Meat and Carcass Evaluation

Use of the EMME as a Measure of Leanness in Swine

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Story in Brief

Forty-one market weight cross-breed barrows were used to evaluate the Electronic Meat Measuring Equipment (EMME) as a tool for estimating leanness in live animals. The repeatability of five counts made on each barrow within a 4 hour period was 0.38. A repeatability this low indicates that many readings on the same animal are required to obtain a precise estimate.

Following live evaluation and slaughter, routine carcass measurements were obtained. Fat-free lean was also determined from the total separable lean mass.

The average EMME count was most highly correlated to separable carcass lean (r=.44) and fat-free lean (r=.44). EMME accounted for only a small proportion of the total variation in the traits studied. Although the relationship between EMME count and the above described measures of leanness were positive and statistically significant, they are not strong enough to accurately predict leanness in live market barrows.

Introduction

As production costs increase and profit margins narrow, more efficient production of muscle should become one of the producers' primary objectives. An accurate and non-destructive measure of leanness would provide a valuable aid in the selection of breeding animals and of market animals as well. Such a tool could supplement or replace present methods of evaluating potential breeding stock and result in more accurate selection.

The EMME (Electronic Meat Measuring Equipment) is an instrument designed to estimate leanness in the live animal. The principle on which it operates is that the non-fat portion of the animal conducts electromagnetic energy (electrical currents) about 20 times faster than does the fat portion. The non-fat portions of the body contain a significantly greater quantity of free electrolytes, which are free ions that have the ability to more readily conduct electric currents than the fat portions. Thus, as an animal is passed through the EMME chamber, (in which an electrical field is established) the ease with which these electric currents are disrupted is related to the quantity of non-fat material present in the animal.

The objectives of this study were: (1) to determine how well the EMME could repeat counts when measuring the same animal several times, and (2) to study the relationship between the average of several EMME readings and pounds of separable lean and fat-free lean.

Materials and Methods

Forty-one market weight hogs (216-237 lbs.), representing 3 breed crosses were obtained from the Fort Reno Livestock Research Station and used in this study to evaluate the EMME .The hogs were taken off feed for 24 hours, washed and weighed prior to evaluation. Each barrow was randomly counted five times within a 3 hour period. Counts on the same animal were correlated to estimate repeatability which is the ability of the instrument to repeat itself on the same animal.

Following live evaluation, the barrows were transported to the OSU Meat Laboratory for slaughter, routine carcass appraisal and physical separation. The routine carcass data obtained included length, backfat thickness, loin eye area and weights of the trim wholesale cuts. Physical dissection of wholesale cuts (ham, loin, shoulder and belly) was made on the right half of each carcass and weights of separable lean, fat and bone were obtained. Ether-extract analyses were conducted on a thoroughly mixed sample of the separable lean from each carcass and total pounds of fat-free lean were determined by difference. Fat-free lean provides a more meaningful measure of muscle than "closely trimmed lean" because fat between, as well as, within the muscles is removed.

Results and Discussion

The knowledge of whether independent estimates obtained made on the same animal are close to one another is important in determining the value of an instrument. When measurements are highly repeatable the instrument is said to provide a precise estimate with very little error, thus establishing a certain degree of confidence in the measurement. However, when an instrument has a low repeatability, each measurement has considerable error associated with it so that the average of several measurements are needed to provide a precise estimate. A repeatability coefficient of 1.0 would indicate a perfect agreement among such estimates. The farther apart the counts are, the lower the reepatability and the less confidence one has in the method. A repeatability of zero, indicates no association at all between repeat measurements on the same animal.

The repeatability coefficient of five EMME counts, randomly taken within a short time period, for the 41 head evaluated was 0.38. That is to say that 38% of the variation in the counts can be attributed to the variation in animals and that 62% of the variation is attributed to other sources.

Table 1 presents means and standard deviations for the live weight, EMME count, carcass measurements and physical separation data. There was considerable variation associated with EMME count as indicated by the lagre standard deviation, whereas, the standard deviations of other traits were much less.

Correlation coefficients, which have a range in value from —1.0 to +1.0 reflect the degree of association between two traits or variables. A coefficient of zero or near zero indicates that there is little or no association between the two variables. The correlations in Table 2 present what is termed partial correlation coefficients. That is, the two traits being related have been adjusted to a common basis for a third trait, in this case the data were adjusted to a common live weight of 220 pounds. To accomplish this, data from animals which exceed this weight were adjusted down and data from those animals which weighed less were adjusted upward. Thus, the correlations should be interpreted as if all barrows weighed exactly 220 pounds. EMME count was significantly correlated ($P<.05$) to percent total closely trimmed cuts (.34) and highly significantly ($P<.01$) associated with separable carcass lean (.44 and fat-free lean (.44), respectively. Other correlations were small and non-significant. Although certain of these correlations are positive and

