Effect of Temperament and Growth Rate on Carcass Characteristics of Simmental Cross Steers

Andrew F. Williams[1], Jane A. Boles[1], Katelyn S. Kohlbeck[1], Michael C. Meyers[2], Katharine A. Perz[1], Jennifer Thomson[1] and Kathleen C. Davis[1]

[1]Department of Animal and Range Sciences, Montana State University, Bozeman, Montana, USA 59717; [2]Department of Sport Science and Physical Education, Idaho State University, Pocatello, Idaho USA 83209.

Abstract. Different measures of temperament of steers have been reported to effect carcass characteristics differently. The objective of this study was to determine whether temperament, as measured by docility score, exit velocity, and blood lactate concentration affected carcass composition of steers. Steers (n = 154) were evaluated for docility score, exit velocity, and blood lactate concentration four times prior to harvest. Steers were humanely harvested and carcass data obtained. A strong trend was observed for exit velocity classification to impact carcass weight (P = 0.06) but did not affect marbling scores, ribeye area and fat thickness. The animals that left the chute more slowly had lower carcass weights and significantly (P = 0.01) lower average daily gain than did the steers that left the chute at a fast or medium rate. Blood lactate concentration as an indication of temperament of steers had no impact on carcass characteristics or average daily gain. In conclusion temperament as measured by exit velocity impacted growth rate and average daily gain affected carcass weight.

Key Words – beef, stress, handling, temperament, carcass characteristics

I. INTRODUCTION

Variation in meat quality and tenderness is a challenge for the meat industry (1). With increasing demand for superior meat, ante- and post-mortem factors must be evaluated to improve the ability to create a superior product. In recent years temperament has been studied as a causal reason for decreased growth rates and decreased tenderness (2). Growth rate as measured by average daily gain (ADG) were reduced in cattle with faster exit velocities (3, 4). Furthermore, cattle with higher exit velocity resulted in higher ultimate meat pH and darker color (5). Similar data has been reported using chute score as a measurement of temperament; the chute score based on, 1 = calm no movement to 6 = violent struggling. Cattle with higher chute or docility scores had lower ADG and decreased growth rates, as well as an increased incidence of carcass bruising and dark cutters (6). Curley et al. (7) found that chute score is not a good repeatable measure for evaluating temperament in cattle. They determined that a more quantitative and objective score is needed. In their study, cortisol, a stress hormone was found to be an effective measure of excitability. Stress response normally results in increased epinephrine and cortisol concentrations in the blood. This increase in circulating hormones cause an increase in gluconeogenesis, proteolysis and increased sensitivity of lipids to lipolytic hormones. This ultimately leads to increased anaerobic metabolic processes in the muscle, causing a buildup of lactic acid in the blood. Holmes et al. (8) and Boles et al. (9) found that concentration of lactic acid in circulating blood can be used as a measure of temperament. The objective of this study was to use exit velocity, docility score and blood lactate concentration for determining temperament in steers and to assess the effect of these variables on growth rate and carcass characteristics.

II. MATERIALS AND METHODS

One-hundred and fifty- four Angus x Simmental sire verified steers born at the Bair Ranch in Martinsdale, Montana as part of the American Simmental Association Carcass Merit Project were evaluated for temperament at four different times: weaning, revaccination, entry into feed-lot, and midway through finishing. Temperament was evaluated using docility score, blood lactate concentration, and exit velocity. Docility score ranged from 1-6 (10), and were assigned by a single individual. Systemic blood lactate concentration was analyzed with a Lactate Pro meter (Arkray Inc., Minami-Ku, Kyoto, Japan). Exit velocity was measured using a Polaris timer system (FarmTek Inc., Wylie Texas) with photo-transmitters placed 1.82 meters and 3.64 meters in front of chute.

All steers had the same feed, were exposed to the same environment, and handling over the course of the study. Following a 30 day step-up period at in

the feedlot, steers were fed a 94% concentrate 6% roughage ration containing 14.58%CP and .61 Mcal/lb net energy for gain. Steers were implanted with Component TE-S (Vetlife, West Des Moines, IA) containing 120 mg of trenbolone acetate, 24 mg of estradiol ESP and 29 mg of tylosin tartrate. Average daily gain (ADG) was calculated using an adjusted 205 weaning weight (ADJ wt) and weight at midway through finishing (MTF wt). ADG = (MTF wt – ADJ wt) / 140 days. Following harvest and a 36 hour chill, carcass data were collected using a USDA assisted camera grading system.

