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Comparative Economic Analysis of Beef Calf Preconditioning Programs

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An Honors Thesis

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Abstract

Preconditioning programs are becoming increasingly popular amongst producers as the value of the programs are being recognized and compensated by a market premium; however, limited research in management techniques that are economically favorable for small-scale producers has been done. Furthermore, a gross economic analysis between a commercially available complete and commercially available supplement feeding program has not been performed. Therefore, it was the goal of this study to identify which feeding strategy can be utilized in a small-scale beef preconditioning program most profitably. Angus crossbred calves (n=66) were stratified randomly into one of two treatment groups based on weaning weight. Treatment 1 (T_1) received Purina© Precon™ 5, a commercially available forage supplement in combination with *ad libitum* access to Bermuda grass hay. Treatment 2 (T_2) received Purina© Precon™ Complete, a commercially available complete feed. Calves were weighed weekly over a 28-day period, during which their average daily gain (ADG) was calculated. Main effects of treatment and week were analyzed for ADG using the Proc GLM procedure of SAS 9.4. Treatment differed ($p = 0.04$) for ADG between T_1 (3.27) and T_2 (2.65) ± 0.79. More sick calves were observed in T_1 than T_2 (6 vs. 2) which resulted in more medical expenses. Although T_1 yielded a higher ADG, a $110.10 advantage in economic return was favored by T_2 due to treatment costs. Because of the circumstances of this study and the inconsequential return difference between treatments, the researchers suggest that: in order for small-scale beef cattle producers to achieve greatest economic success within a preconditioning program, additional costs should be minimized and a feeding program, whether complete or supplement-based, should be utilized that best fits the producer's needs.

Introduction

The beef industry plays a pivotal role within American society by contributing in nutritional, environmental, and economic aspects. According to the Beef Checkoff, a mandatory program that has been in place since the 1985 Farm Bill which specializes in stimulating supply and demand measures within the beef industry (The Beef Checkoff, 2017), 10 essential nutrients are provided in beef. Nutrients include vitamins B_6 and B_{12} which support brain function, and niacin and riboflavin which contribute to energy production. Beef is also rich in iron which aids in oxygen utilization. Furthermore, zinc, phosphorus, choline, protein, and selenium are provided which all contribute to maintain the human body and support development (The Beef Checkoff, n.d.). The versatility of useful nutrients provided by beef highlights its importance as a nutritious food product.

As an industry, beef cattle production is a large component that shapes the American landscape. According to a 2012 report published by the United States Department of Agriculture (USDA) Ag Census, over 600,000 farms and ranches within America specialize in beef cattle. Of the 92 million head of cows and calves accounted for on January 1, 2016, 30.3 million head are classified as beef cows (National Cattlemen's Beef Association, 2017). Given the numerical significance of the beef cattle industry in America, it comes as no surprise that the collegiality produced amongst producers is just as important. BEEF, a national publication which provides business and production information for cattle operators, recognizes that ranching families make up a majority of rural communities across the United States. Whether in cow-calf, stocker, market, feedlot, or processing sector of the industry, a definite and crucial social opportunity is made available between beef production operators (Kay, 2014).

Despite popular belief, beef production not only enhances the social community of people, it can also directly impact the environment in a positive manner. Facts About Beef, an

online blog forum for producers sponsored by the Beef Checkoff, published an article relating the importance of the beef industry and its intrinsic management of range aids in prevention of wildfires. Because cattle consume forages and grasses, their natural grazing behavior reduces the concentrations of these "fuel loads" and aids as a wildfire preventative strategy. In states such as California and Washington, wildfires and their resulting consequences have been witnessed due to a combination of drought, high temperatures, and an over-accumulation of fuel loads across rangelands. Therefore, grazing cattle can help reduce potential implications of wildfires by reducing available biomass that fuels such fires. Not only does this help protect the environment and possible wildfire victims, but farmers and ranchers benefit by being able to supply cattle with a nutritious feed source (2015) which ultimately increases the value of beef marketed for consumption.

In order to finalize a concrete understanding of the importance of the beef industry, its role within the United States' economy must be explored. In 2014, the USDA Economic Research Service (ERS) concluded that $88.25 billion was generated in farm gate receipts as cows and calves. Later, in 2015 it was determined that American beef production lied at 23.69 billion pounds, while the value of beef exports totaled $6.302 billion (National Cattlemen's Beef Association, 2017). Beef production systems are responsible for employing millions of Americans and allocating tens of billions of dollars into local, state, and national reserves (Kay, 2014). As an industry, beef production is an important component contributing to an increase in productivity of the American economy.

