Live Animal Evaluation for the Determination of Carcass Traits

by R.A. Long
Texas Tech University

Finally, the beef industry is becoming almost universally concerned about the composition of its product. Breeders, feeders, packers, retailers and consumers are suddenly concerned for either profits and/or health. Unfortunately, we are being offered solutions to the problem of excess fat that are not based on fact and in some cases are in conflict with efficiency of production.

The evidence is overwhelming in support of genetic change of our cattle population as the only practical solution to uniform size, cutability, tenderness, juiciness and flavor. A great many people believe that they should "background" the cattle on pasture or high roughage diets for 120 to 180 days and then place them in the feedlot on high concentrate diets. They claim that this procedure gives lower cost of gains and leaner, higher cutability carcasses. However, research data support the practice of concentrate diets and taking them to the choice grade in the shortest possible time. This procedure results in a reduction in interest cost, shorter production time, less total body maintenance, more efficient feed conversion and lower total feed requirements. The genetic potential of the cattle dictates their carcass composition at any weight regardless of whether they reach that weight in a short or long period of time.

Ridenour (1982) fed a large number of similar steers on 5 different planes of nutrition and slaughter each steer as they reached 500 kg live weight. No significant differences were noted in fat thickness, skeletal maturity, lean maturity, conformation, USDA quality grade or USDA yield grade. Similarly, Szulc (1979) fed young bulls on two planes of nutrition. The two plane required 373, 577 and 800 days to reach live weights of 300, 450, and 600 kg respectively while the high nutritional plane reached those weights in 303, 468, 682 days. Carcass weight, dressing percentage, carcass composition, chemical composition and physio-chemical properties of meat were not affected by diet. These data strongly suggest that genetic potential is the overriding factor here but both studies are vulnerable since they are based on the assumption that the cattle were genetically the same. Winchester (1955, 1956, 1967) working with identical twins reported similar data, with even more drastic reduction in energy intake by the twin on a low nutritional plane. Robbins (1988) working with identical twins, resulting from the embryo splitting technique at Texas Tech University, removed the calves from their recipient mothers at 3 days old of age and treated them alike until they were 200 days old. At that time one member of each twin set was placed on a high concentrate diet and its mate fed to gain at a slower rate of gain. When the "high energy" twin was estimated to have a slaughter grade of low choice it was slaughtered and carcass data recorded. At that time his mate was switched to the high energy diet and slaughtered when it reached the weight at which its mate was killed. Performance, live measurements and carcass characteristics are shown in Tables 1, 2, 3 and 4. Since there were no statistically significant differences in these twins when slaughtered at the same weight as their mates, one can only conclude that the sire and dam, or in other words, the genetics of the calf determines his carcass characteristics at a certain weight.

Your conclusion must be - if you want to change the carcasses of cattle, you must change them genetically.

Now, in order to change the cattle genetically we must practice selection. In order to do this effectively we must accumulate and use a complete -- and accurate set of performance records. To accomplish this you must shorten your calving season, maintain uniform nutrition and management and thereby compare the cattle under the same conditions, at the same age, at the same time and at the same place and then use the records in selection. The procedure in performance selection not performance testing.

Such records can be combined in your breed associations' record systems to generate the genetic values (Expected Progeny Differences) on both males and females with and without progeny.

The extent of the mathematical model and the magnitude of the calculations necessary to accomplish these data are difficult for some of us to comprehend but they work. You must believe and use them.

Now, in order to change the genetic potential of our cattle for carcass composition we must be able to evaluate the cattle for composition as well as weight. Are the cattle composed of fat or muscle? Herein lies our problem - we have a great many breeders and/or judges that cannot accurately evaluate cattle for composition. A case in point is our obsession with frame size. During the past few years almost all breeds have made a great effort and successful one to increase the frame size of their cattle.