The experimental units were the individual steers. Growth and carcass data were collected on each individual steer harvested with analyses conducted on 154 steers. The GLM model of SAS was used to analyze differences in growth and carcass data, where the independent variables were the classifications for growth rate, average exit velocity (average of the four measurements), and blood lactate concentration. The dependent variables were average daily gain and carcass characteristics. To identify the growth, exit velocity, and blood lactate classifications, means and standard deviations were calculated using 154 animals for all temperament measurements. The means plus one standard deviation were designated "high" growth, "fast" speed or "high" lactate, and the mean minus one standard deviation represented "low" growth, "slow" speed or "low" lactate. The remainder were designated as medium for the classification. LSMEANS were used to calculate means due to unequal number of observations upon which to compare differences between variables. Dunnetts test was used to separate means because of the unbalanced representation of the temperament and growth classification variables. Pearson product-moment correlations were calculated on all data. Statistical significance was determined *a priori* at the 0.05 level.

III. RESULTS AND DISCUSSION

Temperament and growth classification significantly affected selected carcass characteristics (Table 1). ADG was significantly different ($P < 0.0001$) between growth classes – high, medium, low confirming the method of classification successfully separated the animals into different growth groups. As expected, faster growing steers resulted in significantly larger carcasses and tended to have larger ribeye area ($P = 0.08$) than medium and slow growing steers. This agrees with data reported by Boles et al., (11) who found that larger carcasses also resulted in larger ribeye muscle size. Average exit velocity significantly affected average daily gain ($P = 0.01$). Steers that left the chute at a slower velocity resulted in lower average daily gains and smaller carcasses. On the contrary Café and co-workers (4) concluded that cattle with more excitable temperaments, as measured by exit velocity and docility score, had less feed intake and therefore slower growth rate than cattle with less excitable temperaments as measured by crush score and flight speed (exit velocity). Voisinet et al. (12) along with Behrends et al., (13) also found a decrease in growth rate (ADG) in animals with more excitable temperament. One potential explanation for this difference is the type of cattle used for the research; the current research was performed with *Bos Taurus*

Table 1: Effect of growth rate, exit velocity, and blood lactate on carcass characteristics (least squares means)

Class	ADG[1]	CWT[2] (kg)	Marb[2]	REA[2] (cm^2)	Fat[2] (cm)	YG[3]
Growth Rate[4]						
Fast	4.05[a]	398.7[a]	488.4	88.3	0.9[b]	2.8[a]
Medium	3.47[b]	384.0[b]	511.5	84.0	1.3[a]	3.2[a]
Slow	2.63[c]	371.2[c]	485.8	83.2	1.1[ab]	2.9[b]
P-Value	<0.0001	<0.0001	0.41	0.08	<0.0001	0.002
Exit Velocity[4]						
Fast	3.5[a]	386.8	502.9	85.0	1.1	3.0
Medium	3.4[a]	390.2	494.1	85.7	1.1	3.0
Slow	2.5[b]	376.9	488.7	84.9	1.1	2.9
P-Value	0.01	0.06	0.75	0.90	0.63	0.82
Blood Lactate[4]						
High	3.4	386.2	507.8	85.1	1.0	3.0
Medium	3.4	386.1	495.6	86.9	1.1	2.9
Low	3.3	381.5	482.3	83.4	1.2	3.1
P-Value	0.39	0.69	0.67	0.16	0.50	0.47

[1] ADG = (feedlot weight – 205 adjusted weaning weight)/140

[2] Carcass weight, Marbling scores: 300 = slight, 400 = small, 500 = modest, 600 = moderate, REA = Longissimus thoracis area measured between the 12th and 13th rib. Fat = Fat thickness measured between the 12th and 13th rib.

[3] Yield grade = 2.5 + (2.5 x adjusted fat thickness, 12th rib, inches) + (0.0038 x hot carcass weight, pounds) + (0.2 x percentage KPH) - (0.32 x ribeye area, sq. in)

[6] Classifications for growth rate, exit speed and blood lactate are based on ± one standard deviation from the mean. Plus one standard deviation is fast or high and minus one standard deviation is low. The rest of the steers were classified as medium.

