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CURRENT STATUS OF NATIONAL CATTLE EVALUATION PROGRAMS FOR CARCASS TRAITS

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At present, diet conscious consumers are exerting considerable pressure on the beef industry. Consumers continually indicate they are concerned about, and in fact, will not tolerate fat associated with red meat products (Breidenstein, 1988). This has resulted in many retailers trimming various cuts of beef to 1/8 inch of subcutaneous fat and in some cases a complete trimming of fat. It is probably conservative to estimate the industry produces an excess of 500 million pounds of fat each year from those carcasses with a yield grade above two. This excess fat represents the nutritional energy in more than a million yield grade 2 carcasses, each weighing 650 pounds. However, because the consumer is also concerned about palatability, the industry at present seems to have no alternative except to feed beef cattle for more than an optimum length of time in order to provide some assurance of "quality". In addition, the packing industry's reliance on dressing percent provides for an even greater emphasis on feeding cattle beyond the optimum length of time.

In addition to excess fat produced in the 12.1 billion pounds of graded beef, there is considerable inefficiency in the production of nongraded or no-roll beef. No-rolls may represent 35-36% of the steers and heifers slaughtered. Most no-rolls are either yield grade 4s or in the Select quality grade category. Conservative comparisons of average prices for Choice, yield grade 3s versus 4s, and Choice versus Select yield grade 3s indicates these no-roll carcasses would have had an added value of $578 million had they been in the Choice, yield grade 3 category. It is obvious that feeding and management alone cannot solve this inefficiency problem in the beef industry. The solution will require genetic manipulation of the raw product utilized by the packing and retail segments of the industry. At present, genetic manipulation available to the industry is either crossbreeding or selection; and both will be required for an efficient industry. However, permanent changes caused by selection should be considered as a method of controlling within breed variability, thus increasing uniformity of carcass product from crosses of breeds. Crossbreeding will aid the efficiency of production primarily through hybrid vigor for reproduction. Selection will have its effect on growth and carcass product. Commercial producers must have assurances that their selection of bulls within breeds provide germ plasm which will enhance the efficiency of breed crosses and not negate breed complementarity.

The accurate prediction of genetic values for carcass characteristics of economic importance to the beef industry would provide the necessary stimulus for a value based marketing system. Accurate carcass trait genetic values within a breed would allow commercial producers to develop breeding programs which would assure uniformity of specification products. The ability to accurately predict

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characteristics at the production level of the segmented beef industry would allow for a more orderly and fair marketing system for beef. If the commercial producer knows the specifications are being met by the germ plasm he is buying, this will enhance retained ownership and increase marketing on grade and yield. Identifying the genetic stocks which can produce uniformity of specified products would certainly enhance contract marketing.

If accurate genetic values are not developed for carcass attributes, it seems certain that the industry will continue to set prices based on averages and move toward even more inefficiency. Some breeds are already being cast as problems in the packing industry when in reality there are certain to be sires in all breeds which can produce progeny meeting specifications for various beef products. Consistent quality of brand name products will be impossible to achieve at a competitive price without identification of genetic stocks within breeds that can assure such quality.

In general, the possibility exists to develop genetic values in the form of expected progeny differences on yearling animals for both growth and carcass characteristics. This would allow commercial producers the opportunity to buy bulls which could assure the production of live cattle specifically for brand name beef products.

**Genetic Parameters**

There is considerable genetic variability within breeds for carcass characteristics. The heritability averages in Table 1 were adapted from Koch et al. (1982) and include two recent studies involving field data (Wilson, 1987 and Benyshek et al., 1988). Several breeds are represented in the average; however, the majority of the estimates are from British breeds. Little information is available for estimates of heritability for carcass traits from Continental, Brahman and Brahman derivative breeds. Johnston et al., 1991, working with Canadian Charolais field data, found ribeye area and marbling (Canadian system) to have heritabilities of .38 and .26, respectively.
TABLE 1. AVERAGE HERITABILITY ESTIMATES FOR CARCASS TRAITS*  

