Title: Predicting Pork Quality Using Measurement Collected from Various Locations on the Boneless Loin. **NPB #17-192**

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Industry Summary: This research was conducted to determine the ability of pork quality measurements collected on the intact boneless pork loin to sort loins into quality based groups. To accomplish this, measurements taken on the blade and sirloin end of the boneless pork loin as well as on the ventral surface were compared to similar measurement collected from the cross-section of the loin at the 10th rib. Based on these results it would appear that 10th rib NPPC marbling scores can be predicted with adequate accuracy to facilitate sorting boneless pork loins into marbling-based quality groups without necessitating cutting the loin at the 10th rib. It would also appear that this could be done in the plant environment using subjective marbling scores on the ventral side of the boneless pork loin. This is confirmed by the fact that 10th rib IMF %, which is highly correlated to 10th rib NPPC marbling score, can be accurately predicted using NPPC marbling scores assessed on the ventral surface of the boneless pork loin. Furthermore, it would appear from these data that 10th rib marbling scores could be predicted in bone-in loins using a marbling score estimate from the sirloin end. Unfortunately, the prediction of 10th rib color, using the measurements assessed in this study, does not appear to be accurate enough to facilitate sorting of boneless pork loins into color-based groups. Dean Pringle (dpringle@uga.edu).

Keywords: pork, loin, boneless, quality, sorting

Scientific Abstract: Many U.S. pork export markets demand high quality pork with darker color and higher marbling content than domestic markets. Although, the U.S pork industry does not have a quality grade program through the USDA-Agricultural Marketing Service, application of voluntary quality grade standards may result in financial benefits to the pork industry as well as enhanced eating experiences for consumers. This study analyzed quality measurements collected at locations along the surfaces of boneless pork loins to determine the relationship between these measures and traditional pork quality measures collected at the 10th rib. Market hogs (n=126) from two genetic lines and two sexes were slaughtered at 113.4, 136.1 and 158.8 kg endpoints. One genetic line was selected for increased lean yield, while the other was selected for meat quality attributes. Seven litters from each line with at least 6 pigs (3 barrows and 3 gilts) were used in the study. When the pigs reached their preassigned endpoint, they were transported to the University of Georgia Meat Science and Technology

Center and slaughtered under federal inspection. Following a 24-hr chill period, carcasses were ribbed between the 10th and 11th ribs, bloomed for 20 min and the following pork quality attributes were measured on 10th rib surface: Hunter L*, a*, b* (D_{65}); Minolta L*, a*, b* (D_{65}); and NPPC color and marbling score. Carcasses were then fabricated and the boneless loin (IMPS# 413C, trimmed to 0.64 cm of fat) was weighed. The loin was allowed to bloom, ventral side up, for at least 20 min before collection of the previously listed loin quality attributes collected at the following 5 locations anterior to posterior: blade-end and sirloin-end (cross section), and at approximately the 7th/8th rib, 12th/13th rib, and 1st/2nd lumbar regions on the ventral surface of the loin. These locations were evaluated since they would allow assessment of quality attributes without devaluing the loin. Pearson correlations were calculated between 10th rib color and marbling scores and all other loin measures and Max R^2 regression was used to determine the best variables to predict 10th rib color and marbling scores (SAS Institute Inc.). Sirloin end marbling score had the strongest correlation with 10th rib marbling score ($r=0.69$; $P<0.01$), followed closely by the 8th rib location on the ventral surface ($r=0.60$; $P<0.01$). Instrumental L* values were more highly correlated to 10th rib color than subjective color scores. For regression, subjective measures collected on the ventral surface of the loin were better predictors of 10th rib marbling score ($R^2=0.42$) than 10th rib color score ($R^2=0.26$), with marbling score and color score collected at the 8th rib region being the most valuable predictor. Inclusion of all subjective measures slightly increased the prediction accuracy for 10th rib marbling score ($R^2=0.53$) and 10th rib color score ($R^2=0.27$). In contrast, instrumental measures were better predictors of 10th rib color ($R^2>0.29$) than 10th rib marbling score ($R^2<0.15$). These results suggest that the U.S. pork industry could use measures on the intact loin to predict 10th rib marbling scores, providing the potential to sort loins into quality-based grades.

Introduction: Many U.S. pork export markets demand high quality pork with darker color and higher marbling content than domestic markets. Although, the U.S pork industry does not have a quality grade program through the USDA-Agricultural Marketing Service, application of voluntary quality grade standards may result in financial benefits to the pork industry as well as enhanced eating experiences for consumers.

