# SELECTION TOOLS FOR IMPROVING CARCASS QUALITY AND YIELD
## Ultrasound and Carcass EPD's

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### Introduction

The 1992 Beef Quality Audit is often referred to as a "wake-up call" for the beef industry. It along with the more recent 1995 Beef Quality Audit has served to help identify problems that exist in the beef industry. The results of these audits suggest that if the beef industry is to remain a viable sector of the food business, it cannot ignore the challenge presented by these results. As Dr. Ronnie Green, Colorado State University, summarized his thoughts on the audit results, he concluded that "the beef cattle industry needs to achieve change at the carcass level, by implementing a combination of changes in feeding and management practices coupled with genetic improvement. We need reliable user-friendly, and accurate tools to assess the carcass merit of our seedstock, i.e. the need for carcass EPDs can no longer be paid lip service, IT IS REAL."

Seedstock and commercial cattle producers continually evaluate and implement new tools that allow them to make genetic improvement in the cattle they produce. Genetic improvement is the result of continued genetic evaluation of seedstock animals and offers both seedstock and commercial producers the opportunities to move forward with their breeding programs. Significant improvements have been made in the past several years in many traits that are genetically controlled. Traditionally, traits of economic importance have been categorized into three general composite areas: reproduction, growth and carcass. The relative economic importance of the three was first addressed in 1979 by Dr. Bryan Melton, Iowa State University. At that time he indicated that theoretically reproductive efficiency was twice as important as growth performance which was about five times as important as carcass merit. More recently (1995) utilizing a more current value-based type of marketing system, Melton concluded that the former 10 (reproduction): 5 (growth): 1 (product) ratio is now closer to 2 (reproduction): 1 (growth): 1 (product). What does this new analysis mean to the beef industry? It continues to indicate that reproductive performance is still the MOST important trait(s) but that measurement of carcass performance is indeed justified.

### Expected Progeny Differences

In recent years one of the most useful and more accurate genetic tools that has been developed for use in the beef industry is Expected Progeny Differences (EPD). Almost all breed associations have developed EPD's for many traits. However, most of the traits for which EPD's have been developed fall into the category of growth, with fewer traits measured for reproduction and carcass. If one stops to ponder this, one might question why more emphasis has not been put on development of EPD's for reproduction and carcass merit. After all, at least in theory,

reproduction represents the most economically important category of traits and carcass merit or product is as important as growth. Additionally, carcass represents the ultimate end product of the beef industry, it is what the industry sells to the consumer.

It is important to understand the reasons that may be behind this lack of effort to develop reproductive and carcass EPD's. Two primary factors seem to surface whenever discussion of this issue surfaces. First, realized or at least perceived economic benefit drives most people to focus on a given set of traits. For most commercial producers growth traits such as weaning and yearling weights have been the ultimate focus and for good reason, they traditionally sell their product as weaned calves or yearlings, on a per pound or per hundred weight basis. Subsequently, seedstock producers have responded to that direction and rightfully so, by putting emphasis on those traits in their breeding programs. No economic incentive has existed for either the commercial or seedstock producer to focus heavily on other traits. Secondly, the development of EPD's is highly dependent upon the collection of progeny data from sires. This is both labor and money intensive. While EPD's can be developed with out progeny data, the accuracy level is low and not acceptable if producers are to make predictable, forward progress genetically. Collecting meaningful carcass data for progeny from a given sire is difficult and has not been extensively done to date. It has been estimated that progeny testing sires for carcass traits would cost from $4,000 - $5,000 per sire and the bull would be four to five years old before acceptable levels of accuracy in the EPD's would be achieved. This is one reason why genetic progress in the beef industry seems to be slower in achieving than other species.

The challenge for the industry then becomes more than development of carcass EPD's, but also to find a way, a tool or a technology in which meaningful and accurate information can be collected on sires that will preclude or supplement progeny testing information and can speed up the development of carcass trait EPD's.

**Ultrasound Technology**

While a relatively new technology to the beef industry, ultrasound technology has been in existence since the mid-1950's. It's initial development and application was first made in human medicine. Only in the last ten years has it's potential use in the beef industry been explored. Currently, ultrasound application in the beef industry reaches from reproductive management to veterinary medicine and also to live animal carcass evaluation. It is a technology that is non-invasive and utilizes high frequency sound waves to interact with body tissues for development of real-time images. These images, taken from a live animal allow for measurement and determination of various carcass traits (Figure l-fat thickness, loineye area and Figure 2-intramuscular fat) similar to those taken on actual carcasses in a cooler. As is the case with any new technology, determination of its accuracy and potential application is the first issue that must be resolved in a scientific manner before its widespread use can be adopted. For the past few years, this technology has been undergoing rigorous testing by several researchers and more recently, application in the beef industry has occurred. Questions and concerns about the accuracy and application have been raised on a continual basis, but continued research and development of the technology has addressed many of these concerns.

