IMPROVING CARCASS MERIT IN SHEEP

JOE EMENHEISER

DEPARTMENT OF ANIMAL AND POULTRY SCIENCES, VIRGINIA TECH

General Introduction (Emenheiser, 2009)

Consumption of lamb meat has steadily declined over the past 40 years and has reached critically low levels in the United States. Increased concern for the health aspects of red meat has led modern consumers to demand products with a higher ratio of lean:fat. The U.S. lamb industry in particular is failing to meet these demands.

Unfulfilled consumer demand for a leaner product affects all segments of the industry, yet some segments hold more potential than others in offering a real solution. In general, the lean content of a carcass or of its component retail cuts can be improved by decreasing fat and/or increasing muscle. However, fat removal by trimming at the retail level is inefficient and costly. Improvements in portion size of muscle cuts are easily accomplished by increasing carcass weight, but modern feed costs dictate that increasing carcass weight simply by feeding lambs to heavier live weights is no longer as viable a solution. Body composition can be influenced by nutritional regime (as well as genetic makeup), yet livestock nutrition has advanced to the point that most animals can at least approach their genetic potential for lean growth. If genetic potential of the animal is the limiting factor, it follows logically that consumer demand for leaner meat should be met by genetic selection for improved carcass composition.

Prediction of post-fabrication lean yield using measurements taken on whole carcasses is well-documented in the meat science literature. Predictive equations developed in the meats area can assist the preceding livestock sector in identifying indicator traits that are best measured and selected upon for genetic improvement of composition. However, there is presently no large-scale genetic evaluation of lamb carcass traits in the U.S.

Limitations exist for genetic evaluation and improvement of carcass traits. Collecting actual postmortem carcass measurements on animals intended for reproduction presents an obvious biological incongruity. Collection of carcass data on progeny and relatives of breeding animals is expensive, and it is difficult for the packer to incorporate such record-keeping into modern high-speed production lines. The use of ultrasound technology that allows carcass traits to be estimated in live animals holds promise to overcome these limitations. However, at present, the accuracy and consistency of ultrasonic measures in predicting carcass measures and eventual carcass yield is not well-established for U.S. lambs. Also, not all carcass measures used in lean yield equations are commonly estimated by *in vivo* ultrasound, whether limited physically or by tradition.

In order for ultrasonic scan data to be useful for genetic evaluation, the data must be adjusted to a common endpoint. Adjustment of ultrasonic measures requires knowledge of animal growth and development, which is generally considered across either age or weight. Within the U.S. sheep population, little research has been done to describe the growth patterns of scan measures or to develop strategies for their adjustment. Identification of *in vivo* measures and the general descriptions of growth that have been developed for sheep in other countries provide valuable information, but it should not be assumed that this research will automatically apply to U.S. lambs because of considerable differences in body size and management systems.

Finally, genetic evaluation of carcass traits in the form of ultrasound EPDs requires estimates of the phenotypic and genetic parameters for the traits of interest. These parameters also are not well-studied in U.S. sheep, partly because current population size and structure would limit their reliability.

Therefore, the objectives of this research were to: 1) Assess both the accuracy and consistency of in vivo ultrasonic measures in predicting the analogous carcass measurements, 2) describe the longitudinal changes in ultrasonic measures of body composition during lamb growth and develop common-endpoint adjustment strategies for lamb scan data, and 3) using estimates of the phenotypic and genetic parameters from the global literature, develop and introduce to the U.S. National Sheep Improvement Program EPDs for ultrasonically-derived indicators of carcass composition in sheep.

Validation of ultrasound technology and development of technician certification (Emenheiser et al., 2010b)

ABSTRACT: Market lambs from the state fair of Virginia (n = 172) were ultrasonically evaluated by 4 scan technicians and 3 image interpreters to determine accuracy of ultrasonic estimates of loin muscle area (ULMA), backfat thickness (UBF), and body wall thickness (UBW). Lambs were initially scanned at the preferred magnification setting of each technician; 2 chose 1.5× and 2 chose 2.0×. Lambs were then scanned a second time for ULMA and UBF with machine magnification settings changed from 1.5 to 2.0×, or vice versa, midway through the second scan. Lambs were then slaughtered, and analogous measurements [carcass loin muscle area, carcass backfat thickness, and carcass body wall thickness (CBW)] were recorded on chilled carcasses. Pooled, residual correlation coefficients within technicians and interpreters between ultrasonic measurements from the first scan and carcass measurements were 0.66 for loin muscle area, 0.78 for backfat thickness, and 0.73 for body wall thickness, but were reduced to 0.43, 0.69, and 0.50, respectively, by inclusion of linear effects of carcass weight in the model. Mean bias for technicians and interpreters ranged from −1.30 to −2.66 cm^2 for loin muscle area, −0.12 to −0.17 cm for backfat thickness, and 0.14 to −0.03 cm for body wall thickness; prediction errors ranged from 1.86 to 2.22 cm^2, 0.12 to 0.14 cm, and 0.35 to 0.38 cm, respectively. Pooled correlations between repeated measures were 0.67 for ULMA, 0.79 for UBF, and 0.68 for UBW at the same magnification and 0.73 for ULMA and 0.76 for UBF across different magnification settings. Mean differences between repeated measures were more variable among technicians and interpreters than statistics comparing ultrasound to carcass measures. Standard errors of repeatability ranged from 1.61 to 2.45 cm^2 for ULMA, 0.07 to 0.11 cm for UBF, and 0.36 to 0.42 cm for UBW. The effect of changing magnification setting on technician and interpreter repeatability was small for UBF and ULMA. The accuracy of prediction of CBW from UBW was similar to that achieved for backfat thickness; further assessment of the value of ultrasonic measurements of body wall thickness in lambs is warranted. These results indicate that ultrasound scanning can reliably predict

