Ultrasound Prediction Model for % Intramuscular Fat in Beef Cattle

A.S. Leaflet R1756

Doyle E. Wilson, professor
Gene H. Rouse, professor
Abebe Hassen, associate scientist

Summary

Real-time ultrasound technology offers producers an opportunity to measure compositional traits in beef cattle. A recent research project focused on the development of a prediction model for the Classic Scanner 200. The accuracy of this model has been previously reported and can be found in the Journal of Animal Science 2000, Volume 78, pages 11-18.

Introduction

Real-time ultrasound technology offers producers an opportunity to measure compositional traits in beef cattle. The information can be used in genetic prediction evaluations, feedlot sorting and in within-herd culling programs. There currently exist several ultrasound equipment brands that have the capability to be used for composition scanning. However, not all of these systems have the necessary software algorithms to accurately predict % intramuscular fat (marbling). A recent research project focused on the development of a prediction model for the Classic Scanner 200. The purpose of this paper is to present the prediction model.

Method and Materials

More than 500 steers from several Iowa State University beef research projects were scanned with a Classic Scanner-200 real-time ultrasound console with a 3.5 mhz, 18cm transducer. This equipment is distributed by Classic Ultrasound Equipment, Tequesta, FL. Four to five images were collected on each steer across the 12^{th} and 13^{th} ribs. A Beef Improvement Federation certified technician did the scanning. The images were stored on a ZIP™ diskette and taken to the ultrasound imaging laboratory in the animal science department. Each steer was subsequently harvested, and after being graded, a ¼-inch thick facing was removed from the 12^{th} rib of each carcass. The Iowa State University Meat Laboratory processed the individual samples for % chemical fat. Processing included trimming the samples to remove all fat external to the longissimus dorsi muscle. Regression analysis procedures were used to develop a % intramuscular fat prediction model using the actual chemical fat as the independent variable and image processing parameters as the dependent variables. The image processing produced the Fourier transformation, gradient, histogram and co-occurrence matrix parameters. The processing region for each image was a 100 by 100 pixel area. The area was selected to be free from ultrasonic echoes due to external fat, the spinalis dorsi muscle, and ribs.

Results and Discussion

The prediction model developed in this project follows:

$$y = 2.513 + .444269*P_1 + .000585*P_2 .043428*P_3 + .405327*P_4 + .040859*P_5 - .218224*P_7 + .010477*P_8 - .013070*P_9$$

$$\% \text{ intramuscular fat, } \% = e^y.$$

where,

P_1 = Fourier, coefficient of variation
P_2 = Fourier, ratio of low to high average power at (1-50)/(50-100)percentile
P_3 = Fourier, ratio of low to high average power at (1-30)/(30-100)percentile
P_4 = Fourier, ratio of low to high average power at (1-10)/(10-20)percentile
P_5 = Gradient, mean
P_7 = Histogram, skewness
P_8 = Hostogram, 10^{th} percentile of cumulative histogram pixel frequency
P_9 = Co-occurrence, difference variance at angle 90°

This model only works with the Classic Scanner 200/18cm transducer system. It will not work with other ultrasound systems or even with the different transducers that can be used with the Classic Scanner 200. The accuracy of this model has been previously reported and can be found in the Journal of Animal Science 2000, Volume 78, pages 11-18.

Iowa State University has taken reasonable research measures to ensure the quality and accuracy of the information made available in this report. However, Iowa State University assumes no responsibility for the accuracy, timeliness, correctness, or completeness of the prediction model presented in this research report when used by other persons. Results from imaging processing of ultrasound images are heavily influenced by many conditions, including system calibration, temperature, animal preparation, electrical interference and radio frequency interference. Any conclusions that users draw from the information presented here or results obtained are their own and are not to be attributed to Iowa State University.

Implications

Real-time ultrasound offers the beef cattle industry an opportunity to retool the total beef population from a compositional standpoint in a very short period of time. Producers can select for optimum levels of intramuscular fat while maintaining external (waste) fat at acceptable levels for all young animals that are to be retained for breeding.

Acknowledgments

The authors wish to express their appreciation to the many support staff that have been involved in this research effort for the beef cattle industry. They include: Abebe Hassen, Viren Amin, Craig Hays, Richard R. Tait and Jodi Kruser.