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PREDICTING BEEF CARCASS SUBPRIMAL WEIGHT AND VALUE WITH ELECTROMAGNETIC SCANNING AND USDA YIELD GRADE

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BACKGROUND:

The U.S. beef industry has embraced the concept of value-based marketing. This means that cattle (or their carcasses) would be bought and sold on the basis of individual carcass merit. An effective value-based marketing program will require accurate techniques for assessing carcass composition. Electromagnetic scanning (also know as total body electrical conductivity; ToBEC) offers the accuracy and precision necessary for assessment of carcass value (Gwartney et al., 1994). Using electromagnetic scanning as a means to predict value is a relatively new idea. Akridge et al. (1992) indicated that the technology was effective at predicting pork carcass value. Determination of wholesale value requires that the technology be able to predict weight of the common subprimal cuts from a beef carcass, since they form the basis of value.

OBJECTIVE:

The objective of this study was to evaluate the use of electromagnetic scanning as a means to predict subprimal weight and carcass value, and to compare the technology to U.S. Department of Agriculture (USDA) yield grades.

METHODS:

Crossbred steers (n=219) from the U.S. Meat Animal Research Center germ plasm evaluation (cycle V) research program were slaughtered at a commercial plant on four different dates. These cattle represented a diversity of genotypes. After chilling, hindquarters were scanned in a model MQI-Pork Carcass electromagnetic scanner (Meat Quality, Inc., Springfield, IN) at 2.5 MHz. The internal temperature of the meat and the length of the hindquarter were recorded. The forequarters and hindquarters of each carcass were subsequently fabricated into primal cuts (round, loin, rib, and chuck) and then into sub-primal cuts, first with 0.76 cm of trimmable fat and then with 0 cm of trimmable fat. Weights of all primal and subprimal cuts were recorded at both levels of trimmable fat.

The USDA yield grade factors were obtained by USDA personnel to facilitate calculation of the correct yield grade. In addition, the single digit yield grade applied by the USDA grader in the meat plant was recorded.

Prices for the primal and subprimal cuts were obtained from the USDA Agricultural Marketing Service (Nov., 1994) where possible; in a few cases it was necessary to estimate wholesale value. Linear regression was used to predict primal and subprimal cut weights using the variables of scan peak, hindquarter weight, and hindquarter length. Similar estimates were obtained using the calculated yield grade and using the single-digit yield grade applied by the grader.

RESULTS AND DISCUSSION:

Electromagnetic scanning was successful in predicting lean weight contained within the round, loin, rib and chuck, with R-squares and residual mean square errors (RMSE), of .91 (1.0 kg), .82 (.8 kg), .78 (.6 kg), and .81 (1.7 kg), respectively, for primals containing 0.76 cm of trimmable fat. Results for primals containing 0 cm of trimmable fat, R-squares were equal or slightly lower and RMSE were of the same magnitude. Scanning the hindquarter predicted overall lean with R-squares of .92 (3.5 kg) and .91 (3.6 kg) for 0.76 and 0 cm of fat, respectively. Relatively strong relationships were also obtained for subprimal cuts (Table 1). Lighter weight cuts were more difficult to predict. Comparable results were obtained when cuts were trimmed to o cm of fat (data not shown).

The equations derived for Table 1, and similar ones which used calculated yield grade and USDA grader single-digit yield grade were used to estimate weight of subprimal cuts from the 219 carcasses. Actual or predicted weights were then multiplied by wholesale subprimal cut value to determine side value (Table 2). In every case, electromagnetic scanning was a more accurate predictor of total side value than either yield grade application . The calculated yield grade was also superior to the single digit yield grade assigned by the USDA grader, as expected. It should be noted, however, that under ideal conditions where yield grades can be calculated, they can be nearly as effective in predicting value. When the value was expressed on a dollars-per-hundred pounds basis, as is commonly done in the U.S., the results generally favored calculated yield grade over the electromagnetic scanning equations used here (data not shown). This is in part because dollars-per-hundred pounds is essentially a percentage value. Electromagnetic scanning predicts weight of cuts and yield grades were designed to predict percentages.

TABLE 1. PREDICTION OF SUBPRIMAL LEAN WEIGHT AT 0.76 CM OF FAT USING ELECTROMAGNETIC SCANNING.

Hindquarter cuts				Forequarter cuts			
Subprimal	R-square	RMSE[1] (kg)	Mean Weight, kg	Subprimal	R-square	RMSE[1] (kg)	Mean Weight, kg
Sirloin tip	.740	.29	4.78	Rib roast	.774	.46	7.07
Top round	.834	.38	8.05	Short ribs	.331	.22	1.51
Bottom round	.836	.46	9.09	Rib trim	.432	.29	2.18
Round trim	.766	.50	7.28	Clod roast	.793	.47	7.50
Tenderloin	.621	.20	2.46	Chuck tender	.603	.11	1.20
Strip loin	.667	.37	5.33	Cube steak	.522	.13	1.17
Sirloin roast	.703	.32	4.92	Chuck roll	.569	.71	7.98
Loin trim	.399	.52	3.44	Chuck trim	.638	1.12	13.92

[1]RMSE = root mean square error.

Note: Prediction model contained scan peak, hindquarter weight, and hindquarter length.

CONCLUSIONS:

These data indicate that electromagnetic scanning can provide accurate predictions of carcass wholesale value. Yield grades, when calculated, can also be useful. Applying the yield grading system on-line, by a USDA grader, in a single-digit format, does not provide equivalent accuracy.

TABLE 2. PREDICTION OF SIDE VALUE FROM ESTIMATED WEIGHTS OF PRIMAL AND SUBPRIMAL CUTS.

Grading technology	Fat trim, cm	Cut	R-Square	RMSE[1], $
Electromagnet scanning	0.76	Primal	.926	8.71
Calculated yield grade	0.76	Primal	.895	10.37
Single digit yield grade	0.76	Primal	.875	11.32
Electromagnetic scanning	0.76	Subprimal	.922	8.12
Calculated yield grade	0.76	Subprimal	.917	8.34
Single digit yield grade	0.76	Subprimal	.900	9.17
Electromagnetic scanning	0.0	Primal	.910	9.97
Calculated yield grade	0.0	Primal	.872	11.93
Single digit yield grade	0.0	Primal	.840	13.33
Electromagnetic scanning	0.0	Subprimal	.907	9.92
Calculated yield grade	0.0	Subprimal	.884	11.03
Single digit yield grade	0.0	Subprimal	.852	12.49

[1]RMSE = root mean square error.

PERTINENT LITERATURE:

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