Objectives: Determine the ability of subjective and instrumental pork quality measurements collected on the intact boneless pork loin to segregate them into quality-based groups that could be used for a pork quality grading system.

Materials & Methods: Market hogs (n=126) from two genetic lines and two sexes will be slaughtered at 250, 300, and 350 lbs to determine the relationship between measurements taken on the intact boneless loin (anterior end, posterior end, ventral side) and traditional quality measurements collected at the 10th rib. One of the genetic lines has been selected for lean yield while the other has been selected for meat quality attributes. Twelve litters from each line with at least 6 pigs (3 barrows/3 gilts) will be selected for use in the study. As the pigs reach approximately 150 pounds they will be randomly assigned within litter and sex class to the three slaughter weight endpoints. As the market hogs reach their assigned slaughter endpoint they will be transported to the University of Georgia Meat Science and Technology Center and slaughtered under federal inspection. Following a 24-h chill, pork carcasses will be ribbed between the 10th and 11th ribs and pork quality attributes will be measured after a 20 min bloom period. Instrumental measures of pH, temperature, and color (Hunter L*, a*, and b*) will be collected, along with subjective scores for marbling and color (NPPC Color Score).

Carcasses will be fabricated and the boneless loin (IMPS# 410), trimmed to ¼ inch of fat, will be weighed. The loin will be allowed to bloom ventral side up for at least 20 min before collection of loin quality attributes. Instrumental color (Hunter L*, a*, and b*) along with

NPPC color and marbling scores will be recorded on the anterior and posterior ends of the loin as well as the exposed lean on the ventral side of the loin.

Loin chops (1/2 inch thick) will be collected from the anterior, posterior, and 10th rib locations for determination of intramuscular fat content. Chops will be vacuum-packaged and frozen for subsequent analysis. Additionally, two loin chops (1 inch thick) will be collected from the 10th rib location of the loin for determination of Slice Shear Force and Warner Bratzler Shear Force. Shear force steaks will be vacuum-packaged, aged for 14 days, and frozen for subsequent analysis.

Results and Discussion: Table 1 shows the means for the NPPC Color and Marbling scores along with instrumental measures of color (L*, a*, and b* from a Hunter and a Minolta colorimeter) across the various locations measured on the boneless pork loin, as well as analyzed composition data from the 10th rib, blade end and sirloin end locations. NPPC color scores tended to be darker on the blade end and become lighter as measurement location moved towards the sirloin end. The region from the 8th rib to the 2nd lumbar was similar in color. In contrast, NPPC Marbling scores increased nearly stepwise from the blade to the sirloin end. The changes in color may be related to the prevalence of intramuscular fat in the various locations with the blade end being darker and lower in marbling than the sirloin end. Compositionally, the moisture percentages decreased going from the blade end to the sirloin end of the loin. Samples from the sirloin end of the loin were highest in measured fat percentage, followed by the blade end and finally the 10th rib location. One interesting finding was that the marbling scores collected at the 10th most closely resembled the lipid content at that location; however, the marbling scores on the sirloin and blade ends underestimated the corresponding lipid content.

Table 1. Means for subjective color and marbling and instrumental color at various locations on the boneless loin.

	Location					
	Blade end	8th rib*	10th rib	13th rib*	2nd lumbar*	Sirloin end
NPPC color	3.9	3.2	3.3	3.3	3.0	2.6
NPPC marbling	1.9	2.1	2.4	2.5	2.8	3.2
Hunter L*	47.1	56.0	57.8	53.8	53.9	57.7
Hunter a*	12.8	10.5	8.6	9.7	9.0	7.7
Hunter b*	16.5	17.5	17.3	16.5	16.4	16.0
Minolta L*	53.1	58.0	59.4	56.1	56.5	60.5
Minolta a*	24.0	20.8	19.0	20.3	19.6	18.9
Minolta b*	7.9	8.9	8.9	8.1	7.9	8.2
10th Rib moisture, %	73.10		72.27			70.68
10th Rib fat, %	3.06		2.77			4.75

* Measures from the exposed lean on the ventral surface of the loin.

Table 2 shows the Pearson correlations between NPPC marbling scores and measured intramuscular fat percentage (IMF %) from the 10th rib, blade end and sirloin end of the boneless loin. The correlations between the NPPC marbling scores collected at the ends of the boneless loin and the 10th rib location were highly significant, indicating that there is potential to utilize these measures to predict similar measures collected at the 10th rib. This may provide an opportunity to predict pork quality in the boneless loin without having to cut through the loin at the 10th rib. Likewise, the IMF % collected at the various locations on the loin were highly correlated. Correlations between the NPPC marbling scores and IMF % collected at the ends of the loin and the 10th rib location were also highly significant.

