Tenderness and beef palatability traits of Limousin Jersey cross bred steers and Certified Angus Beef.

Final Report to Wulf Limousin

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Introduction

Delivering a quality eating experience is essential to the continued success of the beef industryôs efforts to build consumer demand for beef products. Beef tenderness has become an important topic in todayôs cattle industry as tenderness is the primary determinant of eating satisfaction among beef consumers (Huffman et al., 1996). Furthermore, structural changes in the beef industry have resulted in greater vertical coordination of production, processing, and marketing activities, making it feasible to manage product attributes along the entire beef chain (Barkema et al., 1996). Variation in meat tenderness has significant impact on consumer satisfaction with beef; however, classic selection techniques have not been effective in eliminating the portion of animals yielding undesirable palatability traits. Cattle producers who operate successfully in todayôs vertically coordinated business structures possess a heightened awareness of consumersô preferences and embrace production goals that are more clearly focused on satisfying the end-users of their products. ñThe produce-and-then-sell mentality of the commodity business is being replaced by the strategy of first asking consumers what they want as attributes in their food products and then creating or manufacturing those attributes in the productsò (Boehlje et al., 1995). The Limousin x Jersey cross compliments positive attributes in both breeds with Jersey cattle offering an exceptional eating experience and Limousins contributing outstanding cutability attributes. Jersey cattle have proved to rank the highest among all breeds in tenderness, juiciness, and flavor. Limousin ranked sixteenth in tenderness, fifth in flavor, and fifteenth in juiciness. Angus was third in tenderness, tenth in flavor, and third in juiciness (Shanks and Wulf, Personal Communication, July 9, 2012). Research is limited on the palatability of Limousin x Jersey crosses and how they compare in tenderness, flavor, and juiciness to Certified Angus Beef. Therefore, the objective of this study was to determine the overall acceptance and palatability of Limousin x Jersey crosses compared to Certified Angus Beef.

Material and Methods

Sample Collection

Limousin x Jersey cross steers (n=56) were randomly selected and slaughtered at Tyson Fresh Meats (Dakota City, NE). Hot carcass weights (HCW); ribeye area (REA); 12th rib fat thickness

(FT); percent kidney, pelvic, and heart fat (KPH); marbling score (MS); were provided from the plant camera data collection system. Objective color analysis including L* (a measurement of brightness, 0 = black, 100 = white); a* (a measure of redness/greenness, positive value = red, negative values = green); and b* (a measure of yellowness/blueness, positive values = yellow, negative values = blue) colorimeter measurements was recorded on the exposed external carcass fat over the rib and loin sections using a Minolta Chroma Meter CR-310 (Minolta Corp., Ramsey, NJ) with a 50-mm diameter measuring area and a D65 illuminant were obtained approximately 30 minutes after grading. Carcasses (n=32) were randomly selected that were less than 30 months of age, showed no dairy influence, contained adequate marbling to grade select or better, and was not a dark cutter. Carcasses were then separated based upon the steerôs sire. One carcass was removed from the subsample as it did not fit the criteria of the subsample. Full strip loins (n=31) were removed from the subsample and were transported to the South Dakota State University Meat Laboratory along with randomly selected Certified Angus Beef (CAB) full strip loins (n=25) under refrigeration for further analysis.

Sample Processing

Strip loins were held at 34°F for 12-18 hours upon receiving at the SDSU Meat Laboratory. Strip loins were first prepared by trimming the *longissimus dorsi* muscle of all excess fat and then two 1 in steaks were cut using a meat slicer in preparation for Warner-Bratzler shear force (WBSF), and taste panel analysis. Steaks were vacuum packaged and stored at 34°F for 14 days then frozen at -20°F prior to further analysis.

Warner-Bratzler shear force

Frozen steaks were allowed to thaw at 36°F for 24 hours before tenderness evaluation. Warner-Bratzler shear force (WBSF) was evaluated and recorded using protocol standards developed by the American Meat Science Association (AMSA, 1995). The steaks were cooked in an electric clamshell grill (George Foreman Indoor/Outdoor Grill, model GGR62, Lake Forest, IL) to an internal temperature of 160°F, and peak internal temperature was recorded. Steaks were cooled for 24 h at 34°F, and six cores were removed parallel to the muscle fiber orientation from each steak and sheared once perpendicular to the muscle fibers. The mean WBSF value was calculated by averaging all 6 cores for each steak.

