematical model has been gained as a tool in many disciplines of engineering and science. The power of ANN depends on its ability of learning linear and nonlinear relationships from training data without any knowledge about the physics of the phenomenon. Artificial neural network has been used in many kinds of fields.

Artificial neural networks have already been applied to model processes such as prediction of cold spot temperature (Llave *et al*., 2012), Estimation of the Canola Oil Stability (Dehghani *et al*., 2012), drying behavior of different food and agricultural materials such as carrot (Erenturk and Erenturk 2007; Kerdpiboon *et al*., 2006), banana (Mohebbi *et al*., 2011), ginseng (Martynenko and Yang, 2006), cassava and mango (Hernandez-Perez *et al*., 2004), storage quality of fresh-cut green peppers (Meng *et al*., 2012) and osmotically dehydrated kiwi fruit (Fathi *et al*. 2011).

However, there is no published data in model of extract from alcohol of furfural content. The purpose of this study was to investigate the effect of extracting time, methanol concentration and four different temperatures on furfural content of extract lotus seed liquor by methanol. ANN models were developed to predict furfural content for extract lotus seed liquor using multi-layer perception neural network and Radial Basis Function (RBF) network and compare their accuracy.

Corresponding Author: Dongsheng Li, Key Laboratory of Fermentation Engineering (Ministry of Education),
HuBei University of Technology, WuHan, 430068, China

MATERIALS AND METHODS

Samples preparation: Lotus seed liquor lees tank samples were cleaned and then they were transferred into a hot-air-drying oven at 105°C for 12 h. The dry matter were ground to pass through an 80 mesh sieve and stored at refrigerator to further chemical composition analyses.

Extract solution: Lotus seed liquor lees samples were crush by using a domestic grinder. Prior to furfural extraction 3 g of ground samples were mixed with 50 mL of different concentrations (50, 70 and 100%) of samples. The mixtures were heating in water bath at different temperature (20, 30, 40, 50°C) and different time (10, 20, 30, 40, 50, 60 min). Then they were centrifuged at 8000 g for 15 min. One milliliter of supernatant detected for furfural content.

HPLC Determination of furfural: The wine samples (3 g each) were diluted to 50 mL with distilled water, then filtered using a 0.45 μm nylon membrane filter and injected (10 μL) into an HPLC system equipped with a diode array detector and a temperature controlled column oven. An Agilent C18 column (250×4.6 mm, 5 μm) was used as the solid phase. The mobile phase consisted of 10% acetonitrile and 90% of aqueous formic acid solution (10 mM, v) was carried out at a flow rate of 1 mL min^{-1} at 25°C. The detector wave length was set at 285 nm. The HMF content of the sample was calculated by comparing the corresponding peak areas of the sample and those of standard solutions of HMF after correcting for the lotus seed liquor dilution.

Artificial neural network: In this study, multi-layer perception neural network and Radial Basis Function (RBF) network were used. The input layer consists of three neurons (extract temperature, methanol concentration and extract time) and the output layer contains one neuron (furfural content).

Multi-layer perception network: A multi-layer Perception Network is called "Universal Approximator" which was the most popular ANN in engineering problems. It contains three layers namely input, hidden, output layer. Each input neurons according to data, multiplying their corresponding weights and putting the result in non-linear transformation like the sigmoid transfer function. And then summing the values and finally adding bias. A multi-layer Perception Network was designed using neural network toolbox in MATLAB 7.1. Levenberg-Marquardt algorithm (Trainlm) was chosen as training algorithm in this paper. As transfer function, a linear transfer function (purelin) in first hidden layer and a logarithmic sigmoid transfer function (logsig) in the second layer were used. Choosing the appropriate values of learning rate and momentum has strong effect on the prediction accuracy of ANN. Under the test, learning rate and momentum of 0.9, 0.1 was chosen:

$$\log sig(x) = \frac{1}{(1+e^{-x})}$$

$$\text{Purelin}\,(x) = x$$

In this study, 7 and 9 neurons in first hidden layer and second hidden layer with the lowest errors were chosen. The performance of the networks was measured by Mean Squared Error (MSE) and regression coefficient (r^2) between the predicted value and experimental values. The purpose of every training algorithm is to reduce error by adjust the weights and biases.

Radial basis function networks: Recently, the Radial Basis Function (RBF) neural network was widely used in ANN. Owing to RBF network focused on enhanced the training algorithms and exchanged basic architecture. It has a desirable performance in classification and functional approximation. In addition, the RBF network also provided a valuable tool in others application areas. RBF network is divided into three layers: a transparent input layer, a hidden layer with large number of nodes and an output layer. As the name implies, radially symmetric was chosen as the activation function of the hidden layer. RBF network used radially symmetric function as a "root" to structure the hidden layer. In this way, the mapping of input vectors directly influence on the hidden layer. This mapping relationship can be confirms after the centre point was confirmed. However, the mapping of the hidden layer to the input layer was linear. Although the mapping of input layer to output layer was nonlinear. But the output layer for adjustable parameter was linear. Therefore, the bias can be obtained by means of linear equations. Thus, it can improve the learning speed and avoid the problem of local minimum. An unsupervised technique called k-nearest neighbor rule was most widely in RBF network (Dehghani *et al*., 2012). Owing to the output unit is normally linear, the convergence speed was fast.

Training the neural networks: In this study, the experimental data (72 data) were randomly split in three groups: training (50%), validation (25%) and testing data (25%). The first partition was training the network. The second partition was used to the evaluation of the quality

of training in the network. The last partition was used for estimating the performance of trained network on new data. The performance of the network was estimated by Mean Squared Error (MSE) and regression coefficient (r^2) between multi-layer perception neural network and Radial Basis Function (RBF) network. This study provided a theoretical basis for the production of liquor.

