ESTIMATES OF EFFICIENCY OF DORPER AND RAMBOUILLET LAMBS

A Thesis

Presented to the

Faculty of the College of Graduate Studies

Angelo State University

In Partial Fulfillment of the

Requirements for the Degree

MASTER OF SCIENCE

By

Jessup Yeaman

May 2011

Major: Animal Science

ESTIMATES OF EFFICENCY OF DORPER AND RAMBOUILLET LAMBS

by

JESSUP CLAYTON YEAMAN

APPROVED:

Dr. Dan Waldron

Dr. Micheal Salisbury

Dr. B. Frank Craddock

Dr. Gil Engdahl

Dr. David Scott

April 8, 2011

APPROVED:

Dr. Brian May
Dean of the College of Graduate Studies

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to my committee members, Dr. Dan Waldron, Dr. Mike Salisbury, Dr. Frank Craddock, Dr. Gil Engdahl, and Dr. David Scott for their guidance, assistance, and encouragement throughout the course of this project. I would like to especially thank my thesis advisor Dr. Waldron for his invaluable assistance not only with the project itself, but with the preparation for my defense. Additionally, special thanks to Tim Willingham and the rest of the staff at the Texas AgriLife Research and Extension Center in San Angelo, TX for all their work. Most importantly I would like to thank my entire family, especially my parents, for their all their support, love, and my Christian upbringing.

ABSTRACT

Feed intake and body weight were recorded on thirty-seven Dorper ram lambs and forty-two Rambouillet ram lambs from weaning to 61kg of body weight to determine feed conversion efficiency. The data were collected over a two year period. Lambs were progeny of 6 unrelated sires per breed. Lambs were approximately 90 days of age and 31kg body weight at the start of the trial. Lambs were fed a commercially prepared, pelleted diet with an average crude protein content of 16% and TDN of 70.5%. Lambs were divided into groups of 10-11 containing both breeds, and fed using FIRE (Feed Intake Recording Equipment, Osborne Industries, Inc, Osborne, KS, USA). Lambs were identified using a unique electronic identification ear tag transponder. Feed intake was recorded electronically and lambs were weighed every two weeks. Data were analyzed using SAS PROC MIXED with a model that included breed and birth type as fixed effects, a random effect for sire, and starting weight as a covariate. In both years of the trial, breed was not found to have a statistically significant effect on ADG or FCE ($p>0.05$). Post weaning feed efficiency was similar between Dorper and Rambouillet lambs. The Dorpers' total ADG was 340 g/d; the Rambouillets' was 342 g/d. The Dorpers' average FCE was 0.159; the Rambouillets' was 0.158. Over the post weaning period studied there was no advantage shown by either breed.

TABLE OF CONTENTS

Page

LIST OF TABLES

INTRODUCTION

Feed conversion ratio, or feed efficiency, plays a vital role in modern day food animal production systems. According to Elstein (2002), feed expenditures account for roughly 60 percent of total production cost of cattle and sheep. Livestock use the feed they receive to support their basal metabolism, to maintain their current weight, and to grow (Elstein, 2002). Efficiency in converting feed into weight gain is paramount in making a profit versus taking a loss for feed yard operations. This raises many questions as to which breeds of animals perform better in these situations.

In terms of ovine production, the American Southwest has long had a favorite breed in the Rambouillet, a dual purpose/product sheep known for its wool production, and mothering ability. Since the early 1990s the Dorper has rapidly gained popularity with its reputation for hardiness, low inputs, and minimal labor requirements. According to the American Dorper Sheep Breeders' Society, 50,606 Dorpers have been added to the breed registry since 1996, making it the fourth largest sheep registry in the country. The Dorper is a composite breed developed in South Africa from crosses of Dorset Horn and Blackhead Persian in the 1940s for slaughter lamb production (Wildeus, 1997). This hair type sheep does not require shearing. With wool prices being consistently low for the last 15 years, these sheep offer an attractive alternative for lamb production in the Southwest, without the added requirement of shearing and marketing low-valued wool.