Taste Panel Analysis

Taste panel sensory evaluation was performed on one steak per original allotment group which had been aged 14 days and frozen. Frozen steaks were allowed to thaw at 36°F for 12 hours before sensory panel evaluation. Steaks were cooked on an open electric griddle to an internal temperature of 160°F, allowed to rest and cut into 1cm x 1cm x 1in samples for panelists. Six panelist rated the samples based upon a 1 to 8 scale for tenderness (1=Extremely Tough, 2=Very Tough, 3=Moderately Tough, 4=Slightly Tough, 5=Slightly Tender, 6=Moderately Tender, 7=Very Tender, 8=Extremely Tender); juiciness (1 = Extremely Dry, 2 = Very Dry, 3 = Moderately Dry, 4 = Slightly Dry, 5 = Slightly Juicy, 6 = Moderately Juicy, 7 = Very Juicy, 8 = Extremely Juicy); beef flavor intensity (1 = Extremely Bland, 2 = Very Bland, 3 = Moderately Bland, 4 = Slightly Bland, 5 = Slightly Intense, 6 = Moderately Intense, 7 = Very Intense, 8 = Extremely Intense); and off flavor (1=Extremely Intense, 2=Very Intense, 3=Moderately Intense, 4=Slightly Intense, 5=Moderately Detectable, 6=Slightly Detectable, 7=Very Slightly Detectable, 8=Non Detectable).

Statistical Analysis

The carcass data, L*, a*, b*, WBSF, subjective and objective color analysis and taste panel analysis were analyzed as a completely randomized design with steak or animal as the experimental unit using PROC GLM in SAS.

Results and Discussion

Beef palatability is an extremely important attribute of beef products that is influenced by flavor, juiciness and tenderness, with tenderness being the most important trait in fresh beef products. Table 1 shows Warner-Bratzler shear force values and palatability characteristics of Limousin x Jersey and Certified Angus Beef (CAB) steaks. Limousin x Jersey steaks showed increased WBSF values (P = 0.0059, Figure 1) over CAB steaks signifying a less tender steak than CAB. However, WBSF values for Limousin x Jersey steaks were highly acceptable WBSF values as it is under the tenderness threshold of 4.6 kg set by Shackelford et al., (1991). Furthermore, according to Miller et al., (2001) beef steaks having a WBSF value of <3.0 kg would result in 100% consumer acceptability for tenderness. According to the taste analysis results as shown in

Table 1, Limousin x Jersey steaks were not different in tenderness (P = 0.2657), juiciness (P = 0.1476), beef flavor (P = 0.4355), and off flavor (P = 0.6123) when compared to CAB steaks using a trained taste panel.

Table 2 shows objective Minolta colorimeter values of external carcass fat over the loin and rib of Limousin x Jersey and CAB carcasses. Over the rib, L* and b* were significantly lower (P Ò 0.05) in carcass fat color of Limousin x Jersey steers verse CAB carcasses indicating a darker, more blue fat color. Additionally, Limousin x Jersey steers showed a higher (P = 0.0028) a* color value. Over the loin, L* and b* were significantly higher (P < 0.05) for CAB carcasses. Meanwhile a* values over the loin region did not differ (P = 0.3235). Although L*, a* and b* were statistically different, visual appraisal of Limousin x Jersey carcasses showed a thinner layer of fat covering compared to CAB but could not determine any differences in fat color. Consequently, the external carcass fat of Limousin x Jersey carcasses were a visually acceptable white color; however, the thin layer of fat allowed color from the underlying muscle to emerge causing a bluing to occur resulting in statistically lower L* and b* values.

Carcass characteristics between sire groups for the Limousin x Jersey steers are presented Table 3. The results display no differences (P > 0.05) for FT, HCW, REA, KPH, yield grade, MS, lean maturity, or skeletal maturity. However, when Limousin x Jersey carcasses were sorted into marbling scores of greater than Small^{00} (USDA Choice) and less than Small^{00} (USDA Select) differences were found in steak palatability as assessed by a trained taste panel. Panelists ranked USDA Select Limousin x Jersey steaks more tender (P = 0.0078) with a more intense beef flavor (P = 0.0076) than USDA Choice steaks when WBSF was not different (P = 0.2358). Juiciness and off flavors were unaffected by the amounts of marbling content in Limousin x Jersey steaks (P = 0.7266 and P = 0.2349, respectively). According to Killinger et al., (2004), consumers are willing to pay more for a low marbling steak when their tenderness preference is met than a highly marbled steak. This would suggest that at least a portion of consumers may be willing to pay more for Select Limousin x Jersey steaks than Choice based on the difference found in tenderness.

