EFFECT OF PHENOTYPIC CHARACTERISTICS AND PRECONDITIONING GAIN ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF BEEF CATTLE

By

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This thesis is dedicated to my parents, Hollis B. Savell Jr. and Marilyn I. Savell.
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In an attempt to quantify the effects of phenotypic characteristics and preconditioning performance on calf performance during preconditioning, in the feedlot, and on the rail, 1100 steers and 421 heifers from a commercial cow/calf operation in Florida were evaluated. All calves were preconditioned in North Central Florida. Possible predictors of subsequent performance such as weaning weight (WW), estimated Brahman percentage, condition score, sex, color, color pattern, and hair shedding characteristics were evaluated. In the first trial, preconditioning average daily gain (PCADG) decreased as WW increased. As estimated Brahman percentage increased, PCADG also increased. The PCADG of calves with a white hair coat was less than all other observed colors.

Evaluation of feedlot performance found that as WW increased, days on feed (DOF) decreased. Feed efficiency (FE) for steers and heifers improved as PCADG increased. Calves with greater PCADG were also fed for fewer DOF. Improvements in DOF and FE as PCADG increased resulted in a decrease in cost of gain (TCOG). Estimated Brahman percentage had no effect on feedlot performance. Average daily gain (ADG) decreased as condition score increased. Heifers had fewer DOF than steers, while steers had a lower TCOG. Red cattle had
lower ADG values, poorer FE, and higher TCOG than all other colors evaluated. Black cattle were on feed for fewer DOF than all other colors evaluated. White cattle had greater DOF than most other colors. Color pattern had no effect on any parameter measured during the feedlot phase. Non-shed cattle exhibited greater FE and were fed for fewer DOF than shed or partial shed cattle which resulted in a lower TCOG value.

As WW increased, hot carcass weight (HCW), yield grade (YG), and ribeye area (REA) increased, however, REA/100 kg declined. As PCADG increased, HCW increased. Calves that gained more weight during preconditioning had larger REA but smaller REA/100kg values. As estimated Brahman percentage increased HCW and quality grade (QG) decreased. Differences in condition score resulted in heavier HCW for slightly thin and average condition calves when compared to slightly fleshy calves. Slightly thin calves had lower REA/100kg than average condition and slightly fleshy calves. Steers had heavier HCW than heifers and reported smaller REA/100kg values than heifers. Black cattle had lighter HCW than yellow, grey, and white cattle. Black and grey cattle had better QG than red and yellow cattle. Red and yellow cattle had similar QG, while white cattle were intermediate to all other colors and similar. Black cattle had a greater YG and smaller REA than all other colors evaluated. Black cattle had smaller REA/100kg values than yellow and grey calves but were similar to red and white cattle. Color pattern had no significant affect on any of the carcass traits measured indicating that cattle perform similarly for carcass characteristics regardless of color pattern. Shedding characteristics had no significant affect on any of the carcass traits measured in this study.
CHAPTER 1
INTRODUCTION

Retained ownership and preconditioning are two terms that are heard quite frequently when talking with progressive cattlemen. Both of these practices provide an opportunity to capture a greater share of the market dollar. However, opportunities generally come with a certain amount of risk.

When retaining ownership of calves, many cattlemen have struggled with the fact that a small percentage of calves lose a large amount of money and theoretically rob the profit from the rest of the pen. Because of this phenomenon, a tremendous economic improvement can be made by eliminating poor performing calves from a group. Therefore, the objective of this study was to determine if cattle that lost money in the later production stages could have been identified during the preconditioning period. If identified, these calves could be managed differently in order to capture the greatest amount of revenue or at least minimize the loss. Additionally, losses were quantified to determine if they resulted from poor feedlot performance, sub-par carcass characteristics, or a combination of the two. By identifying poor performing calves early, producers would be able to make a more informed decision and hopefully increase the net return of the calf crop.

The preconditioning period is the first opportunity to evaluate a calf’s performance without the influence of the dam. In many cases, it is also the first time that calves are under intensive management and can be identified individually. The purpose of this study was to determine if easily measurable differences between individual calves at weaning could be used to predict that animal’s performance during the preconditioning period, in the feedlot, or on the rail.
CHAPTER 2
LITERATURE REVIEW

Preconditioning

**History of Preconditioning**

Preconditioning is a term used to describe preparation for a later process. In the cattle industry it refers to a number of processes that prepare calves for a latter phase of production. Providing a transition period between weaning and the feedlot is certainly not a new concept. In 1965 Dr. John Herrick first introduced the concept of preparing calves for the feedlot while still on the ranch of origin. In the last 40 years, volumes of research have been conducted to investigate the potential benefits and limitations of preconditioning calves, with mixed results. Economic evaluations of preconditioning have also yielded variable results. Due to the number of variables involved in predicting preconditioning profitability, and the subsequent uncertainty of return on investment, many producers have been reluctant to accept the practice. However, in recent years the demand for preconditioned calves by the feedlot segment has increased the willingness of producers to implement preconditioning programs. Today there are many programs that certify calves based on vaccination procedure and length of the preconditioning period in order to gain market premiums associated with preconditioned calves.

Preconditioning programs on the ranch typically include pre-weaning vaccination, castration, and dehorning (Pritchard and Mendez, 1990). Post-weaning preconditioning as defined by Cole (1985) includes another factor of importance, which is the nutrition of the freshly weaned calf. Nutritional aspects of preconditioning not only consider the nutrient requirements of the stressed calf, but also includes the acclimation of calves to dry feed, feed bunks, and water troughs.
During the preconditioning period calves may be started on a higher plane of nutrition than they were exposed to prior to weaning. Starting diets should be high quality and palatable in order to minimize bodyweight losses immediately after weaning. Starter diets should also be balanced in vitamin and mineral content to ensure optimal immune function. The palatability of the starter ration is of utmost importance to ensure that calves begin eating from bunks as soon as possible.

Economic return from a preconditioning program is primarily determined by the cost of gain during preconditioning and the magnitude of the premium associated with preconditioned calves. However, changes in the market and the weather can have an enormous effect on profitability, as well as increase the economic risk. Costs associated with preconditioning calves vary widely depending on the type of preconditioning program (Dhuyvetter et al., 2005). Lalman and Smith (2001) estimated 45 day preconditioning costs to range from $35 to $60 per head.

One of the greatest costs associated with preconditioning is generally the cost of feed inputs (Cole, 1985). Increasing the amount of supplementation will generally increase the cost of preconditioning. However, the additional gains associated with supplemented calves may prove more economical than grazing alone. For this reason, lower individual calf costs are generally associated with on the ranch preconditioning where calves are allowed to graze. High quality forages may serve as an economical way to precondition calves while still maintaining an adequate level of nutrition for the animal. Supplementation can be a more favorable means of preconditioning when considering the dependency on favorable weather conditions when utilizing forage only. Availability of cheaper byproduct feedstuffs may improve the profitability of the preconditioning program when calves are supplemented (Alkire and Thrift, 2005).
The amount of gain that can be attained during the preconditioning phase is largely due to the quality of available forage and the amount of supplementation. In many situations, gain is secondary to providing an adequate plane of nutrition and teaching cattle to eat from bunks. This is the case in many states that are located great distances from the typical cattle feeding states of the Midwest and Great Plains. In these areas, high rates of gain during the preconditioning period result in extra pounds of calf that must be shipped and therefore higher transportation costs. Furthermore, these pounds can generally be put on much more economically in the feedlot due to their closer proximity to feedstuffs and economies of scale.

**Purpose of Preconditioning**

One of the primary reasons for preconditioning calves is to reduce the stress associated with the weaning process and help calves transition into a new phase of production. The period of time following weaning is a very stressful period in a calf’s life (Hickey et al., 2003). Anxiety associated with removal from the cow, physical irritation of bawling, changes of water and feed, and fatigue from handling and walking the fence predisposes the calf to disease (Herrick 1969). Transportation and commingling can compound the stress on calves during this critical period.

One of the primary objectives of preconditioning is to reduce the incidence of respiratory disease in calves during the period of time between weaning and slaughter. This can be accomplished by increasing each calf’s immunity to organisms that cause bovine respiratory disease (BRD) and by reducing the stress on the calves before, during, and after shipment from the ranch of origin (Speer et al., 2001). Preconditioning also provides an opportunity for calves that do become sick to recuperate before being shipped a long distance to the feeding states and before entering the feedlot. Since the preconditioning period is generally short (14 to 60 days), it allows for intensive observation of calves for signs of morbidity, which helps to ensure that calves are treated sooner. Early detection and treatment of BRD can reduce medicine cost,
recovery time, and the spread of infectious disease. Preconditioning may also serve as a point at which unthrifty or chronically ill calves can be identified and culled without incurring the added costs associated with placement into the feedlot.

Previous vaccinations have a great impact on the success of a preconditioning program. Kreikemeier et al. (1997) showed that calves that were vaccinated prior to weaning responded to vaccination better than calves that were vaccinated after weaning. Calves that have not been properly vaccinated or developed a poor immune response to previous vaccinations may be immunized during the preconditioning period. Preconditioning may be the last chance to raise a calf’s level of immunity to BRD before entering the feedlot phase of production.

It is very important to reduce the stress level in freshly weaned calves. This will allow the calf’s immune system to function properly and reduce the incidence of BRD. It should also be noted that reducing the disease challenge is a very important part of preventing BRD. Reducing or eliminating commingling, and preconditioning calves on the ranch of origin, both reduce the probability that calves will be exposed to an infectious agent.

Bovine respiratory disease has been shown by researchers to be the leading cause of morbidity and mortality in the feedlot (Woolums et al. 2005; USDA, 2006). Snowder et al. (2006) stated that the economic loss associated with lower gains and treatment costs of BRD infected calves resulted in an average loss of revenue of $13.90 per head for the entire lot. However, this analysis did not include feed consumed by calves that died, labor and associated handling cost, or possible effects on carcass characteristics. Fulton et al. (2002) evaluated the losses associated with BRD correlated to the number of times the animal was treated. In a study of 417 head of cattle, individuals that were treated once for BRD returned $40.64 less than
untreated cattle. Cattle treated twice returned $58.35 less and those treated three times returned $291.93 less than their untreated contemporaries.

Establishing a good immune response to BRD before entering the feedlot has been shown to reduce the incidence of morbidity and mortality in the feedlot (McNeill, 2001). In a comprehensive review of preconditioning, Cole (1985) showed that preconditioning was an effective means of decreasing feedlot morbidity and mortality by approximately 6% and 0.7%, respectively.

Reductions in morbidity have also been shown to improve feedlot performance and carcass characteristics (McNeill, 2001). Cravey (1996) reported values for daily gain of 2.59 lbs/day and 2.88 lbs/day for non-preconditioned and preconditioned calves, respectively. Dry matter feed conversion was improved from 6.45 lbs of feed/lb of gain to 5.98 lbs of feed/lb of gain by preconditioning calves. These improvements in performance resulted in preconditioned calves being harvested at heavier weights with fewer days on feed. In a three year experiment by Pate and Crockett (1978), preconditioned calves exhibited a 6% increase in gain during the first year, and an 11% increase the second year. However, no significant differences were observed during the third year. There were also no differences in feed efficiency for any of the three years of the study. Pritchard and Mendez (1990) found no significant difference between average daily gain of preconditioned vs. non-preconditioned calves in a study that evaluated 600 Charolais sired calves from four ranches. The authors also noted poorer feed conversion for preconditioned calves compared to non-preconditioned calves (6.44 and 6.24 respectively), which they attributed to compensatory growth of non-preconditioned calves. The magnitude of improvement in feedlot performance of preconditioned calves is variable and may require further research.
Value of Preconditioning

Preconditioning status is one of the major drivers associated with premium calf prices (King et al. 2006) primarily due to improved health status of the calves. Buyers are willing to pay relatively large premiums for healthy calves (Minert et al. 1988). Premiums paid for calves that have been preconditioned have been reported to vary based on age, sex, weight, condition, lot size, season, and geographic region (Minert et al. 1988).

In an evaluation of 421,478 beef calves that were marketed by videotape auction in the summer of 2005, King et al. (2006) illustrated a $6.64/cwt premium for calves that qualified for the Vac-45 (vaccinated and weaned for 45 d) certified health program. Calves that qualified for the Vac-45 program were compared to similar calves that were not weaned and had not been vaccinated against respiratory tract viruses prior to shipment from the ranch of origin. Premiums associated with Vac-45 calves have consistently trended upward from $2.47/cwt in 1995. In a sensitivity analysis by Dhuyvetter et al. (2005) net return from preconditioning ranged from $1.88/head to $19.40/head. Estimated net return for preconditioned calves was $12.94/head when the premium for preconditioned calves was $4/cwt; this estimate represents a 22.7% return on investment.

In recent years, process and source verification programs have received a lot of attention within the industry as possible means to improve profitability. Process verification is one of the factors affecting calf performance that cattle buyers are willing to pay a premium for. Source verification has been shown to increase calf value as well. Source verification may indirectly result in improvements in performance when dealing with reputable producers. However, it is more commonly used to qualify cattle for marketing programs that pay premiums for source verified cattle at harvest. These programs were implemented to provide traceability for consumers that value that information and to help regain export markets.
Shrink Differences due to Preconditioning

Research has shown variation in transportation shrink between preconditioned and non-preconditioned calves. There are many benefits to reducing the amount of shrink when selling calves or when retaining ownership. Calves with lower shrink values are more likely to start eating after receiving and may also respond better to revaccination. Pritchard and Mendez (1990) found mixed results of preconditioning on transit shrink. In two trials that evaluated a total of 600 calves from four ranches, preconditioning reduced transit shrink in Experiment I, but caused greater shrink in Experiment II. The researchers noted that management, ranch, and management x ranch interactions accounted for more variation in shrink than preconditioning. This indicates that the manner in which calves are handled at the ranch may have a greater impact on shrink than preconditioning, even when preconditioning is capable of reducing shrink losses.