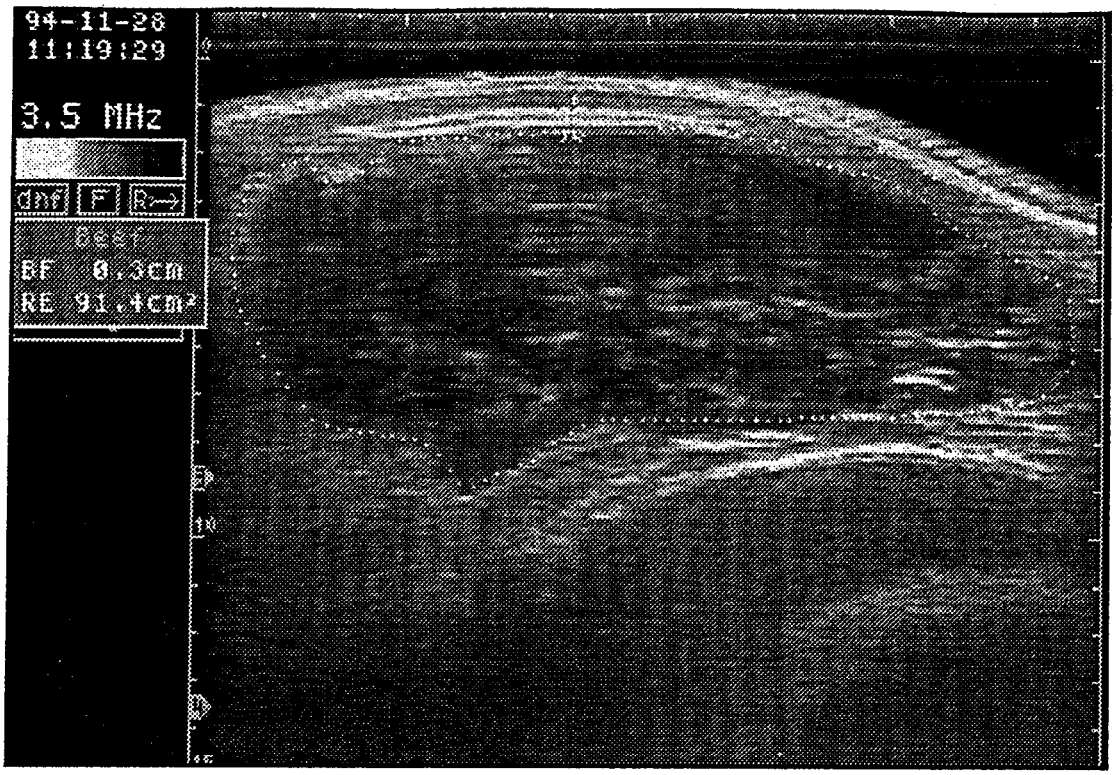


**Figure 1. Sample real-time ultrasound image taken crosssectionanlly between the 12th and 13th rib on a beef steer and depicting the loineye area and fat thickness (Classic Medical Supply, 1996).**

