

## BODY COMPOSITION AND CONSUMER ACCEPTABILITY

G.C. Smith

Texas A&M University  
College Station, Texas

To the commercial cattle feeding industry, body composition relates to "value" inasmuch as (a) the proportion of live weight that is as dressed carcass--the dressing percentage--determines carcass cost and (b) the proportion of carcass weight that is as muscle of acceptable quality--the yield grade and quality grade of the carcass--determines carcass value.

As is well known, dressing percentage is determined by the interactions of fill, finish, muscling and refinement as they relate to the relationship between carcass weight and live weight. Dressing percentage is an extremely important consideration in purchases of live cattle where transfer of ownership takes place prior to slaughter and will continue to be of vital concern so long as someone sells live cattle to someone who accepts ownership and then slaughters them and sells their carcasses. Dressing percentage will be higher in cattle which have (a) lower proportions of their live weight in contents of the gastro-intestinal tract, (b) higher amounts of fat in and on their carcass, (c) higher muscle to bone ratios and (d) lower proportions of their live weight as head, hide, lower legs, and other dress-off items. Of these, variations in fill can cause the widest differentials in dressing percentage. If and when fill is held constant, differences in finish, muscling and proportions of dress-off items can be used to make meaningful evaluations of animals according to their expected dressing percentages.

Dressing percentage is of vital concern to the packer because of its relationship to carcass cost. Assume, for instance, that Choice-3 carcasses can be sold by the packer for \$1.16 per pound. If the packer buyer purchases two 1000 pound Choice-3 steers, both for \$.70 per pound on a live-weight basis, and one dresses 61% (steer A) while the other dresses 63% (steer B), the break-even price or carcass cost for steer A will be \$1.15 per pound and for steer B it will be \$1.11 per pound (Table 1). Obviously, such differences in carcass cost determine success vs. failure and profit vs. loss of purchases of live cattle. While it can be argued that use of dressing percentage is an antiquated concept that encourages overfattening of cattle its importance to and use by industry is very real.

Yield grade and quality grade of a slaughter steer determine its value (at a given weight) because grades determine carcass value.

Table 1. Effect of differences in dressing percentage in determining carcass cost (per pound) of steers purchased at the same price (per pound) alive.

| Dressing percentage | Carcass cost (per pound) <sup>a</sup> |
|---------------------|---------------------------------------|
| 58                  | \$1.207                               |
| 59                  | \$1.186                               |
| 60                  | \$1.167                               |
| 61                  | \$1.148                               |
| 62                  | \$1.129                               |
| 63                  | \$1.111                               |
| 64                  | \$1.094                               |

<sup>a</sup>Using a live price per pound of \$.70

Table 2. Fat percentages for carcasses of different USDA yield grades

| USDA yield grade | Trimmed to one-half inch | Trimmed of all fat |
|------------------|--------------------------|--------------------|
| 1                | 9.1                      | 20.8               |
| 2                | 14.0                     | 29.6               |
| 3                | 17.7                     | 34.9               |
| 4                | 21.0                     | 39.1               |
| 5                | 25.0                     | 43.7               |

Source: Murphey et al. (1982); Texas Agr. Exp. Sta.

Historically, it has been the Choice steer that was the desired end-point of commercial cattle feeding; more recently, the yield grade specification has been added to the desired quality grade such that a Choice-3 steer is the commodity sought. Feeding of a steer to achieve a certain yield grade at the expense of not achieving a certain quality grade is, at present, more realistic than would be the opposite scenario. That is the case because the industry has very recently realized that fat, in excess of that quantity necessary to achieve the desired attributes of quality, prevention of shrinkage and palatability, is a great deterrent to sale of beef at retail. Beef carcasses of yield grade 3 contain more than one-third fat (Table 2); fat is expensive to produce and is becoming more and more difficult to sell. As a result, lean beef is in great demand and Good-grade steers of yield grades 1 and 2 are selling, in many markets, for prices at or near those of Choice quality and yield grade 3.