Table 2. Pearson correlations between NPPC marbling score and intramuscular fat percentage (IMF %) measured at the 10th rib, blade end and sirloin end of the boneless loin. (All correlations are significant, P < 0.01).

	Blade end marbling	Sirloin end marbling	10th rib IMF %	Blade end IMF %	Sirloin end IMF %
10th rib marbling	0.574	0.688	0.726	0.575	0.573
Blade end marbling	---	0.584	0.557	0.537	0.428
Sirloin end marbling		---	0.696	0.557	0.657
10th rib IMF %			---	0.685	0.633
Blade end IMF %				---	0.532
Sirloin end IMF %					---

Table 3 shows the Pearson correlation coefficients between NPPC color and marbling scores along with instrumental L* and IMF % and NPPC color and marbling scores collected at various locations on the boneless pork loin. For 10th rib color, there were significant correlations between NPPC color scores collected on the ventral surface of the loin; however, the NPPC color scores on the ventral surface of the boneless loin accounted for less than 25% of the variation in 10th rib NPPC color scores. Conversely, NPPC marbling scores at all the locations were highly correlated with 10th rib NPPC marbling scores, with sirloin end and 8th rib marbling scores accounting for approximately 60% of the variation in 10th rib NPPC marbling scores. L* values from both the Hunter and Minolta were better at predicting NPPC color than NPPC marbling at all locations accessed along the boneless loin. Compositional analysis showed that 10th rib IMF % is highly correlated to NPPC marbling scores at all locations.

Table 3. Pearson correlations between NPPC color and marbling scores along with instrumental L* and IMF % at the 10th rib and NPPC color and marbling scores from various locations on the loin (Correlations coefficients larger than 0.165 and 0.215 are significant at P < 0.05 and P < 0.01, respectively).

	NPPC 10th rib color	NPPC 10th rib marbling	Hunter 10th rib L*	Minolta 10th rib L*	10th rib IMF %
NPPC Scores					
Blade end color	0.304	0.137	-0.177	-0.249	0.052
Blade end marbling	0.129	0.574	-0.158	-0.139	0.557
Sirloin end color	0.301	0.126	-0.355	-0.362	0.084
Sirloin end marbling	0.136	0.688	-0.077	-0.107	0.696
8th rib color	0.482	0.189	-0.344	-0.410	0.018
8th rib marbling	0.060	0.599	-0.014	-0.030	0.650
13th rib color	0.411	0.193	-0.267	-0.380	0.003
13th rib marbling	-0.025	0.560	0.080	0.063	0.664

2nd lumbar color	0.423	0.191	-0.364	-0.407	0.047
2nd lumbar marbling	0.050	0.584	0.108	0.071	0.671

Table 4 shows the Pearson correlation coefficients between NPPC color and marbling scores along with instrumental L* and IMF % at the 10th rib and Hunter L*, a*, and b* measurements collected at various locations on the boneless pork loin. Hunter L* values collected on the ventral surface of the loin were significantly correlated to 10th rib NPPC color scores, with L* values measured at the 2nd lumbar vertebrae having the highest correlation. The only significant correlation between Hunter measures and 10th rib NPPC marbling scores was the 8th rib a* measurement. Similarly, instrumental measures taken by the Hunter and Minolta show that L* values taken at the 10th rib are significantly correlated to the ventral Hunter L* measurements. Hunter L* values collected at the 8th and 13th rib locations were correlated to 10th rib IMF %.

Table 4. Pearson correlations between NPPC color and marbling scores along with instrumental L* and IMF % at the 10th rib and Hunter Colorimeter (L*, a*, b*) measures from various locations on the loin (Correlations coefficients larger than 0.165 and 0.215 are significant at $P < 0.05$ and $P < 0.01$, respectively).

