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## Review of Lamb Carcass Evaluation

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Sheep industry personnel must continue to stress the importance of producing the lamb which will be efficient for the producer, economical for the packer, easily merchandised by the retailer and readily purchased by the consumer. Sheep and dairy cattle are the only dual-purpose farm animals. With sheep the relative economic importance of wool and meat production varies by locality, breed and production practices. However, meat production usually accounts for about 75 to 80 percent and wool 20 to 25 percent of the total income from the sheep enterprise. This dual purpose is probably the reason why the sheep industry has never completely defined the "desirable or ideal" sheep.

Average lamb consumption per capita has been essentially four and one-half to five pounds for the past ten years. During this same period, beef consumption increased 20 pounds and pork consumption decreased by seven pounds.

This steady consumption figure for lamb, coupled with an increased economic importance from the "meat-end" of the sheep industry, is one reason for the increased interest in lamb carcass evaluation. A large percentage of the research work performed by colleges and universities on lamb carcass evaluation has been done within the past 10 years. Many of the lamb carcass shows have also developed during this period.

When research results and lamb carcass show rules and regulations are reviewed it is very evident that the "desirable" lamb carcass has not been defined by personnel associated with the sheep industry. Z. L. Carpenter, Texas A & M University, in his

presentation at the Lamb Carcass Evaluation Conference held at Ames, Iowa, in September, 1964, stated that some 12 methods had been used in experimental lamb carcass evaluation research. These methods have included:

1. Chemical composition
2. Separable lean, fat and bone
3. Edible portion
4. Trimmed retail cuts
5. Retailed primal cut yield
6. Retail value
7. Wholesale primal cuts
8. Streamlined carcass
9. Specific gravity
10. Loin-eye area and fat thickness
11. Conformation and objective measurements
12. U.S.D.A. grade

As would be expected, these methods vary in the amount of work involved as well as in their predictive value in identifying the more desirable carcass.

Personnel who pioneered in establishing lamb carcass evaluation shows were forced to draw upon the 12 methods listed above. The shows had to utilize method (s) which had a high predictive value in identifying the "ideal" carcass, and the procedures for the shows had to be such that large numbers of animals could be evaluated. In many of the shows the lambs were slaughtered, and carcass evaluation measurements were obtained in the facilities of cooperating packers. Hence, the carcasses had to be easily merchandised after carcass measurements were obtained.

A glance at the 12 methods listed before shows that method one is not practical, and that with methods two and three the carcasses are quite thoroughly fabricated in obtaining carcass evaluation measurements. Consequently, these methods are both slow and expensive, and the resulting carcasses are not in an acceptable form for retailing. Methods four through eight are also slow and expensive. In many instances, the cooperating packers have indicated that with these methods the carcasses were also fabricated to the point that carcass merchandising is a problem.

In many of the earlier shows the personnel were, by necessity, required to use methods 10 through 12. With these methods large numbers of animals could be evaluated and the costs are nominal. Fabrication of the carcass is held to a minimum and, consequently, the carcass is readily retailable.

Measurements for lamb carcass evaluation shows are usually made on carcass weight, quality, conformation, loin-eye area, fat thickness over loin-eye at 12th rib, and percent leg and loin of chilled carcass weight.

In many shows minimum standards are established for carcass weight, loin-eye and fat thickness measurements. In general, these follow the recommendation of the American Meat Science Association listed below in Table one.

These requirements are usually incorporated with a previous grouping of carcasses based on cutability and quality. In these groupings the Arabic number refers to carcass cutability and the small letter refers to carcass quality.

- 1-a. Highly desirable carcasses with a uniform but not excessive fat covering, that are thickly fleshed, and with excellent quality meat. Carcasses placed in this group have trim kidney and pelvic fats and quality equal to or exceeding U.S. Average Choice.
- 2-a. High quality lamb carcasses with quality equal to that in the 1-a carcass, but with slightly less than minimum loin-eye area or slightly more than maximum fat or both or with somewhat less desirable conformation.
- 3-a. High quality lamb carcasses that are lacking in muscling and/or excessively wasty resulting in low cutability.
- 1-b. Lamb carcasses with very desirable conformation but with quality below U. S. Average Choice.
- 2-b. Lamb carcasses lacking in both conformation and quality.