Although a crucial agricultural industry in terms of the nation's prosperity, many beef cattle producers find it difficult to remain in business. As a whole, the beef industry is cyclical and heavily dependent on weather conditions and feed prices; therefore, it is a high-risk business

in which cattle feeders can suffer potential economic challenges. Due to this and that the price per head to feed decreases as the number of cattle within an operation increases, cattle feeding enterprises favor large-scale productions (Comerford et al., 2013). The fact still remains though that small-scale producers exist that aim to be profitable as well. Because weather is an independent variable within the experiment for raising cattle of high quality and return, other dependent variables such as feed prices and programs can be manipulated as an attempt to maximize positive returns within an operation.

Objective

To better prepare small-scale beef producers for financial success within the industry, this study will conduct an economic analysis comparing two different beef starter programs. By determining whether a commercially available supplement or commercially available complete grain-based feeding program is most profitable, this study will most ideally serve to better equip small-scale producers in making management decisions to help reduce the high-risk associated with beef cattle production. After determining the average daily gain (ADG) of each calf and their respective market value within each treatment group, additional costs of beef production (medical expenses, feed and roughage costs, etc.) will be deducted which will provide a reliable estimate as to which feeding program is most overall economically favorable.

Literature Review

Cattle Classification

There is much diversity within the cattle industry; therefore, classifications of cattle can be determined in a single or combination of ways including: age, breed, and production purpose. Calves can be defined as being with their dam (mother) until approximately six months of age,

when they are weaned (The Beef Checkoff, 2014). Once the calves are weaned, they are collectively referred to as weanlings. Intact males are formerly classified as bulls, castrated males are steers, and females that have not calved are heifers. Depending on their production enterprise, some bulls and/or heifers may be kept back from a calf crop for reproductive purposes while dairy breeds are utilized for milking; however, the majority (75%) are used for beef production (FSIS, 2015).

Out of the 250 plus breeds of beef cattle in the world, less than 20 influence the genetic lines of cattle bred for beef production today. Depending on the breed of cattle, important production factors such as growth rate, reproductive ability, maternal instincts, and meat quality are affected (Greiner, 2009). One of the most popular breeds, Angus, is classified as a commercial beef-type animal because of the high quality and quantity associated with its meat production (FSIS, 2015; The Editors of Encyclopædia Britannica, 2012). Other breeds can be classified as either dairy or dual-purpose, depending on their ability to yield either large amounts of high-quality milk or milk and meat, respectively (Syrstad, n.d.).

The Beef Lifecycle

As of 2014, the Beef Checkoff Program recognized approximately five distinct divisions within the beef industry that mark the varying stages within the lifecycle of cattle produced for market: cow-calf, stocker/backgrounding, feed yard, packing plant, and market. (Jackson, 2014). Before examining the production and economic specifics of any one sector individually, the beef lifecycle should first be reviewed in its entirety to understand how one sector contributes to the "big picture" of beef production.

Cow-calf operations initiate the beef lifecycle by supporting a herd of cows and replacement heifers that are annually bred to either a bull or by artificial insemination. Once the females calve, their offspring remain with them on pasture until they are weaned at approximately six months of age (California Cattlemen's Association, 2013; The Beef Checkoff, 2014). Within a cow-calf operation, producers choose whether to manage a seedstock or commercial herd. Seedstock production entails development of purebred and/or registered cattle for breeding purposes; whereas many commercial operations produce composite breeds (cattle consisting of two or more breeds) to eventually harvest for beef consumption. Both production types are advantageous; seedstock operations contribute most by furthering genetic improvements within the beef industry (California Cattlemen's Association, 2013), while commercial operations benefit from the heterozygosity expressed in their crossbred offspring (Gregory and Cundiff, 1980).

Once weaned, calves may enter one of two stages within the cycle: feedlot or stocker/backgrounding division, which serves as an intermediate step between birth and harvest. In a majority of stocker/backgrounder programs, cattle graze on standing or harvested forages (The Beef Checkoff, 2014) for as few as 30 days (McKinnon and Snodgrass, 2009). However, the California Cattlemen's Association recognizes that grain may need to be added in the diet of calves who are weaned in the fall because of the lower quality of available nutrients within roughage throughout the winter months (2013). This recognition is further supported by Dr. Steve Blezinger, a nutritional and management consultant out of East Texas, who recommends stockers/backgrounders incorporate either a feeding or supplementation program with their grazing dietary plan. By doing so, gains and cattle numbers can be maximized while grazing pressure is relieved from pastures so that forage is still plentiful for future calves (2005).

From stocker/backgrounding operations, nine month-old calves are transferred to feedlots for roughly 140 days (Jones, 2017) where they are fed a high-concentrate diet that supports large numbers of cattle and enables them to reach market weight, approximately 1,000 to 1,350 pounds, within a relatively short time (California Cattlemen's Association, 2013; McKinnon and Snodgrass, 2009). This final step in the beef lifecycle contributes significantly to the high quality and production efficiency of the industry (California Cattlemen's Association, 2013). According to the industry standard, beef cattle usually reach market weight no later than 15 months (McKinnon and Snodgrass, 2009) after which they continue fairly quickly to the terminal position in their lifecycle, harvest. At harvest, the cattle are sent to packing plants where they are slaughtered and the meat is prepared for retail and/or foodservice industries (The Beef Checkoff, 2014; Jackson, 2014).