Journal of Animal Science

It is becoming increasingly clear that the Dorper has a place in the broad scope of production. Both the Dorper and Rambouillet have much to offer, however there has been little research done comparing the two breeds, and presumptions and opinions are widespread. Therefore, the purpose of this study is to provide sheep producers an objective estimate of the difference in feed efficiency between Dorper and Rambouillet lambs.

OBJECTIVE

The objective of this study is to provide producers an objective estimate of difference in post weaning feed conversion efficiency between Dorper and Rambouillet lambs.

LITERATURE REVIEW

The Rambouillet is a finewool breed that is well adapted to rangeland conditions and typically does well in arid and semi-arid environments. They have traditionally been touted for their longevity, hardiness, and mothering ability. The Rambouillet was originally developed in France from the Spanish Merino in 1786 and was first imported into the United States in the mid 1800s. Today the breed is the base of most range flocks in the western United States. The Rambouillet is a white-faced, mid-to-large size breed whose mature ewes generally weigh between 64-86 kg and produce high quality grease fleeces weighing 4-6 kg, and measuring 19-24 microns in fiber diameter (Bradford, 2003). The Rambouillet has historically offered two economically important products, wool and lamb. However, in the last 15 years, wool has been on a downward trend in terms of both demand and price. With no obvious reversal of this trend in sight, selection within the Rambouillet breed has increasingly leaned towards lamb production.

The Dorper is a hair/shedding type sheep developed in the early 1940s in the Karoo region of South Africa. The breed originated with the crossing of the Dorset Horn and the Blackhead Persian and was introduced to the United States in the early 1990s (Milne, 2000). Since their development, the Dorper has become a popular sire breed for meat characteristics in South Africa with an estimated population exceeding seven million for the breed (Snowder and Duckett, 2003). They are solid white in color, or white with black heads, and mature ewes weigh from 77-90 kg. They are hardy, adaptable sheep that do well under both extensive and intensive production systems. The Dorper is also a highly fertile breed that has extended breeding seasons and demonstrates good mothering ability (Bradford, 2003). These sheep have been selected for a predominantly hairy coat, although many animals have fleeces containing a mixture of wool and hair fibers (Cloete et al., 2000). Shedding of wool in summer or following lambing is common, and shearing is not normally required. Also, their underbelly is always clean and free of wool. This eliminates the need for crutching. Dorpers are early maturing sheep that grow rapidly and yield muscular, high quality carcasses. Schoeman (2000) reported mean weaning weights for Dorper lambs of 16 to 17 kg at 50 days and 26 to 32 kg at 100 days and that Dorper lambs were usually equal, or superior, in weaning weight to lambs of contemporary breeds including the Merino, Dohne Merino, Mutton Merino, and Afrino.

The introduction of the Dorper has caused much excitement in the sheep industry. Lupton (2008) reported that the Dorper currently is receiving increased attention from researchers and producers alike. It appears to have potential as an "easy-care" breed that does not require shearing and is superior in conformation and muscling relative to other hairsheep breeds. The Dorper is also well adapted to the arid conditions typical of the American Southwest. With the breed’s introduction to the U.S. there has been an intense interest in the possibility of raising high percentage lamb crops, without the need for annual shearing and crutching. This breed appears to be capable of producing fast-growing lambs with good carcasses under grazing conditions.

However, the introduction of the Dorper has also received opposition and antagonism. Many traditional ranchers are opposed to the Dorper because of its shedding. This shedding of hair contaminates the traditional Rambouillet clip and causes the wool to be docked in price. Thus the two breeds cannot be utilized in the same pastures simultaneously. Also there are discrepancies between the two breeds’ carcass traits. The Dorper is a smaller framed sheep, and matures more quickly than typical Rambouillets (Bradford, 2003). To feed a Dorper lamb to the typical finish weight of a traditional Rambouillet can result in excessive amounts of fat tissue deposition. Cloete et al. (2000) characterized the Dorper as early maturing and capable of depositing excess fat at an early age. In South Africa, Dorper lambs are usually slaughtered at 32 to 35 kg to avoid excessive fatness (Cloete et al., 2000).