Once a decision is made to reduce the fatness of animals of any species producing red-meat, it is incumbent upon that industry to draw a bottom line identifying the minimum level of fatness at which the quality of their product will not be compromised. Science has demonstrated that the minimum fatness necessary to achieve satisfactory palatability in beef is best quantified by requiring either a "Small" amount of marbling or, in lieu of that, by requiring a combination of a "Slight" amount of marbling and an external fat covering that is 0.30 inch thick at the 3/4 measure opposite the ribeye at the 12th rib (Tables 3 and 4). Both marbling and subcutaneous fat thickness serve as general indicators that the steer has consumed enough energy (usually from grain) to produce beef of acceptable flavor and to have sufficient insulation (in the form of fat) to prevent muscle fibers from shortening (and toughening) in response to the cold environment present as the carcass goes through the rigor mortis (death stiffening) process.

Research evidence (Table 5) which demonstrated that the feeding of steers for 100 or more days on a high-energy diet assured production of beef of "acceptable" palatability has provided impetus to attempts to produce beef that is leaner than that of the present Choice grade. The importance of defining a minimum feeding period (time-on-feed) necessary to assure product acceptability is magnified greatly when interest rates are unrealistically high (as they presently are) and when leanness is at a premium.

Central to success in commercial cattle feeding is the premise of producing cattle of the desired composition. Attaining the desired composition (whatever that may be for the particular market involved)

Table 3. Percentages of steaks rated as "acceptable" or higher from carcasses with different fat thicknesses (3/4 measure opposite the ribeye at the 12th rib)

| Fat thickness<br>(inches) | Cattle fed<br>0 to 230<br>days | Cattle fed<br>100 to 130<br>days |
|---------------------------|--------------------------------|----------------------------------|
| Less than .20             | 58                             | 75                               |
| .20 to .30                | 75                             | 86                               |
| .30 to .40                | 90                             | 96                               |
| .40 to .50                | 92                             | 95                               |
| .50 to .60                | 90                             | 96                               |
| .60 to .70                | 94                             | 90                               |
| .70 or more               | 96                             | 97                               |

Sources: Dolezal et al. (1982), JFS 47:397  
Tatum et al. (1982), JAS 54:777

Table 4. Overall palatability ratings assigned to loin steaks by 871 consumers

| Marbling<br>score | Fat<br>thickness<br>(inches) | Overall<br>palatability<br>rating |
|-------------------|------------------------------|-----------------------------------|
| Moderate          | .10 to .80                   | 13.8 <sup>a</sup>                 |
| Modest            | .10 to .80                   | 13.7 <sup>a</sup>                 |
| Small             | .10 to .80                   | 13.2 <sup>b</sup>                 |
| Slight            | .30 or more                  | 13.0 <sup>b</sup>                 |
| Slight            | Less than .30                | 12.3 <sup>c</sup>                 |

Source: Gawlik et al. (1982); Texas Agr. Exp. Sta.

Table 5. Percentages of steaks from steers fed for different periods that were "acceptable" or higher in overall palatability.

| Time-on-feed<br>(days) | Study<br>I | Study<br>II |
|------------------------|------------|-------------|
| 0                      | ---        | 51          |
| 30                     | ---        | 59          |
| 60                     | ---        | 70          |
| 90                     | ---        | 63          |
| 100                    | 92         | 93          |
| 130                    | 94         | 91          |
| 160                    | 94         | 93          |
| 200                    | ---        | 95          |
| 230                    | ---        | 97          |

Sources: Tatum et al. (1980); JAS 50:833  
Dolezal et al. (1982); JFS 47:397

Table 6. Priority of nutrient utilization by tissues, body locations and fat depots in growing animals.

| TISSUE       | BODY<br>LOCATION    | FAT<br>DEPOT    |
|--------------|---------------------|-----------------|
| (A) NERVOUS  | (A) HEAD            | (A) KIDNEY KNOB |
| (B) SKELETON | (B) NECK & SHOULDER | (B) SEAM        |
| (C) MUSCLE   | (C) HIND LIMB       | (C) EXTERNAL    |
| (D) FAT      | (D) LOIN & RIB      | (D) MARBLING    |

is a matter of optimizing growth (of muscle and bone) and development (deposition of fat). The principles of growth and development that are applicable to production of a desirable slaughter steer are embodied in the application of three rules of thumb--"full-feed," "market when ready," and "do not hold."