As early as 1967, another supplemental sector, preconditioning (precon), was identified for its ability to increase return associated with feedlot cattle (Neibergs and Kerr, 2013) and has gained increasing credibility over the past few years. Usually combined with other operations such as cow-calf or stocker/backgrounding, precon programs are important in preparing calves for the next stage of the production process by reducing the stress caused by weaning, introducing the calves to a new environment, and training the calves to consume a grain-based diet. As recognized by Dr. Blezinger, such programs are particularly beneficial in stocker/backgrounding operations to help transition cattle from a roughage to concentrated diet (2005). In an article published by the University of Arkansas Cooperative Extension Service, Dr. Jeremy Powell, an associate professor-veterinarian of the University of Arkansas' Department of Animal Science, notes that preconditioning programs are becoming increasingly popular as a way to increase the value of market beef calves. Such programs are designed to protect the

immune systems of calves undergoing the weaning process and decrease the levels of stress they experience. Although increased labor and start-up costs are associated with these programs, precon operations help train calves to eat from feed bunks and drink from water troughs, and allowing for producers to perform castration and/or dehorning procedures, if necessary. Moreover, precon introduces calves to a health program via vaccinations. By managing the training of calves at such a young age and weaning them in an effective, gentle manner, producers that utilize precon programs better equip their cattle to successfully go into latter sectors of the beef lifecycle. Once they reach the next stage, a majority of preconditioned calves begin to gain weight at a faster rate while retaining their health (n.d.), as opposed to non-preconditioned cattle. This realization increases the value of the calves produced because buyers prefer such thorough management and are willing to pay the premium associated with backgrounded calves. *The Professional Animal Scientist* published a case study supporting this claim, finding that about $14 premium was associated with preconditioned calves in a 45-day post-weaning program while a $40-$60 premium was attributed to feedlot calves. Also, cow-calf producers can individually benefit from utilizing a precon program by establishing a reputation for yielding high-quality cattle, increase value of home-raised calves, and obtaining more income via retained ownership of cattle. Furthermore, the demand for preconditioned beef calves has increased alongside the expansion of value-added beef marketing strategies (Parish et. al., 2010; Dhuyvetter et. al., 2005).

After examining the beef lifecycle in its entirety, it is apparent that the impact of each sector on the industry is significant in terms of the quality and quantity of the final meat product. In particular, the cow-calf operation in conjunction with a preconditioning program can enhance

the economic return and the suitability/future success of calves within the market industry by helping to prepare them nutritionally and behaviorally for final sectors.

Average Daily Gain

A performance mechanism utilized by beef producers to monitor the progress of an individual's herd growth rate, average daily gain (ADG) is the amount of weight (in pounds) an animal acquires per day throughout a specific duration of time. This calculation is obtained by dividing the total amount of weight gained throughout that specified period by the number of days within that period. Therefore, the quotient yields an estimated amount of weight an animal gained or lost each day (Mississippi State University Extension, 2013).

This value is specific for each individual animal within a cattle herd, and as so can be impacted in a variety of ways; primarily through diet, genetics, and environment. The quality/availability/type of forages, grains, and supplements can either enhance or lower quality of the diet for beef cattle. Not only do different breeds of cattle characteristically gain weight at varying rates, but individual genetics are influenced by unique production traits, such as growth rate, which can be predicted in progeny based on the pedigree of that animal. Furthermore, the environment of a herd can impact ADG. For example, heat stress and/or production function (reproductive in cow-calf, weight-gain in beef processing) of an animal in an operation can positively or negatively influence that animal's ADG. Positive values of ADG indicate an increase in growth, while negative values translate to loss of weight, and values of zero mean that an animal was able to simply maintain its weight. By examining this value, beef producers can be better aware of the actual performance of their cattle and can consequently adjust their operation's practices/management to ensure maximal production efficiency (Mississippi State University Extension, 2013).

This study will focus on starting weaned calves from a cow-calf operation through utilization of a supplemental and complete preconditioning program. In either treatment, the ideal intent is that cattle express maximum ADG. By standardizing the genetics and environment of each animal to focus solely on their diet, ADG should be an accurate representation of the effectiveness of either feeding program. However, as recognized by Jane Parish, an Extension Beef Cattle Specialist of Mississippi State University, operational input levels should be accounted for when examining production efficiency because they impact productivity and overall costs of a program (Mississippi State University Extension, 2013). Furthermore, it is recognized that operational input costs consist of fixed and variable expenses such as facilities/equipment and feed, respectively (Ellis and Schulz, 2016). Therefore, an accompanying economic analysis and statistical analysis of ADG will be performed to determine which feeding program- as a whole- yields a higher economic return.