RESULTS AND DISCUSSION

Modeling of the furfural content of extract from lotus seed liquor lees by methanol. Under the training, a multi-layer perception neural network with 7, 9 neurons for first and second hidden layer has r^2 and MSE of 1.5363, 0.98. However, Radial Basis Function (RBF) network has r^2 and MSE of 0.8412, 0.99. The performance of multi-layer perception neural network and Radial Basis Function (RBF) network between the experimental values and the prediction values for test data were plotted in Fig. 1. It is showed that the model with lowest MSE and highest r^2 is best to predict the furfural content of extract from lotus seed wine was RBF neural network.

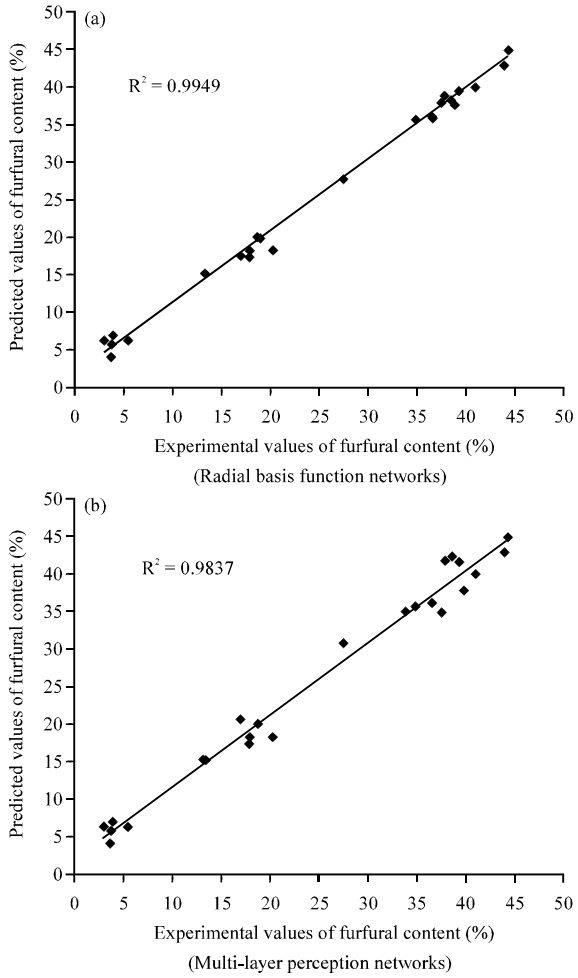

Fig. 1(a-b): Experimental vs. predicted values of furfural content of extraction

CONCLUSION

In this study, the influence of operational parameters on furfural content of extract from lotus seed liquor lees was studied. There were positive correlation coefficients between extracting temperature and furfural content. The furfural content increased with the concentration increased. There were negative correlation coefficients between extracting temperature and furfural content. As the temperature increased, the furfural content is decreased. In addition, it was found that Radial Basis Function (RBF) network has more precision than multi-layer perception neural network.

ACKNOWLEDGMENT

This study was financially supported by the National Key Technology RandD Program (2012BAD27B03).

REFERENCES

Dehghani, A.A., Z.B. Mohammadi, Y. Maghsoudlou and A.S. Mahoonak, 2012. Intelligent estimation of the canola oil stability using artificial neural networks. Food Bioprocess Technol., 5: 533-540.

Erenturk, S. and K. Erenturk, 2007. Comparison of genetic algorithm and neural network approaches for the drying process of carrot. J. Food Eng., 78: 905-912.

Fathi, M., M. Mohebbi and M.A. Razavi, 2011. Application of image analysis and artificial neural network to predict mass transfer kinetics and color changes of osmotically dehydrated kiwifruit. Food Bioprocess Technol., 4: 1357-1366.

Hernandez-Perez, J.A., M.A. Garcia-Alvarado, G. Trystram and B. Heyd, 2004. Neural networks for the heat and mass transfer prediction during drying of cassava and mango. Innov. Food Sci. Emerg. Technol., 5: 57-64.

Kerdpiboon, S., W.L. Kerr and S. Devahastin, 2006. Neural network prediction of physical property changes of dried carrot as a function of fractal dimension and moisture content. Food Res. Int., 39: 1110-1118.

Llave, Y.A., T. Hagiwara and T. Sakiyama, 2012. Artificial neural network model for prediction of cold spot temperature in retort sterilization of starch-based foods. J. Food Eng., 109: 553-560.

Martynenko, A.I. and S.X. Yang, 2006. Biologically inspired neural computation for ginseng drying rate. Biosyst. Eng., 95: 385-396.

Meng, X., M. Zhang and B. Adhikari, 2012. Prediction of storage quality of fresh-cut green peppers using artificial neural network. Int. J. Food Sci. Technol., 47: 1586-1592.

Mohebbi, M., F. Shahidi, M. Fathi, A. Ehtiati and M. Noshad, 2011. Prediction of moisture content in pre-osmosed and ultrasounded dried banana using genetic algorithm and neural network. Food Bioprod. Process., 89: 362-366.

Xu, Y.M., 1992. Study on the content and composition of phospholipids in semen of *Nelumbo nucifera*. Chinese Bull. Bot., 4: 46-47.

Yen, G.C., P.D. Duh and H.J. Su, 2005. Antioxidant properties of lotus seed and its effect on DNA damage in human lymphocytes. Food Chem., 89: 379-385.

Zheng, B.D., J.G. Zheng and Z.X. Zeng, 2003. Analysis of the nutritional composition in Chinese main lotus seed varieties. Nutr. Trans., 25: 153-156.