

Project Title:	Improving the Accuracy of Tenderness Categorization
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Completion Date:	2005

Background

A variety of technologies have been examined as potential methods to improve the accuracy of tenderness predictions for beef carcasses. Tenderness is one of the characteristics that consumers deem most important to overall satisfaction, and consumer research has shown that people are willing to pay a premium for guaranteed tender beef.

The objective of this study was to examine ways to improve the accuracy of tenderness categorization of beef carcasses by augmenting measurements of light reflectance (from the surface of the ribeye muscle) in the visible region of the electromagnetic spectrum (BeefCam). Researchers combined this technology with measurements of near-infrared spectral (NIRS) reflectance using the Oklahoma State University spectral reflectance tenderness prediction instrument.

Methodology

USDA Choice and USDA Select carcasses were identified in two commercial beef processing facilities that use a validated Computer Vision System (CVS) BeefCam™ on-line tenderness prediction device. From these 316 carcasses, 12 USDA Choice carcasses were identified as “tough,” 101 USDA Choice carcasses were identified as being “tender,” 101 USDA Select carcasses were identified as “tough,” and 102 USDA Select carcasses were identified as “tender” according to on-line CVS BeefCam™ evaluations.

Portions of the strip loins were removed prior to carcass fabrication and were sent to Colorado State University, aged for three days postmortem, frozen and held for subsequent Warner Bratzler shear force (WBSF) analysis. The remaining portion of each strip loin was collected following fabrication in the commercial beef processing facility and was shipped to Oklahoma State University. The subprimals were sectioned into two equal portions, aged for nine or 14 days postmortem and frozen for subsequent WBSF evaluations. A steak was also collected from each of the strip loin sections aged 14 days and was evaluated by a trained sensory panel for juiciness, beef fat flavor, overall tenderness and connective tissue amount, as well as flavor intensity and off flavor.

Findings

Warner Bratzler shear force and trained sensory panel results are reported by USDA Quality Grade in Table 1. From these data, it is apparent that the carcasses that were selected for this study did not typify normal trends. The USDA Select grade strip loin steaks had numerically lower WBSF values at all aging periods. Additionally, 8.2 percent and 11.9 percent of USDA Select and USDA Choice strip loin steaks aged for 14 days were tough.

Since this study included inherently tender populations of cattle and carcasses, it was difficult for the researchers to sort carcasses based upon palatability characteristics accurately, as there was not adequate variability in the test population. The researchers

attributed some of these results to the difficulty in identifying “tough” USDA Choice carcasses in one of the commercial packing facilities. Additionally, a lack of product due to market pressures and seasonality also played a role.

Table 1. Mean (standard deviation) for Warner Bratzler shear force from strip loin steaks aged for three, nine or 14 days postmortem and trained sensory panel evaluations of tenderness, juiciness, connective tissue amount and overall desirability from strip loin steaks aged 14 days postmortem and cooked to 70°C.

	USDA Choice		USDA Select	
	WBSF	%>4.5 kg	WBSF	%>4.5 kg
3 Days Postmortem	4.69 (1.22) ^a	53.7	4.44 (1.03) ^c	42.8
9 Days Postmortem	3.85 (1.25) ^b	35.8	3.51 (0.97) ^d	13.2
14 Days Postmortem	3.38 (0.99) ^b	11.9	3.17 (0.83) ^e	8.2
14 Day Taste Panel Tenderness	6.23 (1.40) ^b		6.45 (1.19) ^f	
14 Day Taste Panel Juiciness	5.86 (0.78) ^b		5.81 (0.74) ^f	
14 Day Taste Panel Connective Tissue	1.09 (0.29) ^b		1.06 (0.23) ^f	
14 Day Taste Panel Overall Desirability	5.37 (1.40) ^b		5.87 (1.19) ^f	

After online classification of carcasses into “tender” and “tough” categories, steaks from those carcasses were compared to WBSF values at three, nine and 14 days. BeefCam™ correctly identified 37.9 percent of the selected carcasses (Table 2) and 62.5 percent of the USDA Select carcasses (Table 3) using 14-day WBSF values.

Table 2. Frequency (percentage) of carcasses correctly identified as “tough” using CVS BeefCam™ system based on three-day, nine day or 14 day postmortem aging (WBSF values greater than or equal to 4.5 kilograms).

	% Correctly Identified as Tough
3 Days Postmortem	32.8% (55/144)
9 Days Postmortem	32.8% (21/64)
14 Days Postmortem	37.9% (11/29)

Table 3. Frequency (%) of USDA Choice and Select carcasses correctly identified as “tough” using CVS BeefCam™ system based on three-day, nine day or 14 day postmortem aging WBSF values greater than or equal to 4.5 kilograms.

	USDA Choice	USDA Select
3 Days Postmortem	12.0% (7/58)	55.8% (48/86)
9 Days Postmortem	13.2% (5/38)	61.5% (16/26)
14 Days Postmortem	7.7% (1/13)	62.5% (10/16)

Across both plants and USDA quality grades, neither the BeefCam™ nor the OSU NIR instrument was able to predict strip loin steak palatability with greater than 2 percent accuracy. Based on this research and previous investigations, it appears that on-line determination of palatability is possible, but prediction equations must be tailored for specific production facilities, handling practices and predominant cattle populations.

Implications

Results from this study indicate that current commercial settings utilized in BeefCam™ are not performing optimally. The beef carcasses identified in this study did not adequately reflect the palatability and variation expected in the United States cattle and carcass population. Despite the lack of accuracy of both BeefCam™ and the OSU NIR system within this data set, when the output from these instruments is combined, improvements in palatability prediction can be achieved. On-line carcass classification systems should be tested on a larger, more representative population, to determine if incorporating both the visible and near infrared color spaces would likely be more effective and accurate in classifying beef carcasses into palatability outcome groups.