Managing Fat – The Future of the Beef Industry

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Introduction

Beef cattle are an important link in the food chain. These ruminants can turn roughage and by-products into highly digestible complete protein, energy, minerals, and vitamins.

Ruminants, especially beef cattle can be made a more efficient link in the food chain by managing fat. Fat is a late maturing tissue. As cattle grow, tissue develops in the following order:

1. Organs
2. Skeleton (bones)
3. Muscle
4. Fat

A normal growth curve for beef cattle is shown in Figure 1. This particular curve could represent a feedlot steer that would be expected to grade Choice at 1,250 lbs. Cattle grow rather slowly initially, then grow most rapidly during the phase when they are depositing muscle. The rate of gain normally declines during the fattening process. Fat deposition can be divided into four common depots:

1. Internal fat – surrounds the organs (WASTE FAT).
2. Seam fat – between the muscles (WASTE FAT).
3. Subcutaneous fat – on the surface of the animal under the hide (WASTE FAT).
4. Intramuscular fat – within the muscle, between the muscle fiber bundles, referred to as marbling (TASTE FAT).

In carcass beef, seam fat, subcutaneous fat, and internal fat are referred to as "waste fat," while intramuscular fat is considered "taste fat." The relationship between waste fat and taste fat and the inability to identify amounts of intramuscular fat in live cattle have led to inefficiencies in the beef cattle industry. During normal growth of cattle in the finishing phase, a late maturing phase, when most of the fat is deposited, 10 pounds of waste fat is deposited for each pound of taste fat. During this fattening phase, existing fat cells are filled to a maximum size. This concept applies for both subcutaneous and intramuscular fat depots. However, there is research evidence that new populations of cells may be recruited for fat deposition – particularly intramuscular fat. This results in excess fattening by the beef industry to buy taste fat at a 10:1 cost. If producers and buyers are concerned about quality grades, i.e., marbling level and percent Choice (particularly when Choice – Select spreads are large), they just feed the cattle longer to buy some insurance, since fat is a late maturity tissue and both fat depots are increasing during the finishing phase.

Materials and Methods

The question becomes: How does the cattle industry provide adequate levels of "taste fat" without the added expense of "waste fat"? Several concepts must be implemented:

- The genetic correlation, or relationship, between subcutaneous fat and intramuscular fat is low ($r_g \cong .2$).
- Large seedstock industry must be evaluated with real-time ultrasound for body composition traits, including subcutaneous fat and intramuscular fat.
- Ultrasound EPDs for body composition traits need to be developed for seedstock.
- Beef carcasses must be priced for individual merit, based on retail product and quality grade.

Data from the American Angus Association carcass database (more than 50,000 carcasses) suggests that genetic correlation between subcutaneous fat and intramuscular fat in finished cattle is low, $r_g \cong .05$.

Additional carcass data sets on other breeds suggests a similar relationship. The Angus Body Composition Genetic Evaluation Using Ultrasound Measures on Yearling Bulls and Replacement Heifers (85,951 head) relates a similar relationship. These ultrasound data substantiate the genetic relationship between subcutaneous and intramuscular fat. This data set, with much narrower age range endpoints and more clearly defined contemporary groups, make genetic correlation estimates more accurate.

Results and Discussion

What does this relationship suggest and how can it be used to best advantage in the beef cattle industry? Analysis of both carcass and ultrasound data indicates that the genetic relationship between intramuscular fat (marbling) and subcutaneous fat is very low, revealing that the genetic control of these two fat depots is relatively independent of each other and controlled by different sets of genes. Therefore, it is possible to select cattle that will change the rate of intramuscular fat deposition relative to subcutaneous fat deposition. Research results from the ISU beef cattle breeding project, shown in Figure 2, indicate that the rate of intramuscular fat deposition may vary markedly between progeny of different sires. Each line on this graph represents the pattern of intramuscular fat deposition for a sire; each sire has at least 10 progeny represented at each of five serial scans, to fit the line for each sire from weaning to yearling time. Note that the change in percent of intramuscular fat from weaning (220 days) to yearling (360 days) for sire A is compared to sire B. Sire A increased from 3.6% IM fat to 4.5% DM fat or 0.9% IM fat, while Sire B increased less than 0.1%. The slope of the line for Sire A and Sire B are markedly different. Sire A is nearly linear from weaning to yearling, while Sire B appears to mature earlier, and the graph flattens as the progeny approach a year of age. The data to develop Figure 2 were obtained by scanning bull progeny at approximately 30-day intervals, utilizing real-time ultrasound to determine levels of intramuscular fat. This research demonstrates that sires may dramatically differ in intramuscular fat deposition rate and pattern. These same sires, A and B, appear to deposit subcutaneous fat at a similar rate (Figure 3). These subcutaneous fat changes from weaning to a year of age also were determined by serial scans with real-time ultrasound.

Implementation. The implementation of the “managing fat concept” in the feedlot industry is summarized below:

- Identify feeder cattle of known genetic potential for body composition traits and feed them to fit a given value-based market. Group (purchase) cattle based on ability to deposit % IM fat when cattle have reached target % IM fat to harvest "manage fat."
- The concept of "managing fat in the feedlot" is shown in figures 4 and 5. Today, average cattle of unknown genetic potential for fat deposition are normally very lean (0.1 subcutaneous fat) when put on feed; they then deposit fat cover during the feeding period (Figure 4). Corresponding quality grades for a typical lot of feedlot cattle also are shown (Figure 4). Figure 5 shows feeder cattle that represent progeny of sires that have been selected for increased intramuscular fat while maintaining subcutaneous fat increases at the same rate. Consequently "fat can be managed" to produce cattle with a desired level of intramuscular fat and less subcutaneous fat, essentially resulting in a shift in the relationship between the two fat depots.

