UTILIZATION OF NEAR INFRARED REFLECTANCE SPECTROSCOPY FOR PREDICTION OF THE NUTRITIONAL COMPOSITION OF BEEF AND PORK SAMPLES

G. Garcia-Lagombra, L. H. Harbers, J. Velazco, J. L. Morrill, B. B. Maziya, and C. A. Z. Harbers

Summary

Near-infrared reflectance spectroscopy (NIRS) offers the potential for rapid, low-cost analyses of meat samples. Beef and pork samples were analyzed by both standard laboratory (AOAC) methods and NIRS. Regression equations were developed to relate the two methods. Coefficients of determination between NIRS and AOAC results were .929 for dry matter, .965 for crude protein, and .996 for ether extract. NIRS and AOAC procedures yielded very similar results (DM, 38.82 vs 38.58; CP, 17.78 vs. 17.83; and EE, 18.83 vs. 18.00). NIRS appears to be a rapid and reliable predictor of nutritional composition of ground beef and pork based on regression equations we have developed with a limited number of samples.

(Key Words: Near Infrared Reflectance Spectroscopy, Pork/Beef Equations)

Introduction

NIRS has been used extensively for determining of the nutritional composition of forages and grain. That technology has also been extended to food products, such as meats and milk. We decided to apply NIRS to ground beef and pork. Regression equations have been developed for pork, beef, and beef/pork together. Results from the combined equations are presented in this article.

Experimental Procedures

Eighty-four, commercial, lean and fat, pork samples were processed through a Hobart Grinder and scanned in duplicate with a Pacific Scientific 4250 NIRS instrument. Twenty calibration samples chosen by a subset program plus a set of validation samples chosen at random were analyzed by AOAC methods for dry matter (DM), crude protein (CP), and ether extract (EE).

Beef samples were collected from an experiment involving Holstein steers of different ages and sizes. Beef samples were processed similarly to the pork samples. Twenty eight samples were scanned in duplicate and a subset of 17 was selected as calibration samples. Validation samples were chosen at random.

The spectra of all the samples were then matched to the AOAC laboratory data for the calibration and validation samples. Seven calibrations were necessary to obtain the final predictive regression equations for DM, CP, and EE. Selection of final equations was based on a combination of factors such as the highest R^2 (coefficient of determination) and the lowest standard error of calibration. All samples with AOAC laboratory data were compared to data from NIRS equations to predict how well the systems matched in determining the nutritive value of beef and pork.

Results and Discussions

The beef/pork regression equations contained two terms for DM, three for CP, and four for EE. The DM information was found around wavelengths 2040 and 1995; CP around 1944, 2053, and 2201; and EE around 2057, 2295, 2044, and 2067. The equations are now available for use in our instrument. The coefficients of determination (R^2) for calibration samples (Table 1) indicate that NIRS has excellent potential for predicting the nutritional value of beef/pork (DM = .928, CP = .964,

EE = .996). Validation samples are independent samples not used in developing the equations. The R^2 values for those samples for the same nutrients were .920, .957 and .993, respectively, confirming excellent prediction capabilities.

The statistical results in Table 2, in which NIRS results (calculated from the beef/pork regression equations we derived) and the AOAC laboratory values were compared, showed a very good agreement. The success of our equations is also confirmed by the means of NIRS and wet chemistry results. All means were very similar.

Table 1. Means, Standard Errors, and Correlations of the Best Beef/Pork Equations.

			Calibration		Validation	
Variable	No. Samples	Means	SE	R^2	SE	R^2
DM	30	38.753	3.531	.928	3.410	.920
CP	35	17.625	.780	.964	.648	.957
EE	30	18.976	1.103	.996	.977	.993

SE = Standard Error.
R^2 = Coefficient of Determination.

Table 2. Comparison of the NIRS Beef/Pork Predicted Values vs. the Laboratory Values

Variable		Mean	SD[a]	N[b]	SE[c]	R^2
Lab values	DM	38.58	12.821	35	3.376	.929
NIRS analyses	DM	38.82	12.360			
Lab values	CP	17.83	3.889	44	.719	.965
NIRS analyses	CP	17.78	3.780			
Lab values	EE	18.00	16.180	35	.991	.996
NIRS analyses	EE	18.03	16.105			

[a]SD = Standard Deviation.
[b]N = Number of Samples.
[c]SE = Standard Error of Prediction.