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RESIDUAL FEED INTAKE AND THE RELATIONSHIP WITH PERFORMANCE, TEMPERAMENT AND CARCASS TRAITS IN GROWING AND FINISHING STEERS

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ABSTRACT

Residual Feed Intake and the Relationship with Performance, Temperament and Carcass Traits in Growing and Finishing Steers. (December 2016)

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Two trials were conducted with Santa Gertrudis steers, trial 1 (n = 115) and trial 2 (n = 118), were fed a roughage-based diet during the growing phase and high-grain diet during the finishing phase. Steers were weighed at 14-d intervals and dry matter intake (DMI) measured for 70 d during both phases. Residual feed intake (RFI) is the difference between actual DMI and DMI predicted from linear regression of DMI on mid-test metabolic body weight. Ultrasound carcass measurements were measured on day 0 and 70 of the growing phase. Steers were harvested after finishing phase and carcass cooler traits were obtained. Low RFI steers consumed less than high RFI steers, but did not differ in average daily gain (ADG). Low RFI steers had less backfat compared to high RFI steers. Residual feed intake was independent of growth rate and mature body size, but highly correlated with DMI. Moreover, adjusting RFI for ultrasound carcass traits could improve feed efficiency independent of growth, body size, and carcass composition. Furthermore, residual gain (RG) could have an effect on marbling and quality grade.

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INTRODUCTION

Feed costs account for approximately two-thirds of total production costs in US beef operations (Anderson et al., 2005). To reduce feed costs, producers could select animals that are more feed efficient. Producers can expect 9 to 33% long-term profitability improvement by increasing efficiency within their herd (Archer et al., 2004). Cattle need to consume less and gain as much or more than the less efficient individuals. Many producers select for exceptional carcass traits, but rarely select for feed efficiency. It is also important for producers to consider feed efficiency. With a growing human population, it is important for beef producers to strive for efficiency to lower production cost and increase production to meet a growing demand. One measure of feed efficiency is residual feed intake (RFI). RFI is the difference between actual feed intake and expected intake of the individual. RFI is a moderately heritable trait. Cattle with a low RFI (negative value) are more efficient than those with a high RFI (positive value). This review examines the relationship between RFI, feed conversion ratio (FCR), residual gain (RG), carcass traits, temperament, and average daily gain (ADG).

LITERATURE REVIEW

Measures of Feed Efficiency

Feed conversion ratio. Feed conversion ratio (FCR) is traditionally the most common method to quantify feed efficiency in beef cattle and is generally defined as feed intake per unit of average daily gain (ADG) (Crowley et al., 2010; Berry, 2008). Feed conversion ratio does not separate feed intake into individual components, but includes the requirements for both maintenance and production (Arthur et al., 1996; Hennessy and Arthur, 2004). Research has found that 60 to 65% of total feed requirements are needed to support maintenance requirements within a cow herd (Montano-Bermudez et al., 1990), therefore Arthur et al., (1996) determined that any trait measuring the variation of feed efficiency should include the consideration of feed requirements for both mainenance and production. Feed conversion ratio is calculated as the ratio of dry matter intake (DMI) to ADG or better known as feed:gain ratio. Feed conversion ratio is negatively correlated with ADG and mature body size, which can result in an increased mature body size and reduction in feed efficiency (Lancaster et al., 2009a; Herd and Bishop, 2000). Feed:gain ratio could potentially increase growth rate of young animals (Nkrumah et al., 2007a), but according to Dickerson (1978) this ratio can also result in an increased feed intake which could negatively impact production. Animals with lower or more negative FCR value are reported to be more efficient individuals (Berry and Crowley, 2013). Selecting cattle based on FCR may not result in improved feed efficiency because FCR is correlated with mature body size.

Residual feed intake. Residual feed intake is defined as the difference between actual feed intake and expected feed intake based on body weight and production goal for the animal. Residual feed intake is used to separate feed intake into both growth and maintenance components (Koch et al., 1963). Cattle that have a negative RFI have a lower feed intake, but have similar ADG as high RFI cattle. Cattle that have a positive RFI consume more feed for maintenance and production and are considered to be less efficient. RFI is a measure of feed efficiency that is independent of body size and growth rate, which allows for examination of the physiological mechanisms that have an underlying variation on feed efficiency (Herd and Arthur, 2009). Dry matter intake has been found to be significantly different between low and high RFI cattle, where high RFI cattle consume more feed than low RFI cattle with the same ADG. Perkins et al. (2014) showed that DMI was lowest in low RFI cattle and highest in high RFI cattle. Richardson et al. (2001) also found that high RFI steers consumed 5% more feed than low RFI steers.

Residual feed intake is a moderately heritable trait ($h^2 = 0.16$ to 0.43) (Herd et al., 2003). Residual feed intake offers a genetic selection method to improve beef cattle efficiency without increasing growth rate and mature size (Baker et al., 2006; Johnston et al., 2002). Thus, selecting for RFI will result in progeny that are more efficient (Richardson et al., 2001).

There are two methods that have been used to determine expected feed intake for RFI. The first method uses feeding standards (e.g., NRC, 2000) to predict expected feed intake based on body weight (BW), ADG, and energy content within the diet. By using the NRC equations, Liu et al. (2000) found that the equations predict higher intake than what is actually consumed by the animals. Thus, animals were functioning at a higher level of efficiency than NRC standards predicted. Residual feed intake calculated by NRC equations had a negative correlation with ADG (r = -0.55) and body weight (BW, r = -0.26). Residual feed intake calculated through linear regression did not show a correlation with BW or ADG (Liu et al., 2000). The second method used multiple linear regression of DMI on ADG and mid-test body weight (MBW) to calculate expected feed intake on a contemporary group of cattle (Arthur et al., 1996). Residual feed intake does not have an effect on ADG when using linear regression to determine RFI (Arthur et al., 2001a). Thus, estimating expected feed intake through NRC equations verses linear regression will result in varying correlations with RFI and BW and ADG.

The genetic variation in RFI allows for selection of more efficient cattle that will consume significantly less feed with little effect on growth rate and mature size. However, differences in factors that use energy, such as, digestibility, heat increment, body composition, and physical activity are rarely considered. Herd and Arthur (2009) estimated that individual animal differences in body composition, feeding patterns, protein turnover, tissue metabolism, and stress, heat increment, digestibility, and physical activity accounted for 5, 2, 37, 9, 10 and 10% of variation in RFI in cattle, respectively (Figure 3). Furthermore, approximately 27% of the differences in RFI is due to variation in other processes such as ion transport, which has not yet been measured (Herd and Arthur, 2009).

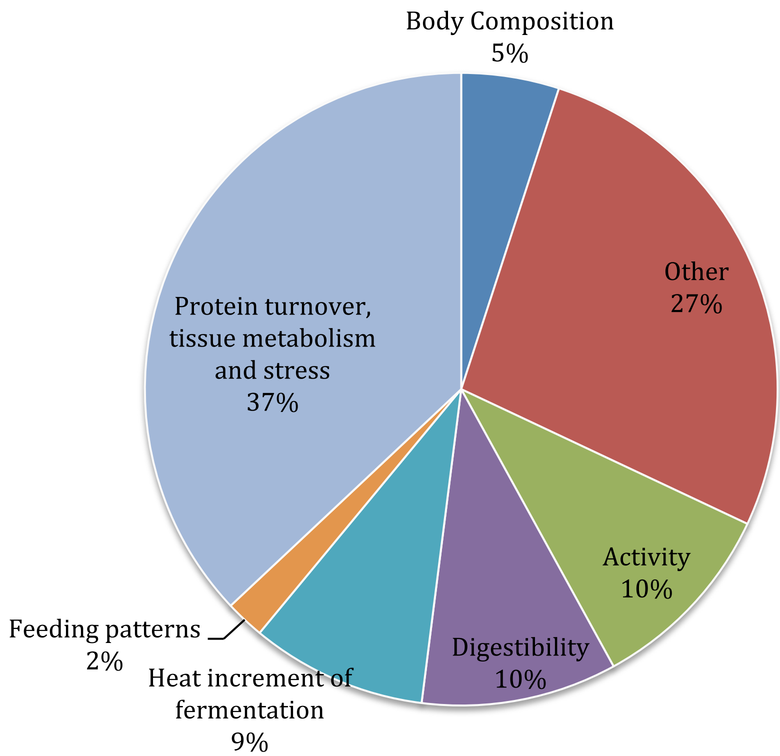

Figure 1. Contributions of biological mechanisms to variation in residual feed intake as determined from experiments on divergently selected RFI cattle (Richardson and Herd, 2004).

Phenotypically, both RFI and RFI adjusted for carcass composition (RFI_c), are strongly correlated with DMI (r = 0.70 and 0.67), but not with ADG or MBW. Heifers with a low RFI had similar ADG and final BW, but consumed 15% less DMI than heifers with a high RFI (Lancaster et al., 2009b). In the same study, RFI was genetically independent of ADG, but positively correlated with MBW (r = 0.33). Therefore, suggesting that selection for a favorable RFI may reduce body size.

Though both FCR and RFI are used as measures of feed efficiency, they have differing effects on varying traits. FCR was found inversely related to ADG (r = -0.15) and mature cattle size (Koots et al., 1994). Therefore, if we reduce FCR, mature size will increase. Residual feed intake is independent of body weight and gain. Therefore, selection for RFI will not have an influence on mature size. Feed conversion ratio and RFI are positively genetically correlated with DMI (r = 0.39 and 0.72, respectively), but FCR was negatively correlated (r = -0.62) with ADG (Berry and Crowley, 2013). In growing bulls and heifers RFI was positively correlated with DMI (r = 0.71 and 0.62), but was not correlated with ADG (Hafla et al., 2012; Hafla et al., 2013). Though FCR and RFI may differ in areas related to growth and mature size, they are positively correlated with each other (Figure 2, Table 1).

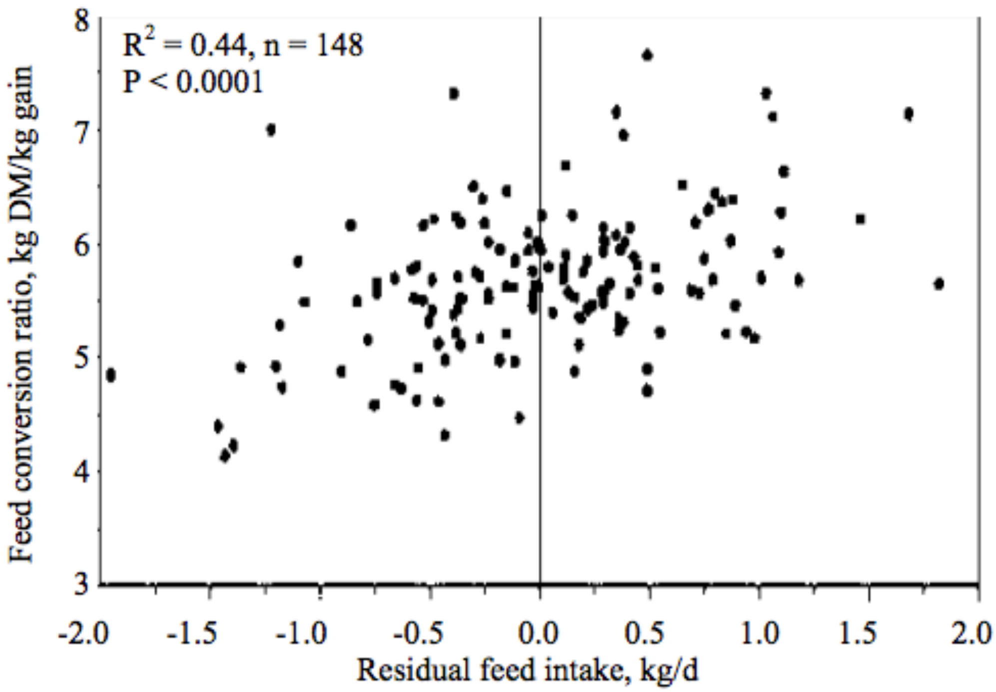

Figure 2. The relationship between RFI and FCR (Barsarab et al., 2003).

Table 1. Phenotypic correlations[a] between feed conversion ratio and residual feed intake.

Trait[b]	Baker et al., 2006	Crowley et al., 2010	Lancaster et al., 2009	Nkrumah et al., 2004	Retallick et al., 2013
			RFI		
FCR	**0.42**	0.48[†]	**0.49**	**0.62**	**0.37**

[a]Correlations in bold are different from zero at P < 0.05.
[†]Correlations are different from zero at P < 0.10.
[b]FCR = feed conversion ratio; RFI = residual feed intake

Residual gain. Residual gain (RG) is another measure of feed efficiency that was proposed by Koch et al. (1963). This measure of feed efficiency is similar to RFI except ADG is regressed on feed intake and BW (Crowley et al., 2010). Residual gain involves a statistical model to adjust for growth rate for the individual differences in feed intake and BW. Cattle with high RG are more efficient and gain more than expected for their BW and feed intake. Cattle with a low RG are less efficient and gain less than expected for their BW and feed intake. Residual gain was correlated with ADG (r = 0.88), but independent of DMI and MBW (Hafla et al., 2013). Therefore improved RG is, on average, associated with faster growth rates, but is not associated with differences in feed intake (Barry and Crowley, 2012).

Feed Efficiency and Temperament

Temperament can be measured objectively through exit velocity (EV) and chute score (CS). Temperament as measured by EV and CS has not been shown to be related to feed efficiency (Black et al., 2013), but more excitable cattle have lower ADG. Initial and final EV were negatively correlated with BW, ADG, and DMI, but EV was not correlated with FCR or RFI in growing bulls (Fox, 2004). The same study concluded that initial CS was not correlated with performance or efficiency traits. Furthermore, EV was negatively correlated with DMI (r = -0.35) in steers (Nkrumah et al., 2007b). The same study reported genetic correlations between EV and DMI (r = -0.11 ± 0.26), a moderate correlation with FCR (r = 0.40 ± 0.26), and a negative correlation with RFI (r = -0.59 ± 0.45). It was reported by Voisinet et al. (1997) that cattle with more excitable temperaments grew slower and produced less tender beef. Furthermore, cattle with a faster EV consume significantly less feed and gain at a slower rate than cattle with slower EV (Lancaster et al., 2005). Though feed efficiency is not related to differences in temperament, more excitable cattle will produce less tender beef.

Feed Efficiency and Body Composition

As research strives to improve feed efficiency in cattle, it is important to consider the relationship between RFI and carcass composition. Research has shown that feed efficiency does not have an influence on carcass traits (Retallick et al., 2013) and selecting for RFI does not have a negative impact on carcass quality (Perkins et al., 2010). High RFI cattle tend to have a greater fat deposit throughout their body (Kelly et al., 2010), while low RFI cattle were found to be leaner individuals (McDonagh et al., 2001). In one study, low RFI steers had less rump fat and rib fat at the beginning of the study, but no significant difference was observed at the end (Richardson et al., 2001). The reduction of fat in low RFI cattle does not have an influence on carcass weight or longissimus muscle area (LM; McDongah et al., 2001). In animals that were selected for RFI, backfat thickness was found to be correlated both genetically ($r_g = 0.17$) and phenotypically ($r_p = 0.14$), which suggests that low RFI cattle are leaner (Arthur et al., 2001a). Positive phenotypic correlations between ultrasound measurements of backfat thickness and RFI were observed in growing steers (Carstens et al., 2002). Marbling scores were greater in low RFI cattle than high RFI cattle. Low RFI cattle have a greater amount of intramuscular fat (IMF) than high RFI cattle (Perkins et al., 2014). These results show that low RFI cattle tend to be leaner, but LM and marbling are not adversely affected, as compared to high RFI cattle. Thus, selecting animals based on RFI is unlikely to result in an undesirable response in performance traits in growing animals.

Conclusion

Due to the fact that feed cost is the greatest input cost a producer will face, they are looking for various ways to reduce input cost. Improving feed efficiency within their herd is where producers are beginning to resort to in order to reduce input cost and increase profit within their operation. Selecting for efficiency based on FCR has the potential to increase feed intake and mature body size. Selecting for efficiency based on RFI does not have the same effect on feed intake and mature size. RFI is a moderately heritable trait that will allow for the same amount of gain of an individual with a decrease in feed intake. Continuing to improve RFI should result in a reduction in input costs.

OBJECTIVES

The overall objective was to further characterize RFI in Santa Gertrudis steers on a growing and finishing diet.

Specific objectives of this study include:

1. To characterize feed efficiency traits in growing and finishing steers.
2. To examine phenotypic correlations between feed efficiency traits measured during two production phases.
3. To examine phenotypic correlations between feed efficiency traits and carcass ultrasound traits in growing and finishing steers.
4. To examine phenotypic correlations between feed efficiency traits and carcass composition and quality traits in finishing steers.
5. To examine phenotypic correlations between feed efficiency traits and temperament traits in growing and finishing steers.
6. To examine phenotypic correlations between temperament traits and carcass ultrasound traits in growing and finishing steers.
7. To examine phenotypic correlations between temperament traits and carcass composition and quality traits in finishing steers.

EXPERIMENT

Material and Methods

Data was used from two feeding trials to evaluate feed efficiency, carcass quality and temperament.

<u>Experimental animals.</u> This study consisted of two groups of Santa Gertrudis steers obtained from the King Ranch (Kingsville, TX). Trial 1 consisted of one hundred and fifteen steers and trial 2 consisted of one hundred and eighteen steers totaling two hundred and thirty-three steers. At five months of age, steers were vaccinated against infectious bovine rhinotracheitis, parainfluenza-3, bovine virus diarrhea, bovine respiratory syncytial virus, *Haemophilus somnus, Pasturella, and Clostridia*. At six to eight months of age, steers were weaned and given booster vaccinations. The steers were backgrounded for two months on rye grass before they were moved to the King Ranch feedyard. At the feedyard, steers were fed (40% milo, 11% whole cottonseed, 5% cottonseed meal, 6% pressed brewers grain, 19.5% cotton burrs, 9.5% molasses, 4% alfalfa pellets, and 5% premix; 15% CP, 2.6% Mcal/kg ME) for twenty days. When steers reached nine to eleven months of age, they were transported to the Texas A&M University Beef Cattle Research Center in College Station, TX. At the research center, steers were randomly allotted to pens furnished with Calan-gate or GrowSafe feeders, by body weight and sire progeny group.

Feeding systems. Two feeding systems were used for this study. Steers in trial 1 were fed using Calan-gate feeders, while steers in trial 2 were fed using GrowSafe feeders. The Calan-gate system uses an electric collar around the steer's neck that triggers the door of the assigned bunk to open.

Animals that were fed using GrowSafe were equipped with a Radio Frequency Identification (RFID) ear tag. The RFID tag and bunk measure feed disappearance every second. This system accurately measures intake in a commercial environment and compares that to growth performance to determine efficiency.

Feeding management. At the beginning of the growing phase steers were adapted to experimental diets and trained to eat from Calan-gate or GrowSafe feeders for 28 days. Steers were fed a high-roughage diet for 70 d consisting of (as-fed basis) chopped alfalfa, alfalfa pellets, cottonseed hulls, and dry rolled corn, molasses, and a mineral supplement was provided, as seen in Table 2. Steers were conditioned to the feeders and fed individually for seventy days. Steers were approximately ten to twelve months of age and weighed 304.2 ± 31.5 kg. Steers were fed twice daily in amounts that allowed for *ad libitum* intake. Feed intake was recorded daily for each individual. Water was provided *ad libitum* for each pen. Ultrasound measurements of the 12^{th} rib fat thickness were obtained on day 0 and 70 along with longissimus muscle area and percentage intramuscular fat.

During the finishing phase, the high-roughage diet was followed by a 28-d transition period to a high-grain diet. Steers were fed a high-grain diet for 70 d consisting of (as-fed basis) alfalfa, cottonseed hulls, cottonseed meal, corn silage, cracked corn, and dry rolled corn, chopped alfalfa hay, costal hay, molasses, and a mineral supplement (Table 3). Steers were approximately thirteen to fifteen months of age and weighed 426.93 ± 38.9 kg. The diet was fed twice per day in amounts to allow for *ad libitum* intake. Individual feed intake data was recorded daily. Water was provided *ad libitum* for each pen. Anabolic implants were not administered to steers during the trials.

<u>Measurement of carcass composition.</u> Following an 80-d test period, steers were harvested at approximately 10 mm of rib fat thickness and transported to Sam Kane Beef Processors, Inc. (Corpus Christi, TX) to be harvested. Hot carcass weight (kg) was obtained prior to a 48-h chill where the 12-13th rib backfat thickness (BF), 12-13th rib longissimus muscle area (LM), marbling score, kidney, pelvic and heart fat (KPH), and yield grade (YG) were obtained by Texas A&M University trained personnel. The 6-12th-rib sections were removed from the carcass, vacuumed packaged, and transported to the Rosenthal Meat Science Center (Texas A&M University, College Station, TX). Two steaks were obtained from the 12th rib section for one and fourteen day aging periods to determine Warner-Bratzler shear force (WBSF) (AMSA, 1995). The 9-11th rib sections were dissected into separable fat, lean and bone tissue, and analysis of moisture, protein and lipid content of carcass were conducted.

Table 2. Composition and analyzed nutrition content of the growing phase diets used in the 2

trials

Item	Trial 1	Trial 2
Dietary composition, % (as-fed basis)		
Chopped alfalfa hay	35.0	35.0
Pelleted alfalfa hay	19.0	15.0
Dry rolled corn	15.5	19.5
Cotton seed hulls	-	21.5
Molasses	7.0	7.0
Premix[a]	2.0	-
Supplement[b]	-	2.0
Nutrients (dry matter basis)		
DM, %	87.1	88.0
ME,[2] Mcal/kg DM	2.13	2.07
CP,% DM	11.2	13.1
NDF, %DM	63.6	32.0

[a]Premix contained 1.66 g/kg monensin, 0.55 g/kg tylosin, 6.5% CP, 675 mg/kg Cu, 1050 mg/kg MN, 2850 mg/kg Zn, 15 mg/kg SE, 35 mg/kg I, 7.5 mg/kg Co, 132,300 IU/kg vitamin A, and 2208 IU/kg vitamin E.

[b]Supplement contained salt, vitamin E (44,000 IU/kg product), vitamin A (2,200,00 IU/kg), vitamin D (440,000 IU/kg product), and a trace mineral containing a minimum of 19.0% Zn, 7.0% Mn, 4.5% Cu, 4,000 mg/kg Fe, 2,300 mg/kg I, 1,000 mg/kg Se, and 500 mg/kg Co.

Table 3. Composition and analyzed nutrition content of the finishing phase diets used in the 2 trials

Item	Trial 1	Trial 2
Dietary composition, % (as-fed basis)		
Chopped alfalfa hay	5.0	-
Coastal hay	5.0	-
Corn silage	-	30.0
Cracked corn	-	49.0
Dry rolled corn	76.5	-
Cottonseed hulls	-	7.0
Cottonseed meal	7.5	5.0
Molasses	4.0	4.5
Premix[a]	2.0	-
Supplement[b]	-	4.5
Nutrients (dry matter basis)		
DM, %	88.2	68.25
ME,[2] Mcal/kg DM	3.01	2.59
CP,% DM	13.8	11.7
NDF, %DM	15.9	26.4

[a]Premix contained 1.66 g/kg monensin, 0.55 g/kg tylosin, 6.5% CP, 675 mg/kg Cu, 1050 mg/kg MN, 2850 mg/kg Zn, 15 mg/kg SE, 35 mg/kg I, 7.5 mg/kg Co, 132,300 IU/kg vitamin A, and 2208 IU/kg vitamin E.

