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Recognition of pork quality assets and liabilities as well as accurate prediction of meatiness in prospective breeding animals are necessary for genetic progress in those economically important traits. Tools which will improve the ability to select animals with superior muscle development and meat quality traits must be developed.

Muscle cell size has been associated with overall muscle or meat yield in past research. Recent European reports indicate relationships between muscle cell size and number and pork quality. A small sample of muscle, removed surgically from a breeding animal, could be evaluated and the results utilized in selection decisions if muscle cell characteristics do indicate meat quality and quantity traits. This study was initiated to determine if the reported relationships could be observed.

Procedure

Eighty-four crossbred barrows were self-fed rations containing 20% (high), 16% (moderate) and 12% (low) protein. Six treatments were designed by changing the protein levels during three feeding periods: 45 to 100 lb., 100 to 170 lb. and 170 to 240 lb. The treatments used are indicated in table 1. The barrows were slaughtered and chilled 24 hours before muscle samples were removed from the ham and loin for muscle cell or fiber evaluation. Carcass data including weight, length and backfat thickness were collected at the same time. Subsequent cutting of the carcasses resulted in the following data: loin eye area, ham weight, loin weight, edible portion weight, percent ham and loin, percent lean cuts, percent edible portion, marbling score of the loin eye and color and firmness score of the loin eye. Samples of the loin were removed and stored until percent moisture, fat and protein as well as shear tenderness and percent cooking loss could be determined.

Thin sections (10 microns) were prepared from the ham and loin muscle samples and photographed under a microscope. From the photographs, the average fiber diameter of each sample was determined by measuring a number of fibers per sample. The number of fibers per square millimeter (mm^2) were counted from the photograph by using a template scaled to equal 1 mm^2 at the original tissue dimension. The total number of muscle fibers per loin eye was calculated by multiplying the number of fibers per mm^2 by the number of mm^2 of loin eye area.

The data were analyzed to determine if treatment (protein levels fed at different growing and finishing stages) influenced fiber measurements. Simple correlation coefficients were calculated to evaluate the relationship between the fiber traits studied and other carcass and meat traits listed earlier.

Results

Table 1 lists the mean or average values for each fiber trait in the six treatment groups. Small differences were observed in the means indicating that the variations in protein levels did not influence muscle cell size and development. Statistical analysis did reveal a significant difference between the mean values for ham fibers per mm^2. The relatively wide spread between 155.06 fibers per mm^2 for treatment 2 and 167.69 fibers per mm^2 for treatment 3 may account for the statistical significance. Although the ham fiber diameter was the largest for treatment 2 and therefore one would expect fewer fibers per mm^2, the differences in fiber size do not account for the differences in interval between fibers per mm^2 means.

Table 2 lists correlation coefficients between muscle fiber traits and other carcass and meat traits studied. A correlation coefficient of ± 1.00 would indicate that a variation of one unit in one trait is always associated with a constant amount of variation in another trait. When correlations are high, it is possible to use an easily obtained measurement to estimate or predict something that is difficult or impossible to measure. Correlation coefficients approaching 0 (0.15 to -.15) indicate that one trait may vary with little, if any, relationship to the other trait.

The correlation coefficients in table 2 are low, particularly in the first four columns. Those columns represent data which could be obtained from a muscle sample removed from the animal. The muscle cell measurements used were of little value in estimating or predicting the other traits measured in the carcass. Larger correlation coefficients resulted when total fibers per loin eye area were calculated using loin fibers per mm^2 and loin eye area. It would appear that fibers per loin eye area may have some predictive usefulness. However, when the correlation coefficients between other traits and loin eye area alone are considered, they are even higher. Therefore, if a loin eye area measure is available, more advantage can be gained by using it alone than is possible by combining it with muscle fiber data to determine fibers per loin eye area. Loin fiber diameter demonstrated the highest correlation coefficients with the quality traits, marbling score and color and firmness score. However, the correlation coefficients of 0.34 and 0.28 are not high enough to permit accurate prediction or estimation of muscle quality from fiber measurements.

Summary

Muscle cell or fiber diameter measurements were made on samples from 84 cross-bred barrow carcasses and related to protein level treatments, pork quality traits and carcass evaluations of meatiness. The six protein level combinations used in this study did not influence muscle fiber diameter in the ham and loin. A significant difference was found between treatments in the number of ham fibers per square millimeter.

Correlation coefficients between muscle fiber traits and both carcass meatiness and pork quality traits were low.

Results of the study indicate that measurement of muscle fiber diameter of the loin and ham and number of fibers per mm^2 would not be effective selection tools in a group of uniform market weight swine.

Table 1. Treatment Means for Muscle Fiber Measurements

Traits	Treatments (Protein level within weight intervals[a])					
	1 (H-H-H)[a]	2 (H-M-L)	3 (L-L-L)	4 (L-M-H)	5 (M-L-L)	6 (M-L-M)
Ham fiber diameter (μ)	77.11	77.52	76.02	76.80	75.08	74.45
Loin fiber diameter (μ)	76.44	77.36	76.08	78.36	78.50	78.67
Ham fibers per mm^2	171.31	155.06	167.69	172.40	174.02	169.21
Loin fibers per mm^2	155.56	148.98	161.94	153.23	164.38	149.06
Total fibers per LEA (100)	4924.38	4567.25	4704.02	4821.44	5109.06	4536.65

[a] Protein levels: H = 20%, M = 16%, L = 12%. Weight intervals: (45 to 100-100 to 170-170 to 240 lb.).

Table 2. Simple Correlation Coefficients Between Muscle Fiber Measurements and Other Traits

	Ham fiber diameter	Loin fiber diameter	Ham fibers per mm^2	Loin fibers per mm^2	Total fibers per LEA	Loin eye area
Age at slaughter	0.10	0.13	0.06	-.27	-.22	0.06
Average daily gain	-.07	-.17	-.05	0.28	0.24	-.05
Carcass weight	0.10	0.24	-.21	-.28	-.07	0.32
Loin eye area	0.05	0.14	-.20	-.14	0.49	1.00
Backfat thickness	0.02	0.06	0.12	0.10	-.22	-.49
Carcass length	-.10	-.25	0.02	0.14	0.21	0.14
Percent ham and loin	-.01	-.08	0.03	0.06	0.43	0.61
Percent lean cuts	0.03	0.02	-.04	-.05	0.35	0.65
Percent edible portion	0.02	0.04	-.17	-.12	0.28	0.62
Ham weight	0.10	0.01	-.07	-.04	0.35	0.65
Loin weight	-.04	0.04	-.05	-.08	0.32	0.64
Edible portion weight	0.08	0.17	-.27	-.26	0.19	0.70
Percent moisture	0.13	-.11	0.04	0.07	0.10	0.10
Percent fat	-.10	0.00	-.02	-.03	-.15	-.25
Percent protein	0.03	0.05	-.06	0.13	0.15	0.07
Marbling score	0.10	0.34	0.07	-.02	-.10	-.18
Color and firmness score	0.20	0.28	0.06	0.05	-.03	-.15
Shear test	0.19	-.02	0.07	0.14	-.09	-.30
Percent cooking loss	-.07	0.13	-.15	-.23	0.11	0.48