

APPLICATION OF FTIR SPECTROSCOPY AND MULTIVARIATE MODELING FOR IDENTIFYING SUGAR ADULTERATION IN BLACK TEA

**G.N. Damayanthi^{1,2*}, K.M. Binduhewa¹, B.A.T. Amalka¹,
C.K. Dissanayake¹, A.G.A.W. Alakolanga² and V.P. Ellepola²**

¹*Sri Lanka Atomic Energy Board, Orugodawatta, Wellampitiya, Sri Lanka.*

²*Department of Export Agriculture, Uva Wellassa University of Sri Lanka,
Badulla, Sri Lanka.*

*nadeekadamayanthi650@gmail.com

Sri Lankan tea is globally acknowledged as the “World’s Cleanest Tea”. However, adulteration, especially in black tea, remains a persistent challenge within the industry. It has recently been recognised that the intentional addition of sugar to processed teas is widespread. To the best of our knowledge, no prior studies have applied Fourier transformed infrared spectroscopy-Attenuated total reflectance (FTIR-ATR) spectroscopy for the detection of sugar adulteration in black tea. Therefore, this study aimed to develop a novel screening protocol for identifying sugar adulteration in black tea. Authentic orthodox black tea samples were collected covering all seven tea-growing regions in Sri Lanka. Adulterated samples were prepared by mixing tea with sugar at different concentration levels (1 – 40% w/w). The spectral data obtained from analyses of both adulterated and unadulterated samples were subjected to three pre-processing approaches; standard normal variate (SNV), multiplicative scatters correction, and first derivative filtering. Subsequently, principle component analysis was applied to pre-processed data separately and SNV pre-processed data resulted highest R^2 value (0.995). Using the SNV pre-processed data set, orthogonal partial least square discriminant analysis (OPLS-DA) showed a clear separation of adulterated and unadulterated tea. R^2 value explained 99% of the total variance, and the model showed strong predictive power with a Q^2 value of (0.953). The application of OPLS-DA proved the strong discriminative power of the model, achieving 100% classification accuracy with the independent test data set. These findings highlight the potential of FTIR-ATR spectroscopy, coupled with multivariate modelling, as a rapid and non-destructive approach for routine quality control and adulteration detection in black tea.

Keywords: Black tea adulteration, FTIR-ATR spectroscopy, Multivariate analysis, Non-destructive screening, Sugar detection