Factors Affecting Calf Value

Weight

Calf weight is one of the biggest drivers in determining the price paid per pound for calves. Price differentials between light weight calves and heavy feeder cattle is amplified in geographic regions that are not in close proximity to commercial cattle feeding operations. In general, there is a decrease in the price paid per pound as weight increases. However, the impact on price of an additional pound of weight decreases as weight increases (Sartwelle et al. 1996). Current market conditions associated with high feed costs have altered this relationship in recent years. Due to the fact that gains can typically be achieved more economically on grass than in the feedlot, placement weights have increased, and the price differential between weight classes of cattle have decreased.
Brahman Percentage

Effects of *Bos indicus* breeding on feedlot and carcass performance have been evaluated and debated for many years. It is well documented that calves that exhibit phenotypic evidence of *Bos indicus* influence are discounted in the marketplace (Minert et al. 1988). Physical traits associated with *Bos indicus* breeding, such as ear length, navel area, and hump height, can be easily recognized allowing discrimination. Whether real or perceived, there are several reasons for the discount associated with these calves. Some of the primary reasons that *Bos indicus* cattle are discounted are disposition, lower feedlot performance, lower carcass quality, and problems associated with meat tenderness. These issues have plagued producers who operate in environments that necessitate the use of *Bos indicus* genetics for years.

Disposition of *Bos indicus* influenced cattle has been questioned for years. In a trial conducted by Voisinet et al. (1997) cattle were assigned a temperament score based on individual animal reactions to confinement and isolation in a non-restraining single-animal scale crate. Crossbred cattle with 25% or greater Brahman breeding had a higher mean temperament rating (3.46) than *Bos taurus* cattle (1.80) on a scale of 1 to 5. The authors also noted that as temperament rating increased, ADG decreased with the exception of *Bos indicus* cross cattle with a temperament score of 1. Research conducted by Australian researchers (Hearnshaw and Morris, 1984; Fordyce et al. 1988) also showed an increase in temperament score for *Bos indicus x Bos taurus* crossbred cattle when compared to *Bos taurus* cattle.

Average daily gain (ADG) decreased as Brahman percentage increased in steers adjusted to a constant slaughter weight by Sherbeck et al. (1995). Values for ADG were 1.83, 1.64, and 1.53 kg for Hereford, 75% Hereford x 25% Brahman, and 50% Hereford x 50% Brahman, respectively. It should be noted that these cattle were fed in Colorado, which may favor *Bos taurus* cattle from an environmental standpoint. Research at the University of Florida conducted
by Peacock et al. (1982) to evaluate the additive genetic effects of breed and heterosis, determined that Brahman breed effects were negative for ADG. However, a later 2-yr study by Huffman et al. (1990) evaluated steers fed in Florida during the cool season and warm season. Results showed that ADG for 50% Brahman x 50% Angus and 75% Brahman x 25% Angus steers was significantly greater than Angus steers and numerically greater than 25% Brahman x 75% Angus steers. Differences in ADG were the result of increased dry matter intake (DMI) during the feeding period suggesting that Brahman influenced cattle will continue to eat when fed in hot climates. No differences in feed efficiency were observed.

Typical discounts for Brahman influenced calves have been reported by Sartwelle et al. (1996). Upper medium framed steers with less than 25% Brahman or more than 25% Brahman were discounted $1.65/cwt and $6.00/cwt, respectively when compared to similar framed Hereford steers.

Crouse et al. (1989) found that as the percentage of *Bos indicus* inheritance increased, marbling scores decreased, Warner-Bratzler shear (WBS) force values increased, and sensory panel tenderness scores decreased. *Bos indicus* breed crosses were also more variable in tenderness than *Bos taurus* breed crosses. Research conducted by Sherbeck et. al. (1996) found that taste panel tenderness ratings decreased and WBS force values increased as both phenotypic estimation of Brahman breed characteristics and hump height increased. However, neither live animal phenotype nor carcass hump height were correlated with marbling score.

Nevertheless, advantages in environmental adaptability to the humid sub-tropics of the Southern United States as well as increases in heterosis will continue to demand the used of *Bos indicus* genetics.
Condition Score

Condition scoring of feeder calves is a relatively new concept. However, cattle buyers have been using calf condition as a price determinant for years. Research conducted by Minert et al. (1988) showed that fleshy steers were discounted in the spring. However, fleshy steers brought a premium in the fall while thin steers were discounted. The authors noted that the difference may be due to the perception that fleshy steers will winter well, while thin steers may pose a potential health risk when placed on feed in the fall. There is certainly a market premium for healthy calves that exhibit less condition. Premiums are associated with the fact that these calves are considered to have greater efficiency of gain than calves that are already fleshy. Evaluating condition on feeder calves may be the best way to evaluate the previous nutritional history of the calf when that information is not provided. Calves of known genetics that have a documented health program and are thin due to limited availability of nutrients certainly have a great amount of potential in the feeding segment of the industry. However, care must be taken to ensure that these thin calves are in fact healthy.

In a trial by Trenkle et al. (2001) calves were sorted into two groups based on backfat measurement when started on feed. The authors realized that the calves that had less initial backfat were $25.47/hd more profitable in the feedlot than the fatter steers. Based on a $40/hd feedlot profit, the steers with more initial backfat should have been discounted about $5.00/cwt compared to the leaner steers.

Sex

Differences in performance between steers and heifers have been documented for many years. In a recent evaluation of 1,752 pens of heifers and 4,549 pens of steers, researchers at Kansas State University found differences between the profitability of steers and heifers was partially explained by differences in feed conversion and average daily gain (Williams et al.
Feed conversion accounted for 8.7 to 12.6 percent of the variation in profit while average daily gain accounted for 9.6 to 15.9 percent of the variation across different weight classes. The authors also acknowledged that the price paid for and received for steers and heifers accounted for more variation in profitability than actual performance.

Differences in the price paid for steers and heifers are well documented. Earlier research by Minert et al. (1988) determined that the discount for a 550 lb heifer was $6.71/cwt when compared to a steer of similar weight when both were marketed in the fall. However, the price differential between heifers and steers diminishes as weight increases. Heifers lighter than 550 lbs were discounted more than $6.71/cwt while heifers heavier than 550 lbs were discounted less. All weight classes still exhibited a significant price difference between heifers and steers in both fall and spring.

Increased risks associated with pregnancy and estrus activity are two of the reasons that heifers are discounted. Pregnant heifers typically exhibit lower levels of performance. Kreikemeier and Unruh (1993) discovered that 4.74% of feedlot heifers were pregnant at harvest. These heifers exhibited lighter carcass weights, greater fat thickness, higher carcass maturity scores, and increased quality grade. The authors noted that any advantage in quality grade was offset by increased backfat and lower dressing percentage. While still in the feedlot, the primary risk is associated with death as well as the increased incidence of dystocia, prolapse, and retained fetal membranes. These factors result in increased labor costs and may also require antibiotic treatment which may result in an extended withdrawal period. Economic losses due to increased activity of heifers in estrus and the risk of injury due to estrus behavior are also partially responsible for the price differential. These concessions may be prevented or reduced by
palpating heifers at receiving, feeding a progestin, or spaying. However, there are costs and risk associated with these practices as well.

It should also be noted that feeder heifers are typically those females that for some reason were not selected as replacement heifers. In some cases, the heifers that are heavier, more phenotypically correct, and have greater genetic potential are retained on the ranch while the lesser quality heifers are sold as feeders. This is not always the case because the heifers that are fed may have stronger growth and carcass characteristics while the heifers that are retained have been selected for maternal traits. Calf-crops that are terminally sired, where that entire group is fed and no replacements are kept, are obviously excluded from this concept.

**Coat Color**

Color, not breed, is a very important, if not the most important, arbiter of the premium in today’s cattle market (Cattle Fax, 1995). However, in a four year trial Loerch et al. (2001) found that hide color did not affect gains, final weights, or hot carcass weights. Cattle Fax (1995) has reported a premium for non-Angus black-hided calves of $1.93/cwt for steer calves of the same weight class.

**Color Pattern**

There is a limited amount of data regarding the performance of cattle based on color pattern. However, calves are discounted in the marketplace for having specific color patterns. Color pattern is a qualitative trait that can be easily recognized and therefore lends itself to discrimination. Methodology behind discounting cattle based on their body pattern is rooted in the fact that buyers believe that they can identify the presence of substandard genetics by evaluating body pattern. Spotted cattle may be discounted because of the perceived influence of Longhorn or Holstein genetics. Calves that exhibit brindle coat characteristics are assumed to have a high level of *Bos indicus* influence even if other phenotypic traits do not exhibit those
characteristics. Blue necked cattle are many times discounted because of the belief that they carry Andalusian type genetics. However, the genetics of coat color and pattern are much more complex.

**Hair Shedding Characteristics**

Characteristics of the coat have been shown to have a significant impact on heat tolerance and growth rate in cattle by Turner and Schleger (1960). Research relating coat characteristics of Angus and Hereford cattle to winter feedlot performance in Canada found that none of the hair coat characteristics evaluated were strongly associated with 168-d post-weaning gain (Gilbert and Bailey, 1991). This information leads to the assumption that characteristics of the coat have a greater effect on performance during periods of long term heat stress than long term cold stress. It may be easier for cattle to adapt to cold temperatures than hot temperatures.

**Age**

Differences in feedlot performance and carcass characteristics between calf-fed and yearling cattle are well known throughout the beef cattle industry. Research conducted by Schoonmaker et al. (2002) evaluated the differences in feedlot performance and carcass characteristics of calves placed in the feedlot at 111, 202, or 371 d of age. Results showed that ADG during the feedlot phase was greater for yearling cattle when compared to traditionally or early weaned calves (1.88, 1.68, and 1.62 kg/d, respectively). However, the early weaned calves were more efficient at converting feed to gain, followed by traditionally weaned calves which were significantly more efficient than yearlings (227, 208, and 180 g of gain/kg of feed, respectively). The authors also noted a difference in DOF (221, 190, and 163 d, respectively) and daily DMI (7.1, 8.1, and 10.5 kg/d, respectively) for calves weaned at 111, 202, or 371 d of age.
Technology Utilization to Improve Performance

Sorting

Marketing finished beef cattle based on carcass value rather than as a commodity will require cattle feeders to improve uniformity of cattle within loads in order to optimize the value of the cattle in a given grid (Trenkle, 2001). This sentiment has resounded throughout the beef cattle industry in the past few years. Many cattle feeders are now utilizing individual animal management practices to capture the maximum value from each calf. It is obvious that each calf cannot be harvested on the exact day that optimizes its profitability. However, sorting is a tool that allows cattle to be assembled into groups according to their optimal harvest date. Sorting does not need to pinpoint each animal’s profit optimum to result in economic gains. Increasing HCW and decreasing carcass discounts will improve profitability (Pyatt et al. 2005). Gresham et al. (2000) indicated that sorting feeder calves into uniform lots would result in an increased value of approximately $3.75 per carcass cwt.

Research of the ACCU-TRAC® Electronic Cattle Management System indicated an advantage of $23.69/hd for cattle managed to individual marketing dates rather than average marketing dates (Micro Beef, 2006). The ECM system combines multiple objective measurements such as weight, ultrasound for internal tissue characteristics, and video imaging of external dimensions to provide optimum individual animal management. This information along with growth and performance models utilizing the Cornell Net Carbohydrate and Protein System allow for accurate prediction of individual animal performance. Information gathered from the ECM is utilized to sort cattle into outcome groups by harvest date for optimal individual profitability. Cattle may also be sorted into different marketing groups based on ECM information.
**Electronic Identification**

Electronic identification (EID), or radio frequency identification (RFID), can been used to quickly and accurately capture individual animal information throughout the supply chain. Automated data capture and record keeping can be achieved using EID with the use of a database. Databases also facilitate the tracking and traceability functions that EID is valued for. Feedlots and packing plants have utilized EID technology for many years to accurately manage and identify individuals. Similar technology has been used in other industries as well, including automated toll payments, product tracking in libraries, and inventory systems for Wal-Mart. EID has received increased attention in the United States since Bovine Spongiform Encephalopathy (BSE) was discovered. Threat of foreign animal diseases, such as foot and mouth disease, have also spurred on the development of a national animal identification plan utilizing EID. Some countries have been using the same or similar technologies for years to facilitate individual animal tracking.

There are several different types of EID devices available to beef cattle producers. The more common EID devices are rumen boluses and ear tags. Utilization of subcutaneous microchips has been limited in food producing animals because devices placed under the skin may migrate through the animal and potentially contaminate the food supply. Removal of implanted microchips at harvest is an intricate and sometimes time consuming process. Conill et al. (2000) reported that 31.9% to 91.1% of injectable transponders were recovered from muscle tissue at harvest. Additionally, 8.9% to 23.4% were recovered on the internal side of the hide. Mean transponder recovery time for different implant locations ranged from 27 to 75 sec.

Rumen boluses and microchips have some limitations due to the fact that they cannot be seen with the naked eye in the live animal. Whether or not a transponder has been lost or has failed cannot be determined for these devices without surgical procedures. Rumen boluses have
been shown to have varied retention rates based on weight, volume, and specific gravity, however, retention rates of 100% were obtainable (Ghirardi et al. 2006). Research conducted by Antonini et al. (2006) showed that the mechanical actions of chewing and regurgitation may be altered by the application of ruminal transponders. However, there were no negative effects on milk production, reproductive traits, or bodyweight gain. Ruminal boluses also have a limitation because they cannot be easily extracted when the animal is harvested. Instances of cattle being implanted with multiple devices has also been observed in these technologies, especially in individuals that frequently change ownership. For these reasons, electronic ear tags have become the preferred choice for cattlemen in the United States.

Utilization of EID ear tags has been seen in the beef industry for years as a means of identifying cattle both in the feedlot and on the rail. Use of EID has allowed feedlots to manage cattle on an individual basis and facilitated changes in the marketing of fed cattle from a live basis to an individual carcass basis. The EID ear tags are easy to apply and easy to read. Furthermore, many ear tags have the individual animal identification number printed on the tag in case of tag failure or instances where a reader is not available. Retention rates for EID ear tags have been acceptable and exceed retention rates of traditional ear tags.

All EID transponders marketed in the United States must meet International Organization for Standardization (ISO) standards 11784 and 11785 which utilize the low frequency 134.2 kHz band. Most of the tags on the market today are a passive tag, which means that they do not contain their own power source. Electrical current induced in the antenna from the reading device provides power for the transponder to transmit a response. Unique identification numbers are hard coded into the chip as part of the manufacturing process and cannot be altered, which provides a high level of authenticity.
Within the realm of low frequency EID transponders there are half-duplex (HDX) and full-duplex (FDX) technologies. Differences between these technologies are that FDX transponders send a continuous return signal as long as the interrogation signal from the reader is maintained. Transponders utilizing HDX technology send a return signal at the end of the interrogation signal which allows the storage capacitor to become fully charged emitting a stronger return signal with a longer read range. It should be noted that HDX transponders are somewhat more expensive.