Conclusion

Limousin x Jersey steaks showed no differences in palatability with CAB steaks as subjectively analyzed by a trained taste panel. Both Limousin x Jersey steaks and Certified Angus Beef steaks were categorized as tender products, with Certified Angus Beef having a slight benefit of being more tender according to WBSF assessment. External fat covering of Limousin x Jersey carcasses are an acceptable white color, but consequently the leanness of the carcasses may produce a darker color measurement value. From a consumer stand point, Limousin x Jersey steaks are comparable to CAB steaks and may provide a favorable eating experience to some consumers as they were leaner steaks that were similar in tenderness and flavor.

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Table 1. Least Squared means of WBSF, and palatability traits of Limousin x Jersey and CAB steaks.

Item[a]	Treatment				
	Limousin x Jersey	SEM	Certified Angus Beef	SEM	*P*-Value
WBSF (kg)	2.58[x]	0.08	2.22[y]	0.09	0.0059
Tenderness	5.78	0.11	5.97	0.12	0.2657
Juiciness	5.34	0.08	5.52	0.09	0.1476
Beef Flavor	6.11	0.07	6.19	0.08	0.4355
Off Flavor	7.68	0.04	7.65	0.04	0.6123

[a] WBSF = Warner-Bratzler shear force; Tenderness: 1 = Extremely tough, 8 = Extremely tender; Juiciness: 1 = Extremely dry, 8 = Extremely juicy; Beef Flavor: 1 = Extremely bland, 8 = Extremely intense; Off Flavor: 1 = Extremely intense, 8 = Non detectable

[xy] Means within rows with different superscripts differ ($P < 0.05$)

Figure 1. Least Squared Means of WBSF of Limousin x Jersey and CAB steaks. [ab]Means with different superscripts differ ($P<0.05$).

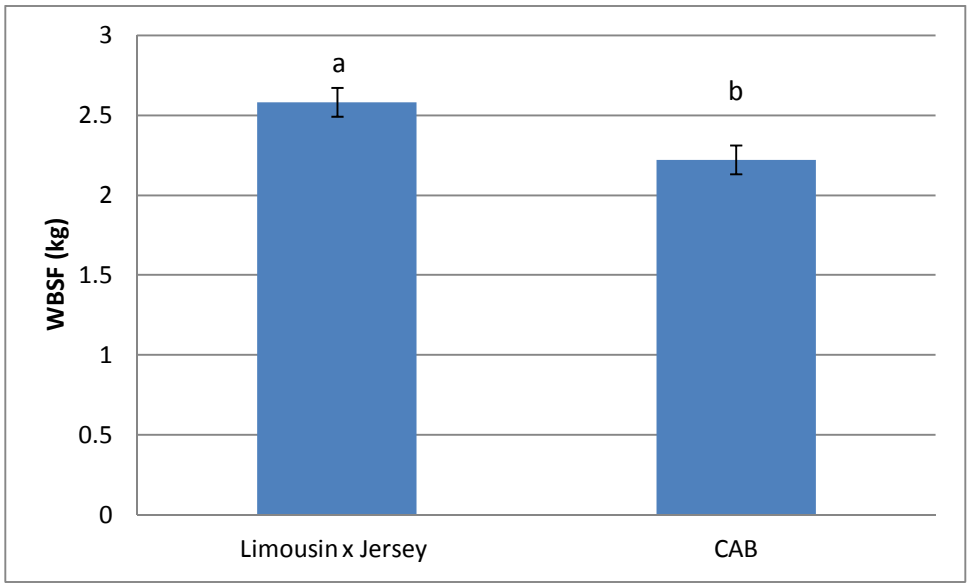

Table 2. Least Squared means of fat color for Limousin x Jersey and CAB carcasses.

Item[a]	Treatment				
	Limousin x Jersey	SEM	Certified Angus Beef	SEM	*P*-Value
Loin Fat L*	82.04[y]	0.25	82.96[x]	0.28	0.0195
Loin Fat a*	1.80	0.14	1.59	0.15	0.3235
Loin Fat b*	10.33[y]	0.26	12.36[x]	0.29	<0.0001
Rib Fat L*	81.32[y]	0.25	83.37[x]	0.28	<0.0001
Rib Fat a*	2.15[y]	0.14	1.48[x]	0.16	0.0028
Rib Fat b*	10.98[y]	0.24	11.88[x]	0.28	0.0179

[a] L*(brightness): 0=black, 100=white; a* (redness/greenness): positive = red, negative = green; b* (yellowness/blueness): positive = yellow, negative = blue.