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Measurement of temperament. Temperament was assessed in each trial using subjective and objective methods. Chute score (1 = calm; 5 = continuous vigorous movement/excitement) was assigned to each steer by a single observer while confined, but not restrained in a squeeze chute on d 0 and 70. Exit velocity (Figure 2) was measured as the rate (m/s) at the time steers transversed a distance of 1.83 m after release from a squeeze chute.

Statistical analysis. A statistical summary was performed for each trial and will be examined for any differences between each trait within the trials. If the traits showed no difference between trials, a Meta analysis was performed to combine both trials. PROC GLM of SAS was used to combine data for meta-analysis. Individual growth rate was computed from linear regression of body weight on day of test using PROC REG of SAS. Regression coefficients were used to derive initial and final body weight, and metabolic body weight. Feed intake was used to compute average daily DMI from feed intake data. Residual feed intake is the difference between actual and expected DMI using a phenotypic regression model, PROC GLM of SAS. RFI groups were determined by ranking steers into low, medium, and high RFI <0.5 SD, $\pm$ 0.5, > 0.5 SD, respectively, from the RFI mean. The least-squares means option of PROC GLM of SAS was used to evaluate differences in body composition traits, temperament, and performance traits among RFI groups. Partial correlation coefficients among traits were determined using PROC CORR of SAS with the partial correlation option used to adjust for random effects of both test groups. RFI was defined in two ways. Base RFI (RFI_p) was calculated as the

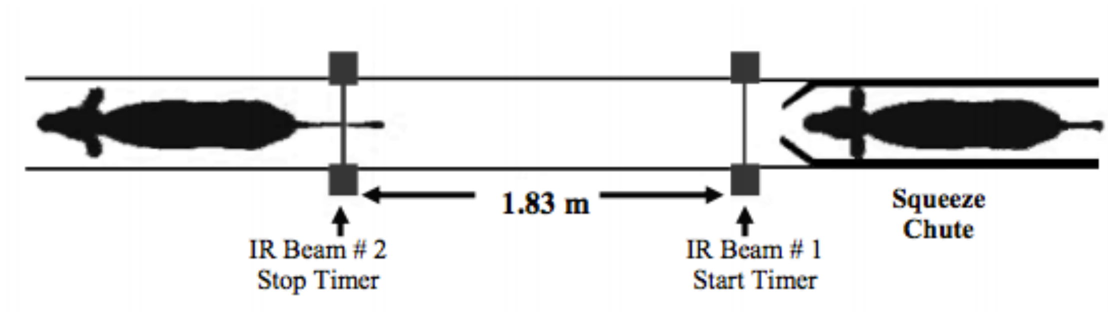

Figure 3. Illustration measuring exit velocity. (Curley et al., 2004)

difference between actual and expected intake from the linear regression model:

$$DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3TEST\ GROUP + error$$

RFIc is the residual term from the phenotypic linear regression of DMI on ADG, MBW and an inclusion of ultrasound carcass trait(s), which will be determined via PROC REG of SAS. Partial correlation coefficients between growing and finishing RFIp and RFIc was determined using PROC CORR SPEARMAN.

Table 4. Amount of variation explained in feed intake models by inclusion of carcass traits during the growing phase.

Model	R^2
$DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3TEST\ GROUP + error$	0.43
$DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3\ GBF^a + error$	0.45

[a]Gain in backfat

Table 5. Amount of variation explained in feed intake models by inclusion of carcass traits during the finishing phase.

Model	R^2
DMI = $ß_0$ + $ß_1$MBW + $ß_2$ADG + $ß_3$TEST GROUP + error	0.53
DMI = $ß_0$ + $ß_1$MBW + $ß_2$ADG + $ß_3$ FBF[a] + error	0.56

[a]Final backfat

RESULTS

Performance and feed efficiency. During the growing phase, steers in this study had an overall ADG of 1.04 kg/d (SD = 0.28), DMI of 9.79 kg/d (SD = 1.19), FCR of 9.96 kg of DMI/kg of gain (SD = 2.46), and RG of 0.00 kg/d (SD = 0.16; Table 6). Residual feed $intake_p$ averaged 0.00 kg/d (SD = 0.88) and ranged from an efficient -2.14 to an inefficient 3.20 kg/d. This represents a difference of 5.34 kg of feed per day. During the finishing phase, steers had an overall ADG of 1.01 kg/d (SD = 0.22), DMI of 8.92 kg/d (SD = 1.38), FCR of 9.12 kg of DMI/kg of gain (SD = 1.71), and RG of 0.00 kg/d (SD = 0.17; Table 8). Residual feed $intake_p$ averaged 0.00 kg/d (SD = 0.91) and ranged from an efficient -2.90 to an inefficient 2.73 kg/d. This represents a difference of 5.63 kg of feed per day. Steers with low RFI_p did not differ during the growing phase ($P > 0.69$) and finishing phase ($P > 0.86$) in initial or final BW, MBW, or ADG compared to steers with medium or high RFI_p. Low RFI_p steers were more efficient ($P < 0.001$) as measured by RFI, FCR, and RG compared to both medium and high RFI_p steers in both phases. Steers with low RFI, FCR, and RG values have more desirable phenotypes.

Phenotypic correlations between performance and feed efficiency traits of both growing and finishing phases are shown in Table 7 and Table 9. Residual feed $intake_p$ was correlated ($P < 0.05$) with FCR (r = 0.49; 0.52), but was not correlated ($P > 0.10$) with ADG and MBW during the growing and finishing phases. Residual feed $intake_p$ was correlated ($P < 0.05$) with RG during both phases (r = -0.42; -0.52). Dry matter intake

Table 6. Characterization of performance and feed efficiency traits in growing steers with low, medium, and high RFI_p[a]

Trait	RFI group[b] Low	Med	High	SE	*P*-value
Number of steers	67	97	69		
Initial BW, kg	302.38	306.16	302.65	3.82	0.69
Final BW, kg	379.65	382.89	380.97	4.39	0.85
Mid-test metabolic BW, kg^{75}	79.29	79.84	79.54	0.71	0.84
ADG, kg/d	1.04	1.03	1.06	0.02	0.79
DMI, kg/d	8.79^x	9.72^y	10.85^z	0.10	0.0001
Residual feed intake, kg/d	-0.97^x	-0.06^y	1.05^z	0.05	0.0001
Residual gain, kg/d	-0.18^x	0.00^y	0.19^z	0.01	0.0001
Feed conversion ratio, kg of DMI/kg of gain	9.05^x	9.89^y	10.91^z	0.19	0.0001
Residual feed intake adjusted for backfat, kg/d	-0.95^x	-0.04^y	1.08^z	0.05	0.0001

[a]Residual feed intake base model.
[b]Steers with low, medium, and high RFI were <0.05, ± 0.05, and >0.05 from the mean RFI, respectively.
[xyz]Means with different superscripts in the same row differ ($P < 0.05$).

Table 7. Phenotypic correlations[a] between performance and feed efficiency traits in growing steers.

Trait[b]	ADG	DMI	FCR	RG	RFI_p	RFI_c
MBW	**0.36**	**0.53**	-0.07	0.00	0.00	0.00
ADG		**0.53**	**-0.70**	**0.85**	0.00	0.00
DMI			0.10	0.00	**0.76**	**0.75**
FCR				**-0.88**	**0.49**	**0.49**
RG					**-0.42**	**-0.42**
RFI_p						**0.98**

[a]Correlations in bold are different from zero at $P < 0.05$.
[b]MBW = mid-test BW $^{.75}$; ADG = average daily gain; DMI = dry matter intake; FCR = feed conversion ratio; RG = residual gain; RFI_p = residual feed intake base model; RFI_c = adjusted for backfat.

Table 8. Characterization of performance and feed efficiency traits in finishing steers with low, medium, and high RFI_p[a]

	RFI group[b]				
Trait	Low	Med	High	SE	*P*-value
Number of steers	67	96	70		
Initial BW, kg	429.24	426.57	425.61	4.84	0.86
Final BW, kg	500.32	497.36	495.80	5.54	0.84
Mid-test metabolic BW, kg^{75}	100.01	99.59	99.37	0.83	0.85
ADG, kg/d	1.02	1.01	1.00	0.03	0.94
DMI, kg/d	7.90^x	8.94^y	9.88^z	0.14	0.0001
Residual feed intake, kg/d	-1.07^x	0.00^y	1.00^z	0.05	0.0001
Residual gain, kg/d	-0.20^x	0.00^y	0.20^z	0.01	0.0001
Feed conversion ratio, kg of DMI/kg of gain	8.15^x	9.03^y	10.09^z	0.19	0.0001
Residual feed intake adjusted for backfat, kg/d	-1.06^x	0.00^y	1.05^z	0.05	0.0001

[a]Residual feed intake base model.
[b]Steers with low, medium, and high RFI were <0.05, ± 0.05, and >0.05 from the mean RFI, respectively.
[xyz]Means with different superscripts in the same row differ ($P < 0.05$).

Table 9. Phenotypic correlations[a] between performance and feed efficiency traits in finishing steers.

Trait[b]	ADG	DMI	FCR	RG	RFI_p	RFI_c
MBW	**0.41**	**0.62**	0.07	0.01	-0.02	-0.04
ADG		**0.66**	**-0.67**	**0.76**	0.01	0.01
DMI			0.07	0.02	**0.63**	**0.43**
FCR				**-0.94**	**0.52**	**0.35**
RG					**-0.52**	**-0.35**
RFI_p						**0.71**

[a]Correlations in bold are different from zero at $P < 0.05$.

[b]MBW = mid-test BW $^{.75}$; ADG = average daily gain; DMI = dry matter intake; FCR = feed conversion ratio; RG = residual gain; RFI_p = residual feed intake base model; RFI_c = adjusted for backfat.

was correlated (P <0.05) with ADG (r = 0.53; 0.66), MBW (r = 0.53; 0.62), RFI_p (r = 0.76; 0.63) and RFI_c (r = 0.75; 0.43), but not correlated with FCR or RG in both phases. Feed conversion ratio was negatively correlated (P < 0.05) with ADG (r = -0.70; -0.67), but not correlated with DMI in both phases. Residual gain was not correlated (P > 0.05) with MBW or DMI during the growing and finishing phases, but was correlated (P < 0.05) with ADG (r = 0.85; 0.76) and FCR (r = -0.88; -0.94) during both phases. Spearman rank correlations show that ADG and FCR measured during the growing phase were weakly associated with ADG (r = 0.26) and FCR (r = 0.28) during the finishing phase (Table 10). Rank correlations were moderately correlated for DMI (r = 0.46), RFI_p (r = 0.43) and RFI_c (r = 0.39). Correlations also show that RG measured during the growing phase was weakly associated with RG (r = 0.18) during the finishing phase.

Ultrasound carcass traits. Low RFI steers had an initial LM of 49.11 cm^2, while high RFI steers had a smaller initial LM of 48.62 cm^2 (P < 0.04; Table 11). Low RFI steers also had less gain in BF than high RFI steers. Phenotypic correlations between carcass ultrasound measurements and performance and efficiency traits are shown in Table 10 and Table 12. Residual feed $intake_p$ was correlated (P < 0.05) with gain in BF (r = 0.14) during growing and had a tendency (P < 0.10) to be correlated with final BF (r = 0.13). Residual gain had a tendency (P < 0.10) to be correlated with final IMF (r = 0.12) during the growing phase. Correlations between RFI_c and ultrasound measurements were not different from zero. Average daily gain was not correlated (P > 0.05) with initial LM, initial BF, or initial IMF, but DMI as positively correlated with initial BF (P < 0.05)

Table 10. Phenotypic correlations between performance and feed efficiency traits in the growing and finishing phases.

Trait[b]	FinishADG	FinishDMI	FinishFCR	FinishRFI_p	FinishRFI_c	FinishRG
GrowADG	**0.26**					
GrowDMI		**0.46**				
GrowFCR			**0.28**			
GrowRFI_p				**0.43**		
GrowRFI_c					**0.39**	
GrowRG						**0.18**

[a] Correlations in bold are different from zero at $P < 0.05$.

[b] ADG = average daily gain; DMI = dry matter intake; FCR = feed conversion ratio; RG = residual gain; RFI_p = residual feed intake base model; RFI_c = adjusted for backfat.

Table 11. Characterization of carcass ultrasound traits following the growing phase in steers with divergent phenotypes for RFI_p.

Trait	RFI group[a] Low	Med	High	SE	*P*-value
Number of steers	67	97	69		
Initial longissimus area, cm^2	49.11[x]	50.65[y]	48.62[z]	0.65	0.04
Initial 12th rib fat thickness, cm	0.27	0.29	0.28	0.01	0.59
Initial intramuscular fat, %	2.14	2.15	2.27	0.07	0.37
Final longissimus area, cm^2	60.14	60.96	60.34	0.08	0.71
Final 12th rib fat thickness, cm	0.36	0.38	0.41	0.02	0.09
Final intramuscular fat, %	2.40	2.42	2.53	0.08	0.42
Gain in longissimus area, cm^2	11.03	10.30	11.69	0.65	0.26
Gain in 12th rib fat thickness, cm	0.09[x]	0.09[y]	0.13[z]	0.01	0.02

[a]Steers with low, medium, and high RFI were <0.05, ± 0.05, and >0.05 from the mean RFI, respectively.
[b]Overall trait standard deviation.
[xyz]Means with different superscripts in the same row differ ($P < 0.05$).

Table 12. Phenotypic correlations[a] between carcass ultrasound measurements and performance and efficiency traits in growing steers.

Trait[b]	ADG	DMI	FCR	RG	RFI_p	RFI_c
Initial longissimus area, cm^2	0.04	**0.14**	0.01	-0.07	-0.04	-0.02
Initial 12th rib fat thickness, cm	0.00	0.12†	0.02	-0.10	0.03	0.02
Initial intramuscular fat, %	0.04	0.10	0.03	-0.04	0.08	0.06
Final longissimus area, cm^2	**0.19**	**0.32**	-0.04	-0.02	0.02	0.03
Final 12th rib fat thickness, cm	0.10	**0.22**	0.02	-0.04	0.13†	0.01
Final intramuscular fat, %	**0.16**	0.12†	-0.09	0.12†	0.09	0.05
Gain in longissimus area, cm^2	**0.20**	**0.25**	-0.06	0.05	0.07	0.07
Gain in 12th rib fat thickness, cm	0.12†	**0.20**	0.02	0.02	**0.14**	-0.01

[a]Correlations in bold are different from zero at $P < 0.05$.

†Correlations are different from zero at $P < 0.10$.

[b]ADG = average daily gain; DMI = dry matter intake; FCR = feed conversion ratio; RG = residual gain; RFI_p = residual feed intake base model; RFI_c = adjusted for backfat.

with initial LM (r = 0.14; r = 0.16, respectively) and tended ($P < 0.10$) to be correlated with initial BF (r = 0.12). Average daily gain was positively correlated ($P < 0.05$) with final LM (r = 0.19), final IMF (r = 0.16), and gain LM (r = 0.20) with a tendency ($P < 0.10$) to be correlated with gain BF (r = 0.12) during the growing phase. Dry matter intake was correlated ($P < 0.05$) with final LM (r = 0.14), final BF (r = 0.22), gain LM (r = 0.25), and gain BF (r = 0.20), with a tendency ($P < 0.10$) to be correlated with final IMF (r = 0.12). Correlations between FCR and ultrasound measurements were not different from zero.

The significant correlation between BF and RFI_p suggests that RFI_p should be adjusted for estimates of carcass fatness (Table 13 and 14). During the growing phase, inclusion of gain in BF in an adjusted model used to calculate RFI_c accounted for more of the variation in DMI ($R^2 = 0.45$) compared to the base model ($R^2 = 0.43$). Previous studies also found that inclusion of carcass traits in the RFI base model explained more of the variation during the growing phase (Table 13). During the finishing phase, inclusion of final BF in an adjusted model used to calculate RFI_c accounted for more of the variation in DMI ($R^2 = 0.56$) compared to the base model ($R^2 = 0.53$). Previous studies also found that inclusion of carcass traits into the RFI base model explained more of the variation during the finishing phase (Table 14). The Spearman rank correlation between RFI_p and RFI_c was 0.97 during growing and 0.92 during finishing, indicating that RFI_p and RFI_c are highly related. Both RFI traits were similarly correlated with performance and efficiency traits. As expected, RFIc was not correlated with gain in BF in the growing phase and final BF in the finishing phase, which was used to calculate DMI for the growing and finishing phases.

Carcass traits. During the finishing phase, steers in the current study had a hot carcass weight (HCW) of 313.14 kg (SD = 2.64), fat thickness at the 12th rib (BF) of 1.12 cm (SD = 0.11), kidney, pelvic, heart fat (KPH) of 2.36 % (SD = 0.11), longissimus muscle area (LM) of 76.31 cm^2 (SD = 0.75), marbling score of 428.09 (SD = 15.35), quality grade (QG) of 394.76 (SD = 7.36), and yield grade (YG) of 2.94 (SD = 0.20). There were no significant differences between HCW, BF, KPH, LM, marbling score, QG, YG and RFI_p groups were observed (Table 15). Residual gain was negatively correlated ($P < 0.05$) with numerical marbling (r = -0.20) and quality grade (r = -0.21) during the finishing phase. However ADG, DMI, FCR, RFI_p and RFI_c were not correlated ($P > 0.05$) with carcass traits during the finishing phase (Table 16).

Estimates of temperament. During the growing phase, steers in the current study had an initial exit velocity (EV) of 0.63 m/s (SD = 0.03) and an initial chute score (CS) of 1.77 (SD = 0.07; Table 17). During the finishing phase steers had a final EV of 0.70 m/s (SD = 0.04) and a final chute score of 1.67 (SD = 0.12; Table 19). No differences were found between low, medium, and high temperament groups during both the growing and finishing phases.

During the growing phase initial exit velocity was not correlated ($P > 0.10$) with performance and feed efficiency traits. Initial chute score was negatively correlated ($P < 0.05$) with ADG (r = -0.23) and DMI (r = -0.20) during the growing phase. Final CS was not correlated ($P > 0.05$) with ADG or DMI during the finishing phase. However, final EV had a tendency ($P < 0.10$) to be correlated with ADG and was correlated ($P < 0.05$) with DMI during the finishing phase. Chute score and EV were not correlated ($P > 0.05$) with feed efficiency traits in both the growing and finishing phases (Table 18 and Table 20).

Initial exit velocity was correlated ($P < 0.05$) with initial BF (r = 0.14) during the growing phase (Table 21). Final exit velocity was correlated ($P < 0.05$) with initial BF (r = 0.19) and final BF (r = 0.17) during the growing phase and was correlated ($P < 0.05$) with initial BF (r = 0.18), final LM (r = 0.22), final BF (r = 0.37), and gain BF (r = 0.30) with a tendency ($P < 0.10$) to be correlated with initial LM (r = 0.13) during the finishing phase. Initial chute score had a tendency ($P < 0.10$) to be correlated with gain LM (r = -0.12) and gain BF (r = -0.11) during the growing phase. During the finishing phase final CS was negatively correlated ($P < 0.05$) with initial REA (r = -0.17) and initial BF (r = -0.17) with a tendency ($P < 0.10$) to be correlated with final LM (r = -0.14) and final BF (r = -0.15).

<u>Conclusion.</u> Residual feed intake$_p$ and RFI$_c$ were both phenotypically correlated with FCR while remaining independent of BW and ADG. Residual feed intake has been shown to be a moderately heritable trait in previous studies. The results from this study suggest that RFI can be used as a selection tool to improve feed efficiency in cattle. Selecting against RFI could result in decreased feed efficiency while increasing mature size. Results also suggest that RG could also have the potential to improve feed efficiency in beef cattle.

Further research is warranted to further explore RG and is associations with performance and feed efficiency traits, ultrasound carcass traits, carcass measurement traits, and temperament traits.

Table 13. Amount of variation explained in feed intake models by inclusion of carcass traits during the growing phase.

Trait	Current Study	Lancaster et al., 2009b	Brown, 2005
RFI_p	0.43[a]	0.53[a]	0.66[a]
RFI_c	0.45[b]	0.58[c]	0.67[d]

[a] $DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3TEST\ GROUP + error$

[b] $DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3GBF^a \times TEST\ GROUP + error$

[c] $DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3TEST\ GROUP + error + GBF + GBF \times TEST\ GROUP + FINAL\ LMA + FINAL\ LMA \times TEST\ GROUP$

[d] $DMI = ß_0 + ß_1MBW + ß_2ADG + ß_3TEST\ GROUP + error + GBF^a + GBF \times TEST\ GROUP$

Table 14. Amount of variation explained in feed intake models by inclusion of carcass traits during the finishing phase.

Trait	Current Study	Lancaster et al., 2009b	Brown, 2005
RFI_p	0.53[a]	0.76[a]	0.64[a]
RFI_c	0.56[b]	0.78[c]	0.69[d]

[a] DMI = $ß_0 + ß_1$MBW + $ß_2$ADG + $ß_3$TEST GROUP + error

[b] DMI = $ß_0 + ß_1$MBW + $ß_2$ADG + $ß_3$FBF[a] × TEST GROUP + error

[c] DMI = $ß_0 + ß_1$MBW + $ß_2$ADG + $ß_3$TEST GROUP + error + GBF + GBF × TEST GROUP + LMA GAIN+ LMA GAIN × TEST GROUP + FBF + FBF × TEST GROUP

[d] DMI = $ß_0 + ß_1$MBW + $ß_2$ADG + $ß_3$TEST GROUP + error + FBF[a] + FBF × TEST GROUP

Table 15. Characterization of carcass traits in finishing steers with divergent phenotypes for RFI_p.

Trait	RFI group[a]			SE	*P*-value
	Low	Med	High		
Number of steers	66	96	67		
Hot carcass weight, kg	311.76	316.18	311.48	3.50	0.92
Fat thickness at 12th rib, cm	1.01	1.22	1.14	0.07	0.28
Adjusted fat thickness at 12th rib, cm	1.00	1.27	1.18	0.07	0.37
Preliminary Yield grade based on 12th rib backfat	2.99	3.17	3.01	0.14	0.43
Adjusted Preliminary Yield Grade at 12th rib	2.98	3.25	3.16	0.07	0.37
Kidney, pelvic, and heart fat, %	2.30	2.49	2.29	0.08	0.84
Longissimus muscle area, cm^2	77.15	76.04	75.73	0.83	0.99
Numerical marbling score, MT = 500, MD = 600	413.81	444.32	426.15	9.75	0.65
Quality Grade, 400 = choice	387.35	402.06	394.86	5.20	0.86
Yield Grade	2.72	3.12	2.97	0.10	0.60

[a]Steers with low, medium, and high RFI were <0.05, ± 0.05, and >0.05 from the mean RFI, respectively.
[b]Overall trait standard deviation.
[xyz]Means with different superscripts in the same row differ ($P < 0.05$).

Table 16. Phenotypic correlations[a] between carcass traits obtained at slaughter and performance and feed efficiency traits in finishing steers.

Trait[b]	ADG	DMI	FCR	RFI_p	RFI_c	RG
Body composition traits:						
Hot carcass weight, kg	0.11	0.07	-0.04	-0.01	-0.02	-0.07
Fat thickness at 12th rib, cm	0.11	0.11	-0.06	0.08	0.07	-0.04
Adjusted fat thickness at 12th rib, cm	0.10	0.06	-0.07	0.03	0.02	-0.07
Preliminary yield grade based on 12th rib backfat	0.12	0.12	-0.07	0.08	0.08	-0.06
Adjusted preliminary yield grade at 12th rib	0.10	0.06	-0.07	0.03	0.02	-0.07
Kidney, pelvic, and heart fat, %	-0.11	-0.07	0.07	0.03	0.02	-0.11
Longissimus muscle area, cm	0.05	0.07	0.00	0.02	0.02	-0.03
Numerical marbling score, MT=500, MD=600	0.05	0.04	-0.02	0.02	0.02	**-0.20**
Quality grade, 400=choice	0.07	0.05	-0.03	0.03	0.03	**-0.21**
Yield grade	0.07	0.03	-0.05	0.02	0.01	-0.07

[a]Correlations in bold are different from zero at $P < 0.05$.
[b]ADG = average daily gain; DMI = dry matter intake; FCR = feed conversion ratio; RFI_p = residual feed intake base model; RFI_c = adjusted RFI for backfat; RG = residual gain.

Table 17. Phenotypic correlations[a] between temperament traits and performance and efficiency traits in growing and finishing steers.

Trait[b]	IEV	ICS	FEV	FCS
ADG	0.09	**-0.23**	0.15†	0.03
DMI	0.04	**-0.20**	0.20	-0.05
FCR	-0.10	0.08	0.01	-0.09
RFI_p	-0.06	-0.01	-0.02	-0.01
RFI_c	-0.06	0.00	-0.12	-0.02
RG	-0.03	0.03	0.02	0.09

[a]Correlations in bold are different from zero at $P < 0.05$.
†Correlations are different from zero at $P < 0.10$.
[b]ADG = average daily gain; DMI = dry matter intake; FCR = feed conversion ratio; RFI_p = residual feed intake base model; RFI_c = adjusted for backfat; RG = residual gain; IEV = initial exit velocity; ICS = initial chute score.

Table 18. Phenotypic correlations[a] between carcass ultrasound measurements and temperament traits in growing and finishing steers.

Trait[b]	Grow IEV	Grow ICS	Finish FEV	Finish FCS
Initial longissimus area, cm^2	0.01	0.07	0.13 †	**-0.17**
Initial 12th rib fat thickness, cm	**0.14**	0.00	**0.18**	**-0.17**
Initial intramuscular fat, %	-0.08	0.01	0.03	-0.05
Final longissimus area, cm^2	0.09	-0.04	**0.22**	-0.14 †
Final 12th rib fat thickness, cm	0.11	-0.09	**0.37**	-0.15 †
Final intramuscular fat, %	0.04	-0.04	0.07	-0.03
Gain in longissimus area, cm^2	0.10	-0.12 †	0.13	-0.01
Gain in 12th rib fat thickness, cm	0.03	-0.11 †	**0.30**	-0.07

[a]Correlations in bold are different from zero at $P < 0.05$.
†Correlations are different from zero at $P < 0.10$.
[b]IEV = initial exit velocity; ICS = initial chute score; FEV = final exit velocity; FCS = final chute score.

DISCUSSION

Measure of Feed Efficiency

Residual Feed Intake. During the growing and finishing phases, steers with low RFI_p did not differ in initial or final BW, MBW, or ADG, as expected (Fox, 2004; Brown 2005; Lancaster 2009b). Residual feed $intake_p$ has been shown to be independent of both growth and mature size (Herd and Arthur, 2009). Thus, the more favorable phenotypes will consume significantly less feed. However, RFI_p and RFI_c were strongly correlated with RG and FCR in the current study as well as previous studies (Lancaster et al., 2009b; Crowley et al., 2010; Berry and Crowley, 2012; Hafla et al., 2013). From the feed efficiency traits examined, RFI_p attempts to separate feed intake into growth and maintenance components. RFI_p is independent of ADG and correlated with DMI as reported in previous studies (Koch et al., 1963; Perkins et al., 2014). Results are in agreement with Fox (2004), who suggests that applying selection pressure against RFI could increase feed utilization efficiency without unfavorable effects on feedlot performance, body composition, and temperament.

Feed Conversion Ratio. During the growing and finishing phase FCR was negatively correlated with ADG and was independent of MBW and DMI, as expected (Lancaster et al., 2009b; Herd and Bishop, 2000; Koots et al., 1994). Thus, selecting for FCR could result in an increased mature body size and reduction in feed efficiency. While selection pressure against DMI would improve RFI_p, selection for ADG could result increased

DMI and improvement of FCR (Brown, 2005). Furthermore, because selection to improve FCR could increase mature size, it could also increase maintenance energy requirements (Fox, 2004).

Residual Gain. In the current study, RG was independent of DMI and MBW and correlated with ADG, FCR, and RFI, which is consistent with the results from Hafla et al. (2013). Residual gain has been associated with faster growth rates, but not associated with differences in feed intake (Berry and Crowley, 2012). As expected, RG and RFI_p would be correlated because they are similar in principle (Crowley et al., 2010). Berry and Crowley (2012) combined RFI_p and RG to identify animals that require a shorter period of time spent in the feedlot and also had a lower DMI. Furthermore, the correlation between RG and FCR was stronger than the correlation with RFI and FCR, which is consistent with the results from Hafla et al. (2013).

Results are in agreement with Brown (2005), who suggests that selection pressure against DMI could improve feed efficiency as measured by RFI_p, but could also result in a reduction in growth rate and mature size. However, selection programs using ADG could result in increases in DMI and improvement in FCR. Ideally, the goal of the beef industry is to improve feed efficiency by reducing intake while maintaining growth rate and mature size. Further research is warranted for RG and its effect on performance, carcass measurements, and temperament.

Carcass ultrasound traits. The correlations between RFI_p and initial LM could indicate that more efficient cattle had larger LM at the start of the study. These results are consistent with Brown (2005), but inconsistent with Basarb et al. (2003), who did not observe significant correlations between RFI and initial LM in steers during a 120-d feedlot period. In the current study, DMI was correlated with initial LM, final LM, and gain in LM in the growing phase. Average daily gain was also correlated with final LM and gain in LM. These results are consistent with Nkrumah et al. (2004), who observed correlations between ADG and DMI with final LM. Correlations between ADG and DMI with LM suggest that cattle with faster growth rates and higher feed intake would also have larger LM compared to cattle with a slower growth rate and less feed intake. In the current study, FCR was not correlated with LM in the growing phase. However, Lancaster et al. (2009b) found FCR to be correlated with final LM in Brangus heifers. Residual gain was not correlated with final LM. Fox (2004) found that RG was positively correlated with final LM. These results are inconsistent with the current study, as RG was not correlated with LM.

Results suggest that the more efficient steers have less BF. Correlations between RFI and FBF are consistent with Carstens et al. (2002) for final BF ($r = 0.22$; $P < 0.01$). Barsarab et al. (2003) reported a tendency for RFI_p to be correlated with gain in BF ($r = 0.22$; $P < 0.01$) during the testing period. Correlations between RFI_p and BF suggest that more efficient steers are leaner than the less efficient steers. The correlation of gain in BF with RFI_p and FBF with RFI_p during the growing phase warranted examination of carcass ultrasound traits in the linear regression model used to calculate DMI. In a previous study, Lancaster et al. (2009b) observed that an increase in variation explained by the model with the inclusion of fat, but addition of other carcass ultrasound traits did not explain any more variation. Calculation of RFI_c for each steer, including gain in BF for growing phase and final BF for finishing phase was warranted via stepwise regression. Adjusting the base model for RFI was successful by the lack of significant correlation with other carcass ultrasound measurements. In previous studies by Basarab et al. (2003) and Lancaster et al. (2009b), RFI adjusted for carcass ultrasound traits was calculated. Furthermore, Basarab et al. (2003) concluded that RFI was independent of most carcass ultrasound and harvested carcass traits. According to Basarab et al. (2003), adjusting the RFI model for harvest carcass traits is not practical, due to the sacrifice of the cattle. Adjusting for carcass traits after harvest limits practical use of RFI_c in developmental programs. The current study and final BF during the finishing phase will explain more of the variation, resulting in no correlation between RFI_c and carcass traits determined after harvest. Furthermore, Basarab et al. (2003) and Lancaster et al. (2009b) concluded that gain in BF added to the base model explains more of the variation and found no significant correlations between RFI_c and carcass traits determined after harvest.

Residual feed $intake_p$ can be used in selection programs because it is not affected by gain or mature size. Furthermore, adjusting RFI for carcass composition will facilitate selection to reduce feed intake in cattle without affecting rate of composition of gain (Lancaster et al., 2009 a). Thus, selecting RFI_c over RFI_p will allow for body composition to be adjusted for all RFI groups to be similar. Positive associations between RFI_p and BF suggest that selection for RFI_p could have detrimental effects on reproductive efficiency in heifers (DeRouen et al., 1994). However, selection for RFI_c will allow for independence of BF, thus heifers will not be too lean and puberty will not be affected. As so for bulls, due to the independence of BF, selecting for RFI_c will allow for sperm morphology to not be affected due to bulls having too much or too little BF (Hafla et al., 2012).

Feed efficiency measurements, FCR and RG, were not correlated with BF during this study. These results are consistent with Fox (2004), who did not find correlations between FCR, RG and BF. However, DMI and ADG were correlated with BF, which is consistent with Nkrumah et al. (2004). These results indicate that cattle with slower growth rates and lower feed intake would have less backfat as compared to cattle with higher growth rates and greater feed intake.

Intramuscualar fat was not correlated with RFI_p or RFI_c and no difference was found between low and high RFI steers. Results are consistent with Richardson et al. (2001), who reported no difference in IMF between low and high RFI steers at slaughter. However, Fox (2004) found that RFI tended to be correlated with final IMF and low RFI bulls had less IMF than high RFI bulls. It was also stated by Fox that this could be due to low RFI bulls having slower rates of lipid accretion as compared to high RFI bulls, which could be unfavorable when associated with RFI. During the growing phase final IMF was correlated with ADG and had a tendency to be correlated with DMI. Furthermore, Lancaster et al. (2009a) also found that ADG and DMI were correlated with final IMF. These results might suggest that increased growth rate and increased feed intake could results in increased IMF. During the growing phase RG had a tendency to be correlated with final IMF. These results are inconsistent with Fox (2004) who did not find a correlation between RG and final IMF.

Carcass traits. There were no correlations ($P > 0.05$) found between feed efficiency traits and carcass traits of hot carcass weight, backfat, longissimus muscle area, KPH, and yield grade in this study. This is in partial agreement with Fox (2004) who did not find RFI_p to be correlated with longissimus muscle area, KPH, yield grade, or quality grade. However, Fox (2004) did find backfat and hot carcass weight to have a tendency ($P < 0.10$) to be correlated with RFI_p. Brown (2005) also found RFI_p to not be correlated ($P > 0.05$) with hot carcass weight, longissimus muscle area, KPH, marbling, and quality grade. However, backfat and yield grade were positively correlated ($P < 0.05$) with RFI_p. Fox (2004) found FCR to be negatively correlated ($P < 0.01$) with hot carcass weight (r = -0.26) and tended to be correlated ($P < 0.10$) with longissimus muscle area (r = -0.18), which suggests that cattle with a lower FCR may have larger carcasses.

Feed conversion ratio was correlated with marbling score (Brown, 2005). However, Nkrumah et al. (2004) did not observe any significant relationships between marbling score and feed efficiency traits. The current study only found RG in the finishing phase to be negatively correlated with marbling score. Thus, suggesting that marbling score will decrease as RG increases. However, Perkins et al. (2014) found marbling score was significantly higher in low RFI steers versus high RFI steers ($P < 0.05$). These results are consistent with the current study. In a previous study by Nkrumah et al. (2007a), marbling score was positively correlated with RFI_p, but the current study is inconsistent with these results.

The current study found RG to be negatively correlated with quality grade. Thus, suggesting that as RG increases, quality grade could decrease. However, Fox (2004) did not find quality grade to be correlated with any feed efficiency traits. Furthermore, Brown (2005) found quality grade to have a tendency to be correlated with FCR, but did not have any relationship with RFI_p or RFI_c. Quality grade was not correlated with any other feed efficiency traits during this study. These results are inconsistent with Nkrumah et al. (2004) who found carcass quality grade to be correlated with FCR, RFI, and DMI.

Estimates of Temperament

Exit Velocity. Previous studies have stated that EV is negatively correlated to DMI, but phenotypically unrelated to FCR, RFI, or RG (Fox, 2004; Nkrumah et al., 2007b). However, genetically EV was correlated with FCR ($r = 0.40 \pm 0.26$) and RFI ($r = -0.59 \pm 0.45$; Nkrumah et al., 2007b). Correlations between EV and BF might indicate that steers with a less excitable temperament could be leaner than steers with a more excitable temperament. These results are inconsistent with Nkrumah et al. (2007b), who did not observe any correlations between EV and BF. However, Nkrumah et al. (2007b) did find a correlation between EV and REA ($r = 0.22$), which is also consistent with findings from the current study where EV and final REA were positively correlated ($r = 0.22$) in the finishing phase.

Chute Score. Previous studies report that temperament was not related to feed efficiency (Fox, 2004; Black et al., 2013). However, temperament traits have shown to be correlated with ADG and DMI. Average daily gain was correlated with CS in both heifers and cows (Black et al., 2013). The current study found ADG and CS to be correlated during the growing phase, but not the finishing phase. However, Fox (2004) did not find any correlation between CS and performance and efficiency traits. During the growing phase, RG was correlated with final CS, which is inconsistent with Fox (2004). Initial chute score had a tendency to be correlated with gain in BF and gain in LM during the growing phase. During the finishing phase, initial LM and initial BF were negatively correlated with final CS and final LM and final BF had a tendency to be correlated with final CS.

Thus, concluding that cattle with more excitable temperaments could tend to be leaner with less intramuscular fat. It was determined by Voisinet et al. (1997) that the more excitable cattle had lighter carcass weights as compared to less excitable cattle. Also, Burrow and Dillion (1997) reported that cattle that were slower, when measured by EV, had heavier carcass weights than cattle with a faster EV. Furthermore, Black et al. (2013) concluded that though feed efficiency was not related to difference in temperament traits, the more excitable females had poorer BW gains and tended to have reduced feed intake. Therefore, temperament should be considered in breeding programs and selection strategies to improve the cattle industry.

Conclusion

Results in this study are in agreement with previous studies that RFI_p is independent of growth rate and mature body size, but highly related to DMI. This study also concludes that selecting for RFI could increase feed efficiency without detrimental effects on performance, carcass traits, and temperament. Similar results between performance traits and RG indicate that RG could be an alternative feed efficiency trait. More efficient steers measured by RFI_p showed to be leaner, with minimal responses to other carcass traits. Therefore, RFI_p could improve feed efficiency, while maintaining carcass quality. Residual feed intake adjusted for backfat could minimize the potential for unfavorable responses in composition. Thus, RFI_c could also improve feed efficiency independent of growth, body size, and carcass composition. Of the feed efficiency traits examined RFI_p and RFI_c were the most highly related between growing steers fed a high-roughage diet and finishing steers fed a high-grain diet compared to FCR and RG. These results indicate that feed efficient cattle on a roughage-based diet could rank differently than cattle evaluated on a high-grain diet.

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Appendix A

Table A1. Growing phase data.						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
5	332.34	374.03	0.74	0.66	1	1
16	291.86	337.84	0.62	0.4	2	2
20	312.53	420.35	0.49	0.89	1	1
55	272.90	367.30	0.51	0.58	1	1
61	270.04	330.56	0.41	0.49	2	2
65	278.81	361.61	0.59	0.76	2	1
69	322.09	403.92	0.63	0.82	1	1
72	338.36	426.38	0.57	0.49	1	1
85	300.87	347.62	0.34	0.54	1	1
87	305.47	396.61	0.54	0.33	3	1
90	342.42	385.15	0.81	0.61	1	1
97	305.15	376.06	0.58	0.57	1	1
98	312.29	389.83	0.93	0.75	1	1
99	347.33	467.78	0.64	0.56	2	2
105.405	255.77	325.39	0.52	0.46	4	1
105.701	302.77	355.11	0.42	0.56	1	1
108	305.63	346.80	0.64	0.68	2	1
109	329.48	383.25	0.63	0.66	1	1
110	285.14	388.42	0.63	0.66	2	2
112	343.33	394.24	0.76	0.4	1	1
114.405	299.72	385.36	0.64	1.06	3	1
114.701	333.25	391.30	1.00	2.53	2	1
119	272.74	402.72	0.71	0.52	1	1
121	303.14	403.04	0.98	0.86	1	1
124	367.49	432.81	0.67	0.64	1	1
127	322.12	388.48	0.41	0.47	1	1
133	324.16	388.57	0.79	1.14	1	1
136	279.08	364.54	0.64	0.51	2	2
138	346.75	409.61	0.44	0.49	1	1
150.405	307.13	407.81	0.57	0.34	3	1
150.701	311.82	370.91	0.71	0.8	1	1
152	325.80	384.50	0.55	0.75	4	2
153	362.90	418.61	0.42	0.4	2	1
158	264.16	324.03	0.53	0.49	2	1
160	315.50	388.74	0.56	0.7	2	1
164.405	261.26	350.75	0.53	0.39	5	1
164.701	350.04	423.29	0.87	1.37	1	1
168	254.07	303.81	0.44	0.39	2	1
170	330.19	431.12	0.80	0.69	2	1
171	253.85	342.16	0.58	0.61	1	1

Table A1. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
172	311.05	387.09	0.46	0.55	1	1
173	287.59	400.39	0.62	0.38	1	1
179	359.20	435.34	0.57	0.62	1	1
180	325.37	386.15	0.72	0.57	1	1
183	305.45	364.55	0.49	0.48	2	1
184	316.06	362.42	0.38	0.44	2	1
194	267.79	311.30	0.37	0.48	1	1
195.405	284.20	373.19	0.50	0.60	3	1
195.701	352.47	408.44	0.36	0.5	2	1
196	298.40	377.36	0.61	0.68	1	1
197	313.12	371.43	0.66	1.13	1	1
198	304.54	386.96	0.47	0.39	3	1
206	332.14	453.26	0.63	0.85	1	1
209	278.13	376.08	0.60	0.59	2	2
211	338.23	386.93	1.33	1.15	2	1
213	339.34	438.18	0.81	0.51	3	2
217	312.79	410.87	0.79	0.66	1	1
220	301.60	341.73	0.53	0.74	1	1
225	323.68	378.74	0.66	0.69	1	1
231	337.09	435.77	0.51	0.49	2	1
232	309.18	365.67	0.55	0.67	1	1
242	296.41	341.47	2.47	1.36	1	2
243.405	316.50	386.44	0.70	0.51	2	1
243.701	294.29	350.26	0.76	0.52	1	2
246	310.36	406.68	1.01	0.76	2	1
250	316.66	391.66	0.73	0.84	1	2
252	324.89	381.77	0.40	0.6	1	1
263	320.22	356.45	0.75	2.74	2	1
269	258.53	287.23	0.35	0.36	2	1
276.405	290.91	382.14	0.73	0.68	1	1
276.701	313.64	373.64	0.54	0.53	1	1
279	326.62	369.74	0.55	0.49	1	1
281	340.00	414.55	0.62	0.65	4	1
282	278.25	383.77	0.58	0.37	5	4
283	332.94	378.27	0.52	0.49	1	1
287	290.87	332.16	0.29	0.29	2	1
290	309.43	374.88	0.51	0.47	3	2
292	361.21	427.58	0.66	0.58	1	1
294	293.12	354.16	0.54	0.64	1	1
295	310.09	368.40	0.51	0.73	1	1

Table A1. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
298	272.29	317.10	0.31	0.52	2	2
302	361.81	479.53	0.63	0.60	2	1
304.405	310.81	418.21	0.65	1.07	2	1
304.701	288.27	348.40	0.52	0.55	1	1
305	316.22	412.49	0.65	0.61	2	1
313	273.25	333.12	0.68	0.39	1	1
320	276.36	343.64	0.54	0.57	1	1
330	290.74	395.19	0.46	0.82	3	1
332	357.75	423.46	0.96	0.71	1	1
341	270.25	354.05	0.46	1.11	2	1
344	280.27	371.53	0.44	0.50	3	1
354	335.92	435.10	0.58	0.62	1	1
355.405	301.95	393.62	0.52	0.49	3	1
355.701	337.10	383.20	0.74	0.68	1	1
361	319.83	378.66	0.46	0.63	1	1
368	336.54	432.85	0.59	2.38	1	1
369	274.20	355.20	0.60	0.54	2	1
372	330.56	398.23	0.37	0.44	1	1
373.405	378.49	475.83	0.76	1.04	2	1
373.701	327.27	389.09	0.63	0.50	2	1
375	321.90	380.22	1.15	2.70	1	2
380	288.12	382.40	0.82	0.52	2	2
388	314.55	371.82	0.58	0.89	2	1
389	299.78	354.46	0.54	0.49	1	1
396	281.08	344.98	0.61	0.50	1	1
400	281.28	391.57	0.63	0.43	1	1
401	299.83	359.57	0.40	0.57	4	1
407	310.22	380.09	0.74	0.72	1	1
410	355.59	473.06	0.42	0.97	2	2
411	316.35	409.69	0.76	0.55	2	1
415	327.75	388.92	0.72	0.67	2	1
419	336.06	427.91	0.65	1.08	2	1
420	350.55	475.79	0.51	0.47	3	1
422	250.87	301.26	0.33	0.44	1	1
425.405	300.93	389.65	0.66	0.53	3	1
425.701	371.52	449.70	0.50	0.66	1	1
439	307.10	356.84	0.40	0.62	2	1
441	330.69	395.37	0.58	0.55	1	1
442	301.39	336.19	0.41	0.43	1	1
443	293.03	355.76	0.55	0.57	2	2

Table A1. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
446	335.54	409.31	0.65	0.74	1	1
451	325.41	383.98	0.45	0.65	1	1
454.405	285.33	370.25	0.73	0.81	2	1
454.701	350.04	401.47	0.33	0.32	2	1
457	319.96	389.44	0.77	0.71	2	2
468	309.78	392.64	0.65	0.90	1	1
478	317.60	403.00	0.55	0.76	3	1
480	288.74	400.84	0.90	1.09	2	1
481	240.44	327.41	0.48	0.33	2	2
485	351.69	424.68	1.36	1.85	1	1
496	316.36	390.00	0.43	0.33	1	1
509	334.14	452.23	0.91	0.98	2	2
513	236.29	334.96	0.65	0.53	2	1
516	310.43	377.45	0.61	1.12	1	1
522	331.56	395.71	4.20	2.06	1	1
524	296.81	402.27	0.50	0.48	2	1
526	267.00	375.64	0.47	0.60	2	1
527	238.69	314.11	0.68	0.75	4	1
541	290.48	342.55	0.39	0.55	2	2
544	311.49	438.30	0.64	0.82	1	1
553	325.71	405.19	0.50	0.58	1	1
559	296.93	349.13	0.51	0.51	1	1
560	204.71	284.08	0.56	0.44	3	2
566	301.73	367.97	0.43	0.35	1	1
567	285.46	380.48	0.45	0.56	3	3
573	339.05	402.16	0.59	1.07	1	1
575	303.22	424.87	0.61	0.41	2	1
576	350.49	451.26	0.64	0.81	1	1
580	286.02	338.23	0.44	0.54	1	1
592	338.08	423.22	0.50	0.89	2	1
593	352.84	469.88	0.72	0.67	2	1
598	303.47	419.79	0.64	0.75	2	1
601	329.88	445.27	0.74	0.54	2	1
605	269.26	314.07	0.50	0.40	2	2
606	282.54	352.01	.	0.89	1	1
607	272.99	323.38	0.51	0.42	2	2
612	280.26	342.47	0.34	0.38	1	1
613.405	308.44	402.76	0.53	0.55	2	1
613.701	242.86	288.05	0.48	0.53	2	2
615	355.84	423.25	0.64	0.58	2	1

Table A1. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
618	276.88	365.84	0.64	0.88	2	1
624	286.55	380.86	0.68	0.62	1	1
627	336.13	420.31	0.56	0.55	3	2
628	302.45	413.62	0.68	0.50	2	2
630	296.73	379.71	0.64	0.98	3	1
635	273.04	356.95	0.61	0.77	2	1
638	280.74	332.29	0.80	0.44	2	2
639	305.19	363.90	0.83	0.51	2	1
640	266.54	328.61	0.38	0.36	1	1
643	350.96	427.00	0.55	0.67	2	1
645	342.34	407.66	0.71	0.98	1	1
648	313.36	397.96	0.49	0.39	3	2
651	318.45	420.02	0.84	0.90	2	2
653	321.47	373.68	0.38	0.35	1	1
655	319.70	387.88	1.24	0.78	1	1
657	313.38	443.45	0.50	0.79	1	1
667	266.02	360.68	0.65	0.66	2	1
668	353.16	422.90	0.67	0.58	2	1
670	284.10	347.24	0.70	0.51	1	1
671	319.42	418.68	0.69	0.69	2	1
675	264.05	367.52	0.59	0.42	3	3
681	309.87	370.13	0.54	0.91	1	1
684	274.13	358.91	0.41	0.45	3	2
686	345.67	394.63	0.57	0.59	1	1
692	287.71	327.45	0.46	0.49	1	1
693	293.43	436.63	0.73	0.71	2	1
699	305.11	371.86	0.69	0.51	2	1
700	212.89	343.09	0.75	0.47	1	2
704	315.61	406.45	0.60	0.97	2	1
706	226.96	303.23	0.77	0.49	5	3
711	281.02	365.76	0.53	0.41	3	1
721	321.04	414.09	0.64	0.58	3	1
726	241.25	347.63	0.62	0.64	1	1
734	285.76	336.67	0.55	0.44	2	1
737	284.76	357.36	0.85	2.67	1	1
751	284.32	358.73	0.69	0.69	3	1
756	228.53	355.39	0.51	0.49	2	1
781	219.30	331.13	0.52	0.39	2	2
783	281.04	376.70	0.73	0.37	2	1
785	268.62	357.91	0.71	0.44	5	2

Table A1. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
786	292.64	405.93	0.81	0.54	1	1
793	274.30	347.33	0.52	0.53	2	2
795	288.18	344.55	0.51	0.49	2	2
800	296.30	396.15	0.93	0.75	2	1
804	295.41	371.26	0.97	1.24	1	1
807	279.76	385.36	0.64	0.59	4	1
826	317.07	402.73	0.62	0.51	1	1
828	329.86	415.84	0.44	0.79	2	2
836.405	320.81	430.84	0.49	0.54	3	3
836.701	285.84	346.88	0.53	0.88	1	1
839	269.05	339.44	0.35	0.49	1	1
840	312.29	398.01	0.60	0.97	1	1
841	321.67	428.87	0.53	0.69	1	2
850	265.67	322.81	0.54	0.55	1	1
856	349.34	446.92	0.53	0.54	2	2
866	340.74	457.39	0.57	0.62	2	1
868	321.63	371.47	0.82	0.53	4	4
870	277.49	351.10	0.54	0.39	3	2
871	250.52	302.21	0.60	0.34	2	2
873	258.22	349.77	0.55	0.45	3	1
875	302.86	398.42	0.55	0.35	1	3
878	331.81	437.24	1.03	1.21	1	1
885	280.91	342.73	0.50	0.44	1	1
886	309.70	358.79	0.56	0.78	2	2
887	289.70	356.06	0.55	0.55	2	1
888	285.63	346.80	0.39	0.73	1	2
889	262.34	314.03	0.40	0.82	1	1
901	307.27	354.55	0.40	0.65	2	1
902	351.65	408.66	0.44	0.42	1	1
903	300.74	354.11	0.67	0.57	1	1
906	266.78	373.40	0.69	0.55	2	2
907	299.14	375.89	0.65	0.54	2	2
924	288.84	387.61	0.63	0.57	3	2

Table A1. (continued)						
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d
5	0.60	81.50	9.13	15.34	-0.01	0.37
16	0.66	74.70	8.20	12.48	-0.69	-0.52
20	1.40	83.75	10.20	7.28	0.59	-0.63
55	1.23	75.68	10.21	8.32	0.64	0.79
61	0.86	72.10	9.66	11.17	0.48	0.45
65	1.08	75.70	8.82	8.20	-0.36	-0.38
69	1.06	83.16	9.19	8.65	-0.68	-0.52
72	1.14	86.47	10.64	9.31	0.24	-0.09
85	0.67	76.40	8.44	12.63	-0.57	-0.62
87	1.18	81.10	11.20	9.46	1.22	1.10
90	0.61	83.30	9.09	14.88	-0.19	-0.08
97	1.01	79.30	9.90	9.77	0.00	0.03
98	1.11	81.10	9.71	8.77	-0.49	-0.50
99	1.56	90.71	12.56	8.03	0.67	0.68
105.405	0.90	70.38	8.92	9.87	0.70	0.77
105.701	0.75	77.20	8.55	11.44	-0.67	-0.34
108	0.59	76.80	8.41	14.30	-0.45	-0.34
109	0.77	82.00	9.09	11.83	-0.45	-0.38
110	1.34	78.62	9.20	6.86	-0.94	-0.85
112	0.73	84.20	8.69	11.95	-0.89	-0.60
114.405	1.11	79.62	9.33	8.39	-0.33	-0.41
114.701	0.83	83.00	9.61	11.58	-0.12	-0.10
119	1.69	78.78	11.85	7.02	0.80	0.81
121	1.30	81.45	10.25	7.90	-0.06	-0.33
124	0.93	89.50	10.33	11.07	0.01	0.00
127	0.95	81.80	9.17	9.67	-0.74	-0.71
133	0.92	82.00	7.77	8.44	-2.09	-2.06
136	1.11	75.98	9.49	8.55	0.20	0.06
138	0.90	85.80	11.68	13.00	1.65	1.68
150.405	1.31	82.21	10.29	7.87	-0.11	-0.18
150.701	0.84	79.40	9.25	10.95	-0.30	-0.34
152	0.84	81.80	10.64	12.69	0.97	1.15
153	0.80	87.90	10.32	12.96	0.38	0.35
158	0.86	71.00	9.86	11.53	0.77	0.84
160	1.05	81.30	9.74	9.31	-0.34	-0.31
164.405	1.16	73.16	9.18	7.90	0.02	0.02
164.701	1.05	87.20	9.82	9.38	-0.60	-0.35
168	0.71	68.30	7.93	11.16	-0.69	-0.75
170	1.31	86.18	11.97	9.13	1.17	1.23
171	1.15	71.72	9.64	8.41	0.67	0.57

Table A1. (continued)						
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d
172	0.99	80.76	9.55	9.68	0.11	0.21
173	1.46	79.87	9.83	6.71	-0.75	-0.68
179	0.99	88.98	10.96	11.08	0.71	0.40
180	0.87	81.90	8.46	9.74	-1.28	-1.04
183	0.84	78.30	8.19	9.70	-1.30	-1.55
184	0.66	79.00	8.76	13.23	-0.38	-0.59
194	0.62	70.20	10.28	16.54	1.73	1.89
195.405	1.16	77.20	7.69	6.65	-1.84	-1.74
195.701	0.80	86.10	9.65	12.07	-0.19	-0.06
196	1.13	78.80	9.81	8.70	-0.30	-0.10
197	0.83	79.60	9.94	11.93	0.40	0.53
198	1.07	80.18	9.21	8.61	-0.39	-0.31
206	1.57	88.22	12.28	7.81	0.61	0.80
209	1.27	76.92	9.04	7.10	-0.77	-1.00
211	0.70	83.10	9.15	13.15	-0.30	-0.18
213	1.28	87.55	10.93	8.51	0.07	0.08
217	1.27	82.96	11.54	9.06	1.15	1.31
220	0.57	76.00	10.00	17.44	1.22	1.05
225	0.79	81.10	10.58	13.45	1.05	0.38
231	1.28	87.16	11.26	8.79	0.45	0.53
232	0.81	78.70	9.41	11.67	-0.02	0.16
242	0.64	75.50	8.35	12.96	-0.55	-0.34
243.405	0.91	81.17	8.98	9.89	-0.30	-0.14
243.701	0.80	76.10	9.28	11.61	0.02	0.20
246	1.25	82.39	9.99	7.99	-0.29	-0.35
250	0.97	81.64	8.87	9.10	-0.63	-0.71
252	0.81	81.50	9.21	11.33	-0.39	-0.43
263	0.52	78.90	8.83	17.06	0.00	-0.38
269	0.41	67.10	7.12	17.38	-0.80	-0.88
276.405	1.18	78.57	12.41	10.47	2.67	2.55
276.701	0.86	79.80	9.61	11.21	0.01	-0.02
279	0.62	80.60	7.75	12.59	-1.38	-1.11
281	1.06	85.60	10.05	9.43	-0.32	-0.23
282	1.37	77.60	10.19	7.44	0.07	0.11
283	0.65	81.90	9.78	15.11	0.51	0.73
287	0.59	74.10	8.48	14.38	-0.23	-0.34
290	0.85	79.56	8.45	9.94	-0.53	-0.58
292	0.95	88.50	10.60	11.18	0.31	0.45
294	0.87	76.30	9.49	10.88	0.06	0.13
295	0.83	79.00	9.76	11.71	0.25	0.33

Table A1. (continued)						
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d
298	0.64	71.10	8.28	12.94	-0.36	-0.47
302	1.53	92.89	11.96	7.82	-0.05	0.10
304.405	1.39	83.42	12.33	8.84	1.58	1.75
304.701	0.86	75.40	10.57	12.31	1.23	1.35
305	1.25	83.39	10.04	8.03	-0.33	-0.19
313	0.86	72.70	9.28	10.85	0.10	0.06
320	0.96	73.90	9.35	9.73	-0.12	-0.47
330	1.36	79.70	10.56	7.79	0.27	0.16
332	0.94	87.90	9.66	10.29	-0.57	-0.54
341	1.09	74.26	8.71	8.01	-0.36	-0.34
344	1.19	76.70	10.01	8.45	0.45	0.48
354	1.29	87.00	11.22	8.71	0.40	0.53
355.405	1.19	80.53	10.19	8.56	0.25	0.40
355.701	0.66	82.70	9.97	15.14	0.62	0.42
361	0.84	80.80	9.30	11.07	-0.32	-0.61
368	1.25	86.86	11.49	9.19	0.78	0.75
369	1.05	74.72	9.25	8.79	0.22	0.22
372	0.97	83.40	9.74	10.07	-0.30	-0.21
373.405	1.26	93.96	11.30	8.94	-0.13	-0.20
373.701	0.88	82.30	10.65	12.06	0.85	0.56
375	0.83	81.10	10.95	13.15	1.33	1.14
380	1.22	78.35	9.33	7.62	-0.49	-0.59
388	0.82	79.70	9.70	11.85	0.18	0.52
389	0.78	76.90	9.05	11.59	-0.22	-0.20
396	0.91	74.40	10.03	10.99	0.63	0.44
400	1.43	78.55	10.95	7.64	0.57	0.46
401	0.85	77.40	10.03	11.75	0.58	0.65
407	1.00	80.10	10.85	10.87	0.94	0.81
410	1.53	91.83	10.37	6.80	-1.53	-1.43
411	1.21	83.17	9.22	7.61	-1.03	-0.96
415	0.87	82.40	9.75	11.15	-0.03	0.10
419	1.19	86.40	9.73	8.16	-0.79	-0.90
420	1.63	91.64	12.68	7.79	0.54	0.51
422	0.72	67.70	6.75	9.38	-1.86	-1.81
425.405	1.15	80.10	9.72	8.43	-0.09	0.02
425.701	1.12	91.20	9.71	8.70	-1.09	-1.20
439	0.71	77.80	10.24	14.41	1.07	0.87
441	0.92	83.20	8.29	8.97	-1.64	-1.67
442	0.50	75.40	9.97	20.04	1.38	1.26
443	0.90	76.40	10.12	11.29	0.63	0.92

Table A1. (continued)						
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d
446	1.05	84.80	10.27	9.74	-0.03	-0.15
451	0.84	81.70	9.76	11.66	0.09	0.28
454.405	1.10	77.04	8.78	7.96	-0.60	-0.48
454.701	0.73	85.30	10.58	14.39	0.92	0.83
457	0.99	81.70	10.60	10.68	0.61	0.59
468	1.18	81.10	10.26	8.67	-0.10	-0.05
478	1.11	82.70	9.88	8.91	-0.07	0.18
480	1.46	80.01	9.54	6.55	-1.03	-1.11
481	1.13	69.17	8.59	7.61	-0.09	-0.13
485	1.04	87.50	10.28	9.86	0.15	-0.16
496	1.05	81.50	12.14	11.54	2.04	2.13
509	1.53	88.30	13.62	8.88	2.05	2.01
513	1.28	69.48	8.97	7.00	-0.14	-0.05
516	0.96	79.90	10.83	11.32	1.02	0.73
522	0.92	83.30	9.51	10.37	-0.41	-0.55
524	1.37	80.84	10.61	7.74	0.18	0.25
526	1.41	75.89	9.77	6.93	-0.29	-0.33
527	0.98	67.79	7.70	7.86	-0.47	-0.47
541	0.74	75.00	8.19	11.01	-0.90	-0.67
544	1.65	85.20	10.37	6.30	-1.19	-1.03
553	1.14	83.60	10.65	9.38	0.25	0.35
559	0.75	76.20	9.78	13.12	0.63	0.64
560	1.03	61.81	8.85	8.59	1.13	1.14
566	0.95	78.30	12.90	13.63	3.20	3.12
567	1.23	77.95	8.70	7.05	-1.11	-1.03
573	0.90	84.50	8.77	9.73	-1.19	-1.16
575	1.58	83.34	10.92	6.91	-0.29	-0.27
576	1.31	89.59	11.19	8.55	0.06	0.11
580	0.75	74.30	8.91	11.95	-0.13	-0.23
592	1.11	86.18	11.25	10.17	0.97	0.79
593	1.52	91.34	10.38	6.83	-1.45	-1.58
598	1.51	82.93	11.86	7.85	0.87	0.77
601	1.50	87.35	12.91	8.61	1.52	1.47
605	0.64	70.60	7.71	12.04	-0.90	-0.80
606	0.90	75.18	8.14	9.02	-0.55	-0.51
607	0.72	71.80	8.44	11.72	-0.41	-0.51
612	0.89	74.10	9.75	10.97	0.41	0.43
613.405	1.22	81.89	11.51	9.40	1.35	1.39
613.701	0.65	65.80	8.56	13.26	0.22	0.26
615	0.96	87.70	9.54	9.90	-0.74	-0.97

Table A1. (continued)						
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d
618	1.27	75.90	10.25	8.06	0.00	0.05
624	1.22	78.08	7.66	6.25	-2.14	-2.24
627	1.09	85.76	9.00	8.23	-1.20	-1.34
628	1.44	82.31	9.83	6.81	-0.93	-0.92
630	1.08	78.87	7.71	7.16	-1.78	-1.73
635	1.09	74.77	9.92	9.10	0.79	0.61
638	0.74	73.30	7.65	10.39	-1.31	-1.52
639	0.84	78.20	9.47	11.29	0.00	-0.14
640	0.89	71.60	9.44	10.65	0.25	0.00
643	0.99	87.59	8.32	8.42	-1.79	-1.88
645	0.93	85.20	9.61	10.29	-0.46	-0.54
648	1.10	81.90	9.48	8.63	-0.36	-0.34
651	1.32	84.23	10.82	8.21	0.19	0.16
653	0.75	80.50	11.31	15.17	1.91	1.87
655	0.97	81.60	9.66	9.91	-0.29	-0.36
657	1.69	85.80	12.89	7.63	1.15	1.07
667	1.23	74.48	10.14	8.25	0.69	0.42
668	1.00	87.40	11.47	11.51	1.14	0.91
670	0.82	74.89	9.94	12.12	1.49	1.54
671	1.29	84.20	11.13	8.63	0.58	0.47
675	1.34	74.91	9.54	7.10	-0.25	-0.30
681	0.86	79.20	9.84	11.43	0.27	0.24
684	1.10	75.04	9.63	8.74	0.45	0.49
686	0.70	84.40	9.89	14.14	0.36	0.42
692	0.57	73.40	7.91	13.93	-0.71	-0.67
693	1.86	83.51	11.00	5.92	-0.95	-1.07
699	0.95	78.90	9.19	9.63	-0.56	-0.59
700	1.69	68.08	8.93	5.28	-1.09	-1.05
704	1.18	82.82	9.31	7.89	-0.83	-0.72
706	0.99	65.70	8.58	8.66	0.59	0.67
711	1.10	76.26	8.81	8.00	-0.49	-0.49
721	1.21	83.95	10.04	8.31	-0.28	-0.12
726	1.38	71.08	9.09	6.58	-0.42	-0.35
734	0.73	74.10	9.17	12.61	0.18	-0.08
737	1.04	75.80	10.82	10.43	1.07	1.21
751	0.97	75.93	9.79	10.13	0.87	0.95
756	1.65	70.63	9.47	5.75	-0.68	-0.78
781	1.45	67.57	7.92	5.45	-1.44	-1.39
783	1.24	77.23	9.13	7.35	-0.62	-0.61
785	1.16	74.46	9.46	8.16	0.18	0.14

Table A1. (continued)						
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d
786	1.47	80.80	12.79	8.69	2.10	2.04
793	0.95	74.02	10.62	11.20	1.93	1.83
795	0.81	75.00	10.43	12.95	1.22	1.12
800	1.30	80.26	9.52	7.34	-0.67	-0.67
804	1.08	78.00	8.87	8.19	-1.10	-1.12
807	1.37	77.88	11.71	8.54	1.56	1.45
826	1.11	82.63	10.17	9.14	0.22	0.19
828	1.12	84.85	8.83	7.91	-1.34	-1.46
836.405	1.43	85.36	11.16	7.81	0.14	0.29
836.701	0.87	75.00	8.81	10.11	-0.54	-0.57
839	1.01	72.80	9.98	9.92	0.47	0.44
840	1.22	81.80	8.95	7.31	-1.53	-1.54
841	1.39	85.26	10.83	7.78	-0.09	-0.21
850	0.82	71.00	8.71	10.67	-0.29	-0.39
856	1.27	89.13	9.80	7.73	-1.17	-1.07
866	1.51	89.29	12.45	8.22	0.83	0.95
868	0.65	80.32	8.22	12.70	-0.31	-0.18
870	0.96	74.65	7.98	8.35	-0.79	-0.71
871	0.74	67.80	8.32	11.27	-0.33	-0.17
873	1.19	72.80	9.09	7.65	-0.10	-0.03
875	1.24	81.03	10.05	8.10	-0.07	0.11
878	1.37	86.83	10.66	7.78	-0.35	-0.22
885	0.88	74.20	10.40	11.78	1.07	0.98
886	0.70	78.20	9.33	13.31	0.16	0.11
887	0.95	76.20	10.32	10.88	0.74	0.82
888	0.87	75.00	7.77	8.89	-1.59	-1.25
889	0.74	69.90	8.23	11.14	-0.55	-0.39
901	0.68	77.60	9.50	14.06	0.41	0.36
902	0.81	86.10	9.72	11.94	-0.15	-0.34
903	0.76	77.00	8.85	11.61	-0.39	-0.37
906	1.38	75.68	9.80	7.08	-0.16	-0.08
907	1.00	78.74	10.31	10.35	1.04	0.93
924	1.28	78.87	10.77	8.40	0.75	0.61

Table A1. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
5	0.33	61.30	2.03	0.28	72.90	2.67	-0.05	11.60
16	0.36	45.80	1.96	0.41	63.20	2.68	0.05	17.40
20	0.36	44.13	2.55	0.48	55.23	3.06	0.13	11.10
55	0.25	41.03	3.06	0.15	55.68	1.53	-0.10	14.65
61	0.28	47.70	1.99	0.43	61.30	2.68	0.15	13.50
65	0.41	41.48	3.38	0.48	52.39	3.42	0.08	10.90
69	0.23	40.71	1.29	0.13	54.97	1.15	-0.10	14.26
72	0.20	48.39	2.96	0.66	63.74	2.48	0.46	15.35
85	0.28	45.20	2.73	0.43	60.00	3.37	0.15	14.80
87	0.23	47.81	2.92	0.43	66.13	1.66	0.20	18.32
90	0.36	51.00	2.71	0.43	62.60	2.69	0.08	11.60
97	0.46	52.90	2.51	0.58	67.70	2.73	0.13	14.80
98	0.28	49.70	2.57	0.43	63.20	4.41	0.15	13.50
99	0.23	47.94	2.60	0.33	67.48	2.31	0.10	19.55
105.405	0.28	52.77	2.28	0.23	66.06	1.71	-0.05	13.29
105.701	0.36	47.70	1.56	0.33	57.40	2.21	-0.03	9.70
108	0.30	48.40	2.11	0.38	58.10	2.63	0.08	9.70
109	0.41	54.20	2.00	0.51	68.40	3.36	0.10	14.20
110	0.25	49.35	1.93	0.23	59.23	2.03	-0.03	9.87
112	0.51	52.30	2.62	0.51	65.20	3.36	0.00	12.90
114.405	0.25	48.06	2.83	0.41	57.87	2.23	0.15	9.81
114.701	0.23	54.20	2.31	0.36	61.30	3.12	0.13	7.10
119	0.18	45.42	1.50	0.25	53.35	1.67	0.08	7.94
121	0.20	52.90	2.59	0.58	62.26	3.15	0.38	9.35
124	0.41	48.40	1.68	0.56	60.60	2.95	0.15	12.3
127	0.30	45.80	2.65	0.43	55.50	3.80	0.13	9.70
133	0.28	54.20	2.56	0.41	63.90	2.61	0.13	9.70
136	0.43	47.16	3.15	0.64	59.48	3.05	0.20	12.32
138	0.33	59.40	2.19	0.46	77.40	2.91	0.13	18.10
150.405	0.20	54.39	1.40	0.36	57.35	1.47	0.15	2.97
150.701	0.33	52.30	2.61	0.48	65.80	2.72	0.15	13.50
152	0.36	55.50	2.45	0.41	72.30	3.64	0.05	16.80
153	0.36	48.40	1.95	0.51	58.10	2.95	0.15	9.70
158	0.18	41.30	1.62	0.28	52.90	2.39	0.10	11.60
160	0.36	54.80	2.56	0.48	76.10	2.59	0.13	21.30
164.405	0.20	46.65	2.87	0.25	54.26	2.54	0.05	7.61
164.701	0.30	57.40	2.70	0.33	69.00	3.16	0.03	11.60
168	0.18	45.10	2.60	0.33	54.20	3.68	0.15	9.10
170	0.28	47.29	2.39	0.30	61.03	2.45	0.03	13.74
171	0.25	42.84	1.82	0.41	43.55	2.69	0.15	0.71

Table A1. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
172	0.20	46.77	2.02	0.15	62.97	1.96	-0.05	16.19
173	0.23	48.84	3.83	0.23	56.06	2.71	0.00	7.23
179	0.48	48.77	3.42	0.91	70.84	2.67	0.43	22.06
180	0.28	52.90	2.37	0.30	69.00	2.68	0.03	16.10
183	0.41	49.00	2.60	0.66	65.80	3.34	0.25	16.80
184	0.46	43.90	3.18	0.69	51.00	3.63	0.23	7.10
194	0.23	45.80	2.44	0.28	53.60	4.14	0.05	7.70
195.405	0.25	58.52	2.11	0.20	64.06	1.15	-0.05	5.55
195.701	0.28	52.90	1.71	0.36	57.40	2.00	0.08	4.50
196	0.30	41.90	2.36	0.36	56.10	3.50	0.05	14.2
197	0.33	39.40	2.50	0.41	57.40	3.81	0.08	18.10
198	0.23	46.58	2.67	0.20	59.81	1.86	-0.03	13.23
206	0.20	56.58	1.76	0.10	62.84	0.91	-0.10	6.26
209	0.25	43.81	1.68	0.58	57.42	2.51	0.33	13.61
211	0.33	51.00	2.49	0.41	61.90	2.50	0.08	11.00
213	0.41	56.00	2.46	0.48	59.68	2.92	0.08	3.68
217	0.23	48.32	1.93	0.13	62.77	1.61	-0.10	14.45
220	0.23	45.20	2.30	0.43	61.30	3.01	0.20	16.10
225	0.58	.	3.00	1.04	62.60	4.23	0.46	.
231	0.18	50.39	1.99	0.18	70.52	1.85	0.00	20.13
232	0.28	48.40	2.26	0.33	50.30	3.09	0.05	1.90
242	0.33	45.20	2.73	0.36	58.70	2.93	0.03	13.50
243.405	0.23	46.97	1.20	0.10	54.65	0.71	-0.13	7.68
243.701	0.28	47.70	1.85	0.33	61.30	2.57	0.05	13.50
246	0.20	50.90	2.11	0.36	57.55	1.99	0.15	6.65
250	0.23	48.39	2.57	0.38	62.06	2.53	0.15	13.68
252	0.28	52.90	2.11	0.43	70.30	2.53	0.15	17.40
263	0.48	50.30	2.38	0.79	58.70	2.49	0.30	8.40
269	0.18	41.90	1.89	0.33	44.50	2.29	0.15	2.60
276.405	0.25	47.55	2.15	0.46	54.00	1.59	0.20	6.45
276.701	0.30	51.00	1.90	0.46	60.60	2.49	0.15	9.70
279	0.33	45.80	2.43	0.33	55.50	3.43	0.00	9.70
281	0.18	57.40	1.61	0.28	72.30	2.17	0.10	14.80
282	0.18	53.74	0.78	0.20	58.45	1.16	0.03	4.71
283	0.23	41.30	1.95	0.25	53.60	3.01	0.03	12.30
287	0.23	51.60	1.73	0.41	53.60	2.38	0.18	1.90
290	0.25	50.45	2.95	0.36	62.52	1.74	0.10	12.06
292	0.33	55.50	2.41	0.41	71.60	3.00	0.08	16.10
294	0.36	51.60	2.54	0.46	56.10	3.85	0.10	4.50
295	0.36	52.30	2.77	0.46	60.60	2.91	0.10	8.40

Table A1. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
298	0.23	51.62	2.34	0.41	60.00	2.20	0.18	8.39
302	0.20	60.00	2.07	0.15	73.74	1.52	-0.05	13.74
304.405	0.25	47.48	1.18	0.15	65.29	1.24	-0.10	17.81
304.701	0.23	47.74	2.69	0.30	61.94	3.10	0.08	14.19
305	0.20	52.39	2.91	0.13	69.68	1.89	-0.08	17.29
313	0.23	47.74	1.79	0.38	52.91	2.52	0.15	5.16
320	0.23	56.78	1.75	0.53	61.29	2.71	0.30	4.52
330	0.23	48.97	1.52	0.43	62.26	2.29	0.20	13.29
332	0.33	52.91	2.57	0.46	65.81	3.45	0.13	12.90
341	0.18	54.13	2.06	0.20	53.81	2.09	0.03	-0.32
344	0.23	40.06	2.30	0.25	57.68	1.11	0.03	17.61
354	0.20	57.03	1.61	0.15	67.10	0.55	-0.05	10.06
355.405	0.28	47.81	2.91	0.18	64.32	3.16	-0.10	16.52
355.701	0.28	52.91	2.65	0.51	58.07	2.51	0.23	5.16
361	0.23	48.39	3.24	0.51	59.36	4.22	0.28	10.97
368	0.20	50.32	0.82	0.33	65.10	0.67	0.13	14.77
369	0.20	40.71	1.80	0.25	44.97	1.45	0.05	4.26
372	0.33	52.33	2.28	0.43	65.81	2.33	0.10	13.48
373.405	0.41	55.61	1.75	0.58	62.19	2.01	0.18	6.58
373.701	0.18	53.55	1.74	0.46	58.07	2.83	0.28	4.52
375	0.51	38.71	2.22	0.74	52.91	3.47	0.23	14.19
380	0.25	50.13	1.17	0.43	62.39	1.78	0.18	12.26
388	0.36	40.00	2.76	0.33	49.04	3.06	-0.03	9.03
389	0.28	50.33	2.35	0.41	52.91	3.21	0.13	2.58
396	0.23	42.58	1.92	0.46	59.36	3.04	0.23	16.78
400	0.20	41.48	1.47	0.41	59.68	0.96	0.20	18.19
401	0.36	51.62	2.91	0.46	65.17	4.25	0.10	13.55
407	0.36	47.74	1.69	0.56	57.42	3.16	0.20	9.68
410	0.15	60.19	1.03	0.15	67.87	0.89	0.00	7.68
411	0.23	50.00	2.15	0.23	61.48	1.89	0.00	11.48
415	0.69	57.42	2.75	0.76	74.20	3.34	0.08	16.78
419	0.28	48.97	3.19	0.48	64.26	2.79	0.20	15.29
420	0.25	46.45	4.00	0.41	59.87	3.62	0.15	13.42
422	0.18	47.10	1.69	0.28	54.84	2.83	0.10	7.74
425.405	0.23	57.68	2.34	0.18	60.26	1.74	-0.05	2.58
425.701	0.36	49.04	2.41	0.56	60.65	3.17	0.20	11.61
439	0.41	57.42	2.57	0.64	65.17	3.11	0.23	7.74
441	0.28	50.33	2.04	0.43	62.58	2.76	0.15	12.26
442	0.23	48.39	2.90	0.41	63.23	3.84	0.18	14.84
443	0.36	51.62	2.61	0.36	60.00	3.16	0.00	8.39

Table A1. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
446	0.46	58.71	1.99	0.66	70.97	2.87	0.20	12.26
451	0.30	56.13	2.26	0.36	64.52	3.05	0.05	8.39
454.405	0.20	46.90	1.31	0.13	58.45	0.84	-0.08	11.55
454.701	0.46	55.49	2.20	0.64	63.87	2.41	0.18	8.39
457	0.48	47.74	2.39	0.64	65.81	3.29	0.15	18.07
468	0.28	44.52	3.47	0.41	58.71	4.38	0.13	14.19
478	0.38	56.00	2.00	0.18	60.58	1.59	-0.20	4.58
480	0.28	47.23	2.09	0.46	54.52	2.23	0.18	7.29
481	0.15	46.71	1.92	0.23	50.65	2.78	0.08	3.94
485	0.41	47.10	1.91	0.56	67.10	2.64	0.15	20.00
496	0.33	45.16	2.26	0.43	56.13	3.61	0.10	10.97
509	0.23	47.29	1.97	0.38	67.29	1.94	0.15	20.00
513	0.25	38.90	1.21	0.20	48.90	1.33	-0.05	10.00
516	0.28	46.45	1.99	0.56	56.78	3.09	0.28	10.32
522	0.30	53.55	1.22	0.51	65.17	3.00	0.20	11.61
524	0.23	55.23	2.49	0.23	63.74	2.27	0.00	8.52
526	0.25	42.39	2.87	0.38	54.45	3.19	0.13	12.06
527	0.20	46.65	1.90	0.23	51.35	1.84	0.03	4.71
541	0.36	52.91	2.66	0.38	60.00	3.55	0.03	7.10
544	0.23	46.39	2.60	0.15	66.00	1.42	-0.08	19.61
553	0.18	54.20	2.27	0.28	69.68	2.20	0.10	15.48
559	0.30	45.81	2.26	0.43	52.91	2.33	0.13	7.10
560	0.23	41.74	1.68	0.23	46.84	2.14	0.00	5.10
566	0.28	50.33	2.09	0.46	63.87	2.32	0.18	13.55
567	0.25	45.16	3.17	0.23	57.74	1.92	-0.03	12.58
573	0.46	49.68	2.63	0.58	60.65	3.18	0.13	10.97
575	0.30	45.87	2.34	0.38	68.52	1.78	0.08	22.65
576	0.38	52.26	1.95	0.43	59.48	1.73	0.05	7.23
580	0.46	48.39	2.54	0.64	59.36	3.23	0.18	10.97
592	0.43	51.68	2.28	0.71	66.19	1.35	0.28	14.52
593	0.20	49.03	2.11	0.46	66.19	1.62	0.25	17.16
598	0.28	54.39	3.13	0.48	58.97	3.1	0.20	4.58
601	0.30	44.97	1.49	0.46	64.90	1.86	0.15	19.94
605	0.18	41.94	1.90	0.25	46.45	2.39	0.08	4.52
606	0.20	61.10	0.47	0.20	64.84	0.84	0.00	3.74
607	0.23	48.39	1.38	0.41	56.13	2.93	0.18	7.74
612	0.28	47.10	1.82	0.41	60.00	2.61	0.13	12.90
613.405	0.18	56.77	1.63	0.20	59.10	1.76	0.03	2.32
613.701	0.18	44.52	1.26	0.28	51.62	2.24	0.10	7.10
615	0.30	54.20	2.13	0.56	64.52	2.87	0.25	10.32

Table A1. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
618	0.30	43.23	2.65	0.43	50.33	3.92	0.13	7.10
624	0.25	60.26	1.43	0.43	60.97	2.21	0.18	0.71
627	0.20	50.97	2.32	0.43	55.29	1.90	0.23	4.32
628	0.38	52.19	1.91	0.46	72.45	1.86	0.08	20.26
630	0.20	55.81	1.53	0.20	63.42	1.27	0.00	7.61
635	0.23	50.00	2.04	0.48	60.39	2.27	0.25	10.39
638	0.23	39.36	2.30	0.46	46.45	2.80	0.23	7.10
639	0.33	48.39	2.34	0.53	56.13	3.93	0.20	7.74
640	0.23	49.04	2.36	0.48	63.23	2.97	0.25	14.19
643	0.28	46.65	1.99	0.46	70.26	1.65	0.18	23.61
645	0.33	54.20	2.33	0.51	73.55	2.94	0.18	19.36
648	0.20	56.90	0.88	0.25	64.65	0.83	0.05	7.74
651	0.38	47.74	1.88	0.51	67.42	2.44	0.13	19.68
653	0.28	60.00	2.32	0.43	69.04	2.50	0.15	9.03
655	0.48	49.68	2.43	0.66	63.23	3.79	0.18	13.55
657	0.23	55.55	2.91	0.43	57.10	2.92	0.20	1.55
667	0.20	46.65	2.35	0.56	56.58	2.01	0.36	9.94
668	0.30	59.36	1.99	0.56	70.33	1.95	0.25	10.97
670	0.20	42.45	1.89	0.18	54.39	1.11	-0.03	11.94
671	0.25	48.26	2.64	0.46	65.42	1.20	0.20	17.16
675	0.23	52.97	2.04	0.36	60.84	1.99	0.13	7.87
681	0.30	56.26	2.14	0.46	61.29	2.68	0.15	5.03
684	0.23	44.39	3.57	0.23	50.13	2.67	0.00	5.74
686	0.28	48.39	1.78	0.38	65.81	3.27	0.10	17.42
692	0.23	43.87	2.16	0.33	54.20	3.07	0.10	10.32
693	0.28	54.00	2.21	0.53	65.35	2.72	0.25	11.35
699	0.30	48.39	2.01	0.46	50.97	2.68	0.15	2.58
700	0.20	31.16	1.80	0.23	42.00	1.45	0.03	10.84
704	0.25	43.81	1.29	0.20	63.35	1.20	-0.05	19.55
706	0.23	43.16	1.52	0.15	53.03	1.38	-0.08	9.87
711	0.20	50.45	2.37	0.25	63.03	1.11	0.05	12.58
721	0.23	62.45	0.72	0.13	63.81	1.02	-0.10	1.35
726	0.23	48.26	1.98	0.20	56.19	1.71	-0.03	7.94
734	0.28	51.62	2.11	0.53	56.78	3.59	0.25	5.16
737	0.28	42.58	2.13	0.36	54.84	3.78	0.08	12.26
751	0.56	52.52	2.34	0.51	56.97	1.89	-0.05	4.45
756	0.23	43.03	1.75	0.41	51.55	1.55	0.18	8.52
781	0.20	48.39	0.71	0.20	50.71	1.53	0.00	2.32
783	0.20	53.55	1.59	0.25	62.39	1.91	0.05	8.84
785	0.38	49.16	2.05	0.48	58.52	1.19	0.10	9.35

Table A1. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
786	0.28	52.06	3.58	0.43	63.42	3.77	0.15	11.35
793	0.25	53.16	2.30	0.41	57.16	2.07	0.15	4.00
795	0.28	49.04	1.95	0.46	52.91	3.89	0.18	3.87
800	0.36	54.06	3.14	0.43	73.55	2.85	0.08	19.48
804	0.30	45.16	1.55	0.46	56.78	2.53	0.15	11.61
807	0.23	46.13	3.23	0.43	66.52	3.43	0.20	20.39
826	0.30	47.74	2.00	0.41	57.42	1.11	0.10	9.68
828	0.23	58.45	3.00	0.43	59.48	2.54	0.20	1.03
836.405	0.23	54.39	1.29	0.15	72.77	0.91	-0.08	18.39
836.701	0.36	43.23	3.01	0.51	55.49	3.51	0.15	12.26
839	0.23	54.20	1.94	0.38	65.17	2.82	0.15	10.97
840	0.28	45.81	2.32	0.43	67.10	2.44	0.15	21.29
841	0.23	58.06	1.87	0.46	76.65	1.79	0.23	18.58
850	0.28	36.78	2.26	0.46	53.55	3.20	0.18	16.78
856	0.20	47.94	1.02	0.18	64.58	1.02	-0.03	16.65
866	0.18	58.06	1.13	0.15	55.48	0.72	-0.03	-2.58
868	0.23	50.32	1.55	0.13	68.00	1.04	-0.10	17.68
870	0.23	61.68	1.87	0.18	54.90	0.87	-0.05	-6.77
871	0.23	47.10	1.86	0.28	57.42	3.11	0.05	10.32
873	0.25	51.16	3.55	0.23	53.03	1.48	-0.03	1.87
875	0.28	66.65	1.27	0.15	77.16	1.26	-0.13	10.52
878	0.23	51.74	1.62	0.18	61.10	1.3	-0.05	9.35
885	0.18	49.04	1.77	0.36	61.29	1.98	0.18	12.26
886	0.28	52.91	2.71	0.43	66.46	3.19	0.15	13.55
887	0.23	37.42	2.76	0.33	53.55	3.32	0.10	16.13
888	0.33	44.52	2.36	0.30	56.13	3.75	-0.03	11.61
889	0.23	43.87	1.80	0.28	57.42	2.75	0.05	13.55
901	0.23	49.68	2.48	0.38	57.42	2.54	0.15	7.74
902	0.28	47.10	1.83	0.51	52.91	3.08	0.23	5.81
903	0.23	49.04	1.66	0.36	58.71	3.07	0.13	9.68
906	0.20	50.84	2.63	0.18	62.39	2.23	-0.03	11.55
907	0.25	50.97	2.04	0.43	63.61	1.54	0.18	12.65
924	0.25	44.90	2.96	0.48	57.42	2.74	0.23	12.52

Table A2. Finishing phase data.						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
5	427.8	485.2	0.8	.	1	1
16	402.7	472.3	0.94	.	1	1
20	467.9	531.4	0.44	0.65	2	2
55	397.5	446.9	0.33	0.69	1	2
61	397.3	468.8	0.49	0.03	1	1
65	399.9	453.3	0.69	0.75	1	2
69	460.5	497.8	0.79	1.16	1	2
72	460.0	516.3	0.84	0.66	2	2
85	399.8	444.1	0.44	.	1	1
87	422.8	475.9	0.39	0.53	2	2
90	429.9	511.7	0.96	.	1	1
97	446.7	513.9	0.67	1.12	1	1
98	471.9	533.8	1.5	0.85	1	1
99	507.3	576.6	0.46	0.72	1	2
105.405	370.9	445.7	0.61	0.45	1	2
105.701	404.1	458.9	0.47	0.03	1	1
108	419.0	493.9	0.44	.	1	1
109	442.6	512.6	0.5	.	1	1
110	427.9	502.6	0.54	0.77	2	2
112	446.9	514.5	0.76	.	1	1
114.405	414.4	462.2	0.37	0.87	1	2
114.701	465.9	543.0	1.83	.	1	1
119	435.5	528.7	0.52	0.49	2	2
121	436.6	494.2	0.51	0.74	2	2
124	486.2	541.6	1.14	0.67	1	2
127	455.3	502.1	0.46	0.03	1	1
133	447.9	525.4	1.21	1.03	1	1
136	397.9	469.1	0.50	0.87	2	2
138	473.2	537.7	0.47	.	1	1
150.405	451.5	523.1	0.69	0.88	2	2
150.701	428.3	507.7	0.58	.	1	1
152	429.2	475.4	0.52	.	1	1
153	461.1	518.7	0.66	.	1	1
158	385.8	435.1	0.54	.	1	2
160	435.1	525.6	0.43	0.02	1	1
164.405	381.9	449.5	0.69	0.71	1	2
164.701	460.0	536.0	1.1	.	1	1
168	370.9	437.1	0.49	.	1	2
170	461.9	547.1	0.81	1.13	1	2
171	373.5	423.5	0.77	0.41	1	2

Table A2. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
172	416.3	496.1	0.41	1.12	1	2
173	419.6	502.4	1.06	2.64	1	2
179	477.2	559.1	0.51	.	1	2
180	419.0	487.4	0.48	0.03	1	1
183	414.4	483.4	0.46	.	1	1
184	406.8	477.8	0.50	.	1	2
194	376.4	446.3	0.48	.	1	1
195.405	402.6	478.0	0.39	0.42	2	2
195.701	473.0	539.2	0.39	.	1	1
196	424.4	514.0	0.68	1.49	1	1
197	422.1	457.1	0.82	.	1	1
198	424.5	511.4	0.56	0.64	3	2
206	493.4	538.4	0.37	0.87	4	2
209	406.0	469.5	0.50	0.83	1	2
211	437.8	507.7	1.62	.	1	1
213	477.3	560.5	0.53	0.77	4	2
217	440.9	529.2	0.62	0.88	1	2
220	394.3	466.2	1.29	.	1	1
225	454.7	531.0	0.45	1.79	1	1
231	473.3	560.7	0.89	1.00	1	2
232	429.4	498.4	0.63	1.83	1	1
242	409.5	485.0	1.03	.	1	2
243.405	431.5	504.6	0.43	0.58	1	2
243.701	422.4	481.1	0.55	0.03	1	1
246	448.9	509.8	0.82	0.85	1	2
250	429.8	498.2	2.38	0.79	1	2
252	441.6	504.3	0.65	.	1	1
263	402.0	489.5	1.72	.	1	1
269	347.4	422.4	0.56	.	1	1
276.405	407.1	482.3	0.42	0.75	3	2
276.701	415.8	460.0	0.44	0.05	2	2
279	428.8	484.6	0.45	.	1	1
281	497.8	557.5	0.53	.	1	1
282	390.5	451.0	0.39	0.65	1	3
283	407.0	480.3	0.43	.	1	2
287	375.0	427.8	0.44	0.06	1	1
290	380.6	433.6	0.35	0.54	3	3
292	460.6	541.9	0.78	1.78	1	1
294	413.1	482.5	0.58	0.03	1	1
295	429.7	492.6	0.55	0.02	1	1

Table A2. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
172	416.3	496.1	0.41	1.12	1	2
173	419.6	502.4	1.06	2.64	1	2
179	477.2	559.1	0.51	.	1	2
180	419.0	487.4	0.48	0.03	1	1
183	414.4	483.4	0.46	.	1	1
184	406.8	477.8	0.50	.	1	2
194	376.4	446.3	0.48	.	1	1
195.405	402.6	478.0	0.39	0.42	2	2
195.701	473.0	539.2	0.39	.	1	1
196	424.4	514.0	0.68	1.49	1	1
197	422.1	457.1	0.82	.	1	1
198	424.5	511.4	0.56	0.64	3	2
206	493.4	538.4	0.37	0.87	4	2
209	406.0	469.5	0.50	0.83	1	2
211	437.8	507.7	1.62	.	1	1
213	477.3	560.5	0.53	0.77	4	2
217	440.9	529.2	0.62	0.88	1	2
220	394.3	466.2	1.29	.	1	1
225	454.7	531.0	0.45	1.79	1	1
231	473.3	560.7	0.89	1.00	1	2
232	429.4	498.4	0.63	1.83	1	1
242	409.5	485.0	1.03	.	1	2
243.405	431.5	504.6	0.43	0.58	1	2
243.701	422.4	481.1	0.55	0.03	1	1
246	448.9	509.8	0.82	0.85	1	2
250	429.8	498.2	2.38	0.79	1	2
252	441.6	504.3	0.65	.	1	1
263	402.0	489.5	1.72	.	1	1
269	347.4	422.4	0.56	.	1	1
276.405	407.1	482.3	0.42	0.75	3	2
276.701	415.8	460.0	0.44	0.05	2	2
279	428.8	484.6	0.45	.	1	1
281	497.8	557.5	0.53	.	1	1
282	390.5	451.0	0.39	0.65	1	3
283	407.0	480.3	0.43	.	1	2
287	375.0	427.8	0.44	0.06	1	1
290	380.6	433.6	0.35	0.54	3	3
292	460.6	541.9	0.78	1.78	1	1
294	413.1	482.5	0.58	0.03	1	1
295	429.7	492.6	0.55	0.02	1	1

Table A2. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
298	376.80	441.20	0.56	.	2	1
302	527.20	635.40	0.54	0.92	1	2
304.405	458.70	549.40	1.09	1.23	1	2
304.701	400.40	482.60	0.55	.	1	1
305	435.80	466.50	0.97	0.61	2	2
313	390.90	454.00	0.47	0.04	1	1
320	407.90	474.10	0.48	0.03	1	1
330	436.50	506.80	0.49	0.69	1	2
332	503.50	565.00	0.56	0.02	1	1
341	400.00	499.20	0.62	0.80	1	2
344	404.50	448.10	0.53	0.59	1	2
354	477.60	560.20	0.52	1.39	1	2
355.405	451.50	517.30	0.82	0.64	1	2
355.701	437.60	481.00	0.65	0.44	1	1
361	417.70	501.00	0.7	.	1	1
368	491.80	566.40	0.59	2.17	1	2
369	403.70	457.40	0.76	0.72	1	3
372	450.00	513.50	0.56	0.05	1	1
373.405	512.10	578.60	0.55	0.87	1	2
373.701	434.00	504.00	0.37	0.02	1.5	3
375	402.80	468.20	1.57	0.14	1	1
380	426.00	533.80	0.79	0.87	2	2
388	402.20	442.00	0.98	.	1	2
389	402.90	472.90	0.41	0.05	1	1
396	399.50	454.90	0.57	.	2	3
400	430.30	486.10	0.56	0.72	2	2
401	423.40	500.30	0.58	.	1	1
407	452.10	527.60	1.02	1.29	1	1
410	517.20	612.80	0.54	0.66	1	2
411	442.40	521.00	0.49	0.81	3	2
415	456.40	522.40	1.12	.	1	1
419	446.80	484.20	0.49	0.89	1	2
420	507.30	619.70	0.55	0.64	2	2
422	376.80	458.50	0.45	0.04	1	1
425.405	399.60	478.30	0.60	0.81	1	3
425.701	522.20	614.20	0.67	0.03	1	1
439	403.30	466.90	0.52	.	1	1
441	444.80	504.70	0.4	0.03	1	1
442	423.30	478.50	0.62	.	1	1
443	410.50	463.80	0.42	.	1	1