There are many different types of EID readers available to producers. Readers are responsible for sending the interrogation signal to the transponder. Simple models are hand held with no memory capability and simply read and display the EID number. More complex readers consist of several integrated panels that read simultaneously in multiple adjacent lanes so that cattle can be moved at the speed of commerce. Read ranges typically span from inches in the simple models for chute side application in restrained animals, up to 3 ft in the more complex multi-lane systems that are capable of handling cattle at virtually any speed. One limitation to the reading system is that cattle must pass the reader in single file to ensure that two animals do not enter the signal field at the same time. This is the reason for multiple lane systems in areas of high cattle volume.

Tethered and cordless reader models are available. Tethered models download information as it is received while cordless models are capable of storing and downloading data at a later time. Some cordless readers have Bluetooth capability which allows for real time data transfer without a cord.
CHAPTER 3
THE EFFECT OF PHENOTYPIC CHARACTERISTICS ON PRECONDITIONING PERFORMANCE

Introduction

It has been demonstrated by Minert et al. (1988) that individual animal characteristics such as sex, Brahman percentage, and condition score have an effect on the price received for calves. Reasons for price differentiation due to these characteristics are based on the belief that these characteristics affect animal performance. However, the effects of these economically important characteristics have not been extensively evaluated during the preconditioning period.

Qualitative characteristics such as coat color, color pattern, and hair shedding characteristics are commonly used as an indicator of animal performance as well. Across the country, calves receive discounts or premiums based on the characteristics of their hair coat. Many producers believe that these characteristics are solely used to discriminate against certain types of cattle. Nevertheless, many cattle buyers, stocker operators, feedlot operators, and packers stand behind the claim that these qualitative characteristics have an impact on subsequent performance.

The objective of this experiment was to evaluate the effects of weaning weight, estimated Brahman percentage, condition score, sex, coat color, color pattern, and hair shedding characteristics on average daily gain during the preconditioning period.

Materials and Methods

Cow/calf pairs were gathered off pasture in the morning from a large commercial cow/calf operation in South Florida. Steers (n=1,575) and heifers (n=1,550) were separated from their dams and shipped approximately 370 km to a preconditioning facility in North Central Florida. Calving season was between October 10, 2003 and February 10, 2004. All calves originated
from the same ranch and had been exposed to similar pre-weaning management practices that
included knife castration, dehorning, and vaccination at approximately 2 to 4 months of age.

All calves were vaccinated on the ranch of origin with Cattlemaster 4® and Ultraback 8®.
Heifers were calf-hood vaccinated against Brucella abortus. An injectable dewormer
(Dectomax®) and a topical fly control (Saber®) were also administered, and calves were
implanted with Ralgo®.

Calves were received at the preconditioning facility in nine shipments across a 15-d period
beginning on July 27th, 2004 and ending on August 10th, 2004. Approximately 350 calves were
received in each shipment. Calves were shipped from the ranch between 0900 and 1200 and
arrived at the preconditioning yard between 1200 and 1700. Upon arrival, calves were offered
hay and water ad libitum. Hay consumption was rarely noted between arrival and processing.

Immediately prior to processing, calves were sorted into groups based on sex and weight
class. Sex classes were feeder steer, feeder heifer, and replacement heifer. Weight classes of
small, medium, and large were also determined. Processing began between 1730 and 1830 each
evening and continued until the entire shipment was processed. Calves were processed at an
average rate of 89 hd/hr.

During processing calves were vaccinated using a modified live vaccine for IBR, BVD,
PI3, and BRSV (Bovi-Shield GOLD®) for respiratory disease, a bacterin toxoid (ONE SHOT®)
to prevent bovine pneumonic pasteurellosis, and an 8-way clostridial vaccine (Ultra Choice™ 8).
An injectable avermectin anthelmentic including clorsulon for treatment of liver flukes (Ivomec®
Plus) was administered according to weight class. Calves also received a vitamin B complex
injection and were mass medicated with Tilmicosin (Micotil® 300) according to label directions.
Calves were treated topically with lambdacyhalothrin (Saber™) to suppress horn flies and lice.
Color coded ear tags containing the lot and individual animal number were applied in the right ear and a low-frequency half duplex electronic identification (EID) unit was placed in the left ear. Calves were also branded with a fire brand on the left hip for ownership identification. Average processing cost was $14.76/hd, not including labor.

During processing each animal was evaluated by two evaluators who classified each animal on the phenotypic evidence of Brahman percentage, condition score, color, color pattern, and hair shedding characteristics.

Estimated Brahman percentage was categorized similarly to that of Sherbeck et al. (1996). Brahman percentage was estimated to be 0, 1/8, 1/4, or 3/8 Brahman influence. Phenotypic evaluations of Brahman percentage were made based on the visual appearance of the underline and size of the hump. Length, shape, and orientation of the ear were also used to estimate Brahman percentage. Actual Brahman percentage of individual animals was unknown. However, evaluators were aware of the calf’s sire breed and dam type.

Condition scores were based on similar scoring done by Grona et al. (2002), and were assigned using a 9-point scoring system and categorized as extremely thin, thin, moderately thin, slightly thin, average, slightly fleshy, moderately fleshy, fleshy, and extremely fleshy (USDA, 1995). Extremes in condition score were not observed. Only two calves were classified less than slightly thin and none were classified greater than slightly fleshy. Therefore, only slightly thin, average, and slightly fleshy categories were evaluated.

Color was based on the predominant color of the animal similar to Loerch et al. (2001) and categorized as black, red, yellow, grey, or white. Color pattern was established as either solid patterned or non-solid patterned. Non-solid color patterned calves included spotted, roan, or brindle color patterns. Spotted calves were categorized only when white markings extended
behind the point of the shoulder or above the flank. White-faced, Hereford type calves were considered solid patterned. Hair shedding characteristics were classified as shed, partially shed, or non-shed (Thrift et al., 1994).

During processing 0.4% of calves were castrated. No designation was made between these calves and calves that were castrated on the ranch in the subsequent evaluation. Horns were tipped on 1.0% of the calves evaluated.

Calves were individually weighed automatically by a Digistar® digital scale with load cells underneath the processing chute. This weight was considered to be a shrunk weight and was designated as weaning weight (WW). Scales were calibrated and set to weigh calves in 2.25 kg increments. Calves’ EID numbers were captured using an Allfex® RS250 Series Stick Reader. Weights and EID were automatically downloaded into a Microsoft Office Excel® spreadsheet using WinWedge® RS232 Data Acquisition Software for Windows®.

After processing calves were placed in 2.02 ha pastures by sex and weight class for weaning and environmental acclimation. Water in these pastures was treated with amprolium (Corid®) according to label dosage to reduce the incidence of coccidiosis. After 5 d calves were moved to 8.09 ha pastures and rotated among pastures as forage availability dictated for the duration of the preconditioning program. Calves were fed a low concentrate starter ration containing monensin sodium (Rumensin®) and tylosin tartrate (Tylan®) with a target dry matter intake of 3% of live bodyweight. Calves were fed in the morning in metal bunks allowing 20 cm of bunk space per animal, and typically reached target consumption by d14.

Calves that showed signs of respiratory disease were treated in the pasture with ceftiofur sodium (Naxcel®) according to label directions using Ballistivet® technology. Calves that had to be treated more than twice were given enrofloxacin (Baytril®) according to label directions and
drenched with amprolium (Corid®). Death loss during preconditioning was 0.6%, and 0.4% were sold as realizers before shipping to the feedlot. Morbidity during preconditioning ranged from 2.1% to 9.5% depending on lot and averaged 5.0% across lots.

At the end of the preconditioning period, calves were gathered in the morning, group weighed, and loaded onto trucks. Duration of the preconditioning period ranged from 34-d to 51-d with a mean number of days preconditioned equal to 42.9-d. Heifers selected as replacements were shipped back to the ranch of origin. Feeder calves in the small weight class were shipped to a stocker operation before entering the feedlot. Feeder calves in the medium weight class were shipped to a feedlot where data on individual animals was not collected. Therefore, the previously mentioned calves were not utilized in further analysis. Only feeder steers (n = 1,100) and feeder heifers (n = 421) in the large weight class were analyzed in this study.

Calves were shipped 2,365 km to a feedlot in western Kansas that utilized the Micro Beef Technologies ACCU-TRAC® Electronic Cattle Management (ECM) system. Four shipments of calves were delivered over a 5-d period. An average of 313 calves were shipped in each group. Upon arrival in Kansas, calves were rested for 24-h and offered hay and water ad libitum. Calves were shipped to the feedlot by sex and weight class, therefore, no sorting was done upon arrival in the feedlot. At the initial feedlot processing, the calf’s individual EID number was recorded. Existing ear tags from preconditioning were recorded as a secondary means of identification and then removed. New color coded ear tags with the feedlot lot and individual number were applied. Calves were weighed individually at initial feedlot processing. This weight plus 6% shrink was considered the ending weight of the preconditioning phase and was used to calculate preconditioning gain.
Data were analyzed using the GLM least squares analysis of variance procedures of SAS (2003). The model included the main effects of weaning weight, estimated Brahman percentage, condition score, sex, color, color pattern, and hair shedding characteristics. All two-way interactions found to be significant at \( P<0.10 \) for a particular variable were included in the model for that variable. Linear regression analysis was performed on all continuous variables.

**Results and Discussion**

**Weaning Weight**

Preconditioning average daily gain (PCADG) was affected (\( P<0.0001 \)) by WW (Figure 3-1). Calves that had heavier WW had decreased PCADG compared to calves that were lighter at weaning. Linear regression analysis revealed that PCADG decreased by 0.45 kg/d for each additional 100 kg of WW. Calves with greater WW are typically believed to be heavier due to greater gain potential (Woodward et al., 1959). However, increases in WW have been shown to be due to differences in age (Pell and Thayne, 1978; Minyard and Dinkle, 1965), which could exceed 120 d in this trial. Maternal effects, such as milk production may also influence WW (Christian et al., 1965) without affecting PCADG. Heavier calves may be fatter which could help explain the negative impact on PCADG (Christian et al., 1965).

**Brahman Percentage**

As estimated Brahman percentage increased, an increase (\( P<0.01 \)) in PCADG was observed (Figure 3-2). Calves estimated to be 3/8 Brahman had greater (\( P<0.005 \)) PCADG than both 1/8 and 1/4 Brahman cattle. However, calves that were estimated to have 0 Brahman percentage had intermediate PCADG values that were similar (\( P=0.27 \)) to all other levels of Brahman. Linear regression analysis indicated that PCADG increased (\( P<0.05 \)) by 0.03 kg/d as estimated Brahman percentage increased by 1/8. Differences in PCADG resulted in an extra 3.1
kg of live weight gain for 3/8 Brahman calves when compared to 0 Brahman calves during the preconditioning period.  

Differences in PCADG due to Brahman percentage are logical for calves that are preconditioned in Florida during the summer months. Huffman et al. (1990) suggests that Brahman influenced cattle consume more feed than Bos taurus cattle when fed in hot climates. The authors suggested that increased dry matter intake during the feeding period resulted in greater ADG for Brahman influenced cattle. Heat stress plays an important role in the ability of cattle to gain weight in tropical and sub-tropical environments. Warwick reported on the effect of heat stress on bodyweight gain as early as 1958. Alkire and Thrift (2005) showed an increase in PCADG for calves that exhibit greater than 20% Bos indicus breeding that they attributed to heat tolerance and heterosis differences.

**Condition Score**

There was a tendency (P=0.07) for PCADG to decline as condition score increased (Figure 3-3). Calves that were categorized as slightly thin had PCADG of 0.43 kg/d. Whereas average condition calves had PCADG that was 0.03 kg/d less than slightly thin calves and 0.06 kg/d greater than slightly fleshy calves. Further analysis revealed a decrease (P<0.05) in PCADG of 0.04 kg/d for each unit increase in condition score. Trenkle (2001) found that performance differences between feeder calves sorted by ultrasound backfat resulted in a theoretical $5/100 lbs of bodyweight discount for fatter steers. He also showed that calves with less backfat tended to have greater bodyweight gain than calves with more backfat.

**Sex**

Steers and heifers had similar (P=0.66) PCADG (Figure 3-4). Savell et al. (2007) found no differences in 42-d PCADG between steers and heifers. However, Alkire and Thrift (2005) observed a tendency for steers to have greater PCADG than heifers in a similar 42-d trial (0.67
and 0.59 kg/d, respectively). Both of these experiments were conducted using the entire calf crop including replacement females.

Differences in feedlot average daily gain (ADG) between steers and heifers have been reported by Williams et al. (1993). However, Marion et al. (1980) reported similar feedlot ADG values for steers and heifers. Previous research supports the fact that differences do exist in certain situations. However, the complexity of the preconditioning period, coupled with a short time interval, reduced the effect of sex on gain performance in this study.

Differences observed in the literature may be explained by the fact that feeder heifers are typically those females that for some reason were not selected as replacement heifers. In some cases, the heifers that are heavier, more phenotypically correct, and have greater genetic potential are retained on the ranch while the lesser quality heifers are sold as feeders. This is not always the case because the heifers that are fed may have stronger growth and carcass characteristics while the heifers that are retained have been selected for maternal traits. Calf-crops that are terminally sired, where the entire group is fed and no replacements are kept, are obviously excluded from this concept.

Coat Color

Calf coat color affected PCADG (P<0.005, Figure 3-5). The PCADG of calves with a white hair coat was 0.18 kg/d less (P<0.05) compared to calves of all other observed colors. Black, red, yellow, and grey coated calves had similar (P>0.10) PCADG. It is worth mentioning that the white calves were predominantly straight bred continental type calves with a heavy influence of Charolais genetics. These calves may lack the environmental adaptability and heterosis benefits of their crossbred contemporaries.

Coat color is a trait that has received significant attention recently in the beef industry. Generally, black cattle receive a premium based on the perceived influence of Angus genetics.
In a comprehensive survey by Cattle Fax (1995) a $1.93/cwt premium for black hided steers was reported. Results of the current study would suggest that performance during the preconditioning period was affected minimally by coat color.

It should be noted that in this study it was not possible to evaluate color differences on cattle of similar genetic composition. In other words, coat color is a function of the breed or breed crosses represented in each animal. Since the breed of dam was not known for any of these calves, it was not possible to stratify by breed type. Results presented as effects of color should be interpreted as including the possible effects of the breed or breed combinations that may potentially produce those colors.

**Color Pattern**

Color pattern (Figure 3-6) had no impact on PCADG of calves in this trial (P=0.31). Calves that are spotted, roan, or brindle are typically discounted in the marketplace due to the perception that these cattle may contain inferior genetics. This study suggests that color pattern has no negative effect on PCADG for calves that have been managed similarly.

**Coat Shedding Characteristics**

Coat shedding characteristics did not affect PCADG (P=0.25, Figure 3-7). However, calves that were still carrying a heavy coat and had not initiated hair shedding had PCADG that was numerically 0.09 kg/d less than calves that were partially or completely shed. Decreased PCADG in non-shed calves may be a result of increased heat stress associated with the heavy hair coat. Non-shed coats may result in an inability to effectively dissipate the increased heat increment associated with the preconditioning diet and subsequent increased growth rate. Differences in characteristics of the coat have been shown by Turner and Schleger (1960) to cause significant differences in heat tolerance and growth rate.
Implications

Calves are routinely assigned a discount or premium based on Brahman influence, body condition, sex, color, color pattern, and hair shedding characteristics. When preconditioning calves for a short time period in hot climates, our data suggests that increasing Brahman influence up to 3/8 improved performance. Increases in body condition score negatively affected PCADG, whereas sex class had no effect on PCADG. Characteristics of the coat such as color, color pattern, and shedding characteristics had a minimal effect on preconditioning performance.
Figure 3-1. Effect of weaning weight on preconditioning average daily gain. Linear regression slope=-0.0045, P<0.001.

Figure 3-2. Effect of estimated Brahman percentage on preconditioning average daily gain. Main effect P<0.01. a,b Means with different superscripts differ P<0.05. Linear regression slope=0.07, P<0.05.
Figure 3-3. Effect of condition score on preconditioning average daily gain. Main effect P=0.07. a,b Means with different superscripts differ P<0.10. Linear regression slope=-0.09, P<0.05.

Figure 3-4. Effect of sex on preconditioning average daily gain. P=0.66.
Figure 3-5. Effect of coat color on preconditioning average daily gain. P<0.001. \(^{a,b}\) Means with different superscripts differ P<0.05.

Figure 3-6. Effect of color pattern on preconditioning average daily gain. P=0.31.
Figure 3-7. Effect of hair shedding characteristics on preconditioning average daily gain. P=0.25.
CHAPTER 4
THE EFFECT OF PHENOTYPIC CHARACTERISTICS AND PRECONDITIONING PERFORMANCE ON FEEDLOT PERFORMANCE

Introduction

In many cases the preconditioning period is the first opportunity to evaluate the performance of calves on an individual basis without the masking effects of their dam. This is also a time where calves are subjected to identical treatments and each has the same opportunity to perform. For these reasons the preconditioning period provides an opportunity to evaluate calves under similar management before entering the feedlot. There are many factors that effect preconditioning performance that may or may not be associated with feedlot performance.

It has been demonstrated by Minert et al. (1988) that individual animal characteristics such as sex, Brahman percentage, and condition score have an effect on the price received for calves. Reasons for price differentiation due to these characteristics are based on the belief that these characteristics affect animal performance. However, the effects of these economically important characteristics have not been extensively evaluated during the preconditioning period.

Qualitative characteristics such as coat color, body pattern, and hair shedding characteristics are commonly used as an indicator of animal performance as well. Across the country, calves receive discounts or premiums based on the characteristics of their hair coat. Many producers believe that these characteristics are solely used to discriminate against certain types of cattle. Nevertheless, many cattle buyers, stocker operators, feedlot operators, and packers stand behind the claim that these qualitative characteristics have an impact on subsequent performance.

The objective of this experiment was to evaluate the effects of weaning weight, estimated Brahman percentage, condition score, sex, coat color, color pattern, and hair shedding
characteristics on subsequent feedlot performance. In addition, this study evaluated the effect of
daily gain during the preconditioning period on feedlot performance.

**Materials and Methods**

Cow/calf pairs were gathered off pasture in the morning from a large commercial cow/calf
operation in South Florida. Steers (n=1,575) and heifers (n=1,550) were separated from their
dams and shipped approximately 370 km to a preconditioning facility in North Central Florida.
Calving season was between October 10, 2003 and February 10, 2004. All calves originated
from the same ranch and had been exposed to similar pre-weaning management practices that
included knife castration, dehorning, and vaccination at approximately 2 to 4 months of age. All
calves were vaccinated on the ranch of origin with Cattlemaster 4® and Ultraback 8®. Heifers
were calf-hood vaccinated against Brucella abortus. An injectable dewormer (Dectomax®) and a
topical fly control (Saber®) were also administered, and calves were implanted with Ralgo.®

Calves were received at the preconditioning facility in nine shipments across a 15-d period
beginning on July 27th, 2004 and ending on August 10th, 2004. Approximately 350 calves were
received in each shipment. Calves were shipped from the ranch between 0900 and 1200 and
arrived at the preconditioning yard between 1200 and 1700. Upon arrival, calves were offered
hay and water ad libitum. Hay consumption was rarely noted between arrival and processing.

Immediately prior to processing, calves were sorted into groups based on sex and weight
class. Sex classes were feeder steer, feeder heifer, and replacement heifer. Weight classes of
small, medium, and large were also determined. Processing began between 1730 and 1830 each
evening and continued until the entire shipment was processed. Calves were processed at an
average rate of 89 hd/hr.

During processing calves were vaccinated using a modified live vaccine for IBR, BVD,
PI3, and BRSV (Bovi-Shield GOLD®) for respiratory disease, a bacterin toxoid (ONE SHOT®)
to prevent bovine pneumonic pasteurellosis, and an 8-way clostridial vaccine (Ultra Choice™ 8).
An injectable avermectin anthelmentic including clorsulon for treatment of liver flukes (Ivomec®
Plus) was administered according to weight class. Calves also received a vitamin B complex
injection and were mass medicated with Tilmicosin (Micotil® 300) according to label directions.
Calves were treated topically with lambdacyhalothrin (Saber™) to suppress horn flies and lice.
Color coded ear tags containing the lot and individual animal number were applied in the right
ear and a low-frequency half duplex electronic identification (EID) unit was placed in the left
ear. Calves were also branded with a fire brand on the left hip for ownership identification.
Average processing cost was $14.76/hd, not including labor.

During processing each animal was evaluated by two evaluators who classified each
animal on the phenotypic evidence of Brahman percentage, condition score, color, color pattern,
and hair shedding characteristics.

Estimated Brahman percentage was categorized similarly to that of Sherbeck et al. (1996).
Brahman percentage was estimated to be 0, 1/8, 1/4, or 3/8 Brahman influence. Phenotypic
evaluations of Brahman percentage were made based on the visual appearance of the underline
and size of the hump. Length, shape, and orientation of the ear were also used to estimate
Brahman percentage. Actual Brahman percentage of individual animals was unknown.
However, evaluators were aware of the calf’s sire breed and dam type.

Condition scores were based on similar scoring done by Grona et al. (2002), and were
assigned using a 9-point scoring system and categorized as extremely thin, thin, moderately thin,
slightly thin, average, slightly fleshy, moderately fleshy, fleshy, and extremely fleshy (USDA,
1995). Extremes in condition score were not observed. Only two calves were classified less
than slightly thin and none were classified greater than slightly fleshy. Therefore, only slightly thin, average, and slightly fleshy categories were evaluated.

Color was based on the predominant color of the animal similar to Loerch et al. (2001) and categorized as black, red, yellow, grey, or white. Color pattern was established as either solid patterned or non-solid patterned. Non-solid color patterned calves included spotted, roan, or brindle color patterns. Spotted calves were categorized only when white markings extended behind the point of the shoulder or above the flank. White-faced, Hereford type calves were considered solid patterned. Hair shedding characteristics were based on previous work done by Thrift et al (1994) and were classified as shed, partially shed, or non-shed.

Calves were individually weighed automatically by a Digistar® digital scale with load cells underneath the processing chute. This weight was considered to be a shrunk weight and was designated as weaning weight (WW). Scales were calibrated and set to weigh calves in 2.25 kg increments. Calves’ EID numbers were captured using an Allfex® RS250 Series Stick Reader. Weights and EID were automatically downloaded into a Microsoft Office Excel® spreadsheet using WinWedge® RS232 Data Acquisition Software for Windows®.

After processing calves were turned out in 2.02 ha pastures by sex and weight class for weaning and environmental acclimation. Water in these pastures was treated with amprolium (Corid®) according to label dosage to reduce the incidence of coccidiosis. After 5 d calves were moved to 8.09 ha pastures and rotated across pastures as forage availability dictated for the duration of the preconditioning program. Calves were fed a low concentrate starter ration containing monensin sodium (Rumensin®) and tylosin tartrate (Tylan®) with a target dry matter intake set at 3% of live bodyweight (Table 1, Appendix). Calves were fed in the morning in
metal bunks allowing 20 cm of bunk space per animal, and typically reached target consumption by d14.

Calves that showed signs of respiratory disease were treated in the pasture with ceftiofur sodium (Naxcel®) according to label directions using Ballistivet® technology. Calves that had to be treated more than twice were given enrofloxacin (Baytril®) according to label directions and drenched with amprolium (Corid®). Death loss during preconditioning was 0.6%, and 0.4% were sold as realizers before shipping to the feedlot. Morbidity during preconditioning ranged from 2.1% to 9.5% depending on lot and averaged 5.0% across lots.

At the end of the preconditioning period, calves were gathered in the morning, group weighed, and loaded onto trucks. Duration of the preconditioning period ranged from 34-d to 51-d with a mean number of days preconditioned equal to 42.9-d. Heifers selected as replacements were shipped back to the ranch of origin. Feeder calves in the small weight class were shipped to a stocker operation before entering the feedlot. Feeder calves in the medium weight class were shipped to a feedlot where data on individual animals was not collected. Therefore, the previously mentioned calves were not utilized in further analysis of feedlot and carcass performance. Large weight class feeder calves were fed in a Western Kansas feedlot that utilizes the Micro Beef Technologies ACCU-TRAC® Electronic Cattle Management (ECM) system. Only feeder steers (n=1,100) and feeder heifers (n=421) in the large weight class were analyzed in this study.

Calves were shipped 2,365 km to the feedlot in western Kansas. Four shipments of calves were delivered over a 5-d period. An average of 313 calves were shipped in each group. Upon arrival in Kansas, calves were rested for 24-h and offered hay and water ad libitum. Calves were
shipped to the feedlot by sex and weight class, therefore, no sorting was done upon arrival in the feedlot.

Cattle were managed individually utilizing the Micro Beef Technologies ACCU-TRAC® ECM system. The ECM system combines multiple objective measurements including bodyweight, ultrasound for internal tissue characteristics, and video imaging of external dimensions to provide optimum individual animal management. This information along with growth and performance models utilizing the Cornell Net Carbohydrate and Protein System allow for accurate prediction of individual animal performance. Information gathered from the ECM was utilized to sort cattle into marketing groups by harvest date for optimal individual profitability.

At the initial feedlot processing, the calf’s individual EID number was recorded. Existing ear tags from preconditioning were recorded as a secondary means of identification and then removed. New color coded ear tags with the feedlot lot and individual number were then applied. Calves were weighed individually at initial feedlot processing. This weight plus 6% shrink was considered the ending bodyweight of the preconditioning phase and the initial weight of the feedlot phase of production. Feedlot arrival bodyweight was used to calculate preconditioning average daily gain (PCADG) and feedlot average daily gain (ADG).

After processing, calves were moved to their home pen and started on feed. Calves were fed a starter ration and moved up on feed according to feed intake and health status. The starter ration composition and analysis is presented in Table 1, Appendix. Once calves were consuming 2.5% of bodyweight on a dry matter basis and no apparent health concerns were present, they were transitioned to the finishing ration. This transition occurred with the replacement of 5% of
the starter ration with the finishing ration each day until calves were consuming 100% of the finishing ration. Finishing ration composition and analysis is presented in Table 1, Appendix.

Sixty days after arrival, calves were processed through the ECM system again. Data were collected through ECM every 60-d until harvest. Cattle were sorted at d120 +/-3 days and again at d180, and d240. All cattle were marketed by 300 days on feed.

Closeout data from the feedlot reported a calculated live weight for each individual animal based on the most recent ECM prediction data. This weight was considered the ending weight of the feeding period. From this information feedlot gain was determined by subtracting feedlot arrival weight from the calculated live weight. Feedlot ADG was calculated by dividing feedlot gain by days on feed (DOF). Feed efficiency (FE) was calculated by the ECM system utilizing the Cornell Net Carbohydrate and Protein System. Total cost of gain (TCOG) was determined by dividing the sum of feed cost, treatment cost, processing cost, and other cost by feedlot gain.

Data were analyzed using the GLM least squares analysis of variance procedures of SAS (2003). The model included the main effects of weaning weight, preconditioning ADG, estimated Brahman percentage, condition score, sex, color, color pattern, and hair shedding characteristics. All two-way interactions found to be significant at P<0.10 for a particular variable were included in the model for that variable. Linear regression analysis was performed on all continuous variables.

**Results and Discussion**

**Weaning Weight**

**Effect of weaning weight on feedlot average daily gain**

Linear regression analysis revealed that cattle had similar (P=0.29) feedlot ADG regardless of differences in WW (Figure 4-1). Calves with greater WW are typically believed to have greater gain potential (Woodward et al., 1959). However, increases in WW have been
shown to be due to differences in age (Pell and Thayne, 1978; Minyard and Dinkle, 1965), which could exceed 120 d in this trial. Maternal effects, such as milk production may also influence WW (Christian et al., 1965) without affecting feedlot ADG. In this study, WW was not a good predictor of feedlot ADG.

**Effect of weaning weight on feed efficiency**

An interaction (P<0.01) between WW and sex was detected for FE (Figure 4-2). At the lightest recorded weaning weight of 180 kg, steers and heifers had similar FE. As WW increased from 180 to 337.5 kg the FE of heifers became poorer (P<0.05). Linear regression revealed a non-significant improvement in FE for steers as WW increased (P=0.32). Marion et al. (1980) indicated similar FE values for steers and heifers during the entire feeding period. However, steers were less efficient than heifers for the last 70 d on feed.

**Effect of weaning weight on days on feed**

Days on feed decreased (P<0.0001) by 23.7d as WW increased by 100kg (Figure 4-3). These findings are similar to those of Schoonmaker et al. (2002) who showed that calves that were older and heavier when placed on feed had 26.9 fewer DOF per 100 kg of bodyweight. In the current trial it is likely that calves with greater WW were physiologically older than those with lighter WW. Therefore, the differences in DOF in the current trial cannot be entirely attributed to differences in WW since the calves with greater WW are likely to be chronologically older as well.

