

Application of FTIR-ATR spectroscopy coupled with multivariate analysis for rapid estimation of butter adulteration

ABSTRACT

In dairy product sector, butter is one of the potential sources of fat soluble vitamins, namely vitamin A, D, E, K; consequently, butter is taken into account as high valuable price from other dairy products. This fact has attracted unscrupulous market players to blind butter with other animal fats to gain economic profit. Animal fats like mutton fat (MF) are potential to be mixed with butter due to the similarity in terms of fatty acid composition. This study focused on the application of FTIR-ATR spectroscopy in conjunction with chemometrics for classification and quantification of MF as adulterant in butter. The FTIR spectral region of $3910\text{-}710\text{ cm}^{-1}$ was used for classification between butter and butter blended with MF at various concentrations with the aid of discriminant analysis (DA). DA is able to classify butter and adulterated butter without any mistakenly grouped. For quantitative analysis, partial least square (PLS) regression was used to develop a calibration model at the frequency regions of $3910\text{-}710\text{ cm}^{-1}$. The equation obtained for the relationship between actual value of MF and FTIR predicted values of MF in PLS calibration model was $y = 0.998x + 1.033$, with the values of coefficient of determination (R^2) and root mean square error of calibration are 0.998 and 0.046% (v/v), respectively. The PLS calibration model was subsequently used for the prediction of independent samples containing butter in the binary mixtures with MF. Using 9 principal components, root mean square error of prediction (RMSEP) is 1.68% (v/v). The results showed that FTIR spectroscopy can be used for the classification and quantification of MF in butter formulation for verification purposes.

Keyword: FTIR spectroscopy; Butter; Mutton fat; Discriminant analysis; Partial least square