<table>
<thead>
<tr>
<th>Trait</th>
<th>Average h²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass wt.</td>
<td>.48</td>
</tr>
<tr>
<td>Retail Product Weight</td>
<td>.51</td>
</tr>
<tr>
<td>Percentage</td>
<td>.49</td>
</tr>
<tr>
<td>Fat trim wt.</td>
<td>.55</td>
</tr>
<tr>
<td>Fat trim%</td>
<td>.57</td>
</tr>
<tr>
<td>Bone wt.</td>
<td>.50</td>
</tr>
<tr>
<td>Bone%</td>
<td>.53</td>
</tr>
<tr>
<td>Kidney fat wt.</td>
<td>.75</td>
</tr>
<tr>
<td>Kidney fat%</td>
<td>.83</td>
</tr>
<tr>
<td>Fat thickness</td>
<td>.43</td>
</tr>
<tr>
<td>Ribeye area</td>
<td>.40</td>
</tr>
<tr>
<td>Marbling Score</td>
<td>.41</td>
</tr>
<tr>
<td>Warner-Bratzler Shear</td>
<td>.31</td>
</tr>
</tbody>
</table>

*Koch et al. (1982); Wilson (1987) and Benyshek et al. (1988).

Carcass Characteristics

The three traits: fat thickness, ribeye area and marbling score will probably receive the most attention in selection programs. All three traits are moderate in heritability and could be changed significantly with intense selection over a short period of time. However, there are several problems that must be addressed before a National Cattle Evaluation program can be implemented. The first and most impending problem is identifying a mechanism for collecting carcass data. The National Cattlemen’s Association, with the help of the Kansas Beef Board, is developing a national carcass data collection program which will be a first step in obtaining the necessary data for an NCE program focused on carcass traits.

A second problem is identifying what data to collect and at what endpoint. For example, the endpoint could be at a fat thickness, grade or weight. The same character, say ribeye area, may be interpreted differently at each of these endpoints. This problem will not easily be solved and the usefulness of large amounts of data at different endpoints is questionable.
In a NCE program for carcass traits the goal would be to change the genetics of the U.S. cattle population such that phenotypic cutability (amount of edible product) and palatability (eating quality) would be enhanced. This reveals the third major problem, i.e., measuring these general characteristics is impossible on a large scale. True cutability can only be obtained by breaking the carcass down to trimmed retail cuts and computing the cutability as the ratio of pounds of trimmed retail cuts to carcass weight. Palatability can only be assessed by using trained taste panels. Therefore, the system must use indicator traits to predict cutability and palatability.

Ribeye area, hot carcass weight, percent kidney, heart and pelvic fat thickness over the twelfth rib are used to predict cutability; and marbling score is used to predict palatability. The problem is that none of these individual traits does a very good job of predicting the overall characteristics of interest for efficient production. Generally, marbling accounts for only 30% of the variation in trained taste panel palatability scores. Marbling probably sorts out the really bad quality carcasses but unjustly penalizes some very good quality carcasses. The question becomes, can we live with a quality control system with this degree of accuracy? The answer is probably yes for buying on averages, but no if the industry is to have a value based marketing system selling one carcass at a time. Another problem with marbling is that the quality control factor is actually based on fat which consumers will probably eventually reject.

The yield grade prediction equation does not seem to fit today's cattle. The reason for this is that those equations were developed many years ago on British cattle. Today's cattle have different maturity patterns from those cattle used to obtain the original equations and there are many more breeds represented in the current cattle population. Of the four characteristics, fat thickness has the largest relationship, both genetically and phenotypically with cutability (genetic correlation = -.74 and phenotypic correlation = -.74). The best way to increase cutability in the beef cattle industry is to simply feed cattle for a shorter period of time. At present, this does not seem feasible in the feedlot and packing segments of the industry due to the reduced tonnage associated with reduced feeding time. This could change with increased numbers of cattle or further reduction in market share by the industry. The retail segment may send a signal that it no longer will absorb the cost of trimming worthless waste fat. The goal then from the feedlot and packing industry point of view is to develop cattle that will feed to current weights with reduced backfat, ensuring the same tonnage of palatable beef products.