**Effect of weaning weight on total cost of gain**

Total cost of gain in the feedlot was not affected (P=0.32) by differences in WW (Figure 4-4). Due to the similarities observed previously for ADG and FE, disparity in TCOG was not expected.
Preconditioning Average Daily Gain

Effect of preconditioning average daily gain on feedlot average daily gain

Preconditioning average daily gain was not a good predictor (P=0.54) of feedlot ADG (Figure 4-5). It would seem plausible that calves that have greater PCADG would also excel for feedlot ADG. However, differences in PCADG may be due to the complex circumstances that are associated with preconditioning. Differences in shrink, health status, and the calf’s ability to cope with the stressors of weaning, commingling, and environmental changes all have an impact on performance during preconditioning. Therefore, some calves that perform poor during preconditioning may actually have similar genetic potential to high performing calves. This may result in greater gain in the feedlot phase for calves that were challenged during preconditioning.

Effect of preconditioning average daily gain on feed efficiency

Feed efficiency for steers and heifers improved (P<0.05) as PCADG increased. However, the magnitude of the improvement between steers and heifers varied resulting in an interaction (P<0.05) between PCADG and sex (Figure 4-6). Feed efficiency improved at a greater rate for steers (0.62 kg of feed/kg of gain) than for heifers (0.46 kg/kg). Body compositional differences between steers and heifers at a given weight have been observed by Fortin et al. (1980) and appear to be responsible for the decreased rate of improvement for heifers when compared to steers. Heifers are physiologically earlier maturing than steers which would result in less efficient gains for heifers than steers. Heifers have a greater percent body fat at a given weight which requires more NEg to achieve similar gains (NRC, 1996).

Having the ability to predict FE by utilizing PCADG has far reaching implications. Fox et al. (2001) indicated that a 10% increase in FE resulted in a 43% increase in profitability. Further investigation is needed to determine if differences in FE are responsible for the differences observed for PCADG. This study did not measure FE during the preconditioning period.
Additional research would be useful to solidify the correlation between PCADG and feedlot FE, and explore the interaction between steers and heifers.

**Effect of preconditioning average daily gain on days on feed**

Differences in DOF ($P<0.005$) due to PCADG were revealed by linear regression (Figure 4-7). Cattle had 7.2 fewer DOF for each 1.0 kg/d increase in PCADG, which suggests that gain during the preconditioning period partially displaced gain in the feedlot. Calves that gained more weight during the preconditioning period did not require as many DOF once in the feedlot.

**Effects of preconditioning average daily gain on total cost of gain**

As PCADG increased by 1.0 kg/d, TCOG values decreased ($P<0.05$) by 0.098 $/kg (Figure 4-8). Since feedlot ADG was not affected by PCADG it is not likely that the economic differences are due to differences in feedlot ADG. However, FE and DOF improved as PCADG increased suggesting that calves with greater PCADG are more efficient in the feedlot resulting in fewer DOF.

**Brahman Percentage**

**Effect of estimated Brahman percentage on feedlot average daily gain**

Estimated Brahman percentage had minimal impact ($P=0.12$) on feedlot ADG during the feeding period (Figure 4-9). However, there was a numerical decrease in feedlot ADG associated with each 1/8 increase in estimated Brahman percentage. Average daily gain was 1.23, 1.14, 1.12, and 1.11 kg/d for cattle that were categorized as 0, 1/8, 1/4, or 3/8 Brahman, respectively. Regression analysis revealed a decrease ($P<0.0001$) in feedlot ADG of 0.03 kg/d for each 1/8 increase in estimated Brahman percentage. This seemingly small difference would result in an extra 18 kg of live weight for 0 Brahman calves when compared to 3/8 Brahman calves over a 200-d feeding period. Sherbeck et al. (1996) observed a similar decrease in ADG, for steers fed in Colorado, as actual Brahman percentage increased in cattle that were 0, 1/4, or 1/2 Brahman.
Peacock et al. (1982) determined that the direct additive Brahman breed effect for ADG was negative. The current study suggests that as Brahman percentage increases, feedlot ADG decreases when cattle are fed in a temperate climate.

**Effect of estimated Brahman percentage on feed efficiency**

An interaction ($P<0.05$) was discovered between estimated Brahman percentage and condition score for FE (Figure 4-10). Cattle categorized as 0 Brahman were similar ($P=0.51$) across all condition scores evaluated for FE. The FE of Brahman influenced calves decreased numerically as condition score increased with the exception of the 3/8 Brahman calves that were slightly fleshy. It would be expected that calves that enter the feedlot with more condition would be less efficient at converting feed to gain due to either their more mature physiological state or higher plane of previous nutrition. However, not all levels of estimated Brahman percentage performed in this manner.

Cattle that were estimated to have 1/8 Brahman inheritance and were slightly thin were more efficient ($P<0.05$) than average condition and slightly fleshy calves of the same Brahman level. Cattle that were 1/4 Brahman and slightly thin were similar ($P=0.21$) to average condition but more efficient ($P<0.05$) than slightly fleshy calves. Cattle that were categorized as 3/8 Brahman and slightly thin were more efficient ($P<0.05$) than average condition calves but similar ($P=0.76$) to slightly fleshy calves. Huffman et al. (1990) found no difference in FE relative to Brahman percentage. Trenkle (2001) reported similar FE between two groups of calves sorted by initial ultrasound backfat measurement, however, calves with greater backfat had numerically greater FE values.

**Effect of estimated Brahman percentage on days on feed**

Estimated Brahman percentage had a no effect ($P=0.68$) on DOF (Figure 4-11). Results of the current study suggest that although feedlot ADG decreased with increasing Brahman
percentage, Brahman cattle had a smaller optimal slaughter weight which resulted in similar DOF. It is noteworthy that cattle in this trial were not slaughtered solely on backfat measurement. Harvest dates were calculated to achieve optimal profitability based on many factors including bodyweight, incremental cost of gain, and backfat. Wyatt et al. (2002) found that Angus sired steers were fed 54 fewer days than Brahman-derivative steers when fed to 10 mm of backfat. Compared with previous research, the current trial indicates that Brahman influenced calves may be overfed from a profitability standpoint if slaughtered at similar backfat measurements to British type calves.

**Effect of estimated Brahman percentage on total cost of gain**

Values obtained for TCOG were similar (P=0.55) as estimated Brahman percentage increased (Figure 4-12). These results indicate that cattle with less than 3/8 or less Brahman inheritance perform similarly in the feedlot from an economic perspective.

**Condition Score**

**Effect of condition score on feedlot average daily gain**

Cattle that were classified as slightly thin gained 1.16 kg/d and had greater (P<0.0001) feedlot ADG than average condition and slightly fleshy cattle. Average condition calves were intermediate and had a feedlot ADG value of 1.11 kg/d, which was greater (P<0.0005) than cattle classified as slightly fleshy (1.06 kg/d). Linear regression revealed that feedlot ADG decreased by 0.05 kg/d for each unit increase in body condition score (P<0.0001, Figure 4-13).

These seemingly small differences in feedlot ADG would result in 20 kg of additional bodyweight for slightly thin calves compared to slightly fleshy calves after a 200-d feeding period. The current data supports the concept of price differentiation of feeder calves based on condition score. Research conducted by Trenkle (2001) found that performance differences between feeder calves sorted by ultrasound backfat resulted in a theoretical $5/100 lbs of
bodyweight discount for fatter steers. The author also showed that calves with less backfat tended to have greater bodyweight gain than calves with more backfat.

**Effect of condition score on feed efficiency**

There was an interaction (P<0.05) between condition score and estimated Brahman percentage for FE. This interaction was discussed previously.

**Effect of condition score on days on feed**

Calves with condition scores of slightly thin, average, and slightly fleshy were similar (P=0.29) for DOF (Figure 4-14). Condition score at weaning does not appear to be a good predictor of DOF. Trenkle (2001) sorted feeder calves based on ultrasound backfat measurement, and found that calves that had more backfat were fed for fewer DOF. However, the current trial evaluated condition score at weaning rather than at feedlot entry, and utilized visual appraisal rather than ultrasound technology.

**Effect of condition score on total cost of gain**

Values for TCOG (Figure 4-15) were $1.31, $1.36, and $1.38/kg for condition scores of slightly thin, average, and slightly fleshy, respectively (P<0.0005). Slightly thin cattle had lower TCOG than average condition (P<0.0005) and slightly fleshy cattle (P<0.0001). Average and slightly fleshy cattle reported similar (P=0.17) values for TCOG. Regression analysis revealed that TCOG increased (P<0.0001) by 0.0349 $/kg of gain for each unit increase in condition score. These results indicate that slightly thin calves at weaning are more economically efficient in the feedlot. Differences in TCOG observed between condition scores appear to be influenced greatest by increased ADG of slightly thin cattle. Trenkle (2001) found that calves that had less initial backfat were $25.47/hd more profitable than fatter steers.
Sex

Effect of sex on feedlot average daily gain

An interaction between sex and coat shedding characteristics (P<0.1) was observed for feedlot ADG (Figure 4-16). Heifers categorized as completely shed or partially shed had less (P<0.05) feedlot ADG than heifers in the non-shed category. Steer calves performed similarly (P>0.10) across all levels of coat shedding, and were similar (P=0.46) to non-shed heifers. Completely shed and partial shed heifers had decreased (P<.05) feedlot ADG compared to steers for all levels of shedding.

The interaction of sex class with coat shedding characteristics may be an artifact of the data set due to the fact that replacement females were removed from the original population of heifers while all steers were evaluated. Heifers in this study that were categorized as completely shed or partially shed likely represented less desirable phenotypes since they were not selected as replacements. Many of the non-shed heifers were placed in the finishing program regardless of type. These heifers were considered unacceptable as replacement females due to many factors including frame size, breed composition, and hair length.

Williams et al. (1993) reported an advantage in ADG for steers compared to heifers in a study of 4,549 pens of steers and 1,752 pens of heifers. Tanner et al. (1970) reported feedlot ADG of 1.16 and 0.94 kg/d for steers and heifers, respectively. In contrast, Zinn et al. (1970) found no significant difference in ADG between steers and heifers, however steers had numerically greater ADG values from 60 to 270 DOF. Likewise, Marion et al. (1980) reported similar ADG values for steers and heifers (1.09 and 1.08 kg/d, respectively). Variability in the literature may be due to the previously mentioned effect of replacement heifer loss when comparing steers and heifers. In the first two trials, replacement heifers were not included in the analysis, similar to the current trial. However, in the latter trials (Zinn et al., 1970; Marion et al.,
1980), an equal number of steers and heifers were selected from a population. Steers were found to have greater ADG in the first two trials, but the different sexes performed similarly in the latter.

**Effect of sex on feed efficiency**

Interactions existed between sex and PCADG, and sex and WW for FE and were discussed previously.

**Effect of sex on days on feed**

Days on feed were fewer (P<0.0001) for heifers (222.8) than steers (244.6) (Figure 4-17). These findings are similar to those of Grona et al. (2002). Marion et al. (1980) found similar results and reported that heifers had 23 fewer DOF than steers. Fewer DOF would be expected for heifers fed to a similar endpoint due to their earlier physiological maturity.

**Effect of sex on total cost of gain**

Steers had a lower (P<0.0001) TCOG ($1.29/kg) than heifers ($1.42/kg, Figure 4-18). These differences appear to be due to small differences in ADG and FE between steers and heifers. Differences in performance between steers and heifers may be partially attributed to differences in physiology including cyclicity and estrous behavior of heifers. Differences between the steer and heifer populations may also exist in regards to genetic potential for performance since the feeder heifer population does not include those calves selected as replacement females.

**Coat Color**

It should be noted that in this study it was not possible to evaluate color differences on cattle of similar genetic composition. In other words, coat color is a function of the breed or breed crosses represented in each animal. Since the individual dam was not known for all of these calves, it was not possible to stratify by breed type. Results presented as effects of color
should be interpreted as including the possible effects of the breed or breed combinations that may potentially produce those colors.

Differences in performance due to color appear to be associated with calf type and breed composition. In this trial, black cattle were 64.6% Angus sired and 27.7% Brangus sired. Red cattle were 89.9% Hereford sired with Braford dams. Yellow cattle were 84.6% Charolais sired, while grey calves were 45.3% Angus sired and 42.0% Charolais sired. White cattle, however, exhibit a strong continental influence, and were 100% Charolais sired and had predominantly Charbray dams.

**Effect of coat color on feedlot average daily gain**

Cattle that were black, red, yellow, grey, or white gained 1.13, 1.00, 1.14, 1.16, and 1.11 kg/d, respectively (Figure 4-19). Red cattle had lower (P<0.05) feedlot ADG values than all other colors evaluated. There was a tendency (P<0.10) for grey cattle to gain better than black cattle and white cattle. Diversity in biological types expressed through coat color resulted in differences for ADG in this trial. However, Loerch et al. (2001) showed that hide color did not affect daily gains.

**Effect of coat color on feed efficiency**

Calculated FE for black, red, yellow, grey, and white calves were 6.57, 7.29, 6.46, 6.58, and 6.73 kg of feed:kg of gain, respectively (Figure 4-20). Red cattle had poorer FE than all other colors evaluated (P<0.05). Black, yellow, grey, and white cattle had similar FE (P=0.14). Decreased FE for calves with a red coat color would appear to be related to the specific genetic combinations that resulted in that coat color. No physiological reason for this difference was identified.
**Effect of coat color on days on feed**

Black cattle were on feed for 218.6 d, which was less (P<0.0001) than all other colors evaluated (Figure 4-21). Values for red (236.5 d), yellow (232.4 d), and grey (232.4 d) calves were intermediate and similar (P=0.39). White (248.7 d) cattle had greater (P<0.05) DOF than black, red, yellow, and grey cattle. Differences observed for DOF appear to be associated with calf type and breed.

**Effect of coat color on total cost of gain**

Previously mentioned differences in performance resulted in an effect of color (P<0.01) on TCOG (Figure 4-22). Red cattle had the greatest (P<0.05) cost of gain compared to all other colors with a value of $1.46/kg of gain. Colors of black, yellow, grey, and white were similar (P=0.18) and had decreased TCOG values of $1.32, $1.30, $1.32, and $1.35/kg of gain, respectively.