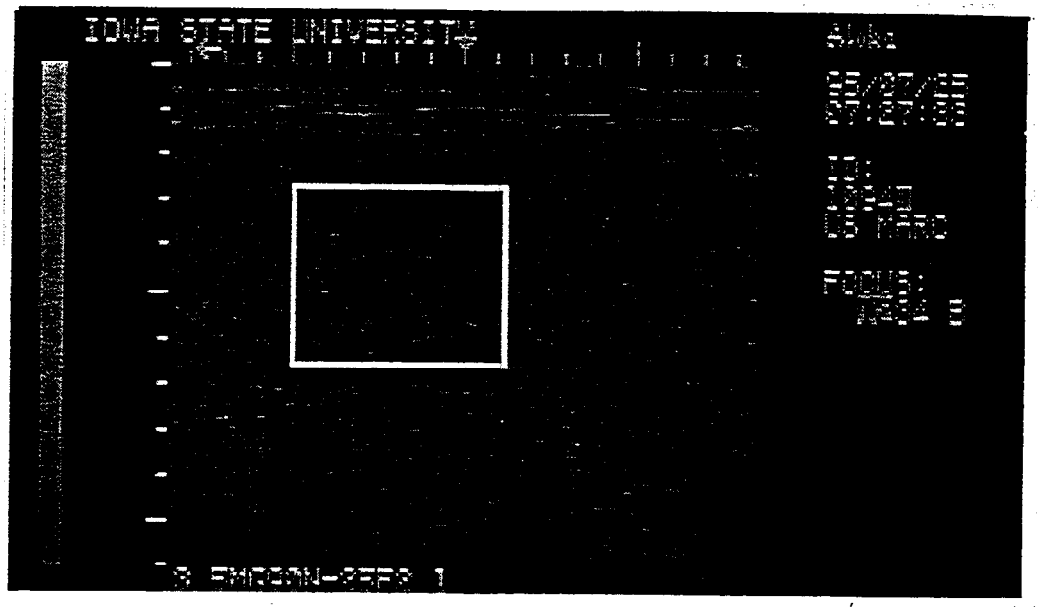


**Figure 2. Sample real-time ultrasound image taken longitudinally across the last three ribs of a beef steer. (Adapted from Rouse, Iowa State University, 1996.)**

One of the leading institutes in research and development of this technology has been Iowa State University. Gene Rouse , Doyle Wilson and numerous graduate students have invested significant amounts of time and effort into this technology. Iowa State University in conjunction with the Beef Improvement Federation currently serves as the provider for certification of ultrasound technicians obtaining carcass information from live animals for both the beef and pork industries. To date, carcass traits that are measured with ultrasound technology and that technicians are certified to collect include loineye area, fat thickness and intramuscular fat (marbling).

Recent work conducted by Iowa State University and the U.S. Meat Animal Research Center illustrate the accuracy of the technology to date. These data were collected from 282 steers involved with the Germplasm Evaluation Study at MARC. They were scanned on one of four dates with approximately 70 animals per scanning date. A cross-sectional image was taken between the 12th and 13th ribs (same location as taken on carcass). All ultrasound data was collected by a certified technician. They were measured 4-5 days prior to slaughter with cattle slaughtered at a commercial packing facility and carcass measures taken 24 hours postmortem. Table 1 illustrates the carcass measures taken by ultrasound and those taken from the actual carcasses.

**Table 1. Means and standard deviations, minimum and maximum values for live animal, carcass and ultrasound measures.**

| Trait | Meanfstd dev. | Minimum | Maximum |
|---|---|---|---|
| **Live wt., lb.** | **1206 f 140** | **780** | **1610** |
| **Carcass wt., lb.** | **735 f 89** | **472** | **991** |
| **Carcass fat thickness, in.** | **.38 f .16** | **.10** | **1.0** |
| **RTU fat thickness, in.** | **.39 f. .14** | **.09** | **.79** |
| **Carcass LEA, sq.in.** | **11.78 f 1.24** | **9.1** | **15.5** |
| **RTU LEA, sq.in.** | **11.94 f 1.16** | **9.18** | **15.84** |

**Adapted from Rouse, Iowa State University, 1995.**

Tests for accuracy of this data indicated that on the average both fat thickness and loineye area were over predicted when measured ultrasonically compared to measurements taken on the carcass. These tests also indicated that in some instances both traits were intrepeted to be larger and some smaller than actual carcass measurements. Ultrasound measurements of both fat thickness and loineye area had positive correlations with carcass measurements of the same traits (r=.9 1 for LEA and r=.93 for fat thickness). Current certification guidelines for technicians use standard errors of prediction of. 10 inches and 1.1 square inches for fat thickness and loineye area, respectively. In this study the standard errors of prediction for those two traits were well below the guidelines used in certification.

The third carcass trait that is more recently being measured is percent intramuscular fat or marbling. Again work at Iowa State University has led to the development of prediction models that are used to estimate the amount of marbling in a live animal from ultrasonic images. A slightly different image is required for determining the amount of marbling. An image is obtained by placing the transducer or probe longitudinally across the 1 lth, 12th and 13th ribs. Development of the prediction equations resulted from studies that compared ultrasound estimates of intramuscular fat to chemical fat extraction data from samples taken from carcasses. In the most recent data (1996) from these studies, the models provided for reasonably accurate estimates of intramuscular fat. For 47.1% of the steers percent intramuscular fat was predicted within 0.5% and for 77.6% of the steers, prediction was within 1.0%. Correlation between the ultrasound predicted and the actual percentage of intramuscular fat was 0.74. The prediction error for this data was 0.9%, again below those guidelines used in the technician certification program. Continued development and implementation of this component of ultrasound technology offers a possible objective replacement for the current subjective means by which quality grade is determined in the beef industry.