Full-feeding (use of a high, versus medium or low, plane of nutrition) will result in production of the desired cattle most efficiently because it minimizes costs associated with maintenance requirements and interest on investment. Cattle with high inherent potential for growth will produce the desired carcass (as defined by yield grade and quality grade) most efficiently when fed on a high plane of nutrition. The latter conclusion is based substantially upon John Hammond's theory of the "priority of nutrient utilization" which says that of the nutrients present within the animal's body at a given point in time, they will be directed first to that tissue (nervous then skeletal then muscle then fat), body location (head then neck and shoulder then hind limb then loin and rib) or fat depot (kidney knob then seam then external then marbling) that is most essential to sustaining the animal's life (Figure 1; Table 6). If, and only if, needs of any or all more essential tissues, body locations or fat depots have been fulfilled will nutrients be directed to a less essential tissue, location or depot. Growth of muscle can be prolonged if the diet is manipulated in a manner that will provide only that quantity of nutrients that is sufficient to sustain nervous and skeletal tissues and to encourage muscle growth but not adequate to cause deposition of fat. Such diet manipulation (so-called "limited feeding") will cause animals to be more muscular and leaner at a given age and live weight (Figure 2) than they would normally be but this is accomplished at great expense and would essentially never be economically feasible in a feedlot program.

Desirability of a slaughter steer can be defined in terms of the composition--proportion of muscle, fat and bone--of its carcass. At some point in time or at some weight, an animal will produce a carcass of the desired composition; this can best be illustrated by the use of carcass-composition growth curves (Figure 3). For a half-century we tried to make all cattle attain the desired composition (for example, 55% muscle, 33% fat and 12% bone in the 1950's) at a live weight of about 1000 pounds. By the middle 1970's it had become obvious that this was a futile attempt--the influx of Continental European breeds made that impossible. Use of super-imposed carcass-composition growth curves illustrates the futility of such practice (Figure 4); optimal carcass composition will be achieved at a slaughter weight of 900 pounds for cattle of one type but at 1300 pounds for cattle of another

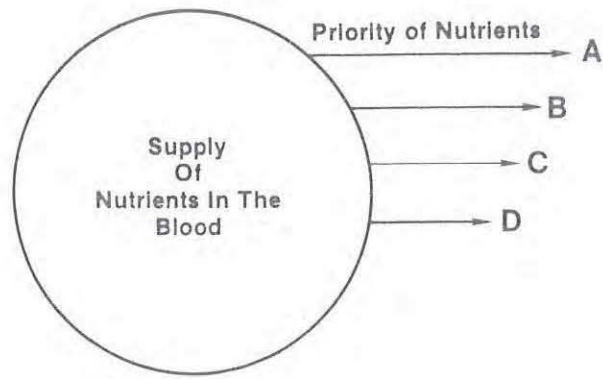


Figure 1.

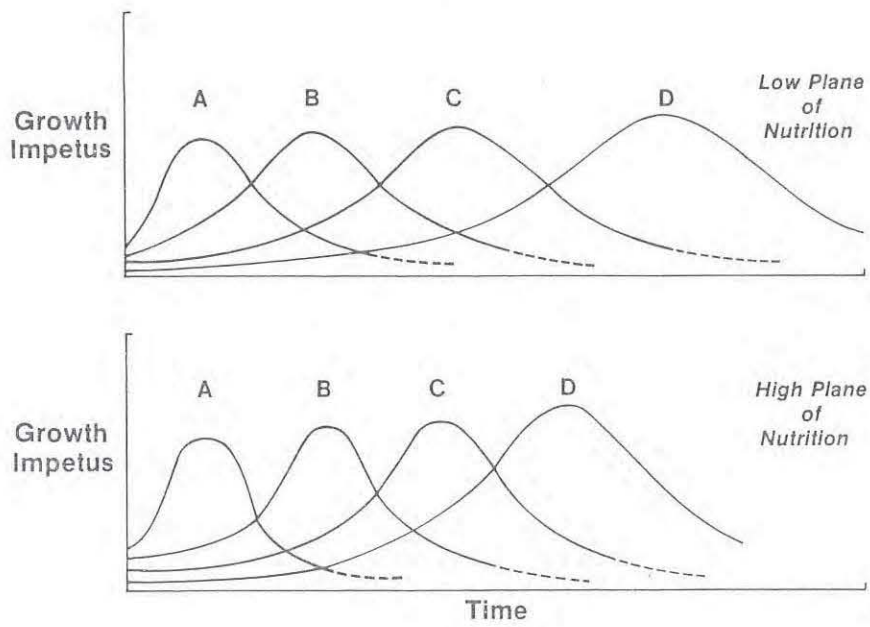


Figure 2.