Table A2. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
446	480.50	563.40	2.35	.	1	1
451	450.60	528.40	0.49	.	1	1
454.405	410.30	488.30	0.67	0.57	1	2
454.701	462.40	538.20	0.35	.	2	1
457	439.70	493.50	0.71	1.06	1	2
468	474.40	566.90	0.93	.	1	1
478	442.20	501.10	0.64	1.78	1	2
480	445.10	524.20	0.53	1.35	1	2
481	362.00	424.70	0.34	0.46	1	2
485	494.00	571.30	0.87	1.14	1	1
496	446.20	504.00	0.53	.	1	1
509	461.40	519.70	0.33	3.35	2	3
513	336.20	375.20	0.58	0.52	1	2
516	432.80	505.70	0.94	.	1	1
522	437.80	500.20	1.48	0.69	1	1
524	438.10	523.90	0.55	0.51	2	2
526	409.20	478.30	0.51	0.71	2	2
527	346.60	425.30	0.60	0.47	1	3
541	399.50	471.50	0.67	.	1	1
544	460.70	527.20	0.67	0.59	1	2
553	462.80	539.60	0.46	.	1	1
559	421.40	490.80	0.61	.	1	1
560	303.10	378.10	0.82	0.50	1	4
566	420.40	493.70	0.55	.	1	1
567	427.70	509.30	0.76	0.54	1	3
573	436.80	485.60	0.61	1.29	1	1
575	438.10	528.70	0.48	0.57	1	2
576	495.80	561.60	0.49	1.09	1	2
580	376.40	443.90	0.36	0.03	1	1
592	471.40	559.60	0.90	1.65	2	2
593	499.60	585.80	1.08	2.33	1	2
598	460.00	562.70	0.98	0.69	1	4
601	475.30	567.00	0.45	0.58	2	2
605	356.80	421.20	0.57	.	2	3
606	385.90	451.90	0.69	0.49	1	2
607	373.70	429.30	0.32	0.04	2	2
612	403.50	484.00	0.34	0.04	1	1
613.405	429.00	503.70	0.44	0.66	2	2
613.701	336.00	400.40	0.32	0.04	2	3
615	478.30	533.20	0.42	0.03	1	2

Table A2. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
618	422.40	490.30	0.51	1.55	1	1
624	442.20	504.90	0.62	.	1	2
627	472.10	563.40	1.21	0.63	1	2
628	428.80	479.60	0.51	0.52	1	2
630	414.50	488.70	0.47	0.86	2	2
635	395.60	447.90	0.38	0.74	1	2
638	381.00	440.60	0.64	0.04	1	1
639	433.50	496.80	0.58	.	1	1
640	370.50	460.70	0.29	0.04	1	1
643	461.70	550.10	0.98	0.65	2	2
645	430.90	488.20	1.60	.	1	1
648	434.00	521.80	1.07	0.54	1	3
651	444.30	510.70	0.75	0.91	1	2
653	414.70	485.50	0.50	0.03	1	1
655	444.40	520.50	0.97	.	1	1
657	481.90	575.50	0.89	0.62	1	2
667	410.30	489.80	0.75	0.81	1	2
668	466.40	547.70	0.47	0.03	1	1
670	365.70	427.10	0.54	0.64	3	2
671	473.00	558.80	0.41	0.65	1	3
675	402.60	464.50	0.66	0.57	1	2
681	416.50	458.00	0.56	0.02	1	2
684	384.80	457.70	0.51	0.57	1	2
686	442.10	514.50	0.58	0.04	1	1
692	382.50	442.00	0.55	.	1	1
693	465.00	559.20	0.55	1.01	1	2
699	422.90	473.60	0.55	.	1	1
700	373.10	480.40	0.75	1.09	1	2
704	434.30	519.90	0.57	1.08	2	2
706	336.30	407.70	1.11	0.58	1	2
711	405.30	483.00	0.47	0.43	2	2
721	440.70	548.30	0.54	0.91	1	4
726	373.20	447.30	0.66	0.59	1	2
734	408.00	485.30	0.44	0.03	1	1
737	413.30	476.90	3.23	0.02	1	1
751	409.20	495.80	0.76	1.10	1	2
756	388.20	460.20	0.81	0.76	1	2
781	365.80	443.30	0.47	0.62	1	2
783	397.60	457.90	0.59	0.53	2	2
785	389.40	472.10	1.04	0.80	1	2

Table A2. (continued)						
ID	IBW,kg	FBW, kg	Initial Exit Velocity, m/s	Final Exit Velocity, m/sec	Initial Chute score, 1-5	Final Chute Score, 1-5
786	431.20	538.70	0.68	1.15	1	2
793	367.70	418.10	0.54	0.44	2	2
795	367.30	433.90	0.62	0.02	1.5	2
800	420.50	483.90	0.45	1.34	1	2
804	433.40	474.60	1.42	1.02	1	1
807	413.80	468.10	0.55	0.53	1	2
826	476.90	551.80	0.39	0.82	1	2
828	471.30	542.30	0.53	0.80	2	2
836.405	432.50	457.90	0.66	0.51	2	2
836.701	416.50	495.10	0.65	.	1	1
839	418.40	491.70	0.57	0.03	1	1
840	458.30	536.40	0.91	.	1	1
841	475.00	546.90	0.60	0.79	1	2
850	379.90	449.00	0.43	.	1	1
856	483.40	563.40	0.58	0.68	1	2
866	503.30	576.80	0.61	0.71	1	2
868	412.10	473.00	0.85	0.54	1	2
870	398.80	473.70	0.97	0.61	1	2
871	348.40	406.90	0.47	0.04	2	2
873	383.50	472.80	0.39	0.71	2	2
875	447.10	539.10	0.71	0.63	1	2
878	500.70	597.60	0.62	2.18	1	2
885	405.20	471.90	0.45	0.04	1	1
886	401.10	490.00	0.89	.	1	2
887	419.60	485.60	0.87	.	1	1
888	379.30	470.10	0.53	.	1	1
889	381.40	460.30	0.59	.	1	1
901	394.60	459.70	0.66	.	1	1
902	471.40	548.50	0.52	.	.	1
903	399.10	452.10	0.6	0.02	1	1
906	427.50	532.60	0.49	0.65	1	2
907	414.50	491.00	0.86	0.55	1	2
924	434.20	528.80	0.89	2.40	1	2

Table A2. (continued)							
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d	RG, kg/d
5	0.82	98.76	8.39	10.23	0.00	-0.01	-0.11
16	0.99	95.66	8.31	8.36	-0.38	-0.49	0.08
20	0.91	105.68	9.95	10.97	0.73	0.44	-0.23
55	0.71	93.14	7.46	10.58	0.25	0.35	-0.19
61	1.02	94.93	9.50	9.30	0.77	0.70	-0.01
65	0.76	93.87	8.22	10.78	0.75	-0.01	-0.20
69	0.53	102.41	9.65	18.13	1.95	1.47	-0.58
72	0.81	103.85	8.62	10.70	-0.09	-0.26	-0.20
85	0.63	93.10	7.48	11.81	-0.20	-0.25	-0.20
87	0.76	97.60	7.82	10.31	-0.05	0.512	-0.17
90	1.17	101.07	9.46	8.09	0.09	0.11	0.14
97	0.96	102.60	8.76	9.12	-0.15	-0.25	0.00
98	0.89	106.19	9.08	10.26	0.21	0.24	-0.11
99	0.99	112.32	10.59	10.69	0.37	0.68	-0.21
105.405	1.07	90.83	7.95	7.44	-0.13	0.40	0.13
105.701	0.78	94.67	6.99	8.92	-1.13	-1.19	-0.01
108	1.07	98.75	8.75	8.18	-0.17	-0.35	0.11
109	1.00	102.16	8.98	8.97	-0.01	-0.14	0.02
110	1.07	100.17	7.86	7.37	-1.24	-0.84	0.13
112	0.97	102.66	9.33	9.65	0.40	0.29	-0.05
114.405	0.68	95.80	6.42	9.41	-1.02	-1.12	-0.11
114.701	1.10	106.45	9.44	8.57	0.01	0.06	0.07
119	1.33	102.88	10.50	7.89	0.28	0.23	0.14
121	0.82	100.20	8.23	10.01	-0.12	-0.44	-0.15
124	0.79	107.93	6.79	8.58	-1.92	-1.91	0.02
127	0.67	102.34	8.23	12.30	0.06	0.09	-0.24
133	1.11	103.61	8.08	7.30	-1.24	-1.25	0.21
136	1.02	95.00	8.88	8.73	0.50	0.14	-0.01
138	0.92	106.60	9.05	9.82	0.06	0.01	-0.07
150.405	1.02	103.72	9.28	9.07	-0.08	-0.09	-0.05
150.701	1.14	100.62	8.53	7.51	-0.73	-0.74	0.19
152	0.66	98.08	7.60	11.52	-0.36	-0.38	-0.19
153	0.82	104.13	7.85	9.53	-0.78	-0.75	-0.05
158	0.71	91.19	8.98	12.74	1.21	1.23	-0.28
160	1.29	102.60	9.11	7.05	-0.63	-0.65	0.29
164.405	0.97	92.07	5.91	6.12	-1.99	-1.73	0.23
164.701	1.09	105.42	7.96	7.32	-1.39	-1.39	0.20
168	0.95	90.11	7.22	7.64	-1.10	-1.10	0.14
170	1.22	106.46	10.90	8.95	0.63	0.58	-0.01
171	0.71	89.19	7.55	10.57	0.75	0.15	-0.18

Table A2. (continued)							
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d	RG, kg/d
172	1.14	98.72	8.00	7.01	-1.18	-1.05	0.20
173	1.18	99.49	8.81	7.46	-0.57	-0.91	0.16
179	1.17	108.60	10.87	9.28	0.51	0.20	-0.06
180	0.98	98.23	8.17	8.37	-0.59	-0.60	0.07
183	0.99	97.53	9.13	9.26	0.38	0.27	-0.01
184	1.01	96.45	8.87	8.75	0.10	0.04	0.04
194	1.00	91.34	9.20	9.22	0.69	0.71	-0.01
195.405	1.08	96.12	8.06	7.49	-0.62	8.57	0.13
195.701	0.95	106.70	8.32	8.80	-0.73	-0.65	0.02
196	1.28	100.81	8.80	6.87	-0.83	-0.78	0.31
197	0.50	96.00	7.65	.	0.18	0.25	-0.35
198	1.24	100.61	9.47	7.63	-0.23	-0.64	0.15
206	0.64	108.24	10.28	15.98	1.59	0.88	-0.53
209	0.91	95.71	7.67	8.45	-0.45	-0.79	-0.01
211	1.00	101.38	8.85	8.86	-0.10	-0.09	0.03
213	1.19	108.72	9.85	8.29	-0.58	-0.60	0.06
217	1.26	103.35	11.05	8.76	0.99	0.64	0.02
220	1.03	94.47	9.01	8.78	0.30	0.26	0.04
225	1.09	104.59	9.15	8.39	-0.17	.	0.09
231	1.25	108.42	11.79	9.44	1.21	2.15	-0.07
232	0.99	99.95	7.31	7.41	-1.55	-1.54	0.16
242	1.08	97.26	8.76	8.12	-0.21	-0.32	0.12
243.405	1.04	100.62	8.76	8.40	-0.32	-0.70	0.02
243.701	0.84	97.99	8.09	9.65	-0.31	-0.31	-0.06
246	0.87	102.45	8.59	9.88	-0.16	-0.39	-0.14
250	0.98	99.98	6.92	7.08	-1.89	-1.69	0.14
252	0.90	101.41	9.42	10.51	0.72	0.75	-0.13
263	1.25	97.01	9.24	7.40	-0.14	-0.27	0.24
269	1.07	86.90	8.55	7.98	0.05	0.09	0.14
276.405	1.07	96.83	9.72	9.05	0.96	0.51	-0.04
276.701	0.63	95.73	6.35	10.06	-1.43	-1.41	-0.10
279	0.80	98.79	8.97	11.26	0.64	0.64	-0.19
281	0.85	110.09	10.39	12.19	1.43	1.43	-0.28
282	0.86	92.89	6.03	6.98	-1.64	-1.13	0.11
283	1.05	96.67	8.86	8.46	0.01	0.06	0.08
287	0.75	89.67	7.58	10.05	-0.25	-0.31	-0.09
290	0.76	90.63	5.45	7.20	-1.64	-1.11	0.06
292	1.16	105.93	9.35	8.05	-0.21	-0.26	0.14
294	0.99	97.35	8.39	8.45	-0.37	-0.41	0.07
295	0.90	99.51	8.91	9.91	0.29	0.24	-0.08

Table A2. (continued)							
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d	RG, kg/d
298	0.92	90.95	8.70	9.46	0.40	0.33	-0.03
302	1.55	118.38	12.12	7.84	-0.47	-0.61	0.19
304.405	1.30	106.37	10.48	8.09	-0.01	0.07	0.11
304.701	1.17	96.32	9.67	8.24	0.50	0.54	0.12
305	0.44	97.89	5.97	13.65	-0.94	-0.44	-0.31
313	0.90	93.18	8.44	9.36	0.09	0.07	-0.03
320	0.95	96.23	8.83	9.32	0.23	0.18	-0.02
330	1.00	101.21	8.74	8.71	-0.28	-0.46	-0.02
332	0.88	111.13	9.07	10.34	0.00	0.00	-0.12
341	1.42	97.64	10.70	7.55	0.79	0.48	0.21
344	0.62	93.82	6.04	9.70	-0.99	-0.78	-0.13
354	1.18	108.72	9.86	8.36	-0.54	-0.54	0.05
355.405	0.94	103.26	8.91	9.49	-0.14	0.00	-0.10
355.701	0.62	99.21	8.32	13.44	0.42	0.42	-0.30
361	1.19	99.22	9.97	8.38	0.64	0.61	0.11
368	1.06	110.32	12.16	11.42	1.94	1.66	-0.29
369	0.77	94.52	8.36	10.91	0.81	0.32	-0.21
372	0.91	102.83	9.25	10.21	0.47	0.50	-0.11
373.405	0.95	112.85	11.18	11.78	1.03	0.86	-0.31
373.701	1.00	100.78	9.70	9.70	0.77	0.81	-0.06
375	0.93	95.33	9.63	10.31	1.11	1.02	-0.11
380	1.54	102.53	10.00	6.49	-0.83	-1.05	0.40
388	0.57	93.12	7.24	12.73	-0.28	-0.22	-0.24
389	1.00	95.73	8.47	8.46	-0.24	-0.20	0.07
396	0.79	93.97	8.55	10.79	0.44	0.46	-0.15
400	0.80	99.04	9.64	12.08	1.49	1.09	-0.31
401	1.10	99.63	8.69	7.91	-0.43	-0.51	0.14
407	1.08	104.12	9.73	9.02	0.46	0.42	0.02
410	1.37	115.89	11.13	8.15	-0.63	-0.69	0.11
411	1.12	102.82	8.10	7.21	-1.48	-1.50	0.17
415	0.94	104.05	8.68	9.21	-0.25	-0.47	-0.02
419	0.53	100.22	5.80	10.85	-1.67	-1.39	-0.20
420	1.61	115.66	11.34	7.06	-1.14	-0.87	0.33
422	1.17	92.39	6.08	.	-2.90	-2.86	0.47
425.405	1.12	95.89	8.41	7.48	-0.40	0.19	0.14
425.701	1.31	116.38	9.93	7.56	-0.46	-0.47	0.23
439	0.91	95.27	9.84	10.83	1.38	1.28	-0.16
441	0.86	101.71	8.30	9.70	-0.30	-0.29	-0.06
442	0.79	97.85	7.71	9.77	-0.56	.	-0.07
443	0.76	95.60	8.71	11.44	0.61	0.61	-0.20

Table A2. (continued)							
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d	RG, kg/d
446	1.18	109.20	10.97	9.26	1.21	1.17	0.00
451	1.11	104.07	9.63	8.66	0.28	0.30	0.06
454.405	1.11	97.59	10.27	9.22	1.30	1.09	-0.05
454.701	1.08	105.78	10.37	9.58	1.02	0.95	-0.04
457	0.77	100.39	8.05	10.47	-0.29	-0.42	-0.13
468	1.32	109.00	10.52	7.97	0.43	0.43	0.18
478	0.84	101.21	9.18	10.90	0.66	-0.08	-0.22
480	1.13	103.29	9.67	8.57	0.03	-0.52	0.02
481	0.90	88.32	7.80	8.71	0.53	0.41	-0.03
485	1.10	110.87	10.05	9.10	0.42	0.40	0.01
496	0.83	101.76	9.92	12.01	1.39	1.40	-0.25
509	0.83	104.24	9.96	11.95	1.12	0.58	-0.31
513	0.56	81.91	4.05	7.27	-1.47	-1.54	0.00
516	1.04	100.82	9.44	9.06	0.40	0.35	0.01
522	0.89	100.78	8.83	9.91	0.17	0.17	-0.08
524	1.23	102.71	10.02	8.17	0.14	0.36	0.08
526	0.99	96.69	8.69	8.80	0.22	0.00	-0.03
527	1.12	87.07	6.61	5.89	-1.22	-0.73	0.32
541	1.03	95.33	9.37	9.10	0.61	0.62	0.01
544	0.95	104.78	7.03	7.41	-2.22	-1.37	0.09
553	1.10	105.93	10.09	9.20	0.70	0.78	0.00
559	0.99	98.69	9.56	9.64	0.74	0.75	-0.05
560	1.07	79.28	7.72	7.21	0.91	0.04	0.16
566	1.05	98.85	10.70	10.23	1.74	1.74	-0.11
567	1.17	100.70	9.55	8.19	0.07	0.14	0.07
573	0.70	99.52	8.59	12.30	0.47	0.41	-0.25
575	1.29	103.09	8.97	6.93	-1.17	-0.94	0.25
576	0.94	110.26	9.42	10.03	-0.41	-0.64	-0.15
580	0.96	91.14	8.01	8.30	-0.41	-0.48	0.08
592	1.26	108.19	11.33	9.00	0.75	0.48	-0.02
593	1.23	112.44	9.16	7.44	-1.81	-2.06	0.17
598	1.47	107.53	11.97	8.16	0.81	0.37	0.13
601	1.31	109.08	12.58	9.60	1.73	2.23	-0.09
605	0.92	87.59	8.39	9.11	0.24	0.27	0.00
606	0.94	92.59	7.56	8.02	-0.33	-0.19	0.04
607	0.79	89.69	7.17	9.03	-0.76	-0.75	-0.01
612	1.15	96.68	8.23	7.16	-0.90	.	0.24
613.405	1.07	100.36	9.69	9.09	0.56	1.14	-0.05
613.701	0.92	84.06	8.11	8.82	0.12	0.13	0.03
615	0.78	106.65	8.47	10.80	-0.17	.	-0.16

Table A2. (continued)							
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d	RG, kg/d
618	0.97	98.74	8.10	8.35	-0.66	-0.72	0.07
624	0.89	101.51	9.26	10.34	0.53	0.25	-0.17
627	1.31	108.54	10.32	7.91	-0.45	-1.33	0.13
628	0.72	98.39	6.48	8.95	-1.37	-0.72	-0.07
630	1.06	97.97	8.75	8.26	-0.09	0.27	0.04
635	0.75	93.07	8.49	11.35	1.15	0.79	-0.24
638	0.85	91.25	7.62	8.95	-0.52	-0.52	0.00
639	0.90	100.16	8.44	9.33	-0.22	-0.28	-0.03
640	1.29	92.05	8.07	6.26	-1.20	-1.26	0.40
643	1.26	106.67	9.05	7.16	-1.38	-1.46	0.21
645	0.82	99.26	7.55	9.23	-0.85	-0.87	-0.03
648	1.25	102.22	9.66	7.70	-0.26	0.05	0.15
651	0.95	102.14	8.19	8.63	-0.77	-1.04	-0.02
653	1.01	97.71	9.33	9.23	0.51	0.46	-0.01
655	1.09	102.94	9.45	8.70	0.21	0.11	0.05
657	1.34	110.26	11.61	8.68	0.55	0.92	0.04
667	1.13	97.71	9.43	8.31	0.39	-0.08	0.05
668	1.16	106.85	8.81	7.58	-0.79	-0.76	0.19
670	0.88	88.83	6.63	7.56	-0.63	-0.40	0.07
671	1.23	108.24	11.73	9.56	1.24	1.48	-0.09
675	0.88	95.01	9.15	10.34	1.17	1.10	-0.17
681	0.59	95.62	6.67	11.27	-1.01	-1.06	-0.17
684	1.04	92.98	9.25	8.89	1.02	0.75	-0.02
686	1.03	102.28	8.49	8.22	-0.58	-0.50	0.10
692	0.85	91.49	8.33	9.79	0.18	0.21	-0.07
693	1.35	107.65	10.02	7.44	-0.77	-0.99	0.20
699	0.73	97.42	8.20	11.30	0.11	0.13	-0.18
700	1.53	93.89	9.84	6.42	-0.02	0.11	0.41
704	1.22	102.08	8.45	6.92	-1.35	-0.51	0.23
706	1.02	84.71	9.15	8.97	1.90	1.91	-0.03
711	1.11	96.75	8.46	7.62	-0.40	0.04	0.12
721	1.54	104.86	10.31	6.71	-0.77	-0.40	0.36
726	1.06	91.16	6.89	6.51	-1.20	-0.82	0.23
734	1.11	97.16	9.60	8.69	0.57	0.56	0.06
737	0.91	96.90	9.03	9.94	0.50	0.54	-0.08
751	1.24	98.12	9.45	7.63	0.04	-0.80	0.15
756	1.03	93.47	9.28	9.02	1.03	0.67	-0.04
781	1.11	90.20	8.48	7.66	0.35	0.01	0.12
783	0.86	94.06	6.82	7.91	-0.98	-0.53	0.03
785	1.18	94.55	9.30	7.87	0.46	0.15	0.11

Table A2. (continued)							
ID	ADG, kg./d	MBW	DMI, kg/d	FCR	RFI_p, kg/d	RFI_c, kg/d	RG, kg/d
786	1.54	103.34	12.96	8.43	2.05	2.32	0.11
793	0.72	88.25	8.76	12.17	2.05	2.04	-0.30
795	0.95	89.54	10.05	10.56	1.73	1.72	-0.13
800	0.91	98.07	8.14	8.99	-0.23	0.25	-0.05
804	0.59	98.36	6.72	11.44	-1.07	-1.08	-0.18
807	0.78	96.23	8.19	10.56	0.42	0.74	-0.19
826	1.07	108.01	10.98	10.28	1.01	0.60	-0.17
828	1.01	106.81	12.41	12.24	2.73	2.67	-0.37
836.405	0.36	96.92	5.41	14.90	-1.17	-0.26	-0.33
836.701	1.12	98.65	9.90	8.82	0.76	0.71	0.05
839	1.05	98.53	9.57	9.14	0.62	0.58	0.01
840	1.12	105.32	8.24	7.39	-1.18	-1.15	0.20
841	1.03	107.47	9.68	9.42	-0.11	0.76	-0.09
850	0.99	91.86	8.83	8.95	0.33	0.35	0.02
856	1.14	109.43	8.56	7.49	-1.80	-0.99	0.14
866	1.05	112.03	10.44	9.94	0.08	-0.87	-0.14
868	0.87	96.49	8.49	9.74	0.39	1.04	-0.12
870	1.07	95.46	9.28	8.67	0.68	0.59	0.00
871	0.84	85.67	6.94	8.30	-0.92	-0.90	0.06
873	1.28	94.12	8.62	6.76	-0.47	-0.38	0.27
875	1.31	104.64	9.64	7.33	-0.73	0.14	0.21
878	1.38	113.44	10.67	7.71	-0.88	-0.68	0.17
885	0.95	95.83	9.25	9.72	0.66	0.62	-0.06
886	1.27	96.98	9.87	7.78	0.43	0.45	0.20
887	0.94	98.13	9.11	9.65	0.44	0.41	-0.05
888	1.30	93.55	9.10	7.01	-0.26	-0.24	0.30
889	1.13	92.92	8.75	7.76	-0.16	-0.19	0.17
901	0.93	93.96	10.15	10.90	1.69	1.73	-0.17
902	1.10	107.31	9.91	9.00	0.44	0.48	0.02
903	0.76	93.70	8.38	11.07	0.37	0.37	-0.17
906	1.50	102.56	10.97	7.31	0.26	0.21	0.26
907	1.09	98.15	11.23	10.26	2.26	2.01	-0.17
924	1.35	102.79	10.18	7.53	-0.10	-0.05	0.19