	NPPC 10th rib color	NPPC 10th rib marbling	Hunter 10th rib L*	Minolta 10th rib L*	10th rib IMF %
Hunter measures					
Blade end L*	-0.200	-0.065	0.194	0.169	0.087
Blade end a*	0.071	-0.007	-0.106	-0.143	-0.079
Blade end b*	-0.204	-0.038	0.032	-0.027	-0.004
Sirloin end L*	-0.317	-0.097	0.433	0.402	0.090
Sirloin end a*	0.300	-0.015	-0.140	-0.167	0.027
Sirloin end b*	0.042	-0.049	0.152	0.102	0.091
8th rib L*	-0.368	-0.036	0.575	0.552	0.228
8th rib a*	0.150	-0.254	-0.022	-0.013	-0.168
8th rib b*	-0.065	-0.130	0.261	0.206	0.079
13th rib L*	-0.338	-0.027	0.557	0.557	0.245
13th rib a*	0.124	-0.055	-0.224	-0.240	-0.062
13th rib b*	-0.087	-0.092	0.144	0.131	0.081
2nd lumbar L*	-0.432	-0.131	0.512	0.528	0.116
2nd lumbar a*	0.299	-0.043	-0.182	-0.216	-0.045
2nd lumbar b*	0.021	-0.133	0.158	0.104	0.056

Table 5 shows the Pearson correlation coefficients between NPPC color and marbling scores along with instrumental L* and IMF % at the 10th rib and Minolta L*, a*, and b* measurements collected at various locations on the boneless pork loin. As expected, the results are similar to those found when comparing 10th rib NPPC color and marbling scores with Hunter colorimeter measures (Table 4), in that NPPC color scores at the 10th rib were correlated with Minolta L* values on the ventral surface of the loin and NPPC marbling scores were correlated with Minolta 8th rib a* values. Instrumental measures taken by the Hunter and Minolta show that L* values taken at the 10th rib are significantly correlated to the ventral Minolta L* measurements. Similar to the Hunter L* correlations from the previous table, the Minolta L* 13th rib measurement was correlated to 10th rib IMF %.

Table 5. Pearson correlations between NPPC color and marbling score along with instrumental L* and IMF % at the 10th rib and Minolta Colorimeter (L*, a*, b*) measures from various locations on the loin (Correlations coefficients larger than 0.165 and 0.215 are significant at $P < 0.05$ and $P < 0.01$, respectively).

	NPPC 10th rib color	NPPC 10th rib marbling	Hunter 10th rib L*	Minolta 10th rib L*	10th rib IMF %
Minolta measures					
Blade end L*	-0.264	-0.069	0.224	0.220	0.038
Blade end a*	-0.037	-0.020	-0.086	-0.051	-0.027
Blade end b*	-0.265	-0.077	0.066	0.089	-0.046
Sirloin end L*	-0.306	-0.120	0.497	0.456	0.032
Sirloin end a*	0.269	0.013	-0.077	-0.127	0.057
Sirloin end b*	-0.105	-0.044	0.334	0.268	0.072
8th rib L*	-0.426	-0.160	0.628	0.604	0.139
8th rib a*	0.144	-0.164	-0.022	-0.007	-0.117
8th rib b*	-0.196	-0.150	0.400	0.394	0.077
13th rib L*	-0.516	-0.070	0.655	0.689	0.212
13th rib a*	0.138	-0.064	-0.056	-0.111	0.015
13th rib b*	-0.241	-0.084	0.347	0.312	0.126
2nd lumbar L*	-0.474	-0.129	0.576	0.605	0.104
2nd lumbar a*	0.365	0.003	-0.124	-0.195	0.055
2nd lumbar b*	-0.084	-0.088	0.277	0.215	0.115

Table 6 shows the ability of subjective color and marbling scores and instrumental color measures collected at various locations on the boneless loin to predict 10th rib NPPC color scores. The first regression shows a practical application by using the 3 ventral subjective color measurements which account for 26% of the variation in 10th rib NPPC color scores. The best three subjective color measures accounted for 27% of the variation in 10th rib NPPC color scores and included color at the 8th rib, 2nd lumbar, and on the blade end. The best models to predict 10th rib NPPC color scores using Hunter colorimeter and Minolta colorimeter measures were slightly better than using subjective measures and accounted for 29% and 37% of the variation in 10th rib NPPC color scores, respectively. When all subjective and instrumental data was used, the best model for predicting 10th NPPC color score accounted for 48% of the variation. However, collecting all the information needed for this model would prove difficult to implement in the plant environment.

Table 6. Prediction of 10th rib NPPC Color Scores (selection of variables by Max R^2 regression).