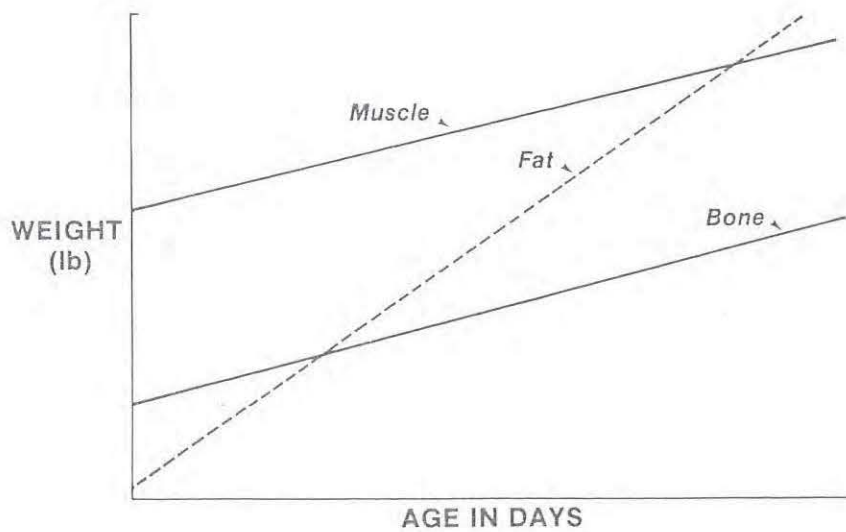


Figure 3.

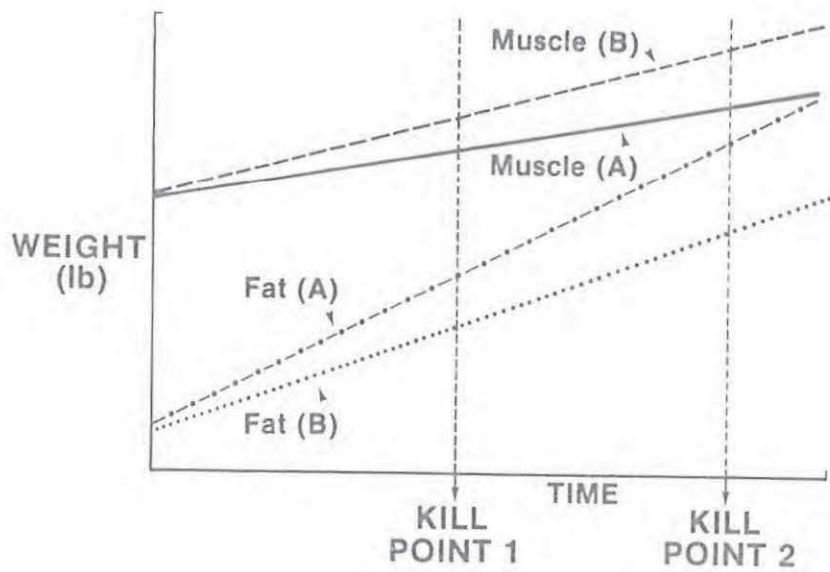


Figure 4.

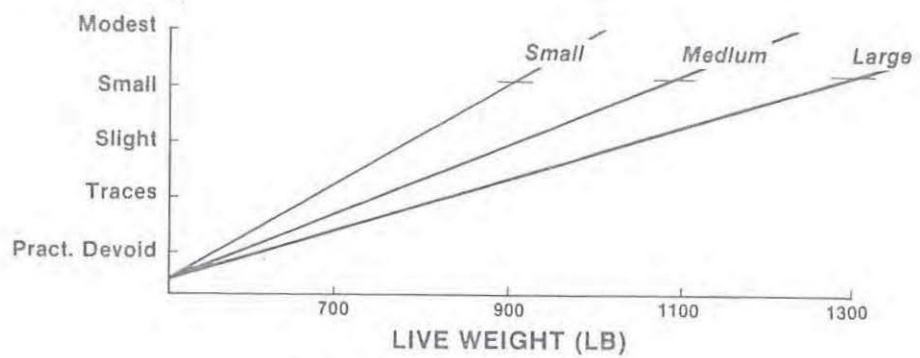


Figure 5.

