Scientific Contributions

History of beef carcass assessment technology south of the 49th

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www.beefresearch.orgCMDocsBeefResearchThe%20History%20of%20Instrument%20Assessment%20of%20Beef.pdf

Grading was introduced in the United States as much for uniformity in reporting the markets as it was for quality assessment. However, as time progressed, carcass yield and quality became indicators of value-based marketing and their standardized assessment contributed to increased consistency and improved communication with all segments of the beef industry . The adv ent of technology provided further opportunity to measure beef carcass quality and yield grade characteristics objectively.

In 1990 the National Cattlemen developed seven requirements for request for proposals for instrument grading of beef.

1. Have ability to predict percentage or kilograms of lean, marbling (or percentage of chemical fat) and skeletal maturity with a high level of accuracy.
2. Have a high level of precision (repeatability) on individual, independent variables.
3. Be totally automated; the interpretation of the image or output should not require human subjective evaluations; thus it must be interfaced with a computer.
4. Be capable of evaluating all carcass traits and computing the dependent variables (percentage or kilograms of lean, marbling and skeletal maturity) at projected industry production rates.
5. Have ability to withstand extremes in temperature (0 to 40°C) and humidity (up to 100%) without losing accuracy and precision.
6. Be tamper-proof to prevent errors in assessment.
7. Have mechanisms for precise, quick and easy, recalibration.

Systems were assessed that could eventually enhance value-based marketing. Yield traits, and quality traits of tenderness and marbling.

YIELD

Video Image Analysis (VIA) for Yield Assessment

VIA provides the opportunity for output from data resulting from the processing of digital images to be used for carcass assessment. Research conducted in the United States

established that the use of VIA was objective, extremely consistent, effective, and more superior than subjective methods for assessing rib eye area. The ability of VIA to assess overall fatness of a beef carcass was limited. Researchers concluded that a combination of VIA 's accurate and precise measurement of the rib eye area, augmented by human (grader) assessment of overall fatness provided the most accurate prediction of carcass cutting yields and as a result, carcass value.

Real Time Ultrasound for Yield Assessment

With this technology, ultrasound images are ultimately digitized. Quantitative analysis is then performed on the image to provide valuable information. Despite the published research confirming the viability of using ultrasound technology to assess live animal yield characteristics to explain variation in beef carcass yield, trials of real-time ultrasound assessment of unchilled, hide-on carcasses at commercial production speeds were not as accurate in the assessment of rib eye area and yield as VIA technology. Therefore real-time ultrasound carcass assessment is not considered an option for determining post slaughter carcass yield characteristics in a value-based marketing system.

Bioelectrical Impedance Analysis (BIA) for Yield Assessment

BIA measures resistance and reactance of constant alternating current passed through tissue. Lean tissue has conductive properties, and fat has insulative properties. This technology has been demonstrated to be highly effective at predicting total muscle mass and saleable product weights of beef. However, further research is required in order to predict individual beef carcass yield.

TENDERNESS

Recognizing that 75% of all US beef carcasses today have sufficient marbling associated with eating quality, further sorting of beef carcasses into palatability groups can only be achieved by shifting focus to identifying beef tenderness through instrument assessment. The challenge then becomes to assess tenderness through a non invasive, tamper-proof, accurate, rapid and robust technology. Warner-Bratzler shear force (WBSF) is widely accepted as the standard for laboratory research and assessment of beef tenderness, but it is not fit for commercial production speeds.

Slice Shear Force (SSF) for Assessing Tenderness

This technology uses a simplified version of shear force determination. Despite accuracy of SSF it is mechanically invasive, and there is monetary loss associated with its use; commercial application is limited.

Tendertec Tenderness Probe for Assessing Tenderness

Designed to measure the amount of connective tissue, this probe is inserted into the rib eye muscle and the force necessary to penetrate the muscle is measured. This method is capable of predicting tenderness

differences in mature beef carcasses but limited in distinguishing differences in youthful carcasses.

Use of Objective Colour Measurement for Assessing Tenderness

Applying the concept that lean colour explains physiological and postmortem factors known to influence beef palatability, objective colour measurement scores for L*, a*, and b* values were found to be highly related to WBSF and could segregate carcasses into tenderness/ palatability groups.

Use of BeefCam Technology for Assessing Beef Tenderness

Building on objective colour measurement, research using a portable spectrophotometer for measuring beef carcass lean and fat colour using L*, a*, and b* colour scale found it to be related to cooked palatability, independent of marbling or carcass maturity. These research findings were incorporated into VIA technology, and carcasses sorted accordingly. Unfortunately the accuracy was limited, and further research is warranted.

Use of Near-Infrared Reflectance (NIR) for Assessing Beef Tenderness

Light reflectance is a non-invasive method used to predict beef tenderness. NIR has been shown to effectively segregate beef carcasses into tenderness categories, but not to quantify tenderness for individual carcasses. Further research is warranted.

MARBLING

Marbling and its association with expected eating quality has been used as a primary value-determining characteristic in beef carcass assessment. Development of a true objective measuring device able to distinguish the enormous variation in the volume and distribution of marbling has been challenging.

Video Image Analysis (VIA) for Marbling Assessment

Multiple variables from a digitized image of a rib eye measure marbling including amount, size and distribution, are used in an equation to calculate marbling level. VIA technologies have met the accuracy and precision requirements for marbling score assignment. Marbling assessment with the use of VIA technology has the potential to increase the consistency of grade placement within and across packing facilities. Objective marbling assessment will bring the beef industry closer to a true value-based marketing system.

Current Status of Instrument Assessment of Beef

It is a foregone conclusion that the use of technology to improve grading accuracy, precision and consistency will benefit all segments of the beef production and consumption supply chain. Any technology to be used

must be accurate, fast, durable and reasonably priced.

The USDA has established a three phase approval process for instruments for official determinations within the USDA grade and yield. Phase I: proven ability to assess given traits with accuracy and precision in a stationary setting, Phase II: proven ability to assess given traits with accuracy and precision at commercial production speeds, Phase III: certification of operational procedures for the utilization of technology . In addition USDA-AMS LS has published standards for instruments measuring rib-eye area, yield grade, fat thickness and marbling score.

It is understood that in March 2009 two VIA technologies, CVS (Computer Vision System; RMS Research Management Systems, USA, Inc., Fort Collins, CO) and VBG2000 (E + V Technology, Oranienburg, Germany) have been approved through Phase II for REA, USDA YG and fat thickness, and USDA marbling score. What remains is Phase III approval.

COMMENT

Canada must look south of the 49 th for progress in assessment of beef technology for a number of reasons. Primarily, we are in the shadow of a country that has ten times the volume of production that we do, and which has established a benchmark for beef carcass quality that is recognized worldwide. Canada strives to attain equivalency at the same time as protecting some of the unique high quality aspects of our grading system that have no parallel in the United States.
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