Commercially Available Feeding Programs

Two popular feedstuffs incorporated by precon producers in their feeding strategy are commercially available supplement for forages (supplement) and commercially available complete (complete) feeds. Previous studies have determined that carcass quality grades nor initial tenderness differ among harvested calves that were finished on a higher forage or grain-based diet (Guretzsky et al., 2005; Realini et al., 2004); therefore, the value of finished calves having received either diet does not differ significantly. Differences do exist between each dietary plan as to the amount of grain distributed per head, ingredients, and costs associated with the feeding program. In order for producers to make effective management decisions, these components ought to be sufficiently explored and compared/contrasted.

A 2000 publication from Oregon State University recognized that up to 75% of animal husbandry expenses are associated with feed costs (Pirelli et al., 2000). Therefore, it is the goal in beef production agriculture to invest as minimal operational costs as possible per head while maximizing economic return. In 2008, the German Institute of Animal Science, Physiology and Hygiene Unit of the University of Bonn concluded that operations exercising traditional weaning programs without a starter supplement were not economically favorable. The large feed amount and yardage expenses of producers were not sufficiently counterbalanced by the lower feed costs and price obtained for lower carcass quality (Blanco et al., 2008). According to Washington State University Extension, one of the most critical components of acquiring financial success through utilizing a preconditioning program is proper marketing. Although preconditioning is linked to improved production efficiency, producers will only obtain competitive market prices by advertising their cattle as such. In 2011, a review was published over eleven studies (ranging from 1985-2010) which analyzed the net profit acquired between calves that received some level of preconditioning versus calves that received no preconditioning. Interestingly enough, the review revealed that cattle buyers are willing to pay a premium for preconditioned calves because the associated benefits of preconditioning is recognized and accepted within the industry (Neibergs and Kerr, 2013). Furthermore, different value-incentive programs exist for cattle producers who desire to capitalize within this precon movement. For example, the Oklahoma Quality Beef Network (OQBN) sponsors its own OQBN PRECON program in an effort to increase the number of quality cattle within their state and to provide producers with a market avenue which respects and matches the premium price of preconditioned cattle (Mourer, 2017). In this way, producers can enter/incorporate a precon sector with increased security that they will receive sufficient economic return for their operational inputs. With the knowledge that

starter/preconditioning programs are ultimately economically favorable for producers, the decision of whether to provide a supplement or complete feed must be made.

Commercially available supplement feed programs combine grain and roughage (Siemens, 1996) to support the nutritional needs of beef herds. Because supplement feeds are fed in conjunction with roughage, they are usually dispensed at a lower rate of poundage per head each day in comparison to commercially available complete programs. These complete feeds contain forages and are preferred by many large-scale producers. Effective monitoring for proper intake of concentrate and forage for all calves is provided by this feeding strategy since selectivity amongst feedstuffs is eliminated (Siemens, 1996). Because the recommended intake of both concentrate and forage is contained within complete feeds, a higher amount in pounds is distributed per head each day. Despite their differing distribution rate, both supplement and complete feeds contain essential nutrients required by growing calves.

Supplement and complete feedstuffs for production beef cattle provide the energy, protein, minerals, and vitamins required in their diet (Knox, 1968). Energy works as the first limiting nutrient (Drouillard, 1990) affecting such factors as maintenance, lactation, and fattening. Although some energy can be stored in the form of glycogen or fat (Knox, 1968), a continual source of energy is required to ensure maximal growth and efficiency. Just as important, protein is the most-contributing nutrient to growth and is required for multiple bodily functions- such as reproduction (Knox, 1968) - since proteins exist in multiple forms with many, specialized functions. Finally, minerals and vitamins are essential dietary components that regulate chemical/bacterial changes and biological processes, respectively. Salt, calcium, and phosphorus are minerals needed in the largest quantities (Knox, 1968). Depending on the

provisions of these nutrients in other feedstuffs within a diet, the available levels of each varies per feeding strategy.

In a late 1980s survey conducted by D.G. Landblom et. al., the effect of four different rations on the ADG and gross economic return of early-weaned beef calves was evaluated. The four different rations were comprised of: commercial, home grown oat base, home grown barley base, and commercial/home grown oat base feeds. The calves that received the commercial feed throughout the initial 1/3 of the feeding period following weaning, and then were provided the home grown oat base feed for the remaining 2/3 proved to be most efficient. Yielding a feed to gain ratio of 4.39, these calves generated the highest gross economic return per head- $267.83 (1986). Once again, the benefit of providing weaned calves with a type of preconditioning program is credited. However, the direct economic comparison between utilizing a supplement versus a complete feeding strategy in terms of ADG and total economic return has not been independently studied.