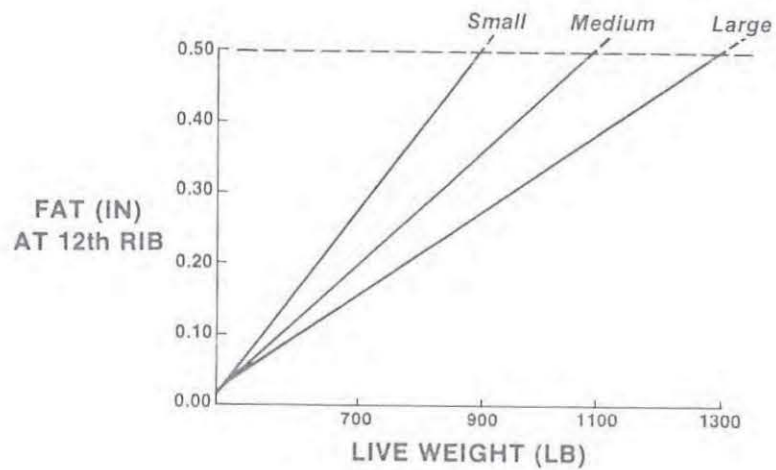


Figure 6.



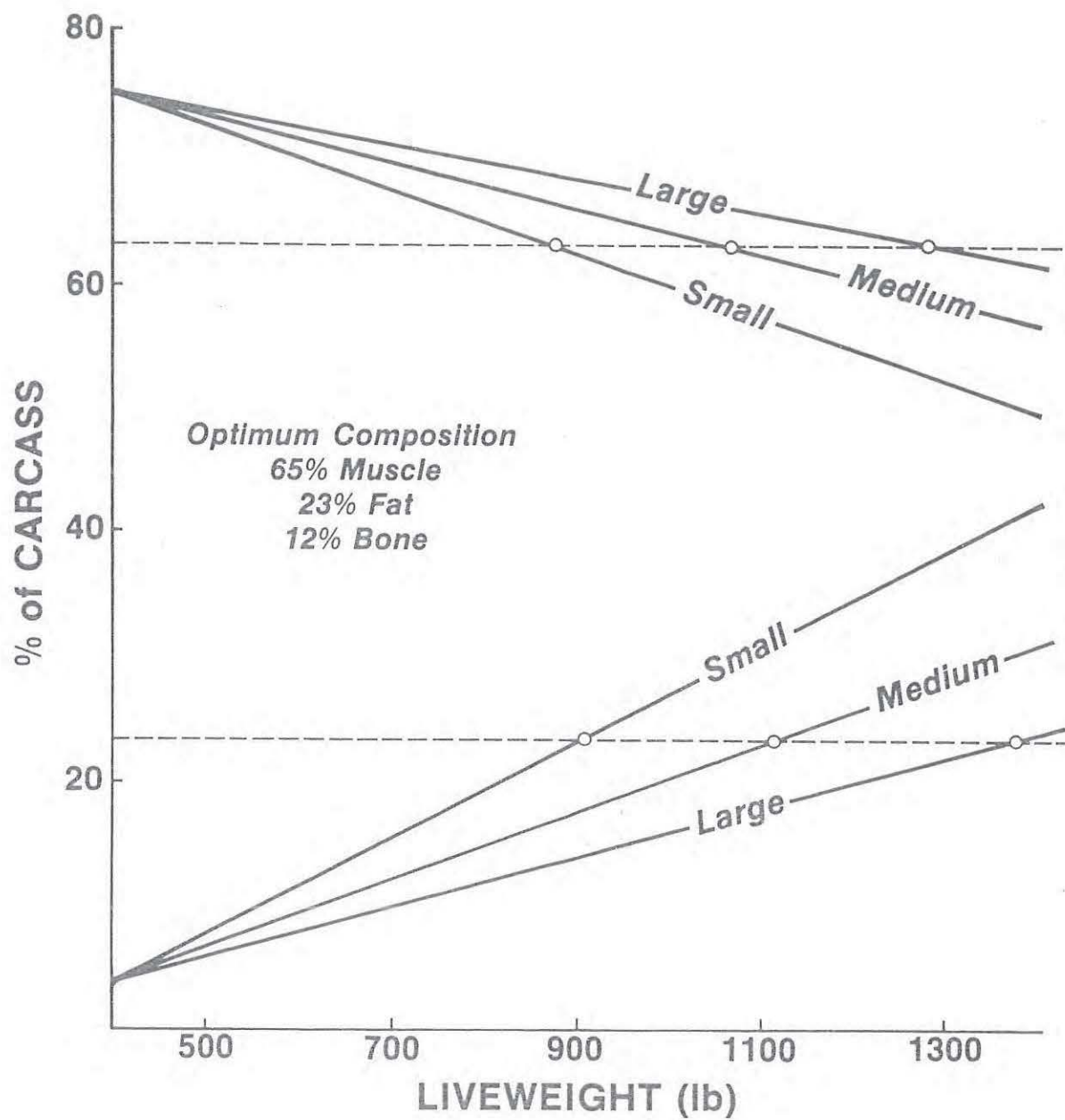


Figure 7.

