Detection and Quantification of Formalin Adulteration in Milk using Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy

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Abstract—*Milk is the best and cheapest source of nutrition and hence adulteration in milk is done to gain economic benefit. Formalin has been added illegitimately in order to increase the shelf life of milk. Formalin is highly toxic and causes kidney and liver damages. Fourier transform infrared spectroscopy (FTIR) combined with multivariate analysis was evaluated as a rapid quality monitoring method for the detection and quantification of formalin in milk. Milk samples were adulterated with five different percentage levels 1%, 5%, 10%, 15% and 20% of formalin. Spectra of pure and adulterated milk were acquired in the wavenumber range of 4000-400 cm^{-1} using ATR-FTIR. The difference observed in the wavenumber range of 1080-950 cm^{-1} corresponds to absorption frequencies of common constituents of formalin. Principal component analysis (PCA) showed clustering of samples based on levels of formalin in milk. Classification efficiency of test samples was found to be 100% using Soft Independent Modelling of Class Analogy (SIMCA) approach. Partial least squares (PLS) regression model was established to quantify the level of formalin in milk. Using PLSR, the coefficient of determination (R^2) for calibration and validation was 0.9936 and 0.9932. This method is non-destructible, cheap, requires little or no sample preparation and having a sensitivity level of 1% level of formalin adulteration.*