Variables	R^2
Best model using subjective color score from the ventral surface of the loin	
8th rib color, 2nd lumbar color, 13th rib color	0.257
Best model using subjective color scores from various locations	
8th rib color, 2nd lumbar color, blade end color	0.270
Best model using all subjective scores from various locations	
8th rib color, 2nd lumbar color, blade end color, blade end marbling	0.282
Best model using Hunter instrumental measurements	
8th rib L*, 2nd lumbar L*, blade end b*, 2nd lumbar a*, sirloin end a*, 8th rib a*	0.287
Best model using Minolta instrumental measurements	
13th rib L*, 2nd lumbar a*, 13th rib a*, blade end b*	0.372
Best model using all data collected	
Min. 13th rib L*, 8th rib color, Min. 13th rib a*, Min. blade end b*, Min. 2nd lumbar a*, 8th rib marbling, Hun. sirloin end a*, blade end color, Min. blade end L*, Hun. 2nd lumbar a*	0.475

Table 7 shows the ability of subjective color and marbling scores and instrumental color measures to predict 10th rib NPPC marbling scores. The first regression shows a practical application by using the 3 ventral subjective marbling measurements which account for 42% of variation in 10th rib NPPC marbling scores. The best three subjective marbling measures accounted for 53% of the variation in 10th rib NPPC marbling scores and included marbling scores on the sirloin and blade ends and on the ventral surface at the 8th rib. The best models to predict 10th rib NPPC marbling scores using Hunter colorimeter and Minolta colorimeter measures were considerably worse than using subjective measures and accounted for 15% and 10% of the variation in 10th rib NPPC marbling scores, respectively. When all subjective and instrumental data was used, the best model for predicting 10th NPPC marbling score accounted for 59% of the variation.

Table 7. Prediction of 10th rib NPPC Marbling Scores (selection of variables by Max R^2 regression).

Best model using subjective marbling scores from the ventral surface of the loin	
Variables	R^2
8th rib marbling, 2nd lumbar marbling, 13th rib marbling	0.418
Best model using subjective marbling scores from various locations	
Variables	R^2
Sirloin end marbling, 8th rib marbling, blade end marbling	0.528
Best model using all subjective scores from various locations	
Variables	R^2
Sirloin end marbling, 8th rib marbling, 13th rib color	0.567
Best model using Hunter instrumental measurements	
Variables	
8th rib a*, 8th rib b*, 2nd lumbar L*, 8th rib L*	0.152
Best model using Minolta instrumental measurements	
Variables	R^2
8th rib a*, 8th rib L*, 2nd lumbar a*, 8th rib b*	0.102
Best model using all data collected	
Variables	R^2
Sirloin end marbling, 8th rib marbling, 13th rib color, Hun. 13th rib b*, Min. 8th rib L*	0.589

Table 8 shows the ability of subjective color and marbling scores and instrumental color measures collected at various locations on the boneless pork loin to predict 10th rib Hunter L* values. Together, subjective color and marbling scores from various locations along the loin accounted for 31% of the variation compared to using only subjective color from various locations which accounted for only 23% of variation in 10th rib Hunter L* values. When looking at instrumental values alone, it was very interesting that the Minolta measurements taken from various locations on the boneless loin accounted for more variability in 10th rib Hunter L* than the Hunter measurements. When all subjective and instrumental data was used, the best model for predicting 10th rib Hunter L* values accounted for 63% of the variation.

Table 8. Prediction of 10th rib Hunter L*values (selection of variables by Max R^2 regression).

Variables	R^2
Best model using subjective color score from the ventral surface of the loin	
2nd lumbar color, 8th rib color, 13th rib color	0.165
Best model using subjective color scores from various locations	
8th rib color, sirloin end color, blade end color, 2nd lumbar color	0.231
Best model using all subjective scores from various locations	
Sirloin end color, 8th rib color, 2nd lumbar marbling, blade end marbling, blade end color, sirloin end marbling	0.309
Best model using Hunter instrumental measurements	
8th rib L*, 13th rib L*, 8th rib a*, 2nd lumbar a*	0.475
Best model using Minolta instrumental measurements	
8th rib L*, sirloin end L*, 13th rib L*, 8th rib a*, blade end b*	0.596
Best model using all data collected	
Min. 8th rib L*, Min. sirloin end L*, Min. 13th rib L*, Min. 8th rib a*, blade end marbling, Hun. Blade end b*, 13th rib marbling	0.633

Table 9 shows the ability of subjective color and marbling scores and instrumental color measures collected at various locations on the boneless pork loin to predict 10th rib Minolta L* values. Both subjective color and marbling scores from various locations along the loin accounted for 31% of the variation in 10th rib Minolta L* values, compared to using only subjective color from various locations which accounted for only 25% of variation in 10th rib Minolta L* values. When looking at instrumental values alone, the various Minolta measurements again accounted for more variability (61%) than that of Hunter measurements (54%). When all subjective and instrumental data was used, the best model for predicting 10th rib Hunter L* values accounted for 67% of the variation.