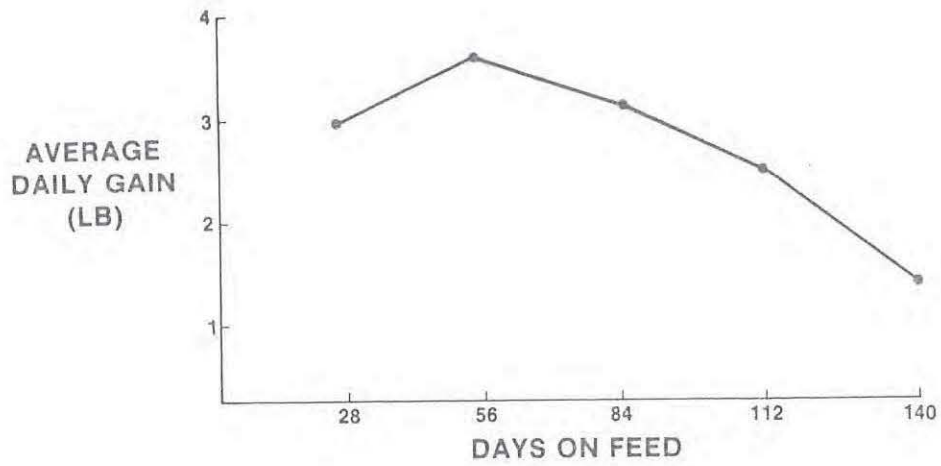


Figure 8.

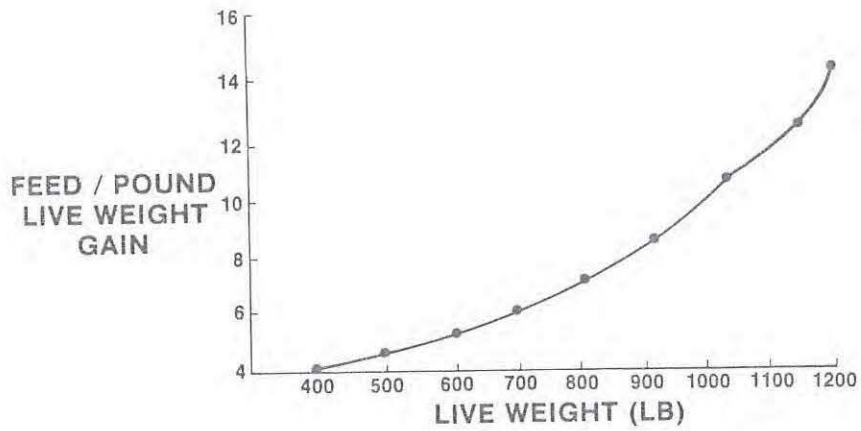


Figure 9.