Figure 1.

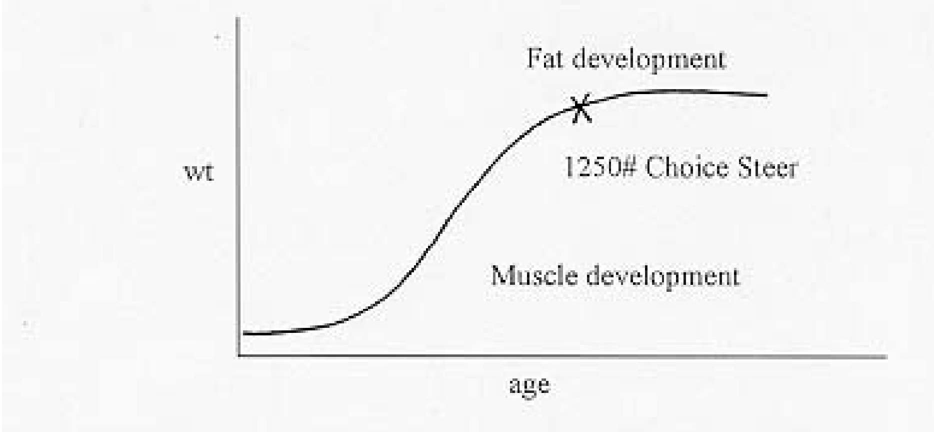

Figure 2.

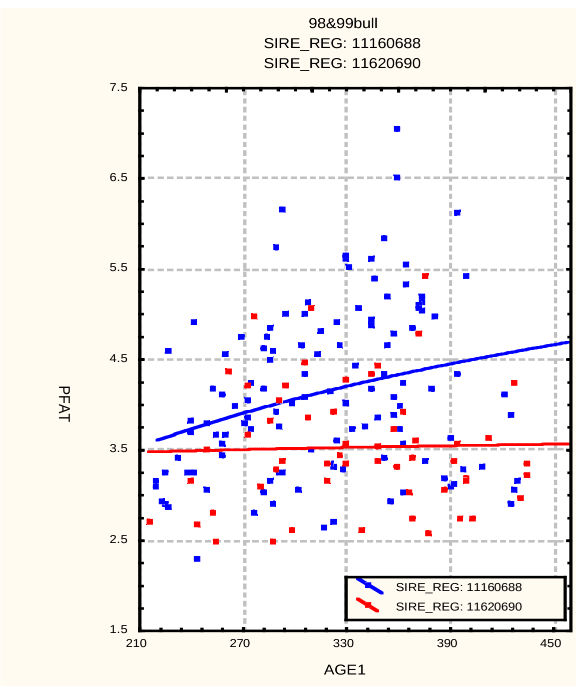

Figure 3.

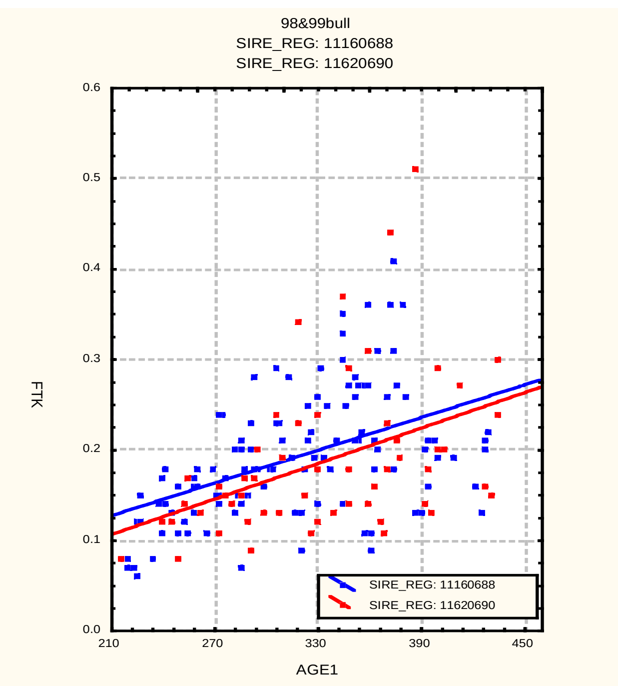

Figure 4.

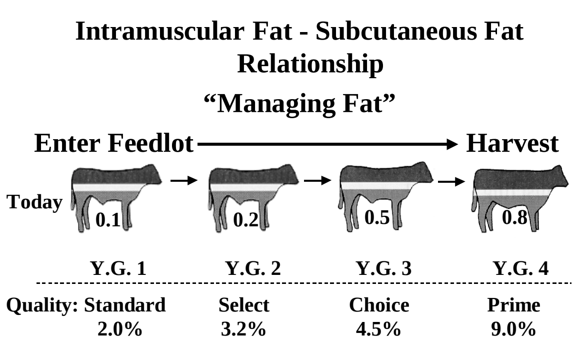

Figure 5.