The Rambouillet and Dorper are both breeds that provide positive traits. The Rambouillet offers the dual purpose of wool and lamb production. In turn, the Dorper represents a lamb product with the added benefit of low maintenance. If we compare the two breeds in a specific study, we should be able to provide real differences in performance that might influence producers’ decisions. Feed conversion ratio is a measure of feed efficiency and is modernly defined as output divided by input, or gain/feed. This equation can be pivotal for producers and feeders. In this study, an attempt will be made to provide an objective estimate of difference in feed conversion ratio between Dorper and Rambouillet lambs.

According to Notter et al. (1984), effective use of breed differences requires knowledge of the growth patterns and feed efficiency of available breeds over a range of feeding levels and physiological intervals. Also, formulation of within-breed selection programs requires knowledge of the extent to which genetic variation in the efficiency of nutrient utilization exists independently of variation in factors such as mature size, degree of maturity, composition of the body, gain, and relative level of feed intake. He reported different gain/feed ratios and rankings for Rambouillet, Dorset, and Finnsheep lambs during different physiological intervals in a breed comparison study. The intervals included 35 to 140 days on feed, 22 to 38 kg of body weight, 12 to 26% body fat, and 44 to 70% mature size. Rambouillet lambs gained 0.125 kg/ kg of feed from 35 to 140 days on feed. Rambouillet lambs gained 0.172 kg/ kg of feed from 22 to 38 kg of body weight. The difference between these estimates is an example of the need for careful choice of feeding interval used for comparison.

Koch et al. (1963), evaluated feed efficiency in beef cattle through different weight ranges, such as 136 to 272, 181 to 318, or 227 to 363kg. He states that for fair comparisons the measure of efficiency must take into account differences in the weight at which various animals were evaluated. In the study's data, feed efficiency was considered a function of gain, feed consumption, and average weight while on test.

Some research shows benefit in measuring gain and feed consumption at other intervals or feeding periods. For instance, Robison and Berruecos (1973) used an age (76 days) to weight (93.5 kg) (AW) interval, weight (45.5 kg) to weight (93.5 kg) (WW) interval, and age (83 days) to age (130 days) (AA) periods for swine. Feed/gain, gain/feed, and average daily gain were then evaluated for the three periods.

Snowder and Van Vleck (2003), state that an increase in profitability of lamb production is dependent on reducing input costs and/or increasing production output. Because a large number of lambs in the United States are conditioned for slaughter in feedlots, cost of feed is an important economic input factor whereas lamb growth rate is an important economic output factor. Any reduction in feed intake or increase in feed efficiency without compromising growth rate or carcass quality can have a significant positive economic impact on lamb production. In the 6 year study Targhee lambs were individually performance-tested each year for postweaning ADG and feed conversion ratio (gain/feed intake) for a 14-wk period and BW was measured every two wks.

When comparing Texel and Suffolk sired crossbred lambs, Leymaster and Jenkins (1993) used fixed time periods for different groups of lambs in trials. They slaughtered individual groups as the groups' average ages reached 63, 105, 147, and 189 days respectively; with approximately one quarter of the lambs being slaughtered at each intended age. The study focused on survival, growth, and compositional traits. At these fixed ages, area of the longissimus muscle did not differ between the Suffolk and Texel breeds. Texel progeny weighed less at 189 d of age, and produced lighter, leaner carcasses of shorter length ($p < .05$). Compositional differences were not detected when sire breeds were compared at 25 kg of carcass weight. However, Texel progeny had significantly greater depth of fat at the 12th rib and weight of kidney-pelvic fat. Data indicated that Texel sired lambs deposited proportionally more subcutaneous and less intermuscular fat than did lambs by Suffolk sires.

Brown et al. (1987) reported post weaning feed efficiencies (gain/feed) during fixed time periods of 0.137 and 0.149 for two lines of Targhee lambs in 1985 and post weaning feed efficiencies of 0.160, 0.172, and 0.163 in three lines of Targhee lambs in 1986.

Efficiency of feed utilization in lambs was observed by Phillips (1936). In his experiments lambs were individually fed over a fixed time period in order to measure feed efficiency. He states that the differences in the response of animals of the same age, size, condition, and type when placed in the feedlot are due to individual variations in appetite, ability to utilize feed efficiently, ability to secure a full share of the daily ration, and perhaps other factors. The total individual differences in the efficiency with which animals are able to utilize feed for gains in weight as a result of all these factors are quite large; too large to be overlooked by producers in selecting their breeding animals.