Table 9. Prediction of 10th rib Minolta L* values (selection of variables by Max R^2 regression).

Variables	R^2
Best model using subjective color score from the ventral surface of the loin	
8th rib color, 2nd lumbar color, 13th rib color	0.206
Best model using subjective color scores from various locations	
8th rib color, sirloin end color, blade end color, 2nd lumbar color	0.258
Best model using all subjective scores from various locations	
8th rib color, sirloin end color, 2nd lumbar marbling, sirloin end marbling, blade end marbling, blade end color	0.313
Best model using Hunter instrumental measurements	
8th rib L*, 8th rib a*, 13th rib a*, 2nd lumbar L*, 8th rib b*, 13th rib b*, blade end a*	0.540
Best model using Minolta instrumental measurements	
8th rib L*, 8th rib a*, 13th rib L*, 2nd lumbar b*, sirloin end L*, 2nd lumbar L*	0.610
Best model using all data collected	
Min. 8th rib L*, Min. 8th rib a*, Hun. blade end b*, Min. 13th rib L*, Min. sirloin end L*, 13th rib marbling, Min. 2nd lumbar b*, blade end marbling, 13th rib color, 8th rib marbling, Min. 2nd lumbar L*	0.665

Table 10 shows the ability of subjective color and marbling scores and instrumental color measures collected from various locations on the boneless pork loin to predict 10th rib intramuscular fat percentage (IMF %). The first regression shows a practical application by using the 3 ventral subjective marbling measurements which account for 53% of variation in 10th rib IMF %. Using subjective marbling scores from all the locations to predict 10th rib IMF % showed that the marbling scores from the sirloin end and on the ventral surface of the loin at the 8th rib and 2nd lumbar locations accounted for 57% of the variation in 10th rib IMF %. As expected, adding subjective color measurements as possible predictors of 10th rib IMF % did not improve the prediction accuracy (57%) and, in fact, the same equation maximized the prediction of 10th rib IMF %. Neither method for measuring instrumental color (Hunter or Minolta) accounted for more than 10% of the variation in 10th rib IMF %, suggesting that there is little value in the instrumental measures to predict this variable. When looking at the best model using all the data collected, 68% of the variation in 10th rib IMF % was accounted for.

Table 10. Prediction of 10th rib intramuscular fat percent (selection of variables by Max R^2 regression).

Best model using subjective marbling score from the ventral surface of the loin	
Variables	R^2
2nd lumbar marbling, 8th rib marbling, 13th rib marbling	0.526
Best model using subjective marbling scores from various locations	
Variables	R^2
Sirloin end marbling, 8th rib marbling, 2nd lumbar marbling	0.571
Best model using all subjective scores from various locations	
Variables	R^2
Sirloin end marbling, 8th rib marbling, 2nd lumbar marbling	0.571
Best model using Hunter instrumental measurements	
Variables	
13th rib L*	0.060
Best model using Minolta instrumental measurements	
Variables	R^2
13th rib L*, 2nd lumbar a*, 8th rib a*	0.093
Best model using all data collected	
Variables	R^2
Sirloin end marbling, 8th rib marbling, Min. 13th rib L*, Min. 13th rib a*, Hun. 13th rib L*, 2nd lumbar color, Hun. 2nd lumbar L*, blade end marbling, Hun. sirloin end a*	0.681

Based on these results it would appear that 10th rib NPPC marbling scores can be predicted with adequate accuracy to facilitate sorting boneless pork loins into marbling-based quality groups without necessitating cutting the loin at the 10th rib. It would also appear that this could be done in the plant environment using subjective marbling scores on the ventral side of the boneless pork loin. This is confirmed by the fact that 10th rib IMF %, which is highly correlated to 10th rib NPPC marbling score, can be accurately predicted using NPPC marbling scores assessed on the ventral surface of the boneless pork loin. Furthermore, it would appear from these data that 10th rib marbling scores could be predicted in bone-in loins using a marbling score estimate from the sirloin end. Unfortunately, the prediction of 10th rib color, using the measurements assessed in this study, does not appear to be accurate enough to facilitate sorting of boneless pork loins into color-based groups.