

A Project to Develop Genetic Specification for the Beef Industry

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Summary

A new beef breeding project will be conducted at the Rhodes and McNay farms of ISU. The project will use the field data of the American Angus Association along with the research resources (cattle) of the farms to study questions that will enhance the genetic investigations using the field data. It will build on the expertise developed at ISU with ultrasound to measure body composition in the live animal and in the carcass. Two selection lines, using registered Angus obtained as heifers and through ET, of 200 females each will be selected for increased intramuscular fat (Q line) and for increased retail product (R line). The estimation of the genetic correlation between quality and amount of product can best be accomplished through the study of one generation of selection using measures of body composition derived from ultrasound. A progeny test herd will be maintained to evaluate all sires used through progeny carcass testing and to further research with ultrasound. The project will study efficiency of body maintenance. Results will be shared through the Beef Improvement Federation to benefit all producers in the development of sound programs to profitably produce specified beef products.

Introduction

This cooperative project between the Iowa Agriculture and Home Economics Experiment Station (IAHEES), the Utilization Center for Agricultural Products (UCAP), the Center for Nondestructive Evaluation (CNDE), and the American Angus Association (AAA) will research the genetics of body composition in beef cattle.

Breeds are competitive; the speed of technology use attests to this. Many performance innovations proposed by faculty and implemented by AAA were shared with other breeds through the Beef Improvement Federation (BIF) forum. Implemented changes were adopted in the BIF guidelines. Therefore, a cooperative project with AAA is an effective way to serve the beef industry.

The performance data of AAA will be researched to estimate genetic and environmental parameters. The cattle resource of IAHEES will be used to acquire information that will enhance the genetic investigations using the AAA field data.

Live animal and carcass measures of body composition using ultrasound were researched and developed at IAHEES and CNE. This expertise will be further developed and verified through the cooperative efforts of IAHEES, UCAP, CNDE, and the AAA.

This project is the beginning of a vision to organize and develop a beef information network in which all relevant information for the beef industry can be collected, managed, analyzed, and disseminated in a timely fashion to the stakeholders in the beef industry. The genetic specification of breeding stock is the first step to grow in service.

Faculty at ISU have a long history of research using beef field data. Data bases from state performance associations and breed associations have been available since the middle 1960s. Involvement with AAA and faculty of ISU spans from 1964 to the present, or 32 years. This working relationship will result in the incorporation of ultrasound measures into the carcass data of AAA.

Analysis of field records to produce expected progeny differences (EPD) by Iowa State University and the University of Georgia has been primarily service oriented. Access to the Angus field records provides two unique opportunities in support of this project. First, the pedigrees and performance data of animals within each of the selection lines will be maintained as a part of the Angus registry and performance data base, allowing the national population of Angus cattle to serve as a control line for the project-selected lines. Genetic trends within the Angus breed for carcass traits have been very static over the past several years; so, comparisons of genetic trends within the project lines to the breed trends should indicate the degree of genetic change. Second, the genetic parameters (heritabilities and genetic covariances) determined from the project selection lines can be used to develop new and better prediction models for use in the National Cattle Evaluations conducted by the Angus Association and by other breed associations. This will enable breeders to more accurately identify sires with the compositional trait levels that they need for their breeding programs.

Coming from two different research directions in the mid 1980s researchers G. Rouse and D. Wilson concluded that: 1) progeny testing for carcass merit in the beef cattle industry had little future and was too costly for the industry to undertake on a sufficiently large and effective scale and 2) value-based marketing and specification end products had to become the norm rather than the exception for the beef cattle industry to survive in the twenty-first century. Both researchers recognized the need for a technology that could be used to accurately measure body composition traits in live beef cattle and give quantitative measures that could accurately instrument grade carcasses. Real-time ultrasound was identified as the technology that could meet these needs.

Their research has resulted in the development of the Beef Improvement Federation (BIF) certification program. This program is hosted by Iowa State University and has served as a method to transfer this technology to commercial application. Currently 51 technicians across the USA, Canada, and Brazil are BIF certified for ability to measure fat cover and ribeye area. In May of 1996, for the first time, certification for measuring intramuscular fat

percentage was offered by BIF; twenty systems met the standard and certified.

Ultrasound measures on the live animal and the carcass for objective grading need to be verified for industry use. The beef industry, especially in the work done by the National Cattlemen's Association and now the National Cattlemen's Beef Association, has emphasized the interests of the consumer and the reduction of waste fat. Yet the Certified Angus Beef program, which emphasizes marbling, is extremely successful. Therefore, body composition information is imperative to the beef industry. Specification of product offered for sale has and continues to be a problem.