Lewis and Emmans (2010), collected data over a five year period on groups of both sexes of Suffolks, purebred Scottish Blackfaces, and their reciprocal crosses. Once the lambs in the study reached their targeted weaning weights, they were put on one of six different quality diets. These lambs were fed twice a day with a feed allowance large enough that there were always refusals, and intake was recorded on an as fed basis. This intake as affected by body weight, sex, breed, and feed composition was studied, with special focus on reducing the variation present by using genetic size-scaling rules.

Casey et al. (2005), identified errors and factors associated with errors in data from FIRE feeders used for swine. The FIRE feeders in the study were used to automatically measure individual feed intake on group housed pigs, and the resulting data was used to identify errors caused by feeder malfunctions and animal-feeder interactions. To identify errors in individual visits, thresholds were assigned to variables related to feed intake, occupation time, and feeding rate per visit, and to consistency of weight and time data between subsequent visits in time. Although error rates were affected by feeder, pig, weather, day within the test period, and sex, management of the feeder seemed to be the main factor. They felt that feeder management was so vital to data quality, a helpful list of problems and recommendations, which can be used to ensure proper functioning of electronic (FIRE) feeder was included in the results. The results of the study indicated that the frequency of errors in data from the FIRE feeders is substantial, but visits with errors can be identified and their frequency can be decreased by proper feeder management.

Cammack et al. (2005), estimated genetic parameters for feed intake, feeding behavior, and average daily gain in ½ Colombia, ¼ Hampshire, and ¼ Suffolk ram lambs using Pinpointer feed units. These feed units operate much like the FIRE feed systems, utilizing radio transponders and allowing measurement of feed intake by individual lambs while penned in a group. The ram lambs in the study were grouped 11 per pen for three years, and nine per pen for seven years. Ram lambs approximately 11 to 17 wk of age were weighed seven times at weekly intervals during the time they were in Pinpointer units. Traits analyzed were: daily feed intake, event feed intake, residual feed intake, daily feeding time, event feeding time, number of daily feeding events, and average daily gain. Data were edited to exclude invalid feeding events, and approximately 80% of the data remained after edits were applied. There were six rules used to edit the data: 1) deletion of all records of ram lambs that did not complete the trial or were unhealthy; 2) deletion of nonpositive feed-intake measurements; 3) assignment of some unidentified feeding records to specific ram lambs and deletion of other unidentified records; 4) deletion of feeding event records with exceptionally large values for event feed intake (over 1,360.8 g) ; 5) deletion of feed records with excessive rates of feed intake; and 6) adjustment of time value for extremely short or long feeding events(15 seconds and 2,400 seconds). Feed intake traits of daily feed intake and event feed intake had estimated heritabilities of 0.25 and 0.33, respectively, whereas estimated heritability of residual feed intake was 0.11. Heritability estimates for feeding behavior traits, including daily feeding time, event feeding time, and daily feeding events, ranged from 0.29 to 0.36. Average daily gain had an estimated heritability of 0.26.

Jenkins and Leymaster (1987) studied feeding behavior characteristics of intact male rams in two experiments that utilized a feeding system similar to FIRE. The ram lambs in their experiments averaged 65 d of age and 36 ±1.6 kg at the beginning of experiment 1, and 100 d of age and 41 ± 1.3 kg for experiment 2. The lambs were composites consisting of ½ Columbia, ¼ Hampshire and ¼ Suffolk. In each experiment, 72 ram lambs were randomly assigned to treatments (pens) with 3, 7, 11 or 15 rams/pen. Although not significantly affected by treatment, as the number of lambs housed in a pen increased, the length of time/visit(s) tended to increase. As the number of lambs/pen increased, the number of visits and time spent feeding/lamb decreased. However, weight gains during the test intervals for both experiments were not affected by number of lambs/pen. They state that if the objective of a study required non-restriction of feed intake or other measures of production associated with full expression of feed intake, moderate levels of animal numbers (9 to 11 animals/pen) would be required.

Varying protein sources provided to different breeds of lambs were considered by Fahmy et al. (1992). The lambs used in his study were evaluated in a fixed weight range.