[xy]Means within rows that have different superscripts differ *P<0.05*.

Figure 2. Least Squared Means of L* Values for Limousin x Jersey and CAB carcasses over the loin and rib region. Means within each measurement different superscripts differ ($P<0.05$).

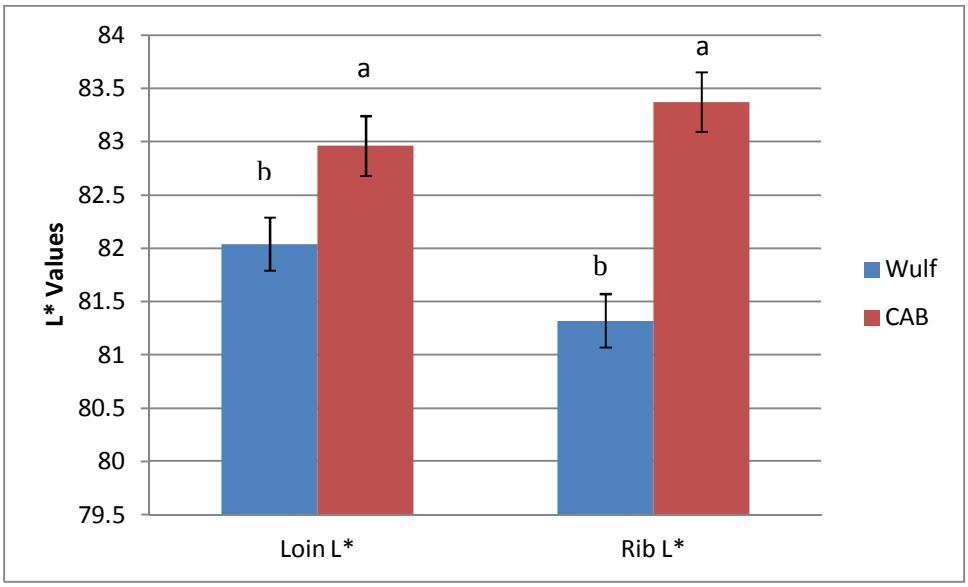

Figure 3. Least Squared Means of a* Values for Limousin x Jersey and CAB carcasses over the rib region. Means within each measurement different superscripts differ ($P<0.05$).

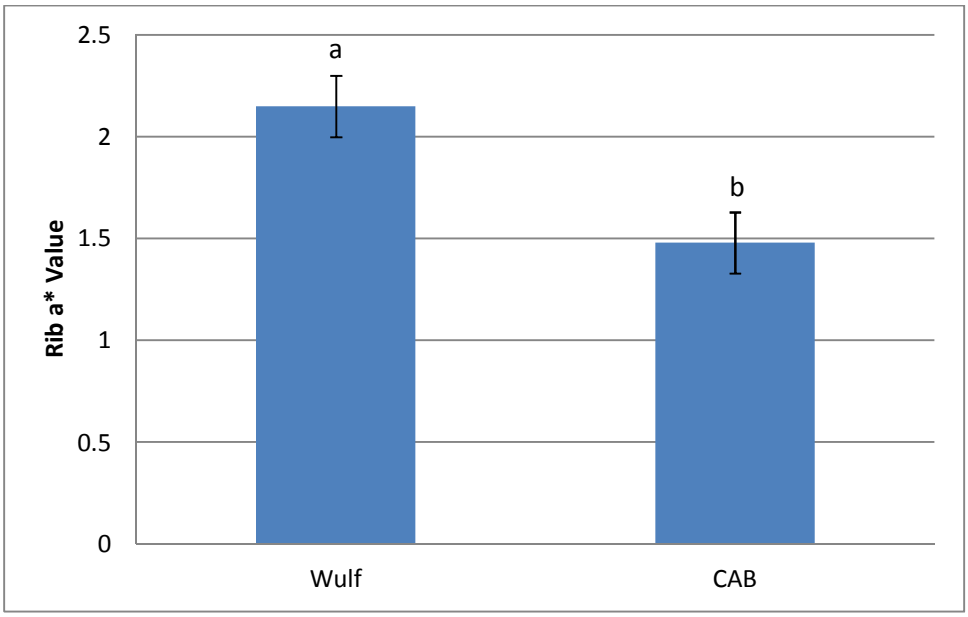

Figure 4. Least Squared Means of b* Values for Limousin x Jersey and CAB carcasses over the loin and rib region. Means within each measurement different superscripts differ ($P<0.05$).

