



An Overview on the Applications of Typical Non-linear Algorithms Coupled With NIR Spectroscopy in Food Analysis

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Abstract

Near-infrared (NIR) spectroscopy as a low-cost technique with its non-destructive fast nature, precision, control, accuracy, repeatability, and reproducibility has been extensively employed in most industries for food quality measurements. Its coupling to different modeling techniques has been identified as a way of improving the accuracy and robustness of non-destructive measurement of foodstuffs. This review provides an overview of the application of non-linear algorithms in food quality and safety specific to NIR spectroscopy. The review also provides in-depth knowledge about the principle of NIR spectroscopy along with different non-linear models such as artificial neural network (ANN), AdaBoost, local algorithm (LA), support vector machine (SVM), and extreme learning machine (ELM). Moreover, non-linear algorithms coupled with NIR spectroscopy for ensuring food quality and their future perspective has been discussed.

Keywords Non-linear algorithm · NIR spectroscopy · Non-linear applications · BP-ANN · AdaBoost

Abbreviations

NIRS	Near-infrared spectroscopy	RBF	Radial basis function
ANN	Artificial neural network	RBFNN	Radial basis function neural networks
BP-ANN	Backpropagation artificial neural network	PLS	Partial least square
BP	Backpropagation	PCR	Principal component regressions
LA	Local algorithm	MLR	Multiple linear regressions
SVM	Support vector machine	APaRP	Mallows augmented partial residual plot
SVR	Support vector regression	PRP	Partial residual plot
ELM	Extreme learning machine	RP	Residual plot
PCs	Principal components	e-PC	Residual versus PC plot
LS-SVM	Least square support vector machine	AVP/PaRP	Added variable plot/partial residual plot
LS-SVR	Least square support vector regression	LOF	Lack of fit
LED	Laser emission diode	Map	Mean average precision
PCA	Principal component analysis	SNV	Standard normal variate transformation
SIMCA	Soft independent modeling of class analogy	MSC	Multiplicative scatter correction smoothing
PE	Processing element	WT	Wavelet transforms
GA	Genetic algorithm	OSC	Orthogonal signal correction
GA-ANN	Genetic algorithm artificial neural network		

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Introduction

Nowadays, food quality and safety are major concerns to food industries across the world due to the increasing demand of consumers for quality, safety, and trust on food products regarding health. Unsafe food is affecting people's health as well as their social progress. Food manufacturers, processors,