**Color Pattern**

Color pattern had no significant effect on any parameter measured during the feedlot phase of production. Solid and non-solid patterned cattle reported similar (P=0.14) feedlot ADG values (Figure 4-23). There were no differences observed (P=0.60) in FE due to differences in color pattern (Figure 4-24). Values for DOF (Figure 4-25) were also similar for different color patterns (P=0.65). Similarity in feedlot performance relative to color pattern did not yield any differences (P=0.37) in TCOG (Figure 4-26).

Lack of significance for any of these productive traits shows that there appear to be no differences in feedlot performance based on color pattern. Differences due to color pattern may have been detected if breed composition was more variable, or included diverse biological types such as dairy or andalusian influence. Therefore, price discrimination based on color pattern
does not appear to be merited, especially within groups of cattle with similar genetics and management.

**Coat Shedding Characteristics**

**Effect of coat shedding characteristics on feedlot average daily gain**

An interaction (P<0.10) between sex and coat shedding characteristics was observed for feedlot ADG and discussed in the section on sex. Turner and Schleger (1960) reported that coat type, as assessed by a subjective score, was well correlated with heat tolerance and growth rate. Effects of coat characteristics on thermal regulation are well documented. However, Gilbert and Bailey (1991) found that none of the hair coat characteristics they measured were strongly associated with post-weaning gain.

**Effect of coat shedding characteristics on feed efficiency**

Cattle that were classified as completely shed and partial shed had similar (P=0.40) FE values (Figure 4-27). Non-shed calves were more efficient than cattle classified as completely shed (P<0.05) and tended to be more efficient (P<0.10) than partially shed cattle.

Differences in efficiency based on coat shedding characteristics may be influenced by environmental factors. It would appear that non-shed cattle would be more easily acclimated to environmental changes between Florida and Kansas during the fall of the year. The ability of the non-shed group to conserve heat, and maintain core body temperature in a temperate environment is a possible explanation for the differences observed (NRC, 1996).

**Effect of coat shedding characteristics on days on feed**

Cattle in the non-shed category were fed for 17.0 fewer (P<0.01) DOF than both other categories (Figure 4-28). Values for the completely shed and partially shed groups were similar (P=0.99). Differences observed for DOF are at least partially explained by the differences in FE.
Effect of coat shedding characteristics on total cost of gain

Due to the differences in ADG, FE and DOF observed previously, economic differences in TCOG existed between the different coat types (P<0.05). Completely shed and partially shed categories had similar (P=0.46) TCOG values of $1.38 and $1.37/kg of gain, respectively. Non-shed cattle had a lower (P<0.05) TCOG value of $1.31/kg of gain (Figure 4-29). These data suggest that Florida calves that have not shed their winter coat at weaning have a greater level of performance when placed on feed in the Midwest during the fall of the year. These differences are believed to be dependent upon specific environmental and seasonal factors.

Implications

Increases in WW resulted in cattle being fed for fewer DOF, however, the level of performance in the feedlot was not affected by WW. Although PCADG was not a good predictor of feedlot ADG, other improvements in feedlot performance were observed as PCADG increased. As PCADG increased, steers and heifers improved in feedlot FE, resulting in fewer DOF and lower TCOG for calves that performed well during preconditioning. Estimated Brahman percentage was not a good predictor of feedlot performance. However, linear regression did reveal a slight decrease in feedlot ADG as estimated Brahman percentage increased up to 3/8. Calves with lower initial condition scores exhibited greater feedlot ADG and decreased TCOG while being fed for similar DOF to flesher calves. Heifers were fed for fewer DOF, yet exhibited greater TCOG than steers due to differences associated with ADG and FE. Calves performed similarly across coat color categories, with the exception of red calves who had lower ADG, and poorer FE, resulting in increased TCOG. Differences in DOF for calves with different coat colors appear to be associated with calf type, such as Continental influence. Solid and non-solid color patterned cattle performed similarly for all feedlot performance traits measured. This suggests that price discrimination on the basis of color pattern
may not be merited. Calves that had not shed their hair coat at weaning performed better than both their shed and partial shed contemporaries for feedlot performance traits. While these non-shed calves tend to struggle in Florida during the summer months, the benefits of their coat characteristics are revealed when fed in the Midwest. These results suggest that many of the preconceived ideas regarding calf type and coat characteristics are not good predictors of feedlot performance of cattle from a single herd.
Figure 4-1. Effect of weaning weight on feedlot average daily gain. Linear regression slope=0.0002, P=0.29.

Figure 4-2. Weaning weight by sex interaction for feedlot feed efficiency. Main effect P<0.01. Heifers linear regression slope=0.0024, P<0.05. Steer linear regression slope=-0.0008, P=0.32.
Figure 4-3. Effect of weaning weight on feedlot days on feed. Linear regression slope=-0.2372, P<0.0001.

Figure 4-4. Effect of weaning weight on feedlot total cost of gain. Linear regression slope=-0.0058, P=0.33.
Figure 4-5. Effect of preconditioning average daily gain on feedlot average daily gain. Linear regression slope=0.0065, P=0.54.

Figure 4-6. Preconditioning average daily gain by sex interaction for feedlot feed efficiency. Main effect P<0.05. Heifer linear regression slope=-0.4626, P<0.10. Steer linear regression slope=-0.6215, P<0.05.
Figure 4-7. Effect of preconditioning average daily gain on feedlot days on feed. Linear regression slope=−7.1927, P<0.01.

Figure 4-8. Effect of preconditioning average daily gain on feedlot total cost of gain. Linear regression slope=−9.8300, P<0.05.
Figure 4-9. Effect of estimated Brahman percentage on feedlot average daily gain. Main effect \( P=0.1175 \). Linear regression slope=-0.03, \( P<0.0001 \).

Figure 4-10. Estimated Brahman percentage by condition score interaction for feedlot feed efficiency. \( P<0.05 \).
Figure 4-11. Effect of estimated Brahman percentage on feedlot days on feed. P=0.68.

Figure 4-12. Effect of estimated Brahman percentage on feedlot total cost of gain. P=0.55.
Figure 4-13. Effect of condition score on feedlot average daily gain. Main effect P<0.0001. a,b Means with different superscripts differ P<0.05. Linear regression slope=-0.05, P<0.0001.

Figure 4-14. Effect of condition score on feedlot days on feed. P=0.29.
Figure 4-15. Effect of condition score on feedlot total cost of gain. P<0.0001. a,b Means with different superscripts differ P<0.05.

Figure 4-16. Sex by hair shedding characteristics interaction for feedlot average daily gain. P<0.10.
Figure 4-17. Effect of sex on feedlot days on feed. P<0.0001. \(^{ab}\) Means with different superscripts differ P<0.05.

Figure 4-18. Effect of sex on feedlot total cost of gain. P<0.0001. \(^{ab}\) Means with different superscripts differ P<0.05.
Figure 4-19. Effect of coat color on feedlot average daily gain. $P<0.01$. $^{a,b}$ Means with different superscripts differ $P<0.05$.

Figure 4-20. Effect of coat color on feedlot feed efficiency. $P<0.01$. $^{a,b}$ Means with different superscripts differ $P<0.05$. 
Figure 4-21. Effect of coat color on feedlot days on feed. $P<0.0001$. $^{a,b,c}$ Means with different superscripts differ $P<0.05$.

![Bar chart of days on feed for different coat colors](image)

Figure 4-22. Effect of coat color on feedlot total cost of gain. $P<0.01$. $^{a,b}$ Means with different superscripts differ $P<0.05$.

![Bar chart of cost of gain for different coat colors](image)
Figure 4-23. Effect of color pattern on feedlot average daily gain. P=0.14.

Figure 4-24. Effect of color pattern on feedlot feed efficiency. P=0.60.
Figure 4-25. Effect of color pattern on feedlot days on feed. P=0.65.

Figure 4-26. Effect of color pattern on feedlot total cost of gain. P=0.37.
Figure 4-27. Effect of hair shedding characteristics on feedlot feed efficiency. P<0.05. \textsuperscript{a,b} Means with different superscripts differ P<0.05.

Figure 4-28. Effect of hair shedding characteristics on feedlot days on feed. P<0.01. \textsuperscript{a,b} Means with different superscripts differ P<0.05.
Figure 4-29. Effect of hair shedding characteristics on feedlot total cost of gain. P<0.05. \(^{a,b}\)
Means with different superscripts differ P<0.05.
CHAPTER 5
THE EFFECT OF PHENOTYPIC CHARACTERISTICS AND PRECONDITIONING PERFORMANCE ON CARCASS CHARACTERISTICS

Introduction

In many cases the preconditioning period is the first opportunity to evaluate the performance of calves on an individual basis without the masking effects of their dam. This is also a time where calves are subjected to identical treatments and each has the same opportunity to perform. For these reasons the preconditioning period provides an opportunity to evaluate calves under similar management before entering the feedlot. Calves that are treated for respiratory disease during preconditioning or in the feedlot have been shown to exhibit poorer carcass quality (McNeill 2001). However, there is minimal data to suggest a correlation between gain during the preconditioning period and carcass performance.

It has been demonstrated by Minert et al. (1988) that individual animal characteristics such as sex, Brahman percentage, and condition score have an effect on the price received for calves. Reasons for price differentiation due to these characteristics are based on the belief that these characteristics affect animal performance. However, the effects of these economically important characteristics have not been extensively evaluated during the preconditioning period.

Qualitative characteristics such as coat color, body pattern, and hair shedding characteristics are commonly used as an indicator of animal performance as well. Across the country, calves receive discounts or premiums based on the characteristics of their hair coat. Many producers believe that these qualitative characteristics are solely used to discriminate against certain types of cattle. Nevertheless, many cattle buyers, stocker operators, feedlot operators, and packers stand behind the claim that these characteristics have an impact on subsequent performance and carcass characteristics.
The objective of this experiment was to evaluate the effects of weaning weight, estimated Brahman percentage, condition score, sex, color, color pattern, and hair shedding characteristics on carcass characteristics. In addition, this study evaluated the effect of daily gain during the preconditioning period on carcass characteristics.

**Materials and Methods**

Cow/calf pairs were gathered off pasture in the morning from a large commercial cow/calf operation in South Florida. Steers (n=1,575) and heifers (n=1,550) were separated from their dams and shipped approximately 370 km to a preconditioning facility in North Central Florida. The calving season was between October 10, 2003 and February 10, 2004. All calves originated from the same ranch and had been exposed to similar pre-weaning management practices that included knife castration, dehorning, and vaccination at approximately 2 to 4 months of age. All calves were vaccinated on the ranch of origin with Cattlemaster 4® and Ultraback 8®. Heifers were calf-hood vaccinated against Brucella abortus. An injectable dewormer (Dectomax®) and a topical fly control (Saber®) were also administered, and calves were implanted with Ralgo®.

Calves were received at the preconditioning facility in nine shipments across a 15 d period beginning on July 27th, 2004 and ending on August 10th, 2004. Approximately 350 calves were received in each shipment. Calves were shipped from the ranch between 0900 and 1200 and arrived at the preconditioning yard between 1200 and 1700. Upon arrival, calves were offered hay and water ad libitum. Hay consumption was rarely noted between arrival and processing. Immediately prior to processing, calves were sorted into groups based on sex and weight class. Sex classes were feeder steer, feeder heifer, and replacement heifer. Weight classes of small, medium, and large were also determined. Processing began between 1730 and 1830 each evening and continued until the entire shipment was processed. Calves were processed at an average rate of 89 hd/hr.
During processing calves were vaccinated using a modified live vaccine for IBR, BVD, PI3, and BRSV (Bovi-Shield GOLD®) for respiratory disease, a bacterin toxoid (ONE SHOT®) to prevent bovine pneumonic pasteurellosis, and an 8-way clostridial vaccine (Ultra Choice™ 8). An injectable avermectin anthelmentic including clorsulon for treatment of liver flukes (Ivomec® Plus) was administered according to weight class. Calves also received a vitamin B complex injection and were mass medicated with Tilmicosin (Micotil® 300) according to label directions. Calves were treated topically with lambdacyhalothrin (Saber™) to suppress horn flies and lice. Color coded ear tags containing the lot and individual animal number were applied in the right ear and a low-frequency half duplex electronic identification (EID) unit was placed in the left ear. Calves were also branded with a fire brand on the left hip for ownership identification.

Average processing cost was $14.76/hd, not including labor.

During processing each animal was evaluated by two evaluators who classified each animal on the phenotypic evidence of Brahman percentage, condition score, color, color pattern, and hair shedding characteristics.

Estimated Brahman percentage was categorized similarly to that of Sherbeck et al. (1996). Brahman percentage was estimated to be 0, 1/8, 1/4, or 3/8 Brahman influence. Phenotypic evaluations of Brahman percentage were made based on the visual appearance of the underline and size of the hump. Length, shape, and orientation of the ear were also used to estimate Brahman percentage. Actual Brahman percentage of individual animals was unknown. However, evaluators were aware of the calf’s sire breed and dam type.

Condition scores were based on similar scoring done by Grona et al. (2002), and were assigned using a 9-point scoring system and categorized as extremely thin, thin, moderately thin, slightly thin, average, slightly fleshy, moderately fleshy, fleshy, and extremely fleshy (USDA,
Extremes in condition score were not observed. Only two calves were classified less than slightly thin and none were classified greater than slightly fleshy. Therefore, only slightly thin, average, and slightly fleshy categories were evaluated.

Color was based on the predominant color of the animal similar to Loerch et al. (2001) and categorized as black, red, yellow, grey, or white. Color pattern was established as either solid patterned or non-solid patterned. Non-solid color patterned calves included spotted, roan, or brindle color patterns. Spotted calves were categorized only when white markings extended behind the point of the shoulder or above the flank. White-faced, Hereford type calves were considered solid patterned. Hair shedding characteristics were based on previous work done by Thrift et al (1994) and were classified as shed, partially shed, or non-shed.

Calves were individually weighed automatically by a Digistar® digital scale with load cells underneath the processing chute. This weight was considered to be a shrunk weight and was designated as weaning weight (WW). Scales were calibrated and set to weigh calves in 2.25 kg increments. Calves’ EID numbers were captured using an Allfex® RS250 Series Stick Reader. Weights and EID were automatically downloaded into a Microsoft Office Excel® spreadsheet using WinWedge® RS232 Data Acquisition Software for Windows®.