Summary

While cattle can be classified in a variety of ways and mature through multiple sectors of the beef lifecycle, this study will utilize freshly-weaned calves in a small-scale cow-calf operation. In this way, the environment/situation shared by most small-scale beef producers will be mimicked. To better these producers for financial success, a gross economic analysis will be performed comparing the main factors within a beef calf supplement and a beef calf complete grain-based preconditioning program. After comparing the average daily gain (ADG) of both treatment groups, taking into consideration the production costs, and subtracting such costs from the market value of each group, the total return associated with each treatment group can be determined.

Methodology

This experiment was conducted at Texas A&M University-Commerce throughout the month of October in 2016. Funding was authorized by the College of Agricultural Sciences and Natural Resources and Purina Feed Greatness™ Challenge.

Angus crossbred calves of mixed sex were used for this four-week long experiment (*n = 66*; average weight 495 lbs). All were approximately six months in age, current on vaccinations, and weaned utilizing a fence-line method to their mothers. Calves were stratified randomly by Excel Spreadsheet into one of two different treatment groups according to recorded body weight on the day of weaning. Both feeds utilized in this trial, Purina© Precon™ 5 and Purina© Precon™ Complete (Purina Animal Nutrition, Gray Summit, MO 63039), were medicated with chlortetracycline and sulfamethazine. Treatment 1 was fed a commercially available forage supplement, Purina© Precon™ 5, at 5lbs/hd/d, in combination with *ad libitum* access to Bermuda grass hay. Treatment 2 was fed a commercially complete feed, Purina© Precon™ Complete, at 10lbs/hd/d. These feedings were split evenly into a morning/evening schedule for each treatment group. Both treatments received *ad libitum* access to water and shelter throughout the day..

Initially, both treatment groups were housed in smaller pens exhibiting a set-up as that shown in the figures below:

Figure 1. Treatment 1
Week 1 Set-Up

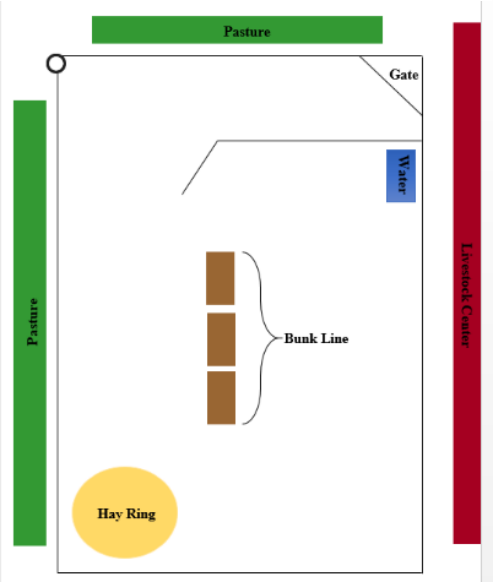
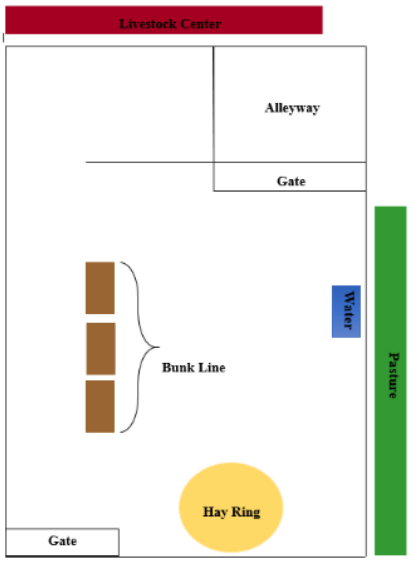


Figure 2. Treatment 2
Week 1 Set-Up



In this way, the health of freshly-weaned calves could be monitored, handlers could familiarize themselves with cattle, calves learned to eat at the bunk and where to find water, and the technique of fence-line weaning could be utilized. Within this week-long period, Treatment 2 was provided a round bale of Bermuda grass hay to help decrease the stress associated with the weaning process. However, hay was removed once the round bale had been consumed; after which, a full transition to a pelleted diet occurred for the remaining three weeks of the study.

Following Week 1, both treatment groups were moved into a larger pasture, respectively. These larger enclosures exhibited a set-up as shown in the figures below:

Figure 3. Treatment 1 Set-Up

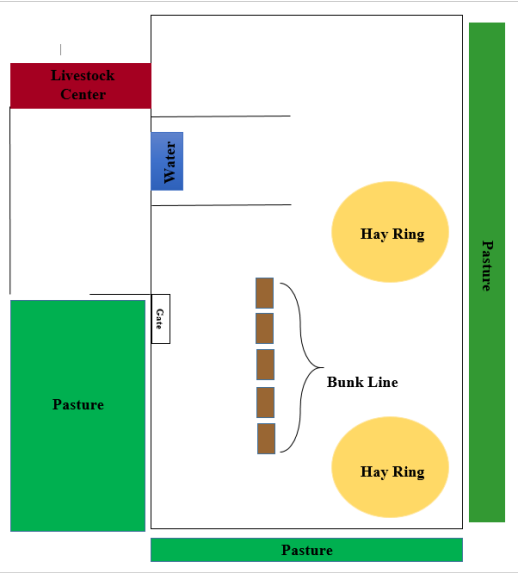
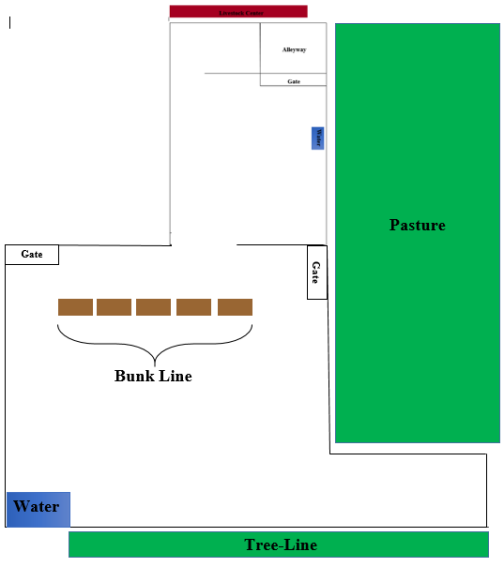


Figure 4. Treatment 2 Set-Up



Any medical illnesses and/or procedures, including their associated costs, were recorded following daily health inspections. Calves that were deemed ill were separated from the main herd in an isolation pen. Following isolation, the University's on-call veterinarian was contacted who performed a health evaluation and prescribed the antibiotic, Draxxin, since the calves were suffering from a mild respiratory disease. This antibiotic was administered daily for a week per calf. Furthermore, each treatment group was worked through a chute system equipped with a built-in scale once a week to record individual weights of calves.

Data was analyzed using Proc GLM Procedure of SAS 9.4 (SAS, Cary, NC 27513) with $p = 0.05$. The model included terms for: treatment and week. By doing so, these independent terms could be related to the dependent variable, ADG, via an analysis of variance (ANOVA). Estimated total market value for each treatment group was then calculated according to the most-current feeder calf price. Total price of each feeding protocol, including additional expenses, was determined by calculating the price of feed, forage, yardage, medicine administered, and

veterinary service received. This calculation was then subtracted from the total market value of each treatment group in order to determine which group, overall, yielded the higher economic return.

Results

Table 1. Total Size and Reported Illness Distribution within Treatment Groups

TREATMENT GROUP	NUMBER OF CALVES	REPORTED SICK
T_1	33	6
T_2	33	2

Table 2. Weekly Weight Average Comparisons between Treatment Groups

WEEK	GROUP	AVERAGE (LBS)	STANDARD DEVIATION (LBS)	MINIMUM (LBS)	MAXIMUM (LBS)
1	T_1	493.21	99.64	310	760
1	T_2	496.76	79.60	281	656
2	T_1	497.33	97.81	303	770
2	T_2	495.06	73.83	296	648
3	T_1	540.27	102.50	344	816
3	T_2	502.58	76.39	292	660
4	T_1	561.91	104.20	364	850
4	T_2	552.55	84.81	320	732