Additional work is being conducted to utilize ultrasound technology to predict carcass composition, i.e. retail product yield. Traditionally, loineye area has been the standard indicator of total muscle in a beef carcass, but evidence suggests that loineye area alone is not an accurate predictor of product yield. Additional measurements of such traits as body wall thickness, rump fat thickness, rump muscle depth, loineye depth or fat area may add to the predictive ability to determine more accurately product yield. Development of carcass retail product prediction equations that could be applied to the live animal would add yet another level of capability to genetic evaluation.

Ultrasound technology and ultrasonic measurements offer the beef industry and producers another tool for making genetic progress in carcass traits. Continued efforts to develop the technology and continued efforts to address concerns and problems should only lead to improved accuracy and application of this tool. Incorporation of ultrasonic measurements into breed improvement program databases also offers promise for enhancing carcass EPD's.

**Carcass Expected Progeny Differences (EPD)**

At this point in time, most seedstock and commercial producers have at least a basic understanding of expected progeny differences or EPD's. Adoption and utilization of EPD's in selection and breeding programs by many commercial producers however has been slow and frustrating for many. Most of the frustration in trying to utilize EPD's likely stems from expectations that are not realistic with what EPD's can do or are capable of doing. As with EPD's for other traits, carcass EPD's are not the whole answer within themselves but rather a genetic tool to be used in decision-making. They do nothing more than predict expected progeny differences between an individual and another animal in that particular analysis - that means within the same breed.

Typically, one of the first questions asked when discussions of carcass EPD's arise is what is the heritability of carcass traits anyway? Little attention has been given to carcass traits in the

past and relatively little information has been put forth in this area. Table 2 illustrates the estimated heritabilities for carcass traits. This information was compiled by Dr. Don Marshall, Animal and Range Sciences Department at SDSU in 1994.

**Table 2. Heritability Estimates of Carcass Traits in Beef Cattle**

| Trait | No. Studies | Avg. Hert. |
|---|---|---|
| **Retail Yield (%)** | 7 | .43 |
| **Retail weight (lb)** | 5 | .43 |
| **Carcass weight (lb)** | 11 | .37 |
| **Ribeye area (sq.in)** | 10 | .37 |
| **12th rib fat (in)** | 7 | .41 |
| **Marbling (or Quality Grade)** | 11 | .35 |
| **Warner-Bratzler Shear Force (kg)** | 6 | .27 |
| **Sensory Panel Tenderness (1 to 8)** | 3 | .13 |

**Adapted from Marshall, South Dakota State University, 1994.**

As can be seen from the table heritability estimates indicate that carcass traits are fairly heritable and in fact the estimates for measures of retail yield and palatability are all in excess of what is generally observed for growth traits. Additionally the collective research data for the past 25 years also indicates that genetic variation exists both between and within breeds for not only other traits but carcass traits as well. From this collection of research data it is evident that indeed, genetic progress can be made in the area of carcass traits and that such progress could be made as quickly as progress that has been made in the area of growth traits. Unfortunately, as stated earlier in this paper, little effort has been directed in the area of data collection, genetic evaluation and development of genetic tools to make change in carcass merit.

A question often raised in regards to carcass EPD's is how many traits or components of carcass merit do we need or should we collect? As is often the case, lots of pieces of information are given to producers without any suggestion for how those pieces fit together into the whole picture. The area of carcass traits or carcass merit is certainly no different and much of the information as it relates to the overall message could fall between the cracks and get lost. There are currently two thoughts as to how or what information should be presented. One thought is that the information be presented in a component format with the other thought being that carcass EPD's should take on a composite format. A discussion of both follows.

First let's look at the component format. Since the current USDA grading system is two-pronged for retail yield (yield grade) and palatability (quality grade) there are a number of components or factors used to estimate differences among carcasses. These include loineye area, fat thickness, carcass weight for retail yield and marbling for quality grade. Strong arguments can be made for including each of these components as part of a national cattle evaluation program: 1) specification marketing provides impetus for producers to know performance in each of the criteria to insure that "they tit the window", 2) some breeds need to improve certain components

(i.e. carcass size, inferior muscling, etc.) while in a composite format they may be acceptable. Another advantage of component trait formatting is that the additional information that exists regarding genetic parameters for the components and the fact that errors made with the components would only be magnified in the composite format. A somewhat different but highly related idea to reporting of carcass EPD's is to report them as falling into an "acceptable" range instead of in units of measure typically associated with a given trait. The thought is that this would give producers a "checkpoint" to look at for an animal that they may have identified as acceptable in other performance areas and can determine if they "tit" on the basis of acceptability. Obviously, determination of what is acceptable would be breed specific. Such reporting would be probability-based. The idea is to ensure that breeding animals selected for use in commercial cow herds "fit the projected window."