They were fed from an initial weight of approximately 23 kg to a slaughter wt of approximately 43 kg and lambs were divided and fed the same basal diet, with varying sources of protein. Data were collected on body weight at 14 d intervals (mainly to monitor rate of gain) and on feed consumption daily for 96 d from the beginning of the feeding test. Because some lambs were heavier at the beginning or gained faster than others on feed, they reached the assigned slaughter weight earlier; accordingly, not all animals completed 96 d on test and number of animal-days was calculated and used to obtain feed conversion ratio. In terms of source of protein the study showed only small differences in gain.

Energy levels of feeds were also taken into consideration in the present study. Energy is the most important nutrient in the sheep diet (Bradford, 2003). Feeds with higher energy and higher total digestible nutrients will result in higher average daily gains and improve the gain/feed ratio. However, excessive energy consumption can lead to a decrease in efficiency due to excessive fattening, and thus reduce growth rate.

According to Terrill (1953), the determination of relative economic value of traits emphasized in breeding and selection is a fundamental problem of animal breeders. This problem can be attacked by obtaining the relationship of sale price to merit of animals sold, since the buyers' willingness to pay more for animals of greater apparent merit in specific traits is one measure of the worth of these traits. Profitable animal production depends on income and expenses. Factors such as growth and carcass composition affect income. Expenses such as feed costs can be decreased when feed efficiency is improved. More productive animals can positively influence profit with improved feed efficiency and feed conversion ratio.

MATERIALS AND METHODS

Animals.

From 2003-2005, approximately 100 Dorper ewe lambs were acquired from 20 flocks from 10 different states: Oregon, South Dakota, Minnesota, Iowa, Missouri, Ohio, Kentucky, Oklahoma, Arizona, and Texas. Approximately 100 Rambouillet ewe lambs were acquired from 13 Texas flocks. These groups were kept in the same environment and were mated to produce crossbred lambs in the spring in an annual lambing management system. Up through the 2007-2008 production year, all ewes had been mated to Suffolk or Composite rams to produce terminal-cross lambs. Starting with the fall 2008 mating, ewes were mated to fullblood sires of their respective breeds. Ewes were mated in single-sire breeding pastures from August 20, 2008 to September 25, 2008 and from August 18, 2009 to September 29, 2009. Three rams per breed were used as sires each year. Cleanup rams were with the ewes from October 1 to October 22, in 2008 and from October 6 to October 28 in 2009. Lambs were born between January 14 and March 12, in 2009 and January 12 and March 23 in 2010. Only lambs born to the single-sire matings were used in the postweaning feeding trial. Thus, the lambs in the postweaning study were born between January 14, and February 17 in 2009 and January 12 and February 17 in 2010. The ewes were grazed on oat fields during lactation and lambs were weaned April 14 in 2009 and April 16 in 2010. All male lambs were left intact, docked at the distal end of the caudal fold, and vaccinated with a *Clostridium perfringins* types C and D and tetanus vaccine, at 1 or 2 d of age. A second CD & T vaccination was given within 3 days after weaning. Lambs were vaccinated with soremouth vaccine at approximately 6 wk of age.

Table 1 shows the mean and standard deviation of age and weight of the lambs at weaning for both 2009 and 2010. As shown in the table, the Dorper lambs were slightly older, and heavier at weaning in both years of the trial.

Table 1. Mean and standard deviation of age and weight of Dorper and Rambouillet ram lambs at weaning.

Year=2009	Dorper N=24	Rambouillet N=26
Age, d	79.5 ± 4.4	75.7 ± 6.6
Body Weight, kg	27.9 ± 3.1	26.6 ± 3.4
Year=2010	Dorper N=27	Rambouillet N=26
Age, d	77.9 ±10.4	72.2 ± 7.9
Body Weight, kg	26.7 ± 4.7	25.7 ± 4.2

Feed Recording.

The lambs were placed on feed test using FIRE (Feed Intake Recording Equipment, Osborne Industries, Inc, Osborne, KS, USA). The feeders operated by recognizing individual lambs via an ear tag transponder, which carried a unique electronic identification. The FIRE feeders consisted of a feed trough, