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Modelling the Formation of Acrylamide in Potato Crisps Using Artificial Neural Network

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After the discovery of probable human carcinogen namely "acrylamide" in thermally processed foods, a number of theoretical mechanisms have been proposed for its formation. Most probably, acrylamide in food results largely from the Maillard reaction between amino acids (primarily asparagine) and a reactive carbonyl, proceeding through intermediates that include a Schiff's base. Several intrinsic and extrinsic factors, such as the initial concentration of reactants and their ratio, temperature and time of processing, have been shown to influence the levels of acrylamide in thermally processed foods. In order to predict and to control the amount of acrylamide formed, kinetics of acrylamide in function of process and product variables need to be known. Considering the complexity of various possible formation mechanisms of acrylamide in Maillard reaction, it seems to be an almost impossible task to elucidate the kinetics of all the pathways involved. Artificial neural network (ANN) modeling, on the other hand, may be a viable alternative to the kinetic models for predicting the acrylamide formations.

Artificial neural network (ANN) is a potent computer model that learns from the examples through iterations without requiring prior knowledge of the relationships of process parameters. Predictions with ANN are not like modeling simulation, but outputs are obtained from a learning algorithm based on experimental data. Here, ANN approach was used to predict acrylamide concentration and browning ratio of potato crisps as influenced by various parameters. Concentrations of asparagine (3500-5000 ppm), glucose (5000-12000 ppm), the temperature (160-180°C) and the frying time (1-5 min) were the parameters used as the input variables to build the ANN model. The experimental data (72 data points) were used for ANN training using a feed forward back propagation network algorithm. Decision on the use of a given number of hidden layer nodes is complex because it depends on the specific problem being solved. In our study, the architecture with two hidden (5 and 3 nodes) layers and one output layer (2 nodes) was selected. The linear regression coefficient of 0.999 and 0.992 were determined between measured and predicted acrylamide levels for the training data set and testing data set, respectively.