The other line of thinking is to report carcass traits in a composite manner. In other words, an EPD would be developed for each of the areas of retail yield and quality. An EPD for prediction of retail yield potential of a sire's slaughter progeny at a standard slaughter age might be based on percentage of retail cuts in the four primal regions of loin, rib, round and chuck at a standard slaughter age of 15 to 17 months. The second part of the system would be an EPD that predicts quality and or palatability. The ultimate goal of this line of thinking is to develop an EPD that couples the two factors of yield and quality together, since the genetic relationship between percentage retail product yield and marbling is negative and antagonistic. This might be accomplished by expressing the quality EPD in terms of the potential of an animal's slaughter progeny for quality grade, marbling score or tenderness level at a specified industry target yield grade. The argument is that such a system would allow for identification of animals that excel in both characteristics.

Obviously, discussions will continue in trying to determine which method of reporting carcass EPD's would be best in serving the producers and users of the information. To date few breed associations have developed and published carcass EPD's in their sire summaries. More associations are in the beginning stages of collecting the necessary data and developing carcass EPD's but have yet to publish those in their respective sire summaries. Some associations are accepting and using ultrasound data collected by BIF certified technicians for development of carcass trait EPD's. Two associations that have developed and published carcass EPD's are the Angus and Simmental associations. Currently the Angus Association reports four carcass EPD's, 1)carcass weight, 2) marbling, 3) ribeye or loineye area and 4) fat thickness. The Simmental Association reports three carcass trait EPD's, 1)carcass weight, 2) percent retail cuts and 3) marbling score.

A two year study conducted at the University of Nebraska evaluated the impact of utilizing Angus bulls differing in EPD's for marbling score. Six Angus bulls with high and six with low EPD's for marbling score were randomly bred to composite cows. Both steers and heifers were slaughtered at two fat thickness endpoints estimated to be .25 and .5 inches. Table 3 contains the results of the study.

**Table 3. Carcass traits of steers and heifers sired by low or high marbling EPD's sires at the two slaughter times over both years.**

| | Slaughter #1 | | Slaughter #2 | |
|---|---|---|---|---|
| **Sire Marbling EPD:** | **Low** | **High** | **Low** | **High** |
| **Steers** | | | | |
| **Number of Animals** | **31** | **31** | **32** | **35** |
| **Days on Feed** | **124** | **124** | **191** | **191** |
| **Fat, inches** | **.36** | **.37** | **.52** | **.54** |
| **Carcass wt., lb.** | **618** | **613** | **747** | **742** |
| **% Choice** | **13** | **59** | **83** | **94** |
| **Yield Grade** | **2.6** | **2.6** | **3.0** | **3.2** |
| **LEA, sq.in.** | **11.1** | **11.1** | **12.6** | **12.2** |
| **Heifers** | | | | |
| **Number of animals** | **33** | **29** | **32** | **30** |
| **Days on Feed** | **85** | **85** | **148** | **148** |
| **Fat, inches** | **.33** | **.29** | **.51** | **.49** |
| **Carcass wt., lb.** | **618** | **591** | **753** | **728** |
| **% Choice** | **21** | **45** | **72** | **97** |
| **Yield Grade** | **2.26** | **2.19** | **2.78** | **2.75** |
| **LEA, sq.in.** | **11.9** | **11.5** | **13.6** | **13.2** |

**Adapted from Viselmeyer et al., University of Nebraska, 1994.**

The conclusions from the study indicated that Angus sires can be selected to produce progeny that have increased ability to marble without increasing subcutaneous fat and that carcass EPD's should be considered as one more tool for producers to utilize when designing breeding programs.

**Summary**

It is apparent that carcass EPD's are receiving much more attention than in the past. Incorporation of ultrasound technology appears to be a viable tool to utilize at least in conjunction with traditional progeny testing in order to collect appropriate data for development of carcass EPD's. The big questions now seem to be how many carcass trait EPD's are needed and in what manner (component or composite) should they be reported. Those discussions will continue and resolution of that will occur. In what ever manner the EPD's are developed, it must be in the best interest of the industry as a whole and certainly be user friendly. The beef industry has the tools, it appears, to make great strides in the area of carcass merit. Proper use and continued development of those tools should aid producers in selection of animals that not only fit their operation but also in producing consumer acceptable beef