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USE OF LINEAR MEASUREMENTS IN A REGRESSION EQUATION TO PREDICT RIBEYE AREA

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Summary

Thirty beef carcasses were used to test the accuracy of three regression equations to predict ribeye area (REA) and to compare several strategies to rapidly estimate REAs. Linear measurements, USDA grids, and Video Image Analysis (VIA) were used to determine REA from both right and left carcass sides. Ribeye areas measured by USDA grids and estimated by regression equations were highly correlated ($r>.94$) with REA measured by VIA. Regression equations using linear measurements and USDA grids were equally ($P=.73$) accurate in predicting VIA REA. Furthermore, REA from either the left or the larger (right or left) carcass sides accurately predicted the VIA REA from the larger carcass side. Therefore, in commercial packing facilities where chain speed may limit the opportunity to accurately grid or measure ribeyes, the linear measurements of left side ribeye length and widest-width can be collected and used in a regression equation to accurately predict the larger REA to be used in calculating yield grade.

(Key Words: Ribeye Area, Beef, USDA Ribeye Grids, Linear Measurements.)

Introduction

Ribeye area (REA) is the muscling factor used to calculate USDA yield grade. If both sides of a carcass are ribbed, the larger REA is used to determine yield grade. At current chain speeds in large commercial packing plants, time is insufficient to accurately measure ribeye area of one or both sides with a USDA grid. Video Image Analysis (VIA, a computerized system to measure REA) consistently and accurately measures REA and was the base against which we compared other measurements. Regression equations using linear measurements were developed previously to predict REA. The objective of our study was to evaluate the accuracy of three regression equations and ribeye grids in predicting REA and simple measurement strategies to accurately predict REA from the largest side (right or left).

Experimental Procedures

At a commercial packing facility, REAs from both right and left sides of 30 randomly selected beef carcasses were measured in three ways: (1) USDA grid, (2) linear measurements of ribeye length, mid-width, and widest-width (nearest .01 in.); and (3) tracing ribeyes onto acetate tracing paper at the packing facility and later measuring by VIA (a method utilizing a digital camera and computer). Linear measurements were used in three regression equations previously published in the 1997 Cattlemen's Day Report of Progress, to estimate REA. The three regression equations used to predict REA were:

(1) $REA = -9.604 + 2.404(L) + 3.317(MW)$, $R^2=.85$

(2) $REA = -10.911 + 2.443(L) + 3.347(WW)$, $R^2=.86$

(3) $REA = -11.011 + 2.216(L) + 1.837(MW) + 2.145(WW)$, $R^2=.91$

where REA is ribeye area (in.^{2})

L = length of ribeye (in.)

MW = width of ribeye at mid-length (in.)

WW = width of ribeye at the widest point (in.)

The 60 REAs from the right and left sides of 30 carcasses were used to compare (T-tests) the three regression equations and the USDA grid to the REA measured by VIA. Because the larger ribeye from the two sides is used to determine USDA yield grade, different strategies were evaluated using T-tests to determine which could most accurately predict the larger REA. Right side REA only, left side REA only, or the larger REA (either the right or left carcass side) using either linear measurements or a USDA grid were compared.

To determine which strategy most accurately predicts larger VIA carcass side (right or left) REA, the predicted REA from each strategy was subtracted from the larger side REA. The differences were analyzed in a 2 × 3 factorial arrangement of treatments with carcass as the blocking factor. Simple correlations were determined among the different measurement strategies.

Results and Discussion

Paired T-tests indicated that REAs predicted from equations 2 and 3 were similar (P$.13) to REA measured by VIA (actual REA, Table 1). The REA predicted from using USDA grids tended (P=.06) to be similar to REA measured by VIA. Equation 2 was selected for further study, because it had a high correlation (.95) and a similar ribeye mean to VIA, and used only two dependent variables to estimate REA.