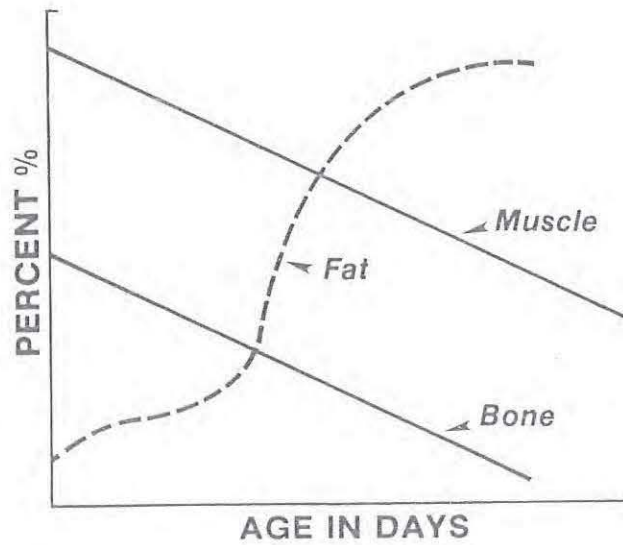


Figure 10.

type. Research on this premise led the USDA in 1979 to adopt a system for the grading of feeder cattle that recognized the existence of cattle of three types--small, medium and large frame sizes--that should be slaughtered at greatly different live-weights in order to achieve production of carcasses with a "Small" amount of marbling and 0.50 inches of external fat thickness (Figures 5 and 6). That same premise could be applied to achieve production of cattle that would have carcasses of a certain composition in terms of percentages of muscle, fat and bone (Figure 7).

Failure to slaughter a steer or heifer at the weight or after the period of feeding commensurate with its production of the desired carcass will cause serious management or marketing problems. The principle "do not hold" is predicated upon substantial decreases in average daily gain (Figure 8), feed efficiency (Figure 9) and leanness (Figure 10) that accompany attempts to continue to feed cattle after they have attained optimal carcass composition. For precisely those reasons, commercial cattle feeders attempt to market feed cattle as soon as they have had adequate opportunity to express their genetic potential to produce the desired carcass.

#### COMPARISON OF COMMERCIAL CATTLE FEEDING AND STEER SHOWS

For purposes of debate and discussion at this Symposium, I offer the personal opinion which follows, regarding other relationships between commercial cattle feeding and steer shows. This is not to say that it should be this way but to say that this is how I believe it is.

Steer shows are not now nor have they been (for at least the last 40 years) indicative of things that are of practical significance to the commercial cattle feeding industry. Use of nurse-cows, cutting of ties, airing-oiling, heat lamps-rolling pins of my day (1952-1955) and of use of diuretics, dyeing of hair and lacing of briskets of the present time (1982) are not of practical significance to the commercial industry. I asked Kenneth Monfort, who followed a very successful high school show-ring experience with a career in commercial cattle feeding and in operating a very large beef packing company, two questions: (1) To what extent did your experience in fitting and showing steers in high school help you in becoming one of the nation's largest cattle feeders? and (2) To what extent do you now look to the nation's show-ring in providing guidance regarding the manner in which you feed cattle and/or regarding the type or kind of slaughter animal you should produce? His answer to both questions was "None, whatsoever!"

What, then could be done to make steer shows more practical and

of greater value to the commercial cattle feeding industry? Again, for purposes of discussion, I offer the personal opinions which follow, regarding possible improvements in steer shows:

- (1) Steer shows should emphasize those things that are of greatest concern to commercial feeders--performance (average daily gain, feed efficiency), dressing percentage and period of feeding (as it relates to equity, commodity costs and interest on investment).
- (2) Things presently given credence in judging show steers that are of minimal importance to commerce--style, balance, structural correctness--should be de-emphasized.
- (3) Present emphasis on large-framed, very tall steers of only certain breeds should change because it ignores the fact that there are steers of other frame sizes and heights and breeds that are of tremendous consequence to industry, because they also perform well and produce highly desirable carcasses.
- (4) Carcass characteristics should be more than merely an afterthought in producing and in judging show-steers; many steers presently winning shows will not produce a desirable carcass.
- (5) Penalties for proof of use of diuretics, surgical alterations and dyeing should be sufficiently punitive to discourage such practices.
- (6) Honesty, integrity and fair-play should of paramount importance in steer shows.