Monitoring fructo-oligosaccharides production with artificial neural network assisted spectrophotometric method

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Short-chain fructo-oligosaccharides (FOS) are low-calorie carbohydrates with prebiotic function. There is a growing demand for commercially available FOS to be used in food products. FOS can be produced from sucrose by whole cell fermentation or purified enzyme reaction with fructosyltransferase activity, resulting in a mixture of saccharides with different chain lengths. Current practice for carbohydrate analysis involves the use of time-costly and off-line chromatographic procedures. A more rapid, possibly on-line carbohydrate analysis method is required to monitor the progress of the bioconversion during FOS manufacturing. This study is dedicated to the development of an artificial neural network (ANN) model for estimating carbohydrate composition from the direct measurement of UV spectra. A total of 182 samples were generated by operating an enzyme membrane reactor (EMR) under both optimal and suboptimal settings. Saccharides concentration and the corresponding UV absorbance readings of the samples were recorded via HPLC and spectrophotometer, respectively. To model the relation between composition and UV spectra, a two-layer feedforward neural network was trained and optimized in MATLAB (MathWorks Inc., Massachusetts, USA). The model was then validated by new observations that were not involved in the model building. Our results suggest that the proposed UV-ANN method adequately estimates the relative amount of FOS fractions to mono- and disaccharides, and thus, enables the real-time monitoring of the bioconversion.