Because the USDA yield grade equation uses the larger side, paired T-tests were performed (Table 2) to compare the larger side (right or left) REA measured by VIA to right, left, or larger side REA predicted from regression equation 2 or measured by USDA ribeye grids. Both left side REA and larger side REA predicted by equation 2 were similar (P>.20) to the larger VIA REA. Furthermore, the larger grid REA tended to be similar (P=.07) to the larger VIA REA. As expected, correlations (Table 3) were high (r≥.93) among all measurement strategies.

In the 2 × 3 factorial difference analysis, no interaction (P=.26) was detected for measurement method (equation 2 and USDA grid) and carcass side (right, left, or larger). No difference (P=.73) occurred between equation 2 and USDA grid for measuring REA. However, the differences from the VIA REA were significantly smaller (P<.001) for ribeyes from carcass left (.29 $in.^2$) and larger side (.14 $in.^2$) than for ribeyes from the right side (.65 $in.^2$). Equation 2 and the USDA grid were equally accurate in predicting REA. However, either the left or larger side REA should be used to accurately predict the REA to be used in the yield grade equation.

In commercial packing plants where chain speeds cause a time constraint, two simple measurements of length and widest-width of the left carcass side ribeye can be collected and incorporated into an equation to accurately predict REA.

Table 1. Means (n=60), Pearson Correlations, and P-Values for Ribeye Area Measured by VIA Compared to Ribeye Areas Predicted from Regression Equations Using Linear Measurements or USDA Ribeye Grid Areas

Item	Mean, $in.^2$	Correlation[a]	P-Value
VIA[b]	14.19	-	-
Equation 1[c]	13.86	.94	.01
Equation 2[d]	14.05	.95	.20
Equation 3[e]	14.04	.96	.13
USDA Grid	14.06	.98	.06

[a]Pearson correlations (r) of VIA with measurement methods.
[b]Video Image Analysis.
[c]y = -9.604 + 2.404(Length, in.) + 3.317(Mid-Width, in.) .
[d]y = -10.911 + 2.443(Length, in.) + 3.347(Widest-Width, in.).
[e]y = -11.011 + 2.216(Length, in.) + 1.837(Mid-Width, in.) + 2.145(Widest-Width, in.).

Table 2. Means (n=30), Pearson Correlations, and P-Values for the Larger Side (Right or Left) Ribeye Area Measured by VIA Compared to Left, Right, or Larger Side Ribeye Areas Predicted from a Regression Equation Using Linear Measurements or USDA Ribeye Grids

Measurement Method	Carcass Side[a]	Mean, $in.^2$	Correlation[b]	P-Value
VIA[c]	Larger	14.53	-	-
Equation[d]	Right	13.79	.95	.001
Equation[d]	Left	14.32	.93	.20
Equation[d]	Larger	14.44	.94	.36
USDA grid	Right	13.96	.98	.0001
USDA grid	Left	14.16	.97	.01
USDA grid	Larger	14.34	.98	.07

[a]Ribeye area measured on the right, left, or larger (right or left) carcass side.
[b]Pearson correlations (r) of VIA with measurement method and carcass side ribeye.
[c]Video Image Analysis.
[d]y = -10.911 + 2.443(Length, in.) + 3.347(Widest-Width, in.).

Table 3. Correlations among Different Strategies to Measure Ribeye Area

Measurement Method	Carcass Side[a]	VIA[b] Larger	Equation[c] Right	Equation[c] Left	Equation[c] Larger	Grid Right	Grid Left
Equation[c]	Right	.95	1				
Equation[c]	Left	.93	.93	1			
Equation[c]	Larger	.94	.95	.99	1		
USDA grid	Right	.98	.96	.96	.96	1	
USDA grid	Left	.97	.93	.96	.96	.97	1
USDA grid	Larger	.98	.95	.96	.96	.99	.99

[a]Ribeye area measured on the right, left, or larger (right or left) carcass side.
[b]Video Image Analysis of the larger (right or left) carcass side.
[c]y = -10.911 + 2.443(Length, in.) + 3.347(Widest-Width, in.).