2-P13

COLOUR-DIFFERENCES MEASUREMENT OF BEEF BY NEAR-INFRARED SPECTROSCOPY

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Background:

New Infrared(NIR) spectroscopy is a rapid, effective analytical tool that is used for the determination of moisture, protein, fat and energy content of raw pork and beef(Lanza, 1983; Mitsumoto et al., 1991). On the other hand, colorimeter and spectrophotometer are used mainly for color-difference measurement in raw pork and beef(Kang et al,. 1998). In this study, color-difference measurements by NIR spectroscopy and colorimeter were compared.

Objectives:

The objectives of this work were to investigate the meat colour of Hanwoo(Korean cattle) beef and imported beef, and to develope NIR measurement method by comparing with tristimulus method

Methods:

NIR system model 6500 and the software of WINISI(intrasoft international USA) were used and the absorbance was determined with 2 nm interval at 400-1450 nm range. The obtained spectrum was calculated by the primary differential prior to the regression analysis with modified PLS(Partial Least Squares). L^*, a^*, b^* values of meat colour were measured by Chroma meter(Japan).

Results and Discussion:

The spectrum of 56 beef samples for standard curves was showed in Fig. 1. As in the statistical summary of L^*value(Table 1), R^2(multiple correlation coefficient) and SEC(standard error of the calibration) were 0.795, 1.685 respectively. SEP(standard error of the prediction) of Hanwoo beef was 1.791, 2.808, 1.670 according to meat quality grades, and that of American and Canadian beef was 2.309 and 2.619. R^2 and SEC of a^* value were 0.797, 1.673 respectively. SEP of Hanwoo beef was also 1.680, 2.340, 1.725 according to meat quality grades, and that of American and Canadian beef was 3.255, and 1.566(Table 2). R^2 and SEC of b^* value were 0.621 and 0.700. In SEP of Hanwoo beef according to meat quality grades, 1st grade was 1.492, 2nd grade was 0.812, and 3rd grade was 1.012 respectively. Canadian and American beef were 1.760 and 1.445(Table 3). In general, R^2 was low and SEP was higher than SEC. However, residual scores were acceptable.

Conclusion:

It is considered that NIR spectroscopy can be useful not only for the measurements of general components such as moisture, fat, protein, energy content etc., but for meat colour measurements.

References:

1. Elanin Lanza. (1983). Determination of moisture, protein, fat, and calories in raw pork and beef by Near spectroscopy. J. Food Sci. 48, 471-474.

2. Mitsru Mitsumoto, Satoshi Maeda, Tadayoshi Mitsuhashi, and Shinobu Ozawa. (1991). Near-Infrared spectroscopy determination of physical and chemical characteristics in beef cuts. J. Food. Sci. 56, No. 6, 1493-1496.

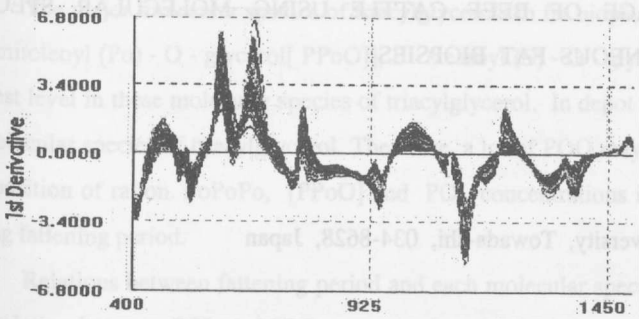

Fig 1. First derivative spectra of beef using reflectance mode by NIR at 400~1450nm.

Table 1. Statistical summary of L* value using reflectance mode by NIR at 400nm~600nm.

	$R^{2\,a}$	SEC[b]	SEP[c]
	0.795	1.685	
Korean cow beef 1st grade			1.791
Korean cow beef 1st grade			2.808
Korean cow beef 1st grade			1.670
Imported beef(Canada)			2.309
Imported beef(USA)			2.619
Total			2.292

Table 2. Statistical summary of a* value using reflectance mode by NIR at 400nm~1450nm.

	$R^{2\,a}$	SEC[b]	SEP[c]
	0.797	1.673	
Korean cow beef 1st grade			1.608
Korean cow beef 1st grade			2.340
Korean cow beef 1st grade			1.725
Imported beef(Canada)			3.255
Imported beef(USA)			1.566
Total			2.205

Table 3. Statistical summary of b* value using reflectance mode by NIR at 400nm~600nm.

	$R^{2\,a}$	SEC[b]	SEP[c]
	0.621	0.700	
Korean cow beef 1st grade			1.492
Korean cow beef 1st grade			0.812
Korean cow beef 1st grade			1.021
Imported beef(Canada)			1.760
Imported beef(USA)			1.445
Total			1.347

a : Multiple correlation coefficient.

b : Standard error of the calibration(n=56).

c : Standard error of the prediction(respectively n=10, Total n=50).

Fig 2. Total Prediction of L* value by NIR in beef samples.

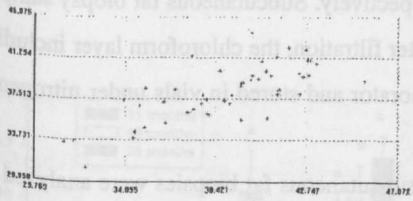

Fig 3. Total Prediction of a* value by NIR in beef samples.

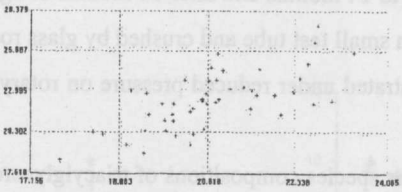

Fig 4. Total Prediction of b* value by NIR in beef samples.