

Project Title:	On-Line Classification of U.S. Select Beef Carcasses for <i>Longissimus</i> Tenderness Using Near-Infrared Reflectance Spectroscopy
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Background

Cuts of beef from carcasses graded as U.S. Select are currently marketed at a discount relative to U.S. Choice cuts despite the fact that many cuts from U.S. Select carcasses are actually very tender. Past research has shown that consumers have shown a willingness to pay a premium for cuts that combine the leanness of the Select grade with superior tenderness.

The development of an accurate and non-invasive method for predicting tenderness in U.S. Select carcasses has a great deal of potential for commercial applications. Near infrared reflectance (NIR) spectroscopy has been shown to be useful in predicting beef tenderness, however past studies have not developed procedures that were commercially viable.

This project was conducted by U.S. Meat Animal Research Center researchers to validate a previously developed model for on-line classification of U.S. Select beef carcasses for *longissimus* tenderness using visible and near-infrared (VISNIR) reflectance spectroscopy.

Methodology

Spectroscopy was conducted on-line at a large-scale commercial fed-beef processing facility. Samples were collected one day per week for three consecutive weeks for a total of 467. At 24 hours after harvest, carcasses were ribbed conventionally between the 12th and 13th rib. Quality and yield grade evaluations were made, and a spectroscopy reading was conducted on the *longissimus* cross section.

Following spectroscopy and grading, carcasses were fabricated and a strip loin (IMPS/NAMP 180) was obtained from the left side of each carcass. A one-inch steak was removed from the anterior end of each strip loin, cooked using a belt grill and slice shear force was measured. The remainder of each strip loin was vacuum-packaged and aged for 14 days. A one-inch steak was removed from the aged strip loins, cooked using a belt grill and measured for slice shear force values. Predicted slice shear force (14 days postmortem) was calculated using the regression model that was developed in previous research.

Based on the favorable results during the initial experiment described above, follow-up research was conducted to facilitate implementation of this technology. The researchers worked with the equipment manufacturer to develop a system tailored for on-line application. The new system was tested on an additional 1,155 carcasses.

Researchers collected spectra, or readings, at two points in the grading process—soon after ribbing and at the grading stand. The purpose was to develop a model that could make unbiased predictions of tenderness regardless of bloom time, which would give beef



processing facilities the flexibility to implement the technology anywhere in the grading process (from 0 to 60 minutes after ribbing) and still maintain the same level of accuracy.

Findings

During the initial study, all of the carcasses sampled that had *longissimus* slice shear force values greater than 35 kilograms at 14 days after harvest were accurately classified as tough by visible and near-infrared (VISNIR) reflectance spectroscopy. However, 15 percent of the carcasses had *longissimus* slice shear force values greater than 25 kilograms at 14 days after harvest, but only 6.8 percent of the carcasses classified as tender by VISNIR had predicted slice shear force values greater than 25 kilograms.

During the second phase of the project, at two days postmortem, 13.1 percent of the carcasses sampled, had *longissimus* slice shear force values greater than 40 kilograms. In contrast, only 5.1 percent of the carcasses classified as tender by the VISNIR system had *longissimus* slice shear force values greater than 40 kilograms at two days after harvest. All of the carcasses sampled that had *longissimus* slice shear force values greater than 45 kilograms were accurately classified as tough by VISNIR.

Implications

The results of this project confirmed that VISNIR spectroscopy can be used to non-invasively classify U.S. Select carcasses for *longissimus* tenderness. The ability to identify U.S. Select carcasses that excel in tenderness has great potential for targeted marketing programs that focus on producing a lean product that can also satisfy consumer desires for tenderness and palatability.

The follow-up research allowed researchers to develop a system that can be applied at any time during the grading process, i.e. anywhere from zero to 60 minutes after ribbing, and still maintain the same level of accuracy.