[a,b,c] means within a column with different superscripts are significantly different $P<0.05$

Table 2: Simple correlations coefficients (P-value) between average chute score, average exit velocity and average blood lactate concentration and carcass measurements.

	CWT[1]	Marb[1]	FAT[1]	REA[1]	YG[2]	ADG[3]	CSAVG[4]	EVAVG[4]	BLAVG[4]
CWT[1]	1	0.15 (0.07)	-0.10 (0.21)	0.42 (<0.0001)	0.01 (0.9)	0.34 (<0.0001)	0.14 (0.08)	0.13 (0.11)	0.07 (0.42)
Marb		1	0.21 (0.01)	0.08 (0.32)	0.10 (0.20)	-0.01 (0.91)	0.04 (0.62)	-0.02 (0.82)	0.02 (0.80)
FAT			1	-0.32 (<0.0001)	0.74 (<0.0001)	0.05 (0.55)	-0.13 (0.12)	-0.14 (0.08)	-0.15 (0.06)
REA				1	-0.78 (<.0001)	0.08 (0.37)	0.03 (0.78)	0.05 (0.59)	0.05 (0.57)
YG					1	0.09 (0.24)	-0.03 (0.71)	-0.06 (0.47)	-0.09 (0.26)
ADG						1	0.08 (0.35)	0.05 (0.56)	-0.10 (0.21)
CSAVG							1	0.66 (<0.0001)	0.48 (<0.0001)
EVAVG								1	0.38 (<0.0001)
BLAVG									1

[1] Carcass weight, [2]Marbling scores: 300 = slight, 400 = small, 500 = modest, 600 = moderate, Fat = Fat thickness measured between the 12th and 13th rib. [4]REA = Longissimus thoracis area measured between the 12th and 13th rib.
[2]Yield grade = 2.5 + (2.5 x adjusted fat thickness, 12th rib, inches) + (0.0038 x hot carcass weight, pounds) + (0.2 x percentage KPH) - (0.32 x ribeye area, sq. in), [3]ADG= (feedlot weight-weaning weight)/140 days
[4]Average blood lactate (BLAVG), average exit velocity (EVAVG), and chute score (CSAVG) are the average of the four measurements taken at weaning, re-vaccination, feedlot entrance, and midway feedlot

cattle while other researchers investigated the effect of temperament on growth rate and ADG on *Bos indicus* and *Bos indicus* cross cattle (3, 4, 5). It is possible there is a difference in the response to stress between *Bos indicus* and *Bos taurus* cattle.

Evaluating correlation between temperament measures and carcass data for all steers (n=154) several significant relationships were observed (Table 2). ADG was significantly associated with carcass weight ($P < 0.0001$). As carcass weight went up the calculated ADG did as well. Carcass weight was significantly correlated to ribeye area ($P < 0.0001$) but not fat thickness or yield grade. Fat thickness was positively correlated to yield grade ($P < 0.001$), indicating as fat thickness increased, yield grade increased. Ribeye area ($P < 0.001$), however was negatively correlated to yield grade. Showing a decrease in yield grade as ribeye area increased as would be expected because ribeye area is part of the yield grade calculation. As expected fat thickness was positively correlated to marbling score ($P = 0.01$), indicating that as external fat increased so did the intramuscular fat or marbling in the ribeye. However, our results showed no relationship between growth rate and marbling ($P = 0.909$). This data is in contrast to Purchas et al. (14) who concluded that faster growth rate was associated with higher levels of intramuscular fat.

IV. CONCLUSION

In this study, steers with a slower exit velocity resulted in lower ADG. This is in contrast to other researchers who found that animals that left the chute faster were smaller with lower ADG. Furthermore, these steers had smaller REA which was negatively correlated to yield grade and fat thickness. This difference implies there is an impact of temperament on growth that is dependent on the breed of cattle being evaluated. This suggests that more objective information is needed before making recommendations on temperament. Blood lactate concentration was directly correlated with exit velocity however did not show any significant relationships to carcass data. In this study, exit velocity was a better predictor of effects on growth rate and carcass characteristics than chute score or blood lactate concentration. More research is necessary to determine if categories can be developed based on exit velocity that would predict which animals will have better growth performance in the feedlot.

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