Table A2. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
5	0.33	74.18	2.58	0.58	81.92	2.38	0.25	7.74
16	0.84	61.92	3.03	1.42	78.05	3.31	0.58	16.13
20	0.48	55.23	3.06	0.91	73.94	3.78	0.43	18.71
55	0.15	55.68	1.53	0.53	69.61	3.37	0.38	13.94
61	0.43	73.53	2.89	0.89	83.85	3.05	0.46	10.32
65	0.48	52.39	3.42	1.07	71.10	3.55	0.58	18.71
69	0.13	54.97	1.15	0.89	73.23	0.91	0.76	18.26
72	0.66	63.74	2.48	1.02	80.19	3.79	0.36	16.45
85	0.46	61.28	3.87	0.84	70.95	3.33	0.38	9.68
87	0.43	66.13	1.66	0.53	85.42	2.86	0.10	19.29
90	0.46	69.66	2.87	0.64	79.34	2.57	0.18	9.68
97	0.81	76.11	2.56	1.30	81.92	2.68	0.48	5.80
98	0.51	65.79	3.82	0.69	85.14	4.51	0.18	19.35
99	0.33	67.48	2.31	0.89	80.00	3.56	0.56	12.52
105.405	0.23	66.06	1.71	0.64	70.84	3.53	0.41	4.77
105.701	0.61	61.92	2.24	0.97	69.02	2.99	0.36	7.10
108	0.53	69.02	2.73	1.19	76.76	2.71	0.66	7.74
109	0.86	72.24	3.27	1.50	83.85	2.35	0.64	11.61
110	0.23	59.23	2.03	0.58	73.87	3.13	0.36	14.65
112	0.76	74.18	2.65	1.37	78.05	4.10	0.61	3.87
114.405	0.41	57.87	2.23	0.74	71.68	2.56	0.33	13.81
114.701	0.56	72.24	2.75	0.56	.	2.61	0.00	.
119	0.25	53.35	1.67	0.84	74.84	3.26	0.58	21.48
121	0.58	62.26	3.15	1.07	91.16	4.31	0.48	28.90
124	0.53	69.02	3.38	0.79	82.56	3.10	0.25	13.55
127	0.53	54.83	3.69	0.74	72.89	4.24	0.20	18.06
133	0.43	75.47	2.86	0.76	80.63	2.53	0.33	5.16
136	0.64	59.48	3.05	1.07	59.68	3.77	0.43	0.19
138	0.56	81.92	2.53	0.94	90.30	2.53	0.38	8.39
150.405	0.36	57.35	1.47	0.81	86.32	2.73	0.46	28.97
150.701	0.43	68.37	2.98	0.81	79.98	2.44	0.38	11.61
152	0.66	67.73	3.22	0.71	76.76	3.27	0.05	9.03
153	0.51	63.86	3.03	0.69	64.50	2.71	0.18	0.64
158	0.28	55.47	2.45	0.51	66.44	2.93	0.23	10.97
160	0.69	81.92	3.43	0.74	88.37	3.69	0.05	6.45
164.405	0.25	54.26	2.54	0.48	60.00	3.48	0.23	5.74
164.701	0.41	79.34	3.54	0.66	90.30	3.37	0.25	10.97
168	0.38	56.76	2.65	0.58	66.44	2.78	0.20	9.68
170	0.30	61.03	2.45	1.02	72.71	3.78	0.71	11.68
171	0.41	43.55	2.69	0.69	73.35	4.32	0.28	29.81

Table A2. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
172	0.15	62.97	1.96	0.89	77.74	2.02	0.74	14.77
173	0.23	56.06	2.71	1.04	88.26	3.92	0.81	32.19
179	0.91	70.84	2.67	1.45	86.90	3.72	0.53	16.06
180	0.46	70.95	3.20	0.69	75.47	2.53	0.23	4.52
183	0.74	69.66	3.50	1.32	78.69	3.46	0.58	9.03
184	0.64	59.34	3.12	1.14	70.31	3.67	0.51	10.97
194	0.28	58.70	3.23	0.53	67.73	2.72	0.25	9.03
195.405	0.20	64.06	1.15	0.89	71.61	2.20	0.69	7.55
195.701	0.38	61.92	2.27	0.51	73.53	2.72	0.13	11.61
196	0.43	66.44	3.13	0.53	78.69	4.08	0.10	12.26
197	0.28	54.18	2.84	0.30	56.12	2.88	0.03	1.93
198	0.20	59.81	1.86	1.22	73.68	3.25	1.02	13.87
206	0.10	62.84	0.91	1.32	73.61	1.40	1.22	10.77
209	0.58	57.42	2.51	0.97	61.29	3.05	0.38	3.87
211	0.46	69.66	2.43	0.64	71.60	2.45	0.18	1.93
213	0.48	59.68	2.92	0.97	86.84	3.45	0.48	27.16
217	0.13	62.77	1.61	1.27	97.23	2.84	1.14	34.45
220	0.41	68.37	2.88	0.76	77.40	2.58	0.36	9.03
225	1.07	.	3.78	1.65	87.08	3.69	0.58	.
231	0.18	70.52	1.85	0.61	88.71	2.97	0.43	18.19
232	0.53	57.41	2.92	0.86	71.60	3.52	0.33	14.19
242	0.56	65.15	3.17	1.42	77.40	3.58	0.86	12.26
243.405	0.10	54.65	0.71	0.99	65.29	1.65	0.89	10.65
243.701	0.33	64.50	2.64	0.64	74.18	2.61	0.30	9.68
246	0.36	57.55	1.99	0.91	72.65	3.39	0.56	15.10
250	0.38	62.06	2.53	0.76	81.23	2.98	0.38	19.16
252	0.43	72.24	2.30	0.46	75.47	2.22	0.03	3.23
263	0.86	69.66	2.68	1.50	70.95	2.88	0.64	1.29
269	0.23	55.47	2.35	0.33	65.79	2.33	0.10	10.32
276.405	0.46	54.00	1.59	1.02	75.48	2.73	0.56	21.48
276.701	0.36	61.92	2.32	0.46	71.60	1.98	0.10	9.68
279	0.33	63.86	3.39	0.71	70.95	3.07	0.38	7.10
281	0.38	79.34	3.26	0.71	89.01	3.19	0.33	9.68
282	0.20	58.45	1.16	0.38	84.84	2.30	0.18	26.39
283	0.28	56.76	2.47	0.43	59.34	2.83	0.15	2.58
287	0.36	64.50	2.60	0.74	77.40	2.80	0.38	12.90
290	0.36	62.52	1.74	0.43	67.81	3.09	0.08	5.29
292	0.46	78.69	3.18	1.04	92.24	3.45	0.58	13.55
294	0.56	62.57	2.87	0.99	76.11	3.01	0.43	13.55
295	0.58	67.73	3.21	1.02	72.89	2.63	0.43	5.16

Table A2. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FREA, cm^2	FIMF, %	GBF, cm	GREA, cm^2
298	0.51	65.79	2.15	0.89	75.47	2.60	0.38	9.68
302	0.15	73.74	1.52	1.57	97.29	2.58	1.42	23.55
304.405	0.15	65.29	1.24	1.07	102.39	2.49	0.91	37.10
304.701	0.30	63.21	2.65	0.53	73.53	3.45	0.23	10.32
305	0.13	69.68	1.89	0.56	79.81	2.61	0.43	10.13
313	0.36	60.63	2.44	0.74	72.24	2.72	0.38	11.61
320	0.51	69.02	2.66	0.86	87.08	2.75	0.36	18.06
330	0.43	62.26	2.29	1.04	89.23	3.06	0.61	26.97
332	0.46	72.24	3.24	0.94	81.92	2.99	0.48	9.68
341	0.20	53.81	2.09	1.04	75.48	3.73	0.84	21.68
344	0.25	57.68	1.11	0.48	80.13	2.60	0.23	22.45
354	0.15	67.10	0.55	1.14	74.90	0.88	0.99	7.81
355.405	0.18	64.32	3.16	0.86	71.16	3.58	0.69	6.84
355.701	0.33	67.73	2.95	0.58	72.89	3.26	0.25	5.16
361	0.56	66.44	3.74	0.99	73.53	4.28	0.43	7.10
368	0.33	65.10	0.67	1.24	102.45	2.30	0.91	37.35
369	0.25	44.97	1.45	0.69	69.35	3.07	0.43	24.39
372	0.41	67.08	3.48	0.58	76.11	3.40	0.18	9.03
373.405	0.58	62.19	2.01	1.07	93.23	3.52	0.48	31.03
373.701	0.28	59.34	2.91	0.69	65.15	2.87	0.41	5.81
375	0.69	57.41	3.04	1.35	59.99	4.10	0.66	2.58
380	0.43	62.39	1.78	1.27	81.61	3.13	0.84	19.23
388	0.30	49.02	3.97	0.41	56.76	3.99	0.10	7.74
389	0.46	52.25	3.25	0.64	66.44	2.79	0.18	14.19
396	0.36	54.83	2.82	0.58	70.95	3.12	0.23	16.13
400	0.41	59.68	0.96	1.04	87.74	2.28	0.64	28.06
401	0.58	61.92	3.83	1.35	82.56	3.26	0.76	20.64
407	0.84	65.79	2.92	1.14	70.95	2.62	0.30	5.16
410	0.15	67.87	0.89	1.30	91.68	2.59	1.14	23.81
411	0.23	61.48	1.89	0.97	72.39	3.46	0.74	10.90
415	1.09	77.40	3.71	2.06	93.53	3.85	0.97	16.13
419	0.48	64.26	2.79	0.61	69.94	4.20	0.13	5.68
420	0.41	59.87	3.62	0.94	88.00	4.66	0.53	28.13
422	0.36	63.21	2.53	0.36	72.89	2.77	0.00	9.68
425.405	0.18	60.26	1.74	0.48	76.26	3.04	0.30	16.00
425.701	0.64	69.66	3.25	1.35	85.79	2.95	0.71	16.13
439	0.58	76.76	3.45	1.04	84.50	3.43	0.46	7.74
441	0.33	63.86	2.42	0.69	87.08	3.38	0.36	23.22
442	0.53	.	3.14	1.22	.	3.67	0.69	.
443	0.41	63.21	3.29	0.58	76.11	2.84	0.18	12.90

Table A2. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
446	0.79	70.31	2.75	1.30	81.92	2.57	0.51	11.61
451	0.51	70.95	2.97	0.69	80.63	2.77	0.18	9.68
454.405	0.13	58.45	0.84	0.99	94.00	2.45	0.86	35.55
454.701	0.81	63.86	2.80	1.45	70.95	3.47	0.64	7.10
457	1.09	63.21	2.19	1.65	.	3.14	0.56	.
468	0.38	72.24	4.00	0.97	80.63	4.02	0.58	8.39
478	0.18	60.58	1.59	1.32	75.87	3.51	1.14	15.29
480	0.46	54.52	2.23	1.14	84.45	3.56	0.69	29.94
481	0.23	50.65	2.78	0.61	65.48	3.46	0.38	14.84
485	0.56	63.21	2.51	1.35	76.76	1.97	0.79	13.55
496	0.36	70.95	3.28	0.61	71.60	2.51	0.25	0.64
509	0.38	67.29	1.94	1.37	80.45	3.09	0.99	13.16
513	0.20	48.90	1.33	0.38	68.77	2.07	0.18	19.87
516	0.61	65.15	2.46	1.17	65.79	3.32	0.56	0.64
522	0.36	69.02	2.55	0.69	78.05	2.72	0.33	9.03
524	0.23	63.74	2.27	0.89	86.84	3.15	0.66	23.10
526	0.38	54.45	3.19	0.84	96.00	3.68	0.46	41.55
527	0.23	51.35	1.84	0.28	82.90	3.51	0.05	31.55
541	0.36	63.21	3.33	0.58	74.18	3.04	0.23	10.97
544	0.15	66.00	1.42	0.43	76.58	2.19	0.28	10.58
553	0.28	69.66	2.13	0.33	79.98	1.80	0.05	10.32
559	0.51	56.76	2.87	0.86	79.34	2.90	0.36	22.58
560	0.23	46.84	2.14	1.04	65.74	3.63	0.81	18.90
566	0.43	66.44	2.73	0.76	75.47	3.30	0.33	9.03
567	0.23	57.74	1.92	0.81	70.84	3.58	0.58	13.10
573	0.66	67.08	2.73	1.02	74.82	3.09	0.36	7.74
575	0.38	68.52	1.78	1.04	77.23	2.94	0.66	8.71
576	0.43	59.48	1.73	1.02	76.32	2.02	0.58	16.84
580	0.74	61.92	3.47	1.02	73.53	3.36	0.28	11.61
592	0.71	66.19	1.35	1.32	87.74	2.17	0.61	21.55
593	0.46	66.19	1.62	1.32	95.87	2.83	0.86	29.68
598	0.48	58.97	3.10	1.32	69.61	3.79	0.84	10.65
601	0.46	64.90	1.86	0.79	87.16	2.80	0.33	22.26
605	0.28	54.83	2.81	0.41	58.05	2.73	0.13	3.23
606	0.20	64.84	0.84	0.84	80.71	1.83	0.64	15.87
607	0.36	60.63	2.50	0.46	75.47	2.49	0.10	14.84
612	0.41	.	3.01	0.76	75.47	2.98	0.36	.
613.405	0.20	59.10	1.76	0.46	89.61	3.29	0.25	30.52
613.701	0.25	52.25	2.04	0.41	61.92	2.29	0.15	9.68
615	0.51	.	3.26	0.48	71.60	2.39	-0.03	.

Table A2. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
618	0.53	63.21	3.08	1.09	67.73	3.47	0.56	4.51
624	0.43	60.97	2.21	1.04	82.13	3.61	0.61	21.16
627	0.43	55.29	1.90	1.47	88.13	3.20	1.04	32.84
628	0.46	72.45	1.86	0.64	73.10	3.27	0.18	0.65
630	0.20	63.42	1.27	0.71	78.77	2.02	0.51	15.35
635	0.48	60.39	2.27	0.99	61.61	3.60	0.51	1.23
638	0.46	52.89	2.66	0.69	60.63	2.35	0.23	7.74
639	0.79	63.86	2.94	1.14	68.37	2.84	0.36	4.52
640	0.46	64.50	2.74	0.99	81.92	3.18	0.53	17.42
643	0.46	70.26	1.65	1.30	68.32	2.53	0.84	-1.94
645	0.58	72.24	2.79	0.66	76.11	2.60	0.08	3.87
648	0.25	64.65	0.83	0.86	90.13	2.48	0.61	25.48
651	0.51	67.42	2.44	1.22	88.84	2.62	0.71	21.42
653	0.33	79.98	2.14	0.74	84.50	2.20	0.41	4.52
655	0.71	67.73	3.51	1.50	83.85	3.53	0.79	16.13
657	0.43	57.10	2.92	0.69	79.87	3.74	0.25	22.77
667	0.56	56.58	2.01	1.12	94.06	3.14	0.56	37.48
668	0.43	72.89	2.47	0.71	76.11	2.77	0.28	3.23
670	0.18	54.39	1.11	0.46	73.55	1.77	0.28	19.16
671	0.46	65.42	1.20	0.94	87.10	2.74	0.48	21.68
675	0.36	60.84	1.99	0.86	78.39	2.85	0.51	17.55
681	0.53	71.60	3.63	0.69	74.82	3.07	0.15	3.22
684	0.23	50.13	2.67	0.76	78.19	3.77	0.53	28.06
686	0.33	61.28	3.00	0.41	72.89	3.14	0.08	11.61
692	0.30	56.76	3.28	0.46	69.66	3.37	0.15	12.90
693	0.53	65.35	2.72	1.30	102.00	3.69	0.76	36.65
699	0.46	59.99	3.30	0.58	61.92	2.62	0.13	1.94
700	0.23	42.00	1.45	0.46	79.61	2.57	0.23	37.61
704	0.20	63.35	1.20	0.46	87.35	2.22	0.25	24.00
706	0.15	53.03	1.38	0.61	75.03	2.58	0.46	22.00
711	0.25	63.03	1.11	0.66	77.42	2.64	0.41	14.39
721	0.13	63.81	1.02	0.91	96.32	1.62	0.79	32.52
726	0.20	56.19	1.71	0.48	83.29	1.88	0.28	27.10
734	0.64	59.99	3.05	0.86	68.37	2.51	0.23	8.39
737	0.33	57.41	3.48	0.56	67.73	3.65	0.23	10.32
751	0.51	56.97	1.89	1.42	93.29	3.04	0.91	36.32
756	0.41	51.55	1.55	0.86	81.03	2.95	0.46	29.48
781	0.20	50.71	1.53	0.84	69.10	3.07	0.64	18.39
783	0.25	62.39	1.91	0.53	85.55	3.11	0.28	23.16
785	0.48	58.52	1.19	1.07	83.10	2.32	0.58	24.58

Table A2. (continued)								
ID	IBF, cm	ILM, cm^2	IIMF, %	FBF, cm	FLM, cm^2	FIMF, %	GBF, cm	GLM, cm^2
786	0.43	63.42	3.77	0.97	83.10	4.11	0.53	19.68
793	0.41	57.16	2.07	0.64	72.32	2.93	0.23	15.16
795	0.48	61.92	3.83	0.58	67.08	4.16	0.10	5.16
800	0.43	73.55	2.85	0.84	81.68	4.39	0.41	8.13
804	0.46	58.70	3.25	0.81	67.73	2.73	0.36	9.03
807	0.43	66.52	3.43	0.71	75.42	4.06	0.28	8.90
826	0.41	57.42	1.11	1.12	85.16	2.64	0.71	27.74
828	0.43	59.48	2.54	0.91	87.74	3.78	0.48	28.26
836.405	0.15	72.77	0.91	0.33	86.45	1.76	0.18	13.68
836.701	0.41	59.99	2.52	1.19	70.95	3.46	0.79	10.97
839	0.30	79.34	2.36	0.74	83.21	2.25	0.43	3.87
840	0.41	65.15	2.35	0.79	77.40	2.59	0.38	12.26
841	0.46	76.65	1.79	0.74	89.94	3.67	0.28	13.29
850	0.53	55.47	3.06	0.56	61.28	3.00	0.03	5.81
856	0.18	64.58	1.02	0.51	82.64	2.77	0.33	18.06
866	0.15	55.48	0.72	1.45	83.81	1.84	1.30	28.32
868	0.13	68.00	1.04	0.56	87.29	2.13	0.43	19.29
870	0.18	54.90	0.87	0.79	78.77	2.60	0.61	23.87
871	0.18	57.41	3.12	0.33	65.15	2.97	0.15	7.74
873	0.23	53.03	1.48	0.69	74.65	3.15	0.46	21.61
875	0.15	77.16	1.26	0.84	76.13	1.67	0.69	-1.03
878	0.18	61.10	1.30	0.94	83.55	2.56	0.76	22.45
885	0.58	61.92	2.88	0.94	67.08	3.36	0.36	5.16
886	0.38	68.37	3.49	0.61	85.79	3.24	0.23	17.42
887	0.30	59.99	2.98	0.94	69.66	3.23	0.64	9.68
888	0.36	61.92	3.23	0.58	68.37	2.58	0.23	6.45
889	0.33	54.18	2.25	1.02	72.24	2.61	0.69	18.06
901	0.28	61.92	3.03	0.41	69.02	2.70	0.13	7.10
902	0.51	67.08	3.01	0.71	79.34	3.28	0.20	12.26
903	0.25	63.86	2.97	0.51	72.24	3.11	0.25	8.38
906	0.18	62.39	2.23	1.14	81.74	3.51	0.97	19.35
907	0.43	63.61	1.54	1.14	76.58	2.49	0.71	12.97
924	0.48	57.42	2.74	0.89	77.81	4.40	0.41	20.39

Table A3. Carcass data.									
ID	HCW, kg	BF, cm	ADJ. BF, cm	APYG, cm	KPH, %	Marbling Score	Quality Grade	LM, cm^2	Yield Grade
5	307.4	0.76	0.71	2.7	2.25	300	300	80.0	2.3
16	297.2	2.79	2.34	4.3	3.00	320	320	70.3	4.4
20	339.1	1.52	1.63	3.6	2.00	415	405	78.71	3.43
55	291.1	1.14	1.12	3.1	2.00	615	472	66.77	3.12
61	304.9	2.03	2.13	4.1	3.00	340	340	80.0	3.8
65	285.7	1.33	1.22	3.2	2.50	585	462	62.90	3.47
69	309.1	1.02	1.02	3.0	2.00	575	458	75.16	2.76
72	325.0	1.33	1.73	3.7	2.00	715	505	89.68	2.87
85	289.2	0.51	0.61	2.6	3.00	450	417	73.5	2.5
87	310.7	0.95	0.81	2.8	3.00	465	422	71.29	2.96
90	318.5	0.76	0.81	2.8	1.75	380	380	71.6	2.8
97	326.2	1.27	1.42	3.4	3.00	410	403	88.4	2.9
98	328.0	1.40	1.22	3.2	2.50	490	430	81.3	2.9
99	348.6	1.40	1.42	3.4	1.50	550	450	78.06	3.24
105.405	274.3	0.76	0.91	2.9	3.25	380	380	67.1	3.0
105.701	288.6	1.08	1.22	3.2	3.00	485	428	78.39	2.83
108	310.1	2.16	1.93	3.9	2.75	340	340	79.3	3.6
109	326.8	1.52	1.52	3.5	2.75	490	430	92.9	2.7
110	328.0	0.89	0.81	2.8	3.00	475	425	74.19	2.96
112	328.4	2.16	2.64	4.6	2.75	410	403	68.4	5.0
114.405	348.8	2.54	2.34	4.3	3.00	420	407	80.0	4.4
114.701	294.3	1.40	1.22	3.2	2.50	450	417	76.13	2.88
119	346.6	0.95	1.32	3.3	3.00	400	400	75.81	3.54
121	327.7	0.95	1.12	3.1	4.00	645	482	79.03	3.22
124	329.8	1.65	1.42	3.4	3.00	290	295	68.4	3.9
127	306.5	0.89	0.71	2.7	3.00	610	470	71.6	2.8
133	311.9	0.76	0.61	2.6	2.50	380	380	70.3	2.7
136	313.9	1.46	1.42	3.4	2.50	590	463	73.87	3.36
138	354.9	1.14	1.02	3.0	2.50	440	413	90.9	2.5
150.405	318.7	0.76	0.71	2.7	3.00	299	300	88.4	2.1
150.701	341.6	1.52	1.83	3.8	2.50	500	433	78.71	3.75
152	311.4	0.51	0.51	2.5	2.50	480	427	84.5	1.9
153	320.3	0.51	0.51	2.5	2.50	280	290	74.2	2.5
158	277.0	0.51	0.51	2.5	2.00	320	320	84.5	1.5
160	337.7	1.91	1.63	3.6	3.00	490	430	81.3	3.5
164.405	347.9	1.02	1.02	3.0	2.00	420	407	86.4	2.5
164.701	261.6	0.25	0.20	2.2	1.50	395	395	77.10	1.36
168	285.4	0.25	0.30	2.3	1.75	280	290	80.0	1.6
170	340.9	1.33	1.52	3.5	1.50	625	475	88.06	2.78
171	273.2	1.84	1.83	3.8	2.50	645	482	73.55	3.44