After processing calves were turned out in 2.02 ha pastures by sex and weight class for weaning and environmental acclimation. Water in these pastures was treated with amprolium (Corid®) according to label dosage to reduce the incidence of coccidiosis. After 5-d calves were moved to 8.09 ha pastures and rotated across pastures as forage availability dictated for the duration of the preconditioning program. Calves were fed a low concentrate starter ration containing monensin sodium (Rumensin®) and tylosin tartrate (Tylan®) with a target dry matter
intake set at 3% of live bodyweight. Calves were fed in the morning in metal bunks allowing 20 cm of bunk space per animal, and typically reached target consumption by d14.

Calves that showed signs of respiratory disease were treated in the pasture with ceftiofur sodium (Naxcel\textsuperscript{®}) according to label directions using Ballistivet\textsuperscript{®} technology. Calves that had to be treated more than twice were given enrofloxacin (Baytril\textsuperscript{®}) according to label directions and drenched with amprolium (Corid\textsuperscript{®}). Death loss during preconditioning was 0.6%, and 0.4% were sold as realizers before shipping to the feedlot. Morbidity during preconditioning ranged from 2.1% to 9.5% depending on lot and averaged 5.0% across lots.

At the end of the preconditioning period, calves were gathered in the morning, group weighed, and loaded onto trucks. Duration of the preconditioning period ranged from 34-d to 51-d with a mean number of days preconditioned equal to 42.9-d. Heifers selected as replacements were shipped back to the ranch of origin. Feeder calves in the small weight class were shipped to a stocker operation before entering the feedlot. Feeder calves in the medium weight class were shipped to a feedlot where data on individual animals was not collected. Therefore, the previously mentioned calves were not utilized in further analysis of feedlot and carcass performance. Large weight class feeder calves were fed in a western Kansas feedlot that utilized the Micro Beef Technologies ACCU-TRAC\textsuperscript{®} Electronic Cattle Management system (ECM). Only feeder steers (n=1,100) and feeder heifers (n=421) in the large weight class were analyzed in this study.

The ECM system combines multiple objective measurements such as weight, ultrasound for internal tissue characteristics, and video imaging of external dimensions to provide optimum individual animal management. This information along with growth and performance models utilizing the Cornell Net Carbohydrate and Protein System allow for accurate prediction of
individual animal performance. Information gathered from the ECM was utilized to sort cattle into marketing groups by harvest date for optimal individual profitability.

Cattle were harvested for five different reasons according to ECM information. Triggering responses for harvest were maximum backfat (n=943), increasing incremental cost of gain (n=197), minimum weight (n=65), and maximum weight (n=298). Eighteen calves were sold as railers before harvest due to illness or injury.

All cattle were humanely harvested at the same packing plant. Individual carcass data was collected by Excel Corporation and utilized to evaluate differences in carcass composition between individuals. Carcass quality was segregated at the plant into 8 categories based on quality grade and qualifications for specific programs. Carcass quality categories were Prime, Certified Angus Beef, Sterling Silver, Angus Pride, Choice, Select, Standard, No Roll, Dark Cutter, Hard Bone, Stag, and Condemned. These categories were condensed to Prime (n=13), Upper 2/3 Choice (n=264), Low Choice (n=529), Select (n=652), and Standard (n=45) for analysis. Condensed categories are represented as adjusted quality grade (AQG) in this analysis. Cattle were assigned an AQG score from 1 to 5, with 1=Prime and 5=Standard, for further analysis.

Yield grade was determined at the packing plant based on USDA standard adjustments for fat over the eye, hot carcass weight (HCW), ribeye area, (REA), kidney, pelvic, and heart fat. Ribeye area REA was measured between the 12th and 13th rib on one side of the carcass in cm². Hot carcass weight was determined on the rail.

Data were analyzed using the GLM least squares analysis of variance procedures of SAS (2003). The model included the main effects of WW, PCADG, estimated Brahman percentage, condition score, sex, coat color, color pattern, and hair shedding characteristics. All two-way
interactions found to be significant at P<0.10 for a particular variable were included in the model for that variable. Linear regression analysis was performed on all continuous variables.

Results and Discussion

Weaning Weight

Effect of weaning weight on hot carcass weight

Linear regression analysis revealed that as WW increased by 100 kg, HCW increased (P<0.0001) by 56.5 kg (Figure 5-1). Christian et al. (1965) indicated a positive correlation between WW and weight at slaughter. The current results indicate that WW is an economically important trait even when retaining ownership, as it has further implications relative to growth. Hot carcass weight is the primary factor associated with profitability at the carcass level (Pyatt et al., 2005). However, differences in WW may be associated with differences in age or growth rate. It is impossible to separate calf age and WW in this trial since individual birth dates were not known.

Effect of weaning weight on adjusted quality grade

Cattle that had different WW were similar (P=0.12) for AQG (Figure 5-2). Schoonmaker et al. (2002) showed that calves that were older and heavier when placed on feed had lower marbling scores and a greater percentage graded Select. However, these older and heavier cattle had fewer DOF. Weaning weight differences at a constant age have not been documented as having a significant effect on quality grade.

Effect of weaning weight on REA and REA/100kg

Cattle that were heavier at weaning had larger (P<0.05, Figure 5-3) REA but smaller (P=0.0001, Figure 5-4) REA/100 kg values. Linear regression revealed an increase of 2.93 cm² in REA as WW increased by 100 kg. However, REA/100 kg declined by 3.94 cm² for each 100
kg increase in WW. These results indicate that increases associated with REA are due to increased HCW for cattle that were heavier at weaning. However, cattle with greater WW were actually lighter muscled from a body composition standpoint.

**Effect of weaning weight on yield grade**

Increases in WW resulted in poorer (P<0.005) values for YG (Figure 5-5). As WW increased by 100 kg, YG values increased by 1/3 of a grade. Poorer YG values are partially explained by the increase in HCW and the decrease in REA/100 kg. Increases in HCW have been show to have a positive effect on YG (Nour et al., 1983). Generally cattle with heavier carcass weights have greater external fat thickness which is the basis for determining preliminary YG. Adjustments to the preliminary YG are then made for REA as compared to carcass weight. Therefore, smaller REA/100 kg values would drive the YG higher.

**Preconditioning Average Daily Gain**

**Effect of preconditioning average daily gain on hot carcass weight**

As PCADG increased by 1 kg, HCW increased (P<0.0001) by 19.48 kg (Figure 5-6). These results suggest that calves that gain more rapidly during preconditioning will ultimately have heavier carcasses. Therefore, selection for post-weaning gain during the preconditioning period may result in greater profitability due to increased HCW when retaining ownership.

**Effect of preconditioning average daily gain on adjusted quality grade**

Differences in PCADG had minimal effect (P=0.24) on AQG (Figure 5-7) suggesting that performance during the preconditioning period is not a good predictor of carcass quality. These two variables would not be expected to be correlated from a physiological standpoint.

**Effect of preconditioning average daily gain on REA and REA/100 kg**

Cattle that gained more weight during preconditioning had larger (P<0.0001, Figure 5-8) REA but smaller (P<0.01, Figure 5-9) REA/100 kg values. As PCADG increased by 1 kg, REA
increased by 3.12 cm². However, REA/100 kg decreased by 0.53 cm² as PCADG increased by 1 kg. These results indicate similarly to WW, that larger REA is associated with increased HCW rather than physiological differences in muscling.

**Effect of preconditioning average daily gain on yield grade**

Cattle that exhibited differences in PCADG had similar (P=0.29) YG (Figure 5-10). Differences in YG would be expected to be minimized in this trial due to the fact that cattle were harvested at each animal’s optimal endpoint through ECM. Individual animal management reduced the upper limit of YG by attempting to eliminate YG 4 and 5 carcasses.

**Brahman Percentage**

**Effect of estimated Brahman percentage on hot carcass weight**

Hot carcass weight decreased (P<0.0001) as estimated Brahman percentage increased (Figure 5-11). Cattle estimated to have 0 Brahman inheritance had greater (P<0.05) HCW (358.3 kg) than all other levels of Brahman observed. Cattle that exhibited 3/8 Brahman had the lightest (P<0.001) HCW (321.1 kg) compared to all other observed levels of Brahman. Cattle that exhibited 1/8 Brahman (339.3 kg) and 1/4 Brahman (334.4 kg) were intermediate and similar (P>0.10). Linear regression revealed an 8.78 kg decrease in HCW for each 1/8 increase in estimated Brahman percentage. McKenna et al. (2002) reported a 17.6 kg decrease in HCW for *Bos indicus* type cattle compared to *Bos taurus* cattle (356.6 and 349.0 kg, respectively).

**Effect of estimated Brahman percentage on adjusted quality grade**

Calves that were categorized as 0 Brahman had better AQG than cattle of 1/4 (P<0.05) and 3/8 (P<0.001) Brahman inheritance (Figure 5-12). Cattle that exhibited 1/8 Brahman were intermediate, and similar (P>0.10), to 0 and 1/4 Brahman cattle. Cattle that exhibited 3/8 Brahman inheritance had poorer (P<0.05) AQG than all other levels of Brahman. Further analysis revealed that AQG declined by 0.07 units as estimated Brahman percentage increased
by 1/8. Similar results were reported by MeKenna et al. (2002) in that *Bos taurus* type carcasses had a greater average quality grade than *Bos indicus* type carcasses. Sherbeck et al. (1995) also showed a decrease in marbling score for 25% and 50% Brahman calves when compared to straight bred Herefords.

**Effect of estimated Brahman percentage on REA and REA/100 kg**

Estimated Brahman percentage had an effect (P<0.01) on REA (Figure 5-13). Cattle that were categorized as 0 Brahman inheritance had similar (P>0.10) REA values to all other levels of Brahman. Cattle that were characterized as 1/8 Brahman had greater REA than those estimated to have 1/4 (P<0.05) or 3/8 (P=0.0001) Brahman inheritance. Cattle classified as 1/4 Brahman reported greater (P<0.05) REA than those estimated to have 3/8 Brahman. Sherbeck et al. (1995) observed that 25% and 50% Brahman crossbred calves had greater REA than straight-bred Herefords.

Cattle that were categorized as 0, 1/8, 1/4, or 3/8 Brahman had REA/100 kg values of 23.5, 25.7, 25.4, and 25.8 cm², respectively, and were similar (P=0.13, Figure 5-14). It is noteworthy that the 0 Brahman group was numerically lower than all other levels of Brahman percentage for REA/100 kg. McKenna et al. (2002) reported that *Bos indicus* type cattle had smaller REA than *Bos taurus* type cattle. However, when adjusted for carcass weight differences *Bos indicus* and native type cattle had similar REA/100 kg values of 24.0 and 23.9 cm², respectively.

Differences observed for REA values relative to Brahman percentage indicate that the smaller REA associated with increasing Brahman inheritance is due to lower HCW of Brahman influenced cattle. Increasing Brahman percentage did not result in lighter muscled animals relative to carcass weight in this trial. Contrary to the perception of Brahman influenced cattle throughout the beef cattle industry, the Brahman influenced animals actually had numerically greater muscle area on a carcass weight basis.
Effect of estimated Brahman percentage on yield grade

An interaction (P<0.10) between estimated Brahman percentage and condition score was identified for YG (Figure 5-15). In the 0 Brahman group, there was a tendency (P<0.10) for slightly fleshy calves to have a greater YG than slightly thin and average conditioned calves. Cattle that exhibited 1/8 Brahman inheritance and were slightly thin had similar (P<0.10) YG compared to average condition and slightly fleshy cattle of the same Brahman percentage. However, slightly fleshy calves had decreased (P<0.05) YG compared to average condition calves. The 1/4 Brahman cattle that were slightly thin had similar (P=0.71) YG to average condition, but tended (P<0.10) to be different than slightly fleshy calves. Slightly fleshy calves had lower (P<0.05) YG values than average condition calves. For cattle that were estimated to have 3/8 Brahman, slightly thin calves had greater (P<0.05) YG than average condition calves. Slightly fleshy cattle were similar (P>0.10) to slightly thin and average condition calves for YG.

A general decline in YG was observed as condition score increased within each level of estimated Brahman percentage with the exception on the 0 Brahman category. This phenomenon is partially explained by the increase in REA and REA/100 kg associated with increasing condition score. McKenna et al. (2002) and Sherbeck et al. (1995) reported no difference in YG values due to Bos indicus inheritance. However, Crockett et al. (1979) showed that cattle from Brahman influenced sires had greater YG values than those sired by continental sire breeds. Calves sired by Brahman influenced sires also had greater condition scores at weaning. Grona et al. (2002) showed that slightly thin cattle had lower final YG than slightly fleshy cattle. Average conditioned cattle were intermediate and similar to both other condition scores evaluated.
**Condition Score**

**Effect of condition score on hot carcass weight**

Differences in condition score at the onset of preconditioning resulted in heavier (P<0.01) HCW for slightly thin and average condition cattle when compared to slightly fleshy cattle (Figure 5-16). Slightly thin cattle tended to have heavier (P<0.1) HCW than average condition cattle. Linear regression analysis revealed a 13.4 kg decrease in HCW as condition score increased. Grona et al. (2002) showed similar results for carcass weight of the three condition scores evaluated in this study.

**Effect of condition score on adjusted quality grade**

An interaction (P<0.1) between condition score and sex was identified for AQG, (Figure 5-17). Heifers that were characterized as slightly thin had decreased (P<0.05) AQG compared to steers of the same condition score. Steers and heifers in the average condition and slightly fleshy groups had similar AQG (P>0.10). Similar research conducted by Grona et al. (2002) indicated that heifers graded better than steers, and no interaction with condition score was observed. McKenna et al. (2002) reported an advantage in marbling score for heifers, however the difference was of no practical significance. Statistically similar but numerically greater quality grades for heifers have also been reported (Marion et al., 1980; Tanner et al., 1970).

**Effect of condition score on REA and REA/100 kg**

Interactions relative to REA were observed between condition score and sex (P<0.10, Figure 5-18) and condition score and shedding characteristics of the coat (P<0.05, Figure 5-19). Marion et al. (1980) reported that steers had larger REA than heifers (76.0 and 68.8 cm, respectively). Tanner et al. (1970) agrees and reported REA values of 68.0 and 65.0 cm for steers and heifers, respectively. Grona et al. (2002) reported no difference in REA or REA adjustment between the three condition scores, however, heifers were heavier muscled than
steers on a carcass weight basis. Hedrick et al. (1969) reported a non-significant 1.4 cm$^2$ advantage for heifers when compared to steers for REA.

Slightly thin cattle had lower REA/100kg than average condition (P<0.05) and slightly fleshy (P<0.0001) cattle (Figure 5-20). Average condition cattle had lower (P<0.01) REA/100kg values than slightly fleshy cattle. Linear regression analysis revealed that REA/100kg increased by 0.4361 cm$^2$ as condition score increased. These results indicate that cattle that have more condition at weaning are heavier muscled at slaughter. However, it is possible that heavier muscled calves appeared flesher to evaluators at weaning.