carcass loin muscle area and backfat thickness in live lambs and, accordingly, has value in selection programs to improve composition. Development of certification standards for US lamb ultrasound technicians based on results of this study and others is proposed.

Changes in composition during growth and development of adjustment strategies for ultrasonic scan data (Emenheiser et al., 2010)

ABSTRACT: Four equations were used to compare alternative procedures to adjust ultrasonic estimates (y) of backfat thickness (BF) and LM area (LMA) for BW using data from a series of 7 scans on 24 Suffolk ram lambs born in 2007. Equations were linear, linear + quadratic, allometric ($y = \alpha BW\beta$), and allometric + BW (ABW; $y = \alpha BW\beta e\gamma W$). Goodness of fit was very similar between equations over the range of the data. Resulting adjustment equations were tested using 3 serial scans on winter-born Suffolk (n = 150), Hampshire (n = 36), and Dorset (n = 43) rams and 52 fall-born Dorset rams tested at the Virginia Ram Test in 1999 through 2002. Partial correlations (accounting for the effect of year) between predicted and actual measures ranged from 0.78 to 0.87 for BF and 0.66 to 0.93 for LMA in winter-born rams and from 0.70 to 0.71 for BF and 0.72 to 0.78 for LMA in fall-born rams. No significant differences in predictive ability existed between equations for BF or LMA ($P > 0.05$), and there was no indication that the allometric equation was a better predictor than linear within the range of the data. Adjustment equations were also tested using serial scan data from 37 Suffolk ewe lambs born in the same contemporary group as the rams used to derive the prediction equations but fed for a substantially slower rate of BW gain. Correlations between predicted and actual values of BF and LMA indicated lambs were too young and small at the first scan (77 d, 32.4 kg) to reliably predict carcass measures at typical slaughter weights. For prediction using data from the 2 subsequent scans, at mean ages >96 d and mean BW >39 kg, correlations between predicted and actual values were 0.72 to 0.74 for BF and 0.54 to 0.76 for LMA. Little difference existed between equations for predicting BF. For LMA, the ABW form was a weaker predictor than the others, and

the linear equation was slightly superior to allometric. Therefore, it appears the linear and allometric forms are both suitable for use in central ram test and performance-tested farm flocks.

Progress since 2009

Considerable interest in genetic improvement of composition was stimulated, particularly among Suffolk sheep breeders, who embraced the newly introduced ultrasound EPDs resulting from my M.S. Thesis work. The next several years saw considerable sharing of rams, increasing the connectedness among flocks and strengthening the genetic evaluation efforts. When NSIP processing transitioned to LAMBPLAN during 2010, momentum had built among breeders to weather the shift while keeping the efforts intact, and sufficient data were available to validate the different procedures. Genetic evaluation of ultrasonically-measured composition traits is now available to and utilized by all terminal sires breeds on NSIP using LAMBPLAN.

Two lamb ultrasound technician education events were conducted, the first in Iowa in 2010 and the second in North Dakota in 2011. Strategies for technician certification were discussed and decided using the results of Emenheiser et al. (2010b), and 14 ultrasound technicians met the certification standards in the Iowa school. A list of certified lamb ultrasound technicians is available on the NSIP web site (www.nsip.org).

While the ultimate success of these efforts for the U.S. lamb industry requires a pricing structure that rewards superior composition (genetics) in lamb carcasses and in seedstock, that structure in some ways relies on the efforts of breeders to make superior composition an available reality. All indications at this point indicate that those efforts are well underway.

References

Emenheiser, J. C. 2009. Use of ultrasound technology in the genetic improvement of U.S. lamb composition. M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg.

Emenheiser, J. C., S. P. Greiner, R. M. Lewis, and D. R. Notter. 2010. Longitudinal changes in ultrasonic measurements of body composition during growth in Suffolk ram lambs and evaluation of alternative adjustment strategies for ultrasonic scan data. J. Anim Sci. 88:1341-1348.

Emenheiser, J. C., S. P. Greiner, R. M. Lewis, and D. R. Notter. 2010. Validation of live animal ultrasound measurements of body composition in market lambs. J. Anim Sci. 88:2932-2939.