Table 1. American Meat Science Association recommendations

Carcass weight (lbs.)	Minimum loin-eye area per 100-lb. carcass (sq. in.)	Maximum fat thickness (in.)
40-45	4.50	.35
46-50	4.40	.35
51-55	4.30	.40
56-60	4.20	.40

These groupings were originally recommended to be assigned on "unbroken" carcasses. However, accuracy is increased if the carcass judges group the carcasses after the loin-eye and fat cover are exposed at the 12th rib.

As mentioned above, not all shows incorporate the American Meat Science Association standards for carcass weight, loin-eye area, fat cover and cutability-quality groupings. In the 1965 International Quality Lamb Contest at Chicago, only the cutability-quality groupings (1-a, 2-a, 3-a, 1-b, 2-b) were used. However, loin-eye area and fat cover (over loin-eye and 2-1/2 inches below lower edge of loin-eye) were made available to carcass judges. Carcasses with less than U.S. Good meat quality were not eligible for carcass competition. Carcass judges were asked to make numerical placings within each grouping (1-a carcasses were top carcasses), using carcasses with the highest meat quality and expected yield of retail cuts.

In the 1965 Eastern States Exposition Lamb Carcass Show, Springfield, Massachusetts, the American Meat Science Association standards were followed. In addition, all lamb carcasses were indexed according to U.S.D.A. prediction equation which will be discussed in a subsequent paragraph. The 1-a lambs having the highest index were considered as most acceptable.

In the 1965 National Lamb Show held at Cedar Rapids, Iowa, carcasses were required to meet the following qualifications:

1. Carcass weight between 40-65 pounds
2. Carcass grade of low choice or better and have a minimum of 0.2 inches of fat cover over the loin-eye.
3. Carcass with dry, firm, desirable colored lean and at least small amounts of marbling.
4. Carcasses weighing from 40 to 52.9 pounds were required to have 2.25 square inch loin-eyes, and car-

asses weighing from 53 to 65 pounds were required to have 2.50 square inch loin-eyes.

If a carcass failed to meet any of the above requirements, it was not evaluated further. Carcass fat was measured in four places: at the 2/3 point over both loin-eyes, over the loin at a point 2 inches below lower edge of loin-eye, and over the rump 2 inches off center on the leg portion after the loin has been removed. Carcasses were ranked on leg-loin index minus fat deduction if the total of the four measurements was over 1.5 inches. (Fat deduction amounted to 1.2 points for every one-tenth inch of fat over 1.5 inches). The leg-loin index was calculated by multiplying the percent leg by 1.0 and percent loin by 1.5.

In the 1965 Hoosier Quality Lamb Show, held in conjunction with the Indiana State Fair, carcass judges sorted the "broken" carcasses into cutability-quality groupings (1-a, 2-a, etc.) as recommended by the American Meat Science Association. Average fat at the 2/3 point over both loin-eyes, average loin-eye area (both loin-eyes traced and measured with planimeter) and carcass weight were provided for the carcass judges. However, no minimums other than those implied in the cutability-quality groupings were placed on fat cover and loin-eye measurements.

The show included the following four liveweight classes: Light (80-90 lbs.), Medium Light (91-100 lbs.), Medium Heavy (101-110 lbs.), and Heavy (111 lbs. and up). All lambs had to weigh 80 pounds and all carcasses over 40 pounds. No upper limit was set for carcass weight. Only 1-a carcasses were considered for carcass competition. These carcasses were indexed using the quality score of 20 possible points and percent leg and loin (hind saddle minus kidney knob and flanks) of chilled carcass with 80 possible points. Carcasses with 39.0% leg and loin received a score of zero, and carcasses with 47+ percent leg and loin received a score of 80.

Many methods have been used in pork and beef carcass evaluation studies to predict yield of retail cuts or trimmed wholesale cuts without actually fabricating the carcasses. With pork carcasses 70 to 75 percent of the differences in yield of major wholesale cuts can be explained by differences in fatness. In beef carcass evaluation studies, objective determination of the yield of retail cuts can be estimated with a high degree of precision by considering (1) fat thickness over the loin-eye at the 12th rib, (2) loin-eye area, (3) percent of kidney fat, and (4) carcass weight.