Objectives

The objectives of this project are as follows:

1. To estimate genetic and environmental parameters for economic characters, especially the efficiency of body maintenance, from the analyses of AAA data coupled with analyses of the Angus sample, the two-line selection experiment for high quality and increased retail product, and the search for Quantitative Trait Loci (QTL).
2. Validate the use of ultrasound on live cattle to make genetic change in the body composition traits of external fat cover, ribeye area, percentage intramuscular fat (marbling), percentage retail product, and total retail product.
3. Develop and evaluate new ultrasound methods to measure on live cattle and carcasses additional quality and retail product traits.

Procedures

The extensive data base of AAA will be acquired, managed, and analyzed to obtain current genetic and environmental parameters for economically important traits and these will be used to produce genetic predictions for the Angus breed. This will be ongoing throughout the project.

Concurrently, 200 head of the cows at Rhodes will be replaced by a sample of 200 head of registered, spring born 1996, Angus heifers (approximately 10 head from each of 20 herds). These will be mated over two years to 20 selected Angus sires (10 for high marbling and 10 for high retail product).

Concurrently, the remaining 200 head of cows at Rhodes and the 300 head of cows at McNay will be used for two years as recipient females for fertilized ova from registered Angus females. A 60% calving rate is anticipated. Nichols Farms, for example, will provide embryos and will purchase the male calves produced.

After the two years as recipient females, the 300 head of cows at McNay will be used to research, develop, and validate the ultrasound measures and other technologies under development. Sires selected for the selection experiment will be used AI on these cows the same year they are used NS or AI in the selection lines. All calves, except replacement heifers, will be slaughtered for detailed carcass evaluation. The 200 head of cows at Rhodes will be

replaced as the numbers in the selection lines increase to 200 head in each line.

Ultrasound measures of 12-13th rib fat thickness, ribeye area, rump fat, and intramuscular percentage of fat will be serially obtained on all offspring of the selection lines and from progeny of the test herd during the period of development after weaning. Routine carcass measures will be made on all slaughtered progeny (primarily steers) from the test herd. Additionally, carcass traits will be collected from the slaughtered yearling bulls produced from the two selection lines that are not destined for breeding purposes or to support the limited public offering. The use of carcass measures, along with complete relationships, will allow for multiple trait evaluation of carcass and ultrasound traits to obtain their covariance. The covariance will be used to validate the ultrasound measures as a means to make genetic change for body composition traits.

One-hundred head of the 200 purchased, registered, Angus heifers will go into each of two selection lines. The heifers produced by the embryos will be divided between the two lines for the two years. Each line will be composed of 200 females.

The selection criteria for the Q and the R lines are first that the female reproduction is perfect (all open heifers and cows are culled) and second that the estimated carcass weight of all perspective candidates falls within a carcass weight window of between 650 and 750 pounds steer equivalent. The criteria for each line are as follows:

- a. Q line: The five highest bulls (five out of 80 or 6.25%) and 40 heifers (40 out of 80 or 50%) for intramuscular fat (marbling) EPDs are selected. The EPDs will be based on all available data to include a multiple trait (ultrasound measures and carcass measures) mixed model analysis using the complete relationship matrix with all the Angus data base.
- b. R line: The five highest bulls and 40 heifers for pounds of retail product EPDs are selected. Similar EPDs will be used as for the Q line.

These two lines in the selection experiment will be continued for at least one generation of selection defined as the complete replacement of foundation females with selected females. The control population will be the field data of the AAA.

Concurrently, linkages and expertise will be developed to identify markers and candidate genes in the foundation animals and those of the selection lines such that QTLs can be identified and incorporated into the genetic predictions. Two researchers are identified to help initiate the protocol of saving DNA from all animals and help in developing linkages to identify markers and candidate genes in the project animals.

Technologies under development within the Department of Animal Science and elsewhere will be tested on samples of the carcasses that will result from this project. Technologies to be pursued include elastography to measure tenderness. Additionally, ultrasound and video imaging measures on various sites of the carcass and weights of

individual major primal cuts will be evaluated for purposes of accurately predicting percentage and total retail product.

As the project proceeds and new information becomes available, programs using ultrasound and other methodology to enhance body composition will be developed and implemented for beef industry use. Verification of ultrasound use to make genetic change is imperative and has been discussed elsewhere.

The project as proposed can be completed in 10 years. This includes sampling the breed and conducting the two-line selection experiment for one generation. In the first five years, new information will be generated to partially answer objectives 1, 2, and 3. Results from the first five years will be used in a revision or a continuation of the project to answer objectives.

Implications

Value-based marketing and branded products are a natural where all industry segments can be “housed” in a localized geographic area. Iowa’s unique natural grassland and cropland resources, abundant feed grain supplies, and its rich history in agriculture and livestock production make it obvious that Iowa should become the premier state in the production, processing, and marketing of healthful, high quality and world renowned beef products. Iowa’s competitive edge can be enhanced by developing branded beef programs for at least two target windows, high quality beef (purveyor merchandised product), and quality lean beef (for the progressive retailer). This project will develop such programs.