2001 Sheep Day Report

ND 1709 Objective: 2

GENETIC AND ENVIRONMENTAL STRATEGIES TO IMPROVE THE EFFICIENCY OF LEAN TISSUE ACCRETION IN LAMBS

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The need for objective value-based market pricing structures has never been more apparent. Meat animal production systems must become more efficient if they are to compete with other protein sources. Producing fat is not efficient. Paying a producer for fat lambs is counterproductive. Since 1994, lambs of known ancestry which have been slaughtered at the NDSU Meat Laboratory have been evaluated for carcass characteristics under the NCR 190 regional umbrella project "Increasing efficiency of sheep production." Data from over 500, mostly Columbia, lambs has been presented in past Western Dakota Sheep Day Reports. All of the prediction formulas have never been presented in a single document. This project is now in its final stage, that of testing the prediction formulas through progeny testing the selected sires. Interest has been expressed in how these formulas might be used by a producer in either a selection program or as a pricing scheme.

Formulas for predicting proportion of trimmed retail product (TRP) have been developed from standard carcass measurement data and from electronic evaluation using bioelectrical impedance (BEI) of both carcasses and live lambs. The accuracy of the prediction formulas was verified by actual cutout data.

An "anatomical" prediction formula, using carcass weight, ribeye area, 12th rib fat thickness, and body wall thickness was developed after summarizing data on 217 lambs slaughtered at the NDSU Meat Lab. All carcasses were processed into wholesale cuts according to North American Meat Purveyors Specifications (NAMPS). Each wholesale cut was weighed, trimmed of external fat, and reweighed. The sum of the trimmed wholesale cuts for each carcass served as the dependant variable. The carcass measurement information which contributed to the prediction of the dependant variable (pounds of trimmed retail product) were identified through the Statistical Analysis System procedure of General Linear Models stepwise regression. The most variation in pounds of retail product was explained by the formula:

(Pounds TRP = 4.80 + (0.58*cold carc.wt.) + (1.39*ribeye area) - (7.36*12th rib fat) -(5.87*bodywall thickness)

which accounted for 95% of the variation in trimmed retail product. As can be deduced from the component cells of the formula, as carcass weight and ribeye become larger, more pounds TRP are predicted. As carcasses become fatter, as expressed by either 12th rib fat or body wall thickness, pounds of predicted TRP decreases. The development of this anatomical prediction formula was very labor intensive because of the need to physically separate the subcutaneous fat from each wholesale cut.

A trimmed retail product prediction formula was developed from BEI analysis of cold carcasses of the same 217 lambs used for the anatomical formula. A BEI transmitter emits a low voltage electrical current into muscle tissue. The amount of resistance to the electrical energy is proportional to the volume or mass of the tissue. Random dispersion of the electrical energy (reactance) is also proportional to mass. The shape of the mass is also important in the amount of resistance and reactance recorded; but since all lambs are roughly the same geometric shape, a formula based on a relatively large sample should be accurate for all lamb carcasses. A formula using carcass weight, resistance, reactance, length (distance) between the detector electrodes and carcass temperature accounted for nearly 93% of the variation in pounds of trimmed retail product.

[Pounds TRP = 6.72 + (.4818*cold carc.wt.) - (.0314*resist.) - (.0481*react.) +(.254*length) + (.0223*temp)]

The component cells in this formula also reflect the fact that larger carcasses produce more pounds of TRP. As temperature decreases, resistance to electrical flow increases. Warmer carcasses generate a larger cell value. The negative mathematic sign for both resistance and reactance indicates that at cold carcass temperatures, carcasses which have greater muscle mass will have less resistance to electric impulse and less reactance. (In terms of electrical conductance, a larger gauge wire has less resistance to current flow than does a smaller gauge wire.) The length measurement is a reflection of a larger volume so the longer distances between the electrodes indicate more muscle. A second set of readings from the BEI analysis was taken using a constant distance between the electrodes, simulating robotic application. This formula also produced an R^2 of nearly 93%. Either the measured length or the constant length method would have easy adaptation to "on-line, chain-speed" carcass evaluation systems.

BEI is one of only two electronic evaluation techniques (the other is ultrasound) which lend itself to live animal adaptation. While ultrasound has received much attention, it only measures estimators (components) of cutability, such as fat thickness and ribeye area. BEI estimates lean tissue directly. A BEI-based prediction formula was developed from 182 live lambs which were slaughtered and processed immediately after BEI evaluation. This formula:

(Pounds TRP = .0973 +(.3318*live wt) + (.017*resist) + (.1739*react) + (.0102*length)

accounted for 79% of the variation in TRP in this set of lambs. As with carcass-based formulas, the mathematic sign associated with live weight and length is "plus" indicating larger animals have more muscle mass than smaller ones. At normal, live body temperature, larger readings for both resistance and reactance result in greater cell values for predicted TRP. That the math sign is opposite between carcass-generated formula and live based may be a function of the different electrolytes present in the live animal versus their carcass.

The percentage of variation explained by each of the formulas was very acceptable when checked against TRP of the same animal carcasses from which the data was gathered. A more definitive test of these formulas was to predict TRP from another slaughter group. The formulas were used to predict TRP on forty-eight lambs slaughtered and processed to trimmed wholesale cuts. The anatomical based formula (cold carc. wt., ribeye, fat and body wall) explained 82% of the variation in this independent set of lambs carcasses. The carcass BEI formula had an R^2 of 84% and the live animal BEI formula explained 79.5% of the variation in TRP.

The development of these formulas has direct application for sheep producers of the state in that either the anatomically-based or the BEI-based prediction formulas could be used for value-based market pricing. The Dakota Lamb Producers Cooperative is currently evaluating the potential to include one or both formulas in their payment program. The live animal BEI prediction formula is currently being evaluated in a feedlot setting under a Hatch Project at NDSU (Fargo and Hettinger). The first 150 lamb carcasses have been evaluated. The BEI generated estimate of "pounds of retail product per day age" EPD for the sires of these lambs accounted for 32% of the variation in retail product of their offspring carcasses. While the 32% is less than we had hoped, it is a major step in improving sire selection efficacy.