**Effect of condition score on yield grade**

An interaction between condition score and estimated Brahman percentage was discovered for YG and discussed previously (Figure 5-15).

**Sex**

**Effect of sex on hot carcass weight**

Steers had 21 kg heavier (P<0.0001) HCW than did heifers (349 and 328 kg, respectively) (Figure 5-21). These results appear to be due to the fact that steers had greater WW, and as indicated earlier, greater feedlot ADG and longer DOF than heifers (Savell et al., 2008). This phenomenon has been observed in the literature for many years. Grona et al. (2002) reported a 31 kg difference in HCW for steers (342 kg) and heifers (311 kg). Similar results were identified by McKenna et al. (2002) who observed a 30 kg advantage for steers. Tanner et al. (1970) indicated a 27.6 kg advantage for steers. However, Zinn et al (1970) found that differences in HCW between steers and heifers are only significant after 120 DOF.

**Effect of sex on adjusted quality grade**

An interaction between sex and condition score for AQG was discussed previously (Figure 5-17).
Effect of sex on REA and REA/100 kg

An interaction (P<0.10) between sex and condition score for REA was discussed previously (Figure 5-18).

Steers reported smaller (P<0.0001) REA/100 kg values than did heifers 24.4 and 25.8 cm²/100 kg, respectively (Figure 5-22). Grona et al. (2002) agree that heifers have larger REA relative to carcass weight than steers. Marion et al. (1980) found that steers and heifers had 24.0 and 25.0 cm²/100kg, respectively. Values for REA/100 kg of 27.8 and 29.9 cm²/100 kg for steers and heifers, respectively, were reported by Tanner et al. (1970).

Effect of sex on yield grade

Steers and heifers had similar (P=0.94, Figure 5-23) YG. These results are similar to those of Marion et al. (1980) who reported YG for steers and heifers to be 3.5 and 3.6, respectively. McKenna et al. (2002) reported a small, but significant difference in YG between steers and heifers (3.0 and 2.9, respectively). Grona et al. (2002) also reported that steers had higher YG than heifers.

Coat Color

It should be noted that in this study it was not possible to evaluate color differences on cattle of similar genetic composition. In other words, color is a function of the breed or breed crosses represented in each animal. Since the individual dam was not known for all of these calves, it was not possible to stratify by breed type. Results presented as effects of color should be interpreted as including the possible effects of the breed or breed combinations that may potentially produce those colors.

Differences in performance due to color appear to be associated with calf type and breed composition. In this trial, black cattle were 64.6% Angus sired and 27.7% Brangus sired. Red cattle were 89.9% Hereford sired out of Braford cows. Yellow cattle were 84.6% Charolais
sired, while grey calves were 45.3% Angus sired and 42.0% Charolais sired. White cattle, however, exhibit a strong continental influence, and were 100% Charolais sired and predominantly out of Charbray cows.

**Effect of coat color on hot carcass weight**

Black cattle had lighter (P<0.05) HCW than yellow, grey, and white cattle (Figure 5-24). However, black and red cattle were similar (P=0.21) for HCW. No other significant differences in HCW were observed between colors. Differences observed in this trial appear to be due to differences in calf type. Calves that were yellow, grey, or white would be expected to have greater Continental influence than black or red calves. Nevertheless, Loerch et al. (2001) found no difference in HCW due to hide color differences. This study indicates that current market trends toward black cattle may actually result in decreased HCW.

**Effect of coat color on adjusted quality grade**

Black and grey cattle had better (P<0.05) AQG than red and yellow cattle (Figure 5-25). White cattle were intermediate and similar (P>0.10) to all other colors. These differences also appear to be related to calf type and breed differences. Darker pigmented black and grey cattle would probably contain some portion of Angus genetics which may predispose them to having better quality grade, especially when compared to Continental type crosses. Similar results for quality grade were reported by Loerch et al. (2001) who observed that black and smoke colored cattle had the highest marbling scores, while reds were the lowest, and white hided cattle were intermediate. These data indicate that market premiums for black cattle may be justified in relation to quality grade. However, the current study also suggests that grey cattle should receive the same market premiums as black cattle on the basis of quality grade.
Effect of coat color on REA and REA/100 kg

Black cattle had smaller (P<0.05) REA than all other colors evaluated (Figure 5-26). No other significant differences (P>0.36) in REA were observed between colors. Loerch et al. (2001) reported that black and smoke colored cattle had smaller REA than red and white hided cattle.

Black cattle had smaller (P<0.01) REA/100 kg values than yellow and grey calves (Figure 5-27). Black cattle were similar to red (P=0.53) and white (P=0.11) cattle. No other significant differences (P>0.41) in REA/100 kg were observed between colors.

These differences in muscle expression also appear to be associated with calf type. Smaller REA values for black cattle were offset by an improvement in AQG presented earlier. However, grey calves were able to hit both targets and exhibited increased AQG, REA and REA/100 kg.

Effect of coat color on yield grade

Black cattle had greater (P<0.05) YG than all other colors evaluated (Figure 5-28). No other significant differences (P>0.13) in YG were observed between colors. Differences observed for YG are partially explained by smaller REA and REA/100kg values for black cattle. Observing that black cattle had higher YG is further evidence of the inverse relationship between AQG and YG. In this trial the grey cattle performed better when considering both AQG and YG. The authors attribute this advantage to breed complimentarity of cattle that exhibit grey color. Loerch et al. (2001) reported that black and smoke colored cattle had poorer YG than red and white hided cattle.

Color Pattern

Color pattern had no effect on HCW (P=0.72, Figure 5-30), AQG (P=0.64, Figure 5-31), REA (P=0.30, Figure 5-32), REA/100 kg (P=0.55, Figure 5-33), and YG (P=0.80, Figure 5-34).
Color pattern had no significant effect on any of the carcass traits measured indicating that cattle perform similarly for carcass characteristics regardless of color pattern. These findings suggest that price differentiation on the basis of color pattern is unwarranted.

**Coat Shedding Characteristics**

Coat shedding characteristics had no effect on HCW (P=0.74, Figure 5-34), AQG (P=0.44, Figure 5-35), REA/100 kg (P=0.40, Figure 5-36), or YG (P=0.35, Figure 5-37). An interaction between hair shedding characteristics and condition score for REA was discussed earlier. Shedding characteristics had no significant affect on any of the carcass traits measured in this study. These data suggest that discrimination on the basis of coat shedding characteristics is unwarranted in relation to carcass characteristics.

**Implications**

Increasing WW and PCADG resulted in an increase in HCW. However, WW and PCADG were not good predictors of AQG. As estimated Brahman percentage increased, HCW and AQG decreased. Increasing calf condition score resulted in lighter HCW. Steers had heavier carcasses than heifers and reported similar YG despite the fact that they had smaller REA/100kg values. Black cattle had lighter HCW, better AQG, poorer YG, and were lighter muscled than other colors evaluated. Color pattern and coat shedding characteristics had minimal effect on any of the carcass characteristics analyzed. These results suggest that differences do exist between biological groups of cattle from a single herd. However, some of the prejudices associated with Brahman percentage, condition score, coat color, color pattern, and hair shedding characteristics are not warranted. Therefore, premiums and discounts associated with these characteristics should be evaluated more closely.
Figure 5-1. Effect of weaning weight on hot carcass weight. Linear regression slope=0.5650, \( P<0.0001 \).

Figure 5-2. Effect of weaning weight on carcass quality grade. Linear regression slope=0.0014, \( P=0.12 \).
Figure 5-3. Effect of weaning weight on carcass ribeye area. Linear regression slope=2.93, $P<0.05$.

Figure 5-4. Effect of weaning weight on carcass ribeye area per 100 kg. Linear regression slope=-0.0394, $P<0.0001$. 
Figure 5-5. Effect of weaning weight in carcass yield grade. Linear regression slope=0.0033, $P<0.001$.

Figure 5-6. Effect of preconditioning average daily gain on hot carcass weight. Linear regression slope=19.4816, $P<0.0001$.  

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Figure 5-7. Effect of preconditioning average daily gain on carcass quality grade. Linear regression slope=0.03, P=0.24.

Figure 5-8. Effect of preconditioning average daily gain on carcass ribeye area. Linear regression slope=3.12, P<0.0001.
Figure 5-9. Effect of preconditioning average daily gain on carcass ribeye area per 100 kg. Linear regression slope=-0.5331, P<0.01.

Figure 5-10. Effect of preconditioning average daily gain on carcass yield grade. Linear regression slope=-0.0514, P=0.29.
Figure 5-11. Effect of estimated Brahman percentage on hot carcass weight. Main effect $P<0.0001$. $a,b,c$ Means with different superscripts differ $P<0.05$. Linear regression slope=-19.5192, $P<0.0001$.

Figure 5-12. Effect of estimated Brahman percentage on carcass quality grade. Main effect $P<0.01$. $a,b,c$ Means with different superscripts differ $P<0.05$. Linear regression slope=0.07, $P<0.10$. 
Figure 5-13. Effect of estimated Brahman percentage on ribeye area. Main effect $P<0.01$. Means with different superscripts differ $P<0.05$. Linear regression slope=-0.9476, $P<0.05$.

Figure 5-14. Effect of estimated Brahman percentage on ribeye area per 100 kg. Main effect $P=0.13$. Linear regression slope=0.0471, $P=0.47$. 
Figure 5-15. Estimated Brahman percentage by condition score interaction for carcass yield grade. $P<0.10$.

Figure 5-16. Effect of condition score on hot carcass weight. Main effect $P<0.01$. $^{a,b}$ Means with different superscripts differ $P<0.05$. Linear regression slope=$-13.4089$, $P<0.001$. 

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Figure 5-17. Condition score by sex interaction for quality grade. $P<0.10$.

Figure 5-18. Condition score by sex interaction for ribeye area. $P<0.10$. 
Figure 5-19. Condition score by hair shedding characteristics interaction for ribeye area. P<0.05.

Figure 5-20. Effect of condition score on ribeye area per 100 kg. Main effect P<0.001. a,b,c Means with different superscripts differ P<0.05. Linear regression slope=0.4361, P<0.001.
Figure 5-21. Effect of sex on hot carcass weight. P<0.0001.  

\[ a, b \] Means with different superscripts differ P<0.05.

Figure 5-22. Effect of sex on carcass ribeye area per 100 kg. P<0.0001.  

\[ a, b \] Means with different superscripts differ P<0.05.
Figure 5-23. Effect of sex on carcass yield grade. P=0.94.

Figure 5-24. Effect of coat color on hot carcass weight. P<0.001. a,b Means with different superscripts differ P<0.05.
Figure 5-25. Effect of coat color on carcass quality grade. P<0.01. \(^{a,b}\) Means with different superscripts differ P<0.05.

Figure 5-26. Effect of coat color on carcass ribeye area. P<0.001. \(^{a,b}\) Means with different superscripts differ P<0.05.
Figure 5-27. Effect of coat color on carcass ribeye area per 100 kg. P<0.05. \(^{a,b}\) Means with different superscripts differ P<0.05.

Figure 5-28. Effect of coat color on carcass yield grade. P<0.05. \(^{a,b}\) Means with different superscripts differ P<0.05.
Figure 5-29. Effect of color pattern on hot carcass weight. P=0.72.

Figure 5-30. Effect of color pattern on carcass quality grade. P=0.63.
Figure 5-31. Effect of color pattern on carcass ribeye area. P=0.30.

Figure 5-32. Effect of color pattern on carcass ribeye area per 100 kg. P=0.55.
Figure 5-33. Effect of color pattern on carcass yield grade. $P=0.80$.

Figure 5-34. Effect of hair shedding characteristics on hot carcass weight. $P=0.74$. 
Figure 5-35. Effect of hair shedding characteristics on carcass quality grade. P=0.44.

Figure 5-36. Effect of hair shedding characteristics on carcass ribeye area per 100 kg. P=0.40.
Figure 5-37. Effect of hair shedding characteristics on carcass yield grade. P=0.35.
## APPENDIX

### DIET COMPOSITION

Table A-1. Feedlot starting ration and finishing ration composition and nutrient profile on a dry matter basis.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Starting Ration</th>
<th>Finishing Ration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaked Corn</td>
<td>32.0%</td>
<td>26.6%</td>
</tr>
<tr>
<td>Flaked Milo</td>
<td>21.5%</td>
<td>26.7%</td>
</tr>
<tr>
<td>High Moisture Corn</td>
<td>0.0%</td>
<td>26.7%</td>
</tr>
<tr>
<td>Distillers Grains</td>
<td>11.1%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>7.3%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Alfalfa Hay</td>
<td>16.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Animal Fat</td>
<td>0.0%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Supplement a</td>
<td>11.9%</td>
<td>6.5%</td>
</tr>
</tbody>
</table>

**Nutrient Composition**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Starting Ration</th>
<th>Finishing Ration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein</td>
<td>16.9%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.00%</td>
<td>0.67%</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.40%</td>
<td>0.35%</td>
</tr>
<tr>
<td>NE(_m), Mcal/kg</td>
<td>2.00</td>
<td>2.24</td>
</tr>
<tr>
<td>NE(_g), Mcal/kg</td>
<td>1.28</td>
<td>1.50</td>
</tr>
</tbody>
</table>

a Contained molasses, urea, vitamin premix, mineral supplements, Rumensin and Tylan.
LIST OF REFERENCES


Micro Beef Technologies. 2006. What is ACCU-TRAC®?


BIOGRAPHICAL SKETCH

Jesse Dan Savell was born in Panama City, Florida, on January 26, 1980, to Hollis B. Savell Jr. and Marilyn I. Savell. He was raised on a small seedstock cattle operation in Chipley, Florida where he was active in 4-H and FFA. Jesse graduated from Chipley High School with High Honors in 1998. The author then attended Chipola Junior College in Marianna, Florida, where he received his Associate of Arts degree. Jesse completed his Bachelor of Science degree, graduating Cum Laude, in Animal Sciences at the University of Florida on August 9, 2003.

After graduation the author was accepted into a graduate program in Animal Sciences at the University of Florida under the guidance of Dr. Todd Thrift. During his graduate program Jesse managed the University of Florida Beef Teaching Unit. The author also served as a teaching assistant for several animal science courses including animal nutrition, cow-calf management, stocker-feedlot management, large animal practicum, and introduction to animal science.