Shining a Light on Tenderness

Researchers consider methods to measure tender beef.

by ***Troy Smith***

Meat scientists have been trying to get a handle on tenderness for a long time. For years, they have tried to develop a method for evaluating beef carcasses to predict the meat's relative tenderness. They have sought a method by which the beef industry could, ultimately, offer consumers products with a no-risk tenderness guarantee.

"We've been studying the biology of meat tenderness for 25 years," says Mohammad Koohmaraie, director of the Roman L. Hruska U.S. Meat Animal Research Center (MARC) near Clay Center, Neb. "Since Day 1, we've been trying to find a way to predict tenderness with accuracy."

Koohmaraie and his colleagues have spent the better part of a dozen years developing, testing and retesting a specific technology promising accurate prediction of beef tenderness. This recently unveiled technology is called visible and near-infrared reflectance spectroscopy. It also overcomes issues that hindered adoption of an earlier MARC-developed method for determining tenderness.

Harboring doubt

Back in the mid-1990s, Koohmaraie and fellow researchers developed an automated, online system for measuring meat tenderness in beef processing plants. There was little doubt that it would work. The system employed a modification of the Warner-Bratzler shear force (WBSF) test — the same test meat scientists routinely use in the laboratory — to precisely measure meat tenderness according to the amount of pressure required to cut it.

This system measured tenderness with great accuracy, but it required a sample — an inch-thick piece of ribeye — from each beef carcass be taken and subjected to the shear force test. Koohmaraie offered evidence that the sacrifice of a steak from each carcass was justified and would more than pay for itself because consumers were more than willing to pay premiums for "guaranteed tender" beef. Too many industry leaders harbored doubt.

"Many considered the method too invasive," Koohmaraie admits, "They didn't want to give up that one steak."

Back to the drawing board

MARC meat scientists went back to the drawing board to search for a noninvasive, less expensive, yet accurate method of predicting tenderness. Others were looking, too. At Colorado State University (CSU), researchers applied visual image analysis technology to the development of BeefCam.™ Essentially, BeefCam is a digital video camera that takes a picture of the ribeye and feeds it into a computer. The image contains thousands of data points allowing measurement of different colors associated with lean muscle, connective tissue and fat.

The technology is complex. Put simply, BeefCam quantifies color parameters believed to be correlated with palatability — including tenderness. Colorimeter technology researched at CSU and South Dakota State University is based on the same concept of measuring subtle differences in tissue color to gauge palatability and rank beef carcasses for tenderness. However, testing of both systems has yielded mixed results.

A National Cattlemen's Beef Association-(NCBA)-supported study of the performance of MARC's slice shear force test, BeefCam and colorimeter systems casts doubt on the validity of color as a tenderness predictor. But, Koohmaraie and fellow meat scientists Steven Shackelford and Tommy Wheeler believe visual and near-infrared reflectance spectroscopy can be used to sort carcasses for tenderness with industry-satisfying accuracy. And, as the industry has demanded, this method is noninvasive.

Validating the system

The system works by bouncing a beam of light off of a beef carcass. More specifically, numerous wavelengths of light are directed at the surface of the ribeye. By analyzing the reflection, the instrument detects chemical differences in the meat — differences that relate to tenderness.

Koohmaraie says the system has been validated in commercial beef processing plants, through cooperation with NCBA, Cargill Meat Solutions, Tyson Foods Inc., Harris Ranch Beef, Nolan Ryan Beef, and Swift & Co. Applied at the grading station, where U.S. Department of Agriculture (USDA) meat graders determine carcass quality and yield grades, the tenderness measurement takes about three seconds. This technology provides the ability to identify USDA Select and Choice carcasses that will be more consistently tender after 14

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PHOTO BY KEITH WELLER, COURTESY USDA-ARS

► Physiologist Mohammad Koohmaraie uses an electronic testing machine to measure tenderness of a sample sheared from a cooked steak.

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days of aging for use in branded beef programs. On average, the system is 85%-90% accurate at identifying carcasses with tender beef after aging.

The system was designed to augment current USDA quality grading procedures. Koohmaraie says marbling, the key factor in determining quality grade, is an important palatability predictor. USDA Select beef is marketed at a discount, relative to Choice, even though many Select cuts are very tender and likely to fit certain branded beef programs.

"About 75% of all U.S. fed cattle grade Select or low-Choice, and we have focused the development of this technology for that segment," Koohmaraie says. "It should allow us to certify that carcasses are tender, as well as lean, and worthy of a premium."

Discussions with a potential manufacturer suggest commercial systems will cost $50,000 to $60,000. Koohmaraie says a number of packers have expressed interest, but he doesn't know how quickly any of them might move toward adoption of visible and near-infrared reflectance spectroscopy.

He notes that MARC has no patent on the technology and will not benefit financially from its commercialization.