Table A3. (continued)									
ID	HCW, kg	BF, cm	ADJ. BF, cm	APYG, cm	KPH, %	Marbling Score	Quality Grade	LM, cm^2	Yield Grade
172	321.6	1.65	1.63	3.6	1.50	600	467	68.06	3.71
173	325.2	1.40	1.52	3.5	3.00	775	525	75.48	3.57
179	361.1	2.60	2.64	4.6	2.50	415	405	76.13	4.84
180	304.9	0.89	0.81	2.8	3.00	410	403	70.3	3.0
183	316.6	1.78	1.83	3.8	2.00	420	407	77.4	3.5
184	303.7	1.52	1.52	3.5	2.75	540	447	69.0	3.7
194	282.0	0.51	0.51	2.5	2.00	390	390	68.4	2.4
195.405	335.2	0.51	0.71	2.7	2.50	360	360	76.1	2.7
195.701	320.5	1.02	1.02	3.0	3.00	410	403	90.00	2.32
196	310.5	0.76	1.12	3.1	2.75	610	470	69.7	3.3
197	281.5	0.25	0.20	2.2	1.50	270	285	61.9	2.3
198	313.2	1.40	1.73	3.7	1.50	485	428	79.03	3.20
206	330.2	0.51	0.51	2.5	1.50	485	428	83.55	1.92
209	286.8	0.89	1.02	3.0	1.50	445	415	79.68	2.25
211	315.7	0.76	0.71	2.7	2.25	320	320	82.6	2.2
213	345.5	1.02	1.32	3.3	1.50	500	433	81.61	2.94
217	330.7	1.40	1.73	3.7	1.50	495	432	77.10	3.44
220	296.3	0.76	0.71	2.7	2.75	380	380	85.8	2.0
225	347.7	3.05	3.25	5.2	2.75	520	440	80.0	5.2
231	347.7	0.83	0.91	2.9	3.00	505	435	80.32	2.92
232	291.1	1.02	1.02	3.0	2.50	360	360	78.7	2.5
242	304.9	2.79	2.34	4.3	3.00	460	420	77.4	4.1
243.405	305.3	0.64	0.71	2.7	3.25	290	295	65.8	3.1
243.701	313.0	0.95	1.22	3.2	2.00	445	415	71.94	3.15
246	317.3	0.89	1.02	3.0	1.00	475	425	74.52	2.66
250	335.9	1.14	1.22	3.2	2.50	420	407	84.52	2.82
252	314.6	0.51	0.51	2.5	1.75	350	350	81.9	1.9
263	322.1	2.54	2.54	4.5	2.00	370	370	72.2	4.5
269	256.4	0.25	0.30	2.3	2.50	260	280	85.1	1.2
276.405	274.5	0.25	0.20	2.2	2.00	240	270	68.4	2.0
276.701	312.7	1.14	1.02	3.0	2.50	445	415	80.00	2.65
279	301.5	0.51	0.41	2.4	1.50	280	290	78.0	1.9
281	349.5	1.52	1.32	3.3	1.75	410	403	83.9	2.9
282	289.8	0.44	0.30	2.3	1.50	430	410	73.55	1.87
283	301.5	0.51	0.51	2.5	2.00	330	330	76.1	2.2
287	272.5	0.76	0.91	2.9	2.00	240	270	63.2	2.9
290	272.0	0.32	0.30	2.3	1.50	405	402	72.90	1.76
292	331.8	1.78	2.03	4.0	2.50	360	360	86.4	3.5
294	310.5	1.40	1.22	3.2	2.00	390	390	74.8	3.0
295	302.6	0.89	1.02	3.0	2.50	390	390	69.7	3.1

Table A3. (continued)									
ID	HCW, kg	BF, cm	ADJ. BF, cm	APYG, cm	KPH, %	Marbling Score	Quality Grade	LM, cm^2	Yield Grade
298	288.6	0.76	1.02	3.0	3.50	340	340	75.5	2.9
302	397.3	1.65	2.03	4.0	2.50	565	455	81.94	4.26
304.405	296.3	0.51	0.51	2.5	3.00	380	380	80.6	2.1
304.701	334.3	1.46	1.52	3.5	2.00	490	430	67.42	3.85
305	292.7	0.76	0.71	2.7	1.50	465	422	79.03	2.03
313	279.0	0.76	0.81	2.8	2.50	360	360	85.1	1.9
320	299.4	0.76	0.81	2.8	2.50	420	407	83.2	2.2
330	308.6	1.08	1.22	3.2	2.50	475	425	85.16	2.56
332	366.9	1.27	1.32	3.3	2.75	440	413	71.0	3.9
341	333.2	1.46	1.42	3.4	3.00	485	428	77.74	3.43
344	268.0	0.64	0.61	2.6	1.50	460	420	74.84	1.93
354	336.8	1.65	2.03	4.0	1.50	415	405	65.48	4.37
355.405	304.4	0.51	0.81	2.8	3.00	440	413	75.5	2.7
355.701	325.0	1.08	1.32	3.3	3.00	635	478	86.13	2.85
361	303.1	2.79	2.24	4.2	1.75	410	403	72.2	4.0
368	345.7	1.78	2.03	4.0	1.00	535	445	62.26	4.50
369	288.6	0.89	0.91	2.9	2.00	475	425	71.29	2.68
372	312.1	1.02	0.91	2.9	2.50	380	380	76.8	2.7
373.405	315.1	0.51	0.71	2.7	3.00	350	350	72.2	2.9
373.701	350.9	1.27	1.32	3.3	1.50	420	407	74.52	3.34
375	287.9	1.27	1.42	3.4	2.50	400	400	63.9	3.6
380	329.3	1.14	1.32	3.3	1.50	435	412	78.39	2.97
388	259.1	0.51	0.30	2.3	2.25	360	360	61.3	2.4
389	287.9	0.89	0.81	2.8	2.25	380	380	72.9	2.5
396	294.9	0.51	0.51	2.5	1.75	290	295	75.5	2.1
400	301.8	1.14	1.32	3.3	2.00	405	402	74.84	3.01
401	319.4	1.91	2.03	4.0	3.50	490	430	79.3	3.9
407	324.3	1.52	1.73	3.7	2.50	390	390	79.3	3.5
410	376.8	2.92	2.54	4.5	1.50	435	412	76.77	4.64
411	326.4	0.70	0.71	2.7	2.00	485	428	80.97	2.31
415	353.8	3.56	3.56	5.5	2.75	370	370	78.0	5.6
419	314.8	0.95	0.81	2.8	2.50	495	432	67.42	3.09
420	390.2	1.65	2.03	4.0	1.00	695	498	75.81	4.20
422	230.1	0.76	0.81	2.8	2.00	440	413	81.3	1.6
425.405	382.6	1.91	1.73	3.7	2.00	370	370	67.7	4.4
425.701	301.8	0.51	0.51	2.5	3.00	400	400	78.39	2.24
439	302.8	1.02	1.02	3.0	3.00	460	420	77.4	2.8
441	315.3	1.27	1.22	3.2	3.00	390	390	74.2	3.3
442	295.1	2.79	1.73	3.7	1.75	290	295	77.4	3.2
443	294.9	0.51	0.71	2.7	3.50	370	370	73.5	2.7

Table A3. (continued)									
ID	HCW, kg	BF, cm	ADJ. BF, cm	APYG, cm	KPH, %	Marbling Score	Quality Grade	LM, cm^2	Yield Grade
446	359.5	1.91	2.03	4.0	3.50	460	420	81.3	4.2
451	345.6	1.27	1.22	3.2	3.50	390	390	88.4	2.9
454.405	337.5	2.29	2.34	4.3	2.75	390	390	72.2	4.6
454.701	297.3	0.89	0.71	2.7	2.00	470	423	76.45	2.29
457	314.6	2.54	2.74	4.7	3.00	430	410	72.2	4.9
468	366.3	1.78	1.73	3.7	3.50	610	470	82.6	3.9
478	317.7	1.14	1.22	3.2	1.50	475	425	73.23	3.02
480	334.1	1.14	1.22	3.2	2.50	540	447	74.52	3.30
481	283.4	0.76	0.81	2.8	2.00	500	433	71.94	2.50
485	358.5	1.14	1.52	3.5	2.75	530	443	80.6	3.6
496	322.1	0.64	0.81	2.8	1.75	360	360	78.7	2.4
509	328.2	1.65	1.73	3.7	2.00	400	400	69.68	3.89
513	241.4	0.38	0.30	2.3	2.00	290	295	71.29	1.68
516	320.7	1.27	1.42	3.4	2.00	360	360	76.8	3.2
522	315.7	1.02	1.02	3.0	3.50	290	295	71.0	3.3
524	326.6	0.76	0.91	2.9	2.50	470	423	87.10	2.31
526	322.0	1.65	1.83	3.8	4.00	650	483	64.84	4.58
527	274.1	0.44	0.51	2.5	2.50	440	413	75.48	2.05
541	306.7	0.76	1.02	3.0	3.00	340	340	80.6	2.7
544	336.8	0.51	0.51	2.5	1.50	405	402	77.10	2.29
553	345.2	0.38	0.51	2.5	2.75	290	295	91.6	1.9
559	313.0	1.91	1.83	3.8	2.50	370	370	65.8	4.2
560	246.1	1.08	1.12	3.1	2.50	580	460	71.61	2.61
566	310.5	0.51	0.71	2.7	2.00	380	380	77.4	2.4
567	315.2	1.08	1.22	3.2	1.50	495	432	73.87	2.97
573	301.2	0.89	0.81	2.8	3.00	380	380	70.3	2.9
575	322.3	1.02	1.02	3.0	1.50	480	427	75.48	2.75
576	343.2	2.41	2.44	4.4	2.00	470	423	75.16	4.44
580	271.3	1.27	1.52	3.5	3.25	490	430	78.7	3.0
592	348.0	1.40	1.52	3.5	2.00	455	418	78.39	3.42
593	362.3	1.21	1.22	3.2	1.50	480	427	83.23	2.90
598	351.1	2.16	2.03	4.0	2.00	435	412	70.65	4.33
601	348.6	1.52	1.73	3.7	2.00	430	410	77.10	3.69
605	265.7	0.51	0.41	2.4	1.75	260	280	49.0	3.0
606	306.8	0.70	0.71	2.7	3.50	285	293	78.71	2.56
607	263.4	0.38	0.30	2.3	2.00	310	310	85.1	1.2
612	302.2	0.89	1.02	3.0	3.50	350	350	65.1	3.5
613.405	245.3	0.51	0.30	2.3	1.75	340	340	74.2	1.5
613.701	335.0	1.33	1.22	3.2	2.50	485	428	70.97	3.48
615	341.1	0.76	0.81	2.8	2.50	390	390	72.9	3.0

Table A3. (continued)									
ID	HCW, kg	BF, cm	ADJ. BF, cm	APYG, cm	KPH, %	Marbling Score	Quality Grade	LM, cm^2	Yield Grade
618	291.3	0.89	0.71	2.7	2.00	360	360	87.7	1.7
624	313.0	1.27	1.32	3.3	2.50	460	420	78.39	3.03
627	352.0	1.46	1.52	3.5	2.00	415	405	78.39	3.46
628	311.1	0.70	0.61	2.6	2.00	420	407	74.84	2.39
630	331.4	1.33	1.22	3.2	2.50	480	427	79.68	3.02
635	275.9	0.89	1.02	3.0	1.50	630	477	68.06	2.73
638	268.2	1.14	1.02	3.0	2.50	340	340	74.2	2.6
639	309.6	1.27	1.22	3.2	3.50	390	390	74.2	3.3
640	294.5	1.02	1.12	3.1	3.00	400	400	73.5	3.0
643	336.4	1.52	1.73	3.7	2.50	405	402	66.13	4.23
645	304.2	0.76	0.71	2.7	2.00	290	295	87.1	1.8
648	349.3	1.27	1.22	3.2	3.00	505	435	73.23	3.59
651	328.9	1.14	1.22	3.2	4.00	450	417	84.19	3.07
653	299.2	0.89	0.81	2.8	2.50	360	360	68.4	2.9
655	335.0	2.03	2.24	4.2	3.50	430	410	72.9	4.6
657	327.3	1.59	1.52	3.5	1.00	505	435	80.97	2.92
667	308.0	1.40	1.73	3.7	1.50	555	452	69.68	3.62
668	347.2	1.02	1.12	3.1	3.00	430	410	74.2	3.4
670	281.4	0.44	0.51	2.5	2.00	425	408	74.19	2.07
671	353.4	1.02	1.02	3.0	2.00	485	428	86.13	2.58
675	313.2	1.08	1.22	3.2	3.00	500	433	86.45	2.63
681	274.3	0.76	0.71	2.7	2.50	370	370	80.0	2.0
684	304.3	0.64	0.71	2.7	2.50	640	480	80.00	2.28
686	310.1	0.64	0.71	2.7	1.75	320	320	81.9	2.1
692	273.4	0.38	0.30	2.3	2.25	340	340	71.0	2.0
693	337.3	1.78	1.83	3.8	1.50	445	415	80.65	3.42
699	292.4	0.51	0.71	2.7	2.00	330	330	72.2	2.5
700	294.1	0.95	0.81	2.8	1.00	425	408	76.77	2.15
704	310.7	0.64	0.81	2.8	3.00	450	417	80.65	2.50
706	272.5	1.14	1.22	3.2	2.00	415	405	77.74	2.52
711	328.9	1.02	1.12	3.1	3.00	405	402	89.35	2.52
721	334.8	0.64	0.71	2.7	2.00	425	408	83.23	2.27
726	283.2	0.70	0.51	2.5	3.00	545	448	77.42	2.13
734	294.2	1.02	1.22	3.2	2.50	330	330	71.0	3.1
737	282.7	0.38	0.41	2.4	2.25	390	390	71.6	2.2
751	308.4	2.03	2.13	4.1	3.50	470	423	72.58	4.28
756	281.1	1.14	1.12	3.1	1.50	470	423	78.39	2.36
781	285.7	1.27	1.42	3.4	1.75	465	422	63.87	3.47
783	317.7	0.95	0.91	2.9	3.00	420	407	80.00	2.69
785	314.5	1.40	1.52	3.5	3.00	410	403	80.65	3.23

Table A3. (continued)

ID	HCW, kg	BF, cm	ADJ. BF, cm	APYG, cm	KPH, %	Marbling Score	Quality Grade	LM, cm^2	Yield Grade
786	355.5	1.21	1.52	3.5	3.50	575	458	87.10	3.35
793	280.5	0.89	0.91	2.9	2.00	455	418	75.81	2.38
795	277.7	1.02	1.12	3.1	2.00	350	350	73.5	2.7
800	321.1	1.40	1.52	3.5	2.75	700	500	80.97	3.22
804	291.1	0.64	0.71	2.7	2.00	340	340	69.0	2.6
807	308.2	1.02	1.12	3.1	2.50	550	450	77.74	2.82
826	349.1	2.35	2.24	4.2	3.50	490	430	79.35	4.38
828	339.3	1.02	1.02	3.0	2.00	460	420	75.81	2.98
836.405	321.2	1.91	1.83	3.8	3.00	360	360	71.6	4.0
836.701	294.8	0.32	0.41	2.4	1.50	390	390	78.39	1.78
839	321.4	0.76	0.71	2.7	2.00	380	380	74.8	2.6
840	333.0	1.02	0.91	2.9	3.00	280	290	83.9	2.6
841	342.3	0.76	0.81	2.8	2.50	490	430	89.03	2.25
850	282.2	1.40	1.42	3.4	3.00	320	320	60.6	3.9
856	351.4	0.64	0.61	2.6	2.00	485	428	82.58	2.34
866	363.6	1.52	1.52	3.5	2.00	470	423	71.94	3.87
868	296.6	0.38	0.30	2.3	1.75	465	422	74.19	1.95
870	304.8	1.14	1.22	3.2	3.00	290	295	71.29	3.31
871	251.4	0.38	0.41	2.4	2.00	280	290	71.6	1.9
873	310.9	0.64	0.51	2.5	2.00	435	412	80.65	2.00
875	332.7	0.83	0.81	2.8	2.00	415	405	71.94	2.91
878	368.9	0.95	0.81	2.8	1.50	465	422	82.26	2.60
885	300.3	1.14	1.02	3.0	2.75	370	370	76.1	2.8
886	306.7	1.02	1.12	3.1	2.50	370	370	79.3	2.7
887	313.5	0.76	0.71	2.7	2.25	360	360	74.8	2.6
888	282.0	0.89	0.81	2.8	2.00	340	340	72.9	2.4
889	296.9	0.64	0.71	2.7	2.50	280	290	72.9	2.6
901	284.9	0.76	0.91	2.9	2.75	330	330	71.0	2.8
902	339.1	1.52	1.32	3.3	2.50	400	400	80.0	3.2
903	286.5	0.51	0.71	2.7	2.50	380	380	73.5	2.5
906	322.7	2.16	2.03	4.0	1.50	425	408	66.13	4.22
907	338.2	1.40	1.63	3.6	3.00	480	427	75.81	3.77
924	337.5	1.14	1.32	3.3	2.00	450	417	75.48	3.28

Table A3. (continued)		
ID	SHEAR 1D, kg	SHEAR 14D, kg
5	3.10	3.83
16	2.13	1.94
20	3.96	2.18
55	2.49	1.72
61	2.66	2.82
65	2.03	1.99
69	2.13	2.24
72	2.11	1.84
85	2.32	1.91
87	2.73	2.16
90	3.04	2.13
97	1.92	1.86
98	1.98	1.95
99	2.71	2.00
105.405	2.23	2.54
105.701	4.39	4.19
108	2.55	1.62
109	1.86	1.70
110	2.96	2.98
112	2.14	1.59
114.405	2.35	1.82
114.701	2.60	1.84
119	2.77	1.90
121	3.33	1.61
124	3.19	2.10
127	3.15	2.25
133	3.15	1.76
136	3.56	1.86
138	2.78	2.18
150.405	1.95	1.90
150.701	1.98	2.01
152	3.36	2.06
153	2.76	1.88
158	2.25	1.89
160	2.35	2.02
164.405	2.12	1.83
164.701	2.87	2.60
168	2.95	2.17
170	2.69	2.51
171	2.69	1.85

Table A3. (continued)		
ID	SHEAR 1D, kg	SHEAR 14D, kg
172	3.04	2.40
173	1.86	1.70
179	3.10	1.87
180	1.74	1.96
183	1.63	2.19
184	2.99	2.19
194	2.38	1.76
195.405	2.08	1.59
195.701	3.68	2.58
196	1.84	2.03
197	2.37	2.04
198	2.84	1.98
206	2.18	2.23
209	2.19	1.94
211	2.68	2.63
213	2.53	1.85
217	3.06	2.12
220	2.11	1.79
225	2.06	1.92
231	3.09	2.33
232	1.86	1.75
242	1.94	1.78
243.405	1.84	1.76
243.701	2.79	2.82
246	1.73	1.90
250	2.56	2.84
252	2.60	1.83
263	.	2.24
269	1.80	1.71
276.405	.	.
276.701	2.57	2.86
279	3.58	1.66
281	2.81	2.26
282	3.99	2.50
283	2.83	1.77
287	3.15	2.12
290	3.43	.
292	2.28	2.04
294	2.80	1.77
295	2.71	2.02

Table A3. (continued)		
ID	SHEAR 1D, kg	SHEAR 14D, kg
298	3.08	3.07
302	2.47	2.00
304.405	2.76	1.80
304.701	1.85	1.76
305	2.67	1.59
313	2.35	1.74
320	2.15	1.99
330	2.44	2.04
332	2.89	1.81
341	2.64	2.01
344	2.41	1.76
354	2.39	2.40
355.405	2.03	2.01
355.701	2.19	2.38
361	2.39	1.99
368	.	.
369	3.87	2.65
372	3.73	2.76
373.405	2.24	2.49
373.701	3.21	1.99
375	2.42	2.25
380	2.24	2.03
388	1.34	1.40
389	3.07	2.23
396	2.02	1.75
400	2.30	2.13
401	2.14	2.11
407	2.56	2.50
410	2.92	2.67
411	2.34	2.16
415	2.38	2.24
419	2.25	2.22
420	1.78	1.57
422	2.32	2.25
425.405	3.40	2.35
425.701	3.13	2.10
439	.	1.59
441	2.90	2.84
442	2.20	1.55
443	2.30	2.11

Table A3. (continued)		
ID	SHEAR 1D, kg	SHEAR 14D, kg
446	1.83	2.22
451	2.51	2.37
454.405	2.33	1.80
454.701	3.21	1.96
457	4.68	2.41
468	1.70	2.16
478	3.42	2.30
480	1.79	1.77
481	1.92	1.92
485	2.86	2.26
496	2.33	2.35
509	3.21	1.87
513	4.82	2.16
516	2.38	1.97
522	2.54	2.84
524	2.63	2.11
526	2.31	1.65
527	2.74	1.79
541	2.67	1.47
544	2.46	2.01
553	2.90	2.89
559	2.39	1.95
560	4.52	3.36
566	2.89	2.26
567	1.73	1.32
573	2.33	2.15
575	3.63	2.29
576	2.58	1.96
580	2.73	2.38
592	.	1.96
593	2.83	1.87
598	2.48	2.73
601	2.80	2.45
605	2.48	1.79
606	3.4	3.06
607	2.73	1.61
612	2.27	2.06
613.405	2.05	2.20
613.701	5.00	3.32
615	2.60	2.99

Table A3. (continued)		
ID	SHEAR 1D, kg	SHEAR 14D, kg
618	2.09	2.13
624	2.40	1.84
627	2.74	1.56
628	3.69	1.93
630	3.60	2.92
635	2.22	2.28
638	4.02	1.51
639	2.45	1.83
640	1.95	1.74
643	2.12	1.90
645	4.18	2.14
648	2.84	2.41
651	2.26	2.21
653	2.37	1.58
655	2.19	1.97
657	2.60	2.52
667	1.80	1.84
668	2.28	2.22
670	3.91	3.12
671	4.47	3.35
675	3.00	2.29
681	2.23	1.84
684	4.42	3.46
686	2.56	1.84
692	3.70	2.14
693	2.16	2.57
699	2.29	2.85
700	3.25	1.99
704	2.24	2.73
706	2.40	1.78
711	3.72	2.06
721	3.07	2.16
726	2.16	2.56
734	3.62	2.92
737	3.35	2.13
751	3.16	2.23
756	1.84	1.83
781	2.36	2.08
783	3.09	2.18
785	3.10	.

Table A3. (continued)		
ID	SHEAR 1D, kg	SHEAR 14D, kg
786	2.43	2.03
793	4.74	3.02
795	3.03	1.63
800	2.08	2.12
804	2.64	2.07
807	3.13	2.12
826	3.10	2.13
828	2.59	2.03
836.405	1.86	1.95
836.701	3.73	2.53
839	2.32	1.72
840	2.35	1.85
841	2.85	2.11
850	2.97	1.92
856	2.70	2.33
866	2.27	1.97
868	3.23	2.14
870	2.28	2.55
871	2.83	1.96
873	4.18	3.22
875	2.94	2.02
878	2.10	1.53
885	2.82	2.68
886	2.25	2.41
887	1.96	1.63
888	3.08	1.72
889	2.12	2.63
901	2.60	3.46
902	.	1.59
903	3.08	2.03
906	1.93	2.02
907	3.41	2.69
924	1.90	1.71

VITA

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