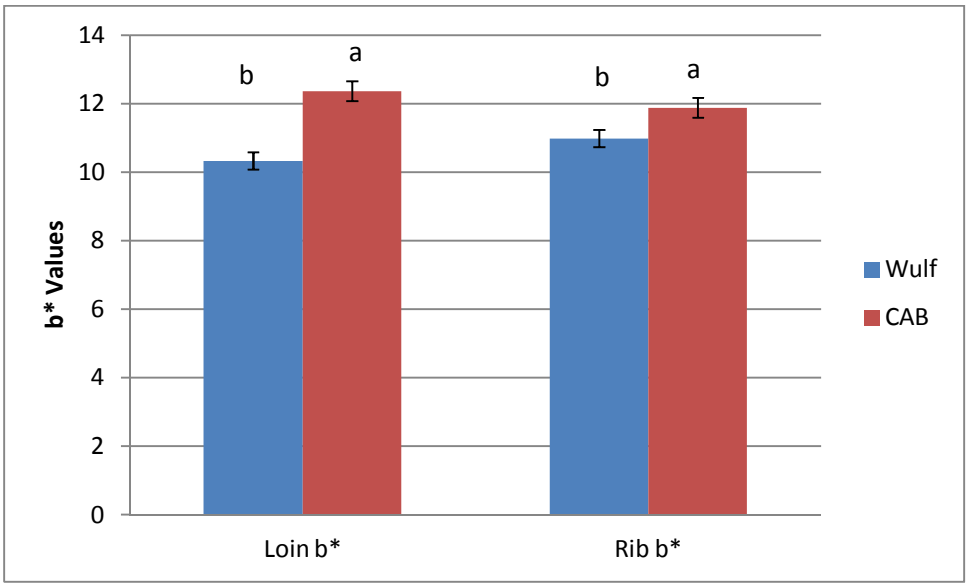

Table 3. Least Squared Means of carcass quality traits of Wulf Limousin x Jersey sires.

Item	Sire Group				
	Sire A[a]	SEM	Sire B[b]	SEM	*P*-Value
12th Rib Fat Thickness (in)	2.84	0.08	2.8	0.05	0.8589
Hot Carcass Weight (lbs.)	759.38	17.69	787.61	10.43	0.1798
Ribeye Area (in^2)	14.16	0.38	14.46	0.22	0.5022
KPH[c] (%)	2.25	0.11	2.37	0.06	0.3395
Yield Grade	2.10	0.15	2.17	0.09	0.7062
Marbling Score[d]	400.00	49.15	399.57	11.30	0.9845
Lean Maturity[e]	162.50	6.95	168.70	4.10	0.4489
Skeletal Maturity[e]	152.50	5.30	155.22	3.13	0.6622

[a] Wulf Limousin x Jersey sire 137LM3270, n = 8
[b] Wulf Limousin x Jersey sire 137LM3405, n =23
[c] Kidney, Pelvic, Heart fat
[d] Slight 00 = 300, Small = 400
e A 00 = 100, B 00 = 200

Table 4. Palatability and WBSF values of Limousin x Jersey steaks based upon Quality Grade.

	USDA Quality Grade				
Item[a]	USDA Choice[b]	SEM	USDA Select[c]	SEM	*P*-Value
Tenderness	5.49[y]	0.14	6.00[x]	0.11	0.0078
Juiciness	5.31	0.12	5.36	0.11	0.7266
Beef Flavor	5.91[y]	0.09	6.25[x]	0.08	0.0076
Off Flavor	7.62	0.06	7.71	0.05	0.2349
WBSF	2.72	0.14	1.59	0.12	0.2358

[a] WBSF = Warner-Bratzler shear force; Tenderness: 1 = Extremely tough, 8 = Extremely tender; Juiciness: 1 = Extremely dry, 8 = Extremely juicy; Beef Flavor: 1 = Extremely bland, 8 = Extremely intense; Off Flavor: 1 = Extremely intense, 8 = Non detectable

[b] n = 13

[c] n = 18

[xy] Means within rows with different superscripts differ ($P < 0.05$)