Figure 5. Weekly Weight Average Comparisons between Treatment Groups

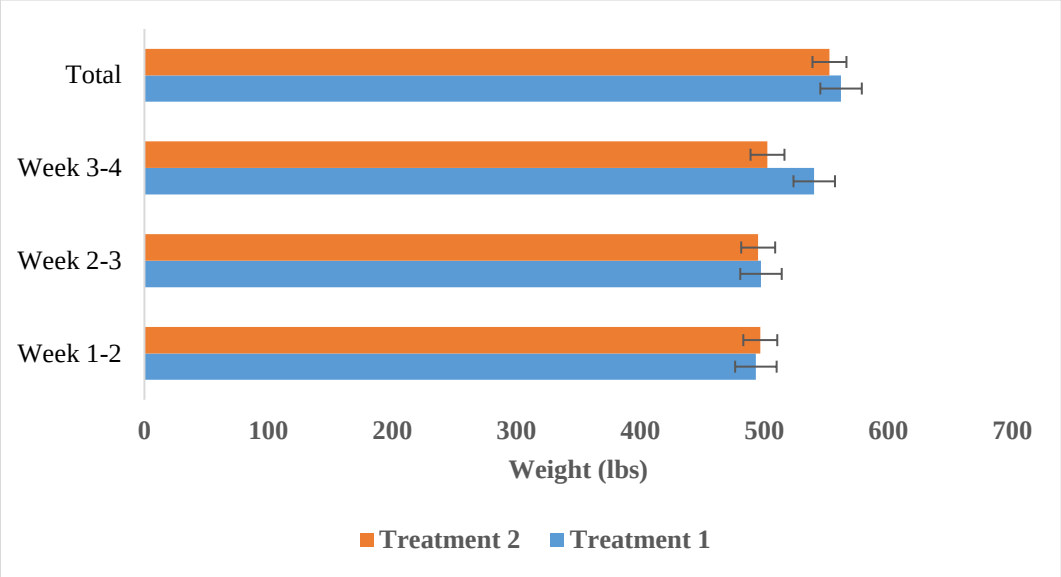


Table 3. Weekly Average Daily Gain Comparisons between Treatment Groups

WEEK	GROUP	ADG (LBS)	STANDARD DEVIATION (LBS)	MINIMUM (LBS)	MAXIMUM (LBS)
1-2	T_1	0.59	6.08	-19.57	21.14
1-2	T_2	-0.24	2.16	-4.43	5.57
2-3	T_1	6.13	2.22	-2.00	12.57
2-3	T_2	1.07	2.57	-5.29	5.14
3-4	T_1	3.09	1.64	-0.57	6.57
3-4	T_2	7.14	2.73	2.71	14.29
TOTAL	T_1	3.27	2.13	-3.71	9.52
TOTAL	T_2	2.66	1.33	1.33	4.57

Figure 6. Weekly Average Daily Gain Comparisons between Treatment Groups

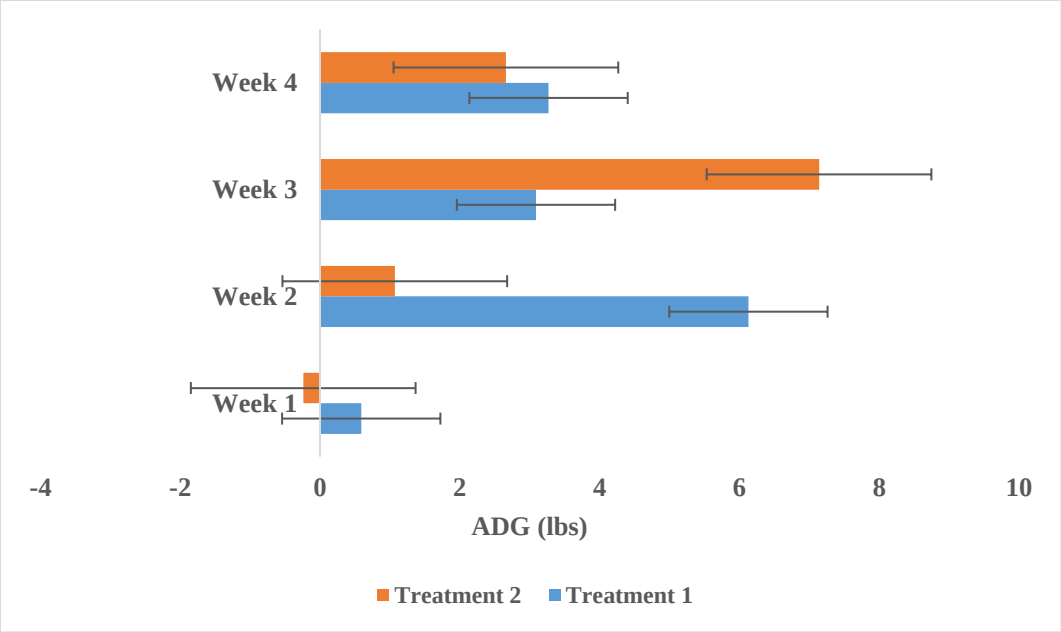


Table 4. Proc GLM Analysis of Main Effect Statistical Significance

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Treatment	1	47.77	47.77	4.46	0.0400
Week	3	846.07	282.02	26.32	< .0001

Table 5. Tukey's Pair-Wise GLM Analysis of Weekly ADG Statistical Significance

Week	Tukey Grouping	Mean	N
1	C	0.1736	66
2	B	3.6035	66
3	A	5.1144	66
4	B	2.9633	66

Table 6. Current Feeder Calf Market Price Value of Treatment 1 and Treatment 2

Treatment 1	Treatment 2
$27,814.55	$27,351.23

Table 7. Treatment 1 and Treatment 2 Cost Implementation Comparison

Cost Factor	Treatment 1	Treatment 2
Precon Feed ([1] $15/50# bag) ([2]$10/50#bag)	$1,395.00[1]	$1,850.00[2]
Yardage ($0.30/head)	$277.20	$277.20
Roughage ($0.50/head)	$485.10	$121.28
Medicine ($21.95/dose)	$921.90	$307.30
Veterinarian Visit ($100)	$75.00	$25.00
Total	$3,154.20	$2,580.78

Table 8. Treatment 1 and Treatment 2 Return Comparison

Economic Variables	Treatment 1	Treatment 2
Feeder Calf Market Price	$27,814.55	$27,351.23
Cost Implementation	$3,154.20	$2,580.78
Return	$24,660.35	$24,770.45

Discussion

After performing the study, analyzing collected data, and gathering the economic information associated with each treatment group, it was determined that T2 which received the commercially complete feed, Purina© Precon™ Complete, yielded a higher gross return of $110.10 (Table 8). Although T1 which was fed out the commercially available forage supplement, Purina© Precon™ 5, consistently weighed more (Table 2 and Figure 5) with greater ADG values (Table 3 and Figure 6) than T2 ($p = 0.05$), impact of illness (T1 = 6 sick calves; T2 = 2 sick calves) and corresponding cost of medical treatment (Table 7) outweighed the greater feeder calf market price associated with this group (Table 6).