There are three major problems with this desire to increase the height of cattle:

1. Height at the withers or hips is not an accurate measure of skeletal size. Measurements across movable joints are not accurate since slope of shoulder, angle at the stifle and hock can effect such measurements greatly. See Figures I, II, III. These three skeletons are identical in size.
2. Skeletal size is not a measure of potential for reproductive efficiency, growth rate or carcass desirability. In fact, selection for increased length of the long bones, or length of leg if you will, is selection for late sexual maturity.
3. Skeletal size (frame size) is not a measure of carcass composition or yield of edible portion.

I want you to look at the data from three steers in Table 5. Their weight is very different but their skeletons are practically identical in size, which is, of course, their frame size. Now examine the dissection data in Table 6. Not only were their skeletons identical in linear measurements, but their skeletons weighed the same. However, here the similarity stops. Note the tremendous difference in muscle, in total weight and as a percentage of the carcass, of the #1 steer. This gives a muscle:bone ratio of just twice as much for the heavily muscled steer as is the case with the thinly muscled one. Fat varies only a little in this case but keep in mind that it would be easy to put together a large group of steers with identical skeletons that vary widely in fat and muscle composition. Table 7 lists the conventional carcass measurements. These tables make two major points.

1. The Yield Grade formula ranked these three steers essentially the same, which is obviously in error. This is because the formula was constructed with conventional British breeds which did not offer the range in muscling we have in the U.S. It under evaluations the heavily muscled #1 steer, over evaluates the thinly muscled #3 steer and does a good job on #2.
2. The frame size or skeletal size of these steers has nothing to do with desirability of their carcasses.

I would hope that your conclusion would be something like mine which simply stated is: Why anyone would use frame size in the evaluation of cattle for composition is beyond me. Yet, that is exactly what takes place in the majority of showings in the U.S. - they put the tall ones up. Think what this means. Most steers are shown by weight and most of them have been fed and managed in such a way that they are not excessively fat. Therefore, placing the tall, big framed steers up in class and the small framed ones down means that selection was against muscle or meat which makes no sense at all in the beef production business. The placing of the tall ones of the same weight on top of the class further complicates the situation. Large framed cattle mature later which in fact decreases the chances of the large framed steer making the choice grade.

What is the Value of frame size?

Skeletal growth or bone formation in growing animal takes priority for nutrients over fat deposition and even maximum muscle growth. Therefore, regardless of plane of nutrition, if we compare animals at the same age and sex, their frame size has probably increased according to genetic potential and is a good measure of what their mature frame size will be. When compared at the same age, the larger the frame the larger it will be at maturity and the longer it will take to reach that point. Also, we know that as an animal approaches maturity, he begins to deposit fat in the muscle, which is the marbling that puts him in the Choice grade. This is the very basis for the U.S.D.A. Feeder Grades which separate cattle into large, medium and small frame sizes. If cattle of the same age are sorted into uniform frame size groups, each frame size will reach the choice grade after a different length of time on feed. The larger the frame size, the longer the feeding period required to reach slaughter condition.

Of course, this same principle works on breeding cattle and if they are compared at the same age and are of the same sex, the larger framed animals will be larger at maturity and likewise requires longer to reach maturity. Therefore, if your only goal is size at maturity, go for frame size. Remember, frame size tells you nothing about the composition of the carcass, growth rate or reproduction efficiency.

<u>Muscling</u>

So much for frame size - now we must concern ourselves with what is on the frame. We often hear the remark, "I like a lot of length and elevation in my cattle because it gives me more space to hang muscle." This is parallel to doing business with a big bank in the hope that your cash deposits will increase accordingly. If you want to evaluate cattle for muscling, you must measure the muscle.