Table 1. Means and Standard Deviations of Certain Live and Carcass Measurements

Trait	Mean[1]	S.D.
Live Weight, lbs.	218.3	7.63
EMME Count[2]	499	94
Carcass Weight, lbs.	157.2	6.11
Backfat, in.	1.15	0.16
Loin eye area, sq. in.	4.53	0.50
Closely trimmed lean cuts, lbs.	90.4	4.27
Separable lean, lbs.	82.4	5.56
Separable fat, lbs.	49.0	5.96
Separable bone, lbs.	20.0	2.56
Fat-free lean, lbs.	72.0	5.12

[1] Sample size = 41.
[2] EMME Count = Mean value of 5 random counts per animal.

Table 2. Correlations of EMME Count with Live Weight, Certain Carcass Measurements and Separable Lean, Fat and Bone

Trait	EMME Count[1]
Live Weight	0.30
Closely trimmed lean cuts, lbs.	0.20
Closely trimmed lean cuts, %	0.34*
Ham and Loin, %	0.23
Loin eye area, sq. in.	—.05
Backfat, in.	—.26
Separable lean, lbs.	0.44**
Separable lean, %	0.29
Separable fat, lbs.	—.19
Separable fat, %	—.29
Separable bone, lbs.	0.05
Separable bone, %	—.04
Fat-free lean, lbs.	0.44**

[1] Partial correlation coefficients for EMME count (mean of 5 values) and traits holding weight constant (with the exception of live weight).
* ($P < .05$).
** ($P < .01$).

statistically significant, they indicate at best a very weak relationship between EMME count and the traits evaluated in this study.

A graphical presentation of the relationship between mean EMME count and fat-free lean is shown in Figure 1. It can be seen from this

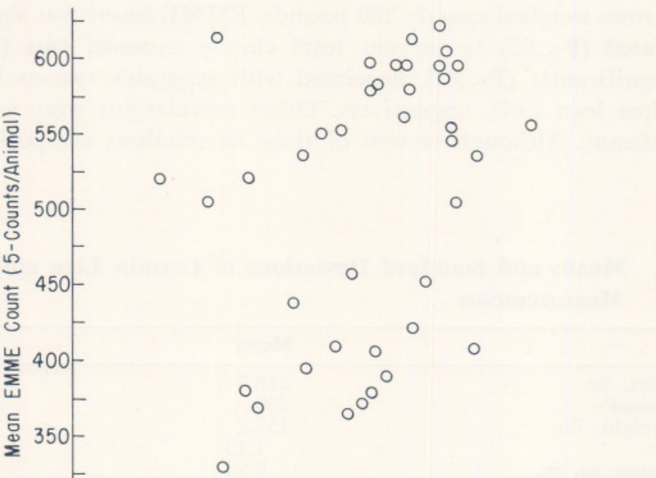

Figure 1. Plot of Mean EMME Count and Fat-Free Lean.

plot that there is a slight tendency for an increase in mean EMME count to be accompanied by an increase in fat-free lean. However, the inconsistency of this relationship can be observed in the scattered array of the points.

Prediction equations developed from this data provide a means by which measurements on live animals similar to those used in this study could be used to estimate the separable carcass lean and fat-free lean without slaughtering the animal. The coefficient of determination (R^2) indicates the total variation of the dependent variable (separable carcass lean or fat-free lean) accounted for by the independent variable (mean EMME count and live weight). Many factors constitute what would be a desirable coefficient of determination, but in general, the higher the better. The more sophisticated and expensive the measurement is the greater the accountable variation obtained should be to justify the added expense. The standard error of the estimate is the amount by which the predicted value differs on the average from the actual measurement being studied.

Linear prediction equations for separable carcass lean and fat-free lean using mean EMME count, and mean EMME count and live weight, respectively, as the independent variables are presented in Table 3. Coefficients of determination and standard error of estimate are also given for each prediction equation. Although the average miss of the prediction equations were not excessively large, the data suggest that the mean EMME count was not accountable for a large enough portion of the variation in these measurements of leanness to provide a useful estimate of leanness. Although the variation accounted for increased when mean EMME and live weight were fitted simultaneously to the model, it was still considerably less than that required to provide a strong and reliable predictor of leanness in market barrows.

Table 3. Prediction Equations for Certain Measurements of Carcass Leanness

Dependent Variable	R^2	Standard error of estimate	Independent Variable	
Separable lean, lbs.	25%	2.44	EMME	------
Fat-free lean, lbs.	24%	4.51	EMME	------
Separable lean, lbs.	31%	2.38	EMME	Live Weight
Fat-free lean, lbs.	27%	4.48	EMME	Live Weight