According to Proc GLM Procedure performed on the main effects of the study in Table 4, both independent variables Treatment ($p = 0.0400$) and Week ($p = <0.0001$) were different. Both the assigned treatment group and the four different weeks within the study impacted the ADG performance of the beef calves. However, no significant difference existed between the overall ADG recorded for each treatment group (T1 = 3.27; T2 = 2.66). While this analysis points to the conclusion that treatment groups performed similarly with respect to average weight gain, Table 5 shows that some variation did exist from week to week (Week 1 = C; Week 2 = B; Week 3 = A; Week 4 = B). Such variation can be attributed to external factors. In Week 1, calves were undergoing the fence-line weaning process, were subject to unfavorable weather, and all ill calves were identified and treated within this time frame. While Week 2 and Week 4 experienced no significant ADG differences ($p = 0.05$), Week 3's greater ADG can be attributed to the following factors: calves were fully-accustomed to eating at the bunk, ill calves were recovered therefore overall herd health was greater, and protocol of each feeding regime was fully-implemented (i.e. no Bermuda grass hay for Treatment 2 following Week 1). In conclusion, although the main effects of this study were significant in how they impacted ADG, the overall ADG differences expressed by each treatment group was not.

In light of this conclusion, an analysis of the cost associated with each treatment group in this study served as a measure to evaluate their effectiveness. Once the current market price for feeder calves (approximately $1.50/lb.) was identified, estimated price of selling each treatment group at an auction was determined (T1 = $27, 814.55; T2 = $27,351.23). This total worth was then compared to implementation costs associated with each group (T1 = $3,154.20; T2 = $2,580.78), such as yardage, roughage, grain, and medical bills. While most costs were similar across treatment groups, both were housed on the University farm and received the same-quality

hay, differences arose in the amount of hay provided, type and amount of grain utilized, medicine doses, and amount of veterinary service received. Therefore, difference between total worth and program costs was calculated (T1 = $24,660.35; T2 = $24,770.45), with T2 proving to be more economically favorable than T1.

Because this study's primary focus was to identify which type of preconditioning feed program yielded the greatest economic benefit for small-scale producers, it is the researchers' recommendation to utilize either a commercially available complete or forage supplement feed and take precautionary measures in terms of illness prevention. Although neither ADG value of T1 nor T2 differed significantly (T1 = 3.27; T2 = 2.66), Table 4 and Table 5 reflect that independent variables evaluated in this study do exert a significant impact ($p < 0.05$). Therefore, for a more conclusive focus of future studies, regarding the economic effectiveness of complete versus supplement preconditioning feeding programs, the researchers pose the following suggestions: account for calf sex and age during randomization, perform such studies over a longer period of time, maintain records accordingly, and check the accuracy of the scale utilized for weighing calves frequently. While reviewing the model and results, it was observed that more male calves were in T2 versus T1 which may have impacted observed weight gain and ADG values of the treatment groups. Furthermore, large values for standard deviation, minimum calf weight, and maximum calf weight were observed in Table 2 and Table 3; such differences could be attributed to the different ages of the calves. Also, because week to week differences in ADG proved significant in Table 5, a longer study duration may find that such differences between treatments become more evident leading to a determination of the most appropriate type of feeding strategy for producers, or determine if compensatory gain influenced T2. Finally, ensuring to maintain detailed observations and checking the quality of the equipment utilized

(i.e. digital scale) are important practices that can be overlooked in field trials; however, will impact the accuracy of data collected.

Conclusion

In conclusion, it was determined that the Treatment 2 group which received the commercially complete feed, Purina© Precon™ Complete, produced a higher gross return of $110.10 than Treatment 1 which received Purina© Precon™ 5, a commercially available forage supplement. By performing an analysis with Proc GLM and Tukey's Pair-Wise Procedures, it was further determined that: while the main effects of Treatment and Week exerted a significant impact on the study model, overall ADG value of each treatment group was not different. Therefore, additional production costs of each program, specifically medical bills, had a great impact on the economical effectiveness of each treatment group. In order for small-scale beef producers to succeed in utilizing a preconditioning program, such additional production costs should be as minimized as possible and the feeding program that best suits the producer's needs should be utilized.

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