Effect of spectral measuring spots on the precision of moisture calibrations of minced meats packed in polyethylene bags

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Introduction

Sample presentation and spectral acquisition is very important for near infrared (NIR) spectroscopy. It would be very difficult to achieve precise calibration results from poorly acquired spectra, even with the assistance of sophisticated chemometrics software. In case of minced meat, which is not uniform in composition, sample presentation (selection of spectral measuring spots, i.e positions from where the sample is to be scanned) is very important for acquiring informative spectra. In this study, the effect of measuring spot selection on the precision of moisture calibration on minced meats packed in polyethylene bags was examined. Because meat is stored under refrigerated conditions the effect of temperature at the time of scanning was also studied.

Materials and methods

A total of 72 minced meat samples were purchased from local supermarkets. Each sample was packed in a polyethylene bag and kneaded by hands through the bag to remove cracks in the meat and make the sample more homogeneous inside the bag. Each sample was scanned to acquire NIR spectra in the wavelength region of 700 nm to 1100 nm at 5°C and 15°C using the NIRSystems Model 6500 (NIRS6500), equipped with the "Interactance probe" (Figure 1).

Spectra of meat were acquired through the polyethylene bag at five measuring spots (Figure 2), while all spectral acquisitions were performed inside a cold room at 15°C.

After the NIR measurements, each sample was homogenised with a speed cutter; then its moisture content was analysed from a portion of 5 g with an oven drying method. PLS regression with full cross-validation was performed on MSC and second derivative-treated spectra. All calculations were performed with "The Unscrambler" software.

Figure 1. The instrument used for NIR measurements.

Results and discussion

Sample presentation using polyethylene bags was suitable for NIR measurement of minced meat. For moisture determination, neither second derivative nor MSC could improve the PLS calibration results.

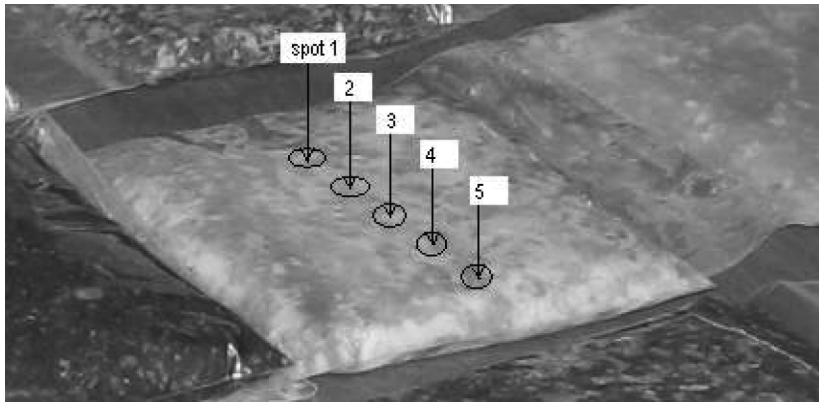

Figure 2. Positions where NIR spectra were taken (measurement spots).

Table 1. PLS calibration results for moisture content of minced meats using spectra recorded from different measuring spots.

Spectra used	Sample temperature									
	5°C					15°C				
	F	*R*	*SEC*	*SECV*	Bias	*F*	*R*	*SEC*	*SECV*	Bias
Average 1	5	0.95	2.18	2.38	0.01	4	0.95	2.06	2.22	0.02
Average 3	5	0.96	1.96	2.15	0.01	5	0.96	1.78	1.92	–0.00
Average 5	5	0.96	1.85	2.01	0.00	4	0.97	1.72	1.84	–0.01

Unit: % w/w; Wavelength region used: 900 – 1100 nm; Average 1: Spectra measured at spot 3 in the sample; Average 3: Average spectra of spectra measured at spot 2, 3 and 4 in each sample; Average 5: Average spectra of spectra measured at spot 1, 2, 3, 4 and 5 in each sample

However, the precision of the calibrations developed showed obvious improvement when average spectra acquired from various measuring spots were used (Table 1).

These results could be noted in both the 5°C and 15°C samples. The calibration results obtained from the 15°C samples improved by comparison with those obtained from the 5°C samples. The measurement of sample temperature fluctuation during spectral recording indicated that, even though the acquisition period was only 5 minutes, the temperature of samples scanned at the original temperature of 5°C would fluctuate to a greater extent [Standard deviation (*SD*) of sample temperature = 1.2°C] compared with that of samples maintained at 15°C, where the *SD* of sample temperature was only 0.3°C during the scanning time. Hence, the improved results obtained from the higher temperature samples was attributed to the reduced fluctuation in temperature during spectra acquisition. For calibration structure, a positive peak in a vicinity of 970 nm, which is a water band, could be observed in the regression coefficient plots of all calibrations.