Similar studies have been conducted with lamb carcasses. In general, high precision may be obtained in estimating cutability (edible portion, percent lean, and percent yield of trimmed major cuts) by considering (1) fat thickness over loin-eye, (2) kidney and kidney fat (either as pounds or percent), (3) loin-eye area, (4) conformation score, (5) percent untrimmed leg, and (6) chilled carcass weight. The following index procedures were advocated by a special Ad Hoc Committee at the Lamb Carcass Evaluation Conference held at Ames, Iowa, in September, 1964. This committee recommended that the carcasses be classified into cutability-quality groups, as per American Meat Science Association standards, and that some (at least the 1-a carcasses) be analyzed for cutability using one of the following index procedures. Placing should be on descending order of cutability.

The following are indices used to estimate cutability:

A. Purdue Index (Judge and Martin, 1963)

Percent edible portion (trimmed boneless cuts) =  $87.76 - 16.59$  (fat thickness, in.) -  $2.05$  (kidney and kidney fat, lb.) -  $.27$  (chilled carcass weight, lb.)

B. Kentucky Index (Field, Kemp and Varney, 1963)

Percent lean in carcass =  $33.27 + 3.90$  (area of loin-eye/45 lb. carcass) -  $.46$  (fat thickness over loin-eye, mm.) -  $.80$  (percent kidney and kidney fat) +  $.53$  (percent leg)

C. U.S.D.A. Index (Hoke, 1961)

Percent yield of trimmed retail cuts (leg, loin, rib and shoulder, including neck) =  $74.27 + 0.20$  (conformation grade) -  $0.55$  (single fat measurement over loin-eye, mm.) -  $0.85$  (percent kidney fat)

These indices give estimated cutability values for each carcass without complete fabrication of the carcasses. With all three indices the carcasses are broken between the 12th and 13th rib and kidney knob and kidney fat weights obtained. In addition, the Kentucky system requires the removal of the leg from the hind saddle so as to obtain the percent leg.

The Kentucky and Purdue indices have the advantage of being completely objective; whereas, the U.S.D.A. index uses a subjective measurement of conformation. Both the Purdue and U.S.D.A. indices use relatively few components; consequently, they are easier and faster in use.

How do these recommended indexing procedures compare with other systems of lamb carcass evaluation? California workers (Spurlock and Bradford, J. Animal Sci. 24:1086-1091) have reported research in which they compared the American Meat Science Association, Kentucky, Purdue and U.S.D.A. systems of carcass evaluation.

The California study indicates that the American Meat Science Association system does not appear to be of value in ranking

lambs according to meatiness. This is apparently due to the fact that carcasses from overfat lambs are given a higher numerical score than carcasses from leaner lambs which are in the same weight classification. This study indicates that the Kentucky, Purdue and U.S.D.A. indices will result in accurate evaluation of groups of lambs if the spread in grade is equivalent to two U.S.D.A. grades. With this variation in grade, kidney fat (either percent or pounds) and fat depth over loin-eye provide the same accuracy as combinations of larger number of measurements. However, with lambs having relatively uniform fat cover, more accurate estimation of meatiness is obtained if loin-eye area or other measures of muscling (such as percent leg) are included with the two fat measurements. Conformation score did not increase accuracy of estimation when fat measurements (depth and percent) were included in the U.S.D.A. index.

Amended lamb carcass evaluation recommendations will be presented at the 1966 Annual Meeting of the American Meat Science Association.

The California workers advocate that with lamb carcass contests, all carcasses should grade U.S.D.A. Average Choice or higher.

Regardless of the evaluation methods used, certain carcass measurements appear to be common to all lamb carcass evaluation contests. These are: chilled carcass weight, fat covering and loin-eye area at 12th rib, kidney and kidney fat (either percent or pounds), percent leg or percent leg-loin, either conformation score or carcass grade, and score or grade for carcass quality. These measurements will account for 80 to 85 percent of the differences observed in actual poundage of meat produced from carcasses grading U.S. Average Good or higher.

Lamb carcass evaluation measurements have been and will continue to be only one "tool" which may be used by personnel associated with the sheep industry in describing the "desirable or ideal" sheep. Evaluation methods will change as newer more exact methods are forthcoming from present and future research.

Other "tools", which are probably at present as important, are breeding, management and nutrition practices associated with the economical production of quality lamb meat in volume. By use of the breeding, management, nutrition and carcass measurement tools, sheep producers will be able to define the characteristics of the desirable lamb. This information must in turn be used in selection of those animals within a flock or breed which will transmit these characteristics to a large number of progeny.