The genetic correlations (Koch et al., 1982) between cutability and the three characteristics: ribeye area, percent KPH and carcass weight are .53, -.43, and -.11, respectively, and the phenotypic correlations are .27, -.43 and -.31, respectively. These correlations indicate that none of these characteristics would be the sound phenotypic predictors necessary for a marketing classification scheme, nor would they be good genetic indicators. Changing ribeye area alone will result in very little increase in cutability. In fact, increases in ribeye area may actually be somewhat detrimental to the industry in light of portion sizes being dictated by consumer diet-health considerations.
A final problem which will have to be addressed is how will other production traits change as the genetics for carcass characteristics are changed. For example, research based on breed differences seems to indicate that as cattle become leaner reproductive efficiency decreases. A slight decrease in reproductive efficiency would negate all of the profit envisioned with improved carcass characteristics. The general question of how the female counterparts of the desired lean steers perform as brood cows will need to be answered for an overall efficient industry.

Generally, for a NCE program to work for carcass traits, large numbers of individuals must be measured. This will be difficult if the data has to be gathered on carcasses at a packing plant. Live animal measurements which are good indicators of carcass traits will have to be developed if NCE is to be successful for carcass traits.

Ultrasound Technology

One major breakthrough in the last couple of years has been the development of portable ultrasound technology for live cattle imaging. This holds out the possibility that we may now be able to collect actual carcass data for ribeye area and backfat on breeding animals and progeny without the time and expense of slaughter tests. Ultrasound is not without its limitations (for instance, marbling cannot currently be measured with acceptable accuracy) but it does appear to be fast, accurate for some traits and certainly less expensive than slaughter tests.

Before this new technology can be incorporated into current genetic evaluation programs, studies must be implemented by breeds to obtain reliable estimates of heritability for various imaged carcass traits. In addition, as selection for net merit becomes more important, multiple trait selection will require a clear understanding of phenotypic, genetic and environmental relationships among a variety of production traits including growth, carcass and reproduction.

Arnold et al., 1990 at The University of Georgia analyzed a field dataset (n=2411) from the American Hereford Association consisting of ultrasound images of ribeye area and fat thickness on yearling bulls. This study found heritabilities for ribeye area and fat thickness measured via ultrasound to be .28 and .26, respectively. In the same study an analysis of actual carcass data from Hereford steers provided heritability estimates of .46 and .49 for ribeye area and fat thickness, respectively. These two analyses show that there is some difference in the variability associated with ultrasound images and actual carcass data. In this case the datasets were both Hereford (steers in one dataset and bulls in the other dataset) and sires did not overlap so they were essentially independent datasets. A very important difference between the two datasets was in the genetic correlations between the two traits. In the actual carcass data, the genetic correlation was found to be -0.37 indicating as one characteristic increased the other would decrease. In the ultrasound dataset on yearling bulls the genetic correlation between fat and ribeye area was 0.48 which was just the opposite of the steer data. It may be that these characteristics are not the same traits in steers and intact males. The positive correlation in
the bull data may be an artifact of the small amount of variability for backfat. If both these relationships are biologically sound then there are serious problems with using yearling live animal ultrasound measurements for fat thickness on bulls in a carcass improvement program. These early results indicate that it is necessary to image other muscles in the live animal if the accuracy of predicting breeding values for cutability is to be enhanced.

The question of imaging marbling in live animals is being addressed at several institutions. Brethour (1990) reported the correlation between carcass marbling scores and ultrasound speckle to be .5 in a study of 619 animals made up of steers, heifers and bulls. If a national program of carcass genetic improvement is to be successful, then the issue of palatability will have to be addressed. The scientific literature is lacking information concerning the muscle biology involved with the aspects of beef palatability. It will be difficult to develop selection programs which can have significant economic impact if there is not a better understanding of the basic biology of carcass quality.

It is possible to change the genetics of the U.S. beef population for carcass traits since there is significant genetic variability within and between breeds. The key to success will be determining how to manipulate that genetic variability in an economical manner.
LITERATURE CITED