<u>That Long, Smooth Muscle</u>

We also hear a great deal about the "kind" of muscle on cattle and the favorite terms are "the right kind of muscle" of "that good, long, smooth muscle". Fortunately, there is only one "kind" of muscle. It is composed of muscle fibers bundled together by connective tissue and attached by connective tissue and tendons to other muscles and to the skeleton. The "<u>length</u>" of the muscles is determined by the size of the skeleton since each muscle is attached to the skeleton at the identical spot in all cattle. Therefore, cattle of equal frame size have the same length of muscle. "<u>Smooth Muscle</u>" is a term used to describe cattle that have a layer of subcutaneous fat or are thinly muscled, or both.

<u>Don't Fear Muscle</u>

Muscle is beef and beef is our business. It makes no sense to select against the growth and development of muscle. This fear of muscle has developed through the use of large breeds and strains of bulls on smaller breeds and strains of females together with the occurrence of the "Doubled Muscled" gene. Obviously, the gene for double muscling is a detrimental one and must be avoided. However, if you select for muscle in a population where this gene does not occur, you can increase muscling and there is no double muscling. If you select for muscle in a population that does carry the gene you can identify it and eliminate it.

<u>How to Measure Muscle</u>

To select for muscle, we must identify degree of muscling in live animals. Here, again, we are fortunate in that numerous research reports show a constant proportion between muscles among all breeds and types of cattle. This fact allows us to observe the degree of muscling in an exposed area of the animals body and it is a measure of total muscle mass. This can be done visually by simply keeping in mind a few basic facts of anatomy.

There are other methods of measuring muscling such as dilution techniques, ultrasound measurements and, of course, magnetic response. However, each of these methods has a serious shortcomings such as time required, cost, measurement at only one site and inaccuracy. Regardless of which method we select the data is illegitimate unless the cattle are compared at the same age, sex, and have been treated alike.

Conclusion

When it is all said and done, there are only four measures of production worthy of consideration in evaluation beef cattle. They are:

Reproductive Efficiency
Increase in Weight per Unit of Feed
Composition
Longevity

I submit that there are no criteria that measure the efficiency of production of palatable, wholesome, healthful beef that are not covered by the above. Therefore, our goal must be a combination of genetic material that gives us maximum productivity in each of these traits. There are two ways to accomplish this.

1. The development of a super breed strain which is the answer to everyone's prayer and takes over the world.
2. The development of identification so several breed strains each which excels in certain areas of productivity and with genetic potentials that allow their complimentary combination in such a way as to maximize the efficient production of a superior product under a specific environment.

Unfortunately, the development of a super, all excelling breed is very unlikely. For example, the ideal mother cow on the range must have the ability to store fat in the good times in order to survive the blizzard and the drought. This is in conflict with desirable carcass composition. Likewise, maximum performance in growth rate and composition is in conflict with reproductive efficiency etc...

This leaves us with crossbreeding. Not crossbreeding for the sake of crossbreeding, but the crossing of strains that are complimentary and compatible. In addition to complimentary we are interested in heterosis. We define heterosis as the improvement in performance of a trait above the average of the parent stock. This means that we can improve performance in some traits with heterosis but the major, determinant of level of productivity is the excellence of the animals that are crossed. If we cross junk with junk we get more junk that is slightly improved. Therefore, we as beef cattle breeders must decide why our breed or strain is to contribute and establish selection criteria toward that end. Some breeds must excel in maternal traits, some in growth and composition, some in heat tolerance etc...

What Now?

What greater accomplishment can man have than the molding of living flesh and blood into a functional form that his mind has conceived. We have only to look to the past for a dramatic illustration of the diverse forms possible. From the first wild ox (Bos primigenius) of Europe, whose fossils indicate a frame of 72 inches at the shoulder, through the entire array of Bos Taurus and Bos Indicus breeds available to us today, we have almost unlimited variation in color, form, and function.

Incidentally, that first wild ox that stood 6 feet at the shoulder might be likened to some cattle of present vintage in both frame size and disposition. So we have come full circle.

The question before us, however, is not where we have been but where we are going. We have the germplasm and the tools to breed superior producing cattle. Let's get on with it.

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