Determination of fat, MSNF and sucrose contents in commercial ice-cream by near infrared spectroscopy

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Near infrared (NIR) spectroscopy has been recognized for decades as a powerful method for analyses of various food and agricultural materials. It has the advantages of speed and non-destruction of samples and can be used for on-line composition analysis. In this study we have evaluated the feasibility of NIR spectroscopy for analysis of chemical composition of commercial ice-ream.

A total of 43 ice-cream samples in two batches were collected from commercial markets. The first batch of 30 samples were used for establishing calibration equations and the second batch of 13 samples were used for validation. All samples were passed through a sieve (pore size 0.3 mm) to remove any large pieces of fruits or nuts. The reference values of fat, milk solid nonfat (MSNF) and sucrose contents in all samples were determined by the standard methods (1). Spectroscopic analyses were performed on a Vis-NIR scanning spectrophotometer (NIR System 6500, Perstrop Analytical Inc.). Prior to the analyses all samples were defrosted in a water bath of about 40 C, and then placed on laboratory bench to reach an equilibrium of room temperature. Each sample was scanned at 2 nm intervals in wavelength range of 400 to 2500 nm, and the spectral data were recorded as the average of 32 scans. Data recording and processing were performed by a computer program (ISI version 3, Infrasoft International). Spectra data were collected at both reflectance and transmission scanning modes. Under the reflectance scanning mode samples were presented using either a high-fat/moisture cell of 0.5 cm path length or a quartz glass cell of 10 mm path length. Under the transmission mode samples were presented using a quartz glass cell of 1.0 mm path length. The reflectance spectra were recorded as log 1/R, where R is the proportion of reflected light energy. The transmission spectra were recorded as log 1/T, where T is the proportion of transmitted light energy.

Table. Mean, range and mean deviation (MD) and percentage deviation of percentage contents of fat, MSNF and sucrose in validation samples (n=13) determined by NIR and reference methods respectively.

	Mean	Range	MD	MD%
NIR method				
Fat	13.7	7.8 - 19.1	0.66	5.0
MSNF	10.9	8.5 - 13.8	0.62	5.9
Sucrose	16.2	13.6 - 18.8	1.15	7.2
Reference method				
Fat	13.6	8.3 - 18.6	0.18	1.2
MSNF	10.8	8.0 - 13.6	0.29	2.9
Sucrose	16.7	13.0 - 20.2	0.22	1.3

It was observed that spectral range between 1100 and 2500 nm produced the best calibration equations based on the lowest standard error of calibration when compared with the spectral range of 400 to 2500 or 400 to 1100 nm. Second derivation of the spectral data improved the accuracy of the calibration. Presenting samples with the high fat/moisture cell and scanning under reflectance mode produced most accurate calibration equations for all three compositions when compared with presenting samples with quartz glass cells under either reflectance mode or transmission mode. Cross validation revealed that the percentage composition of fat, MSNF and sucrose in ice-cream determined by the NIR method was comparable with the values determined by the reference method with the percentage deviation between 5 and 7.2% (Table). The results indicate that NIR spectroscopy can be used for fast screening chemical composition of commercial ice-cream samples.

(1) Kirk RS, Sawyer R. Pearson's Composition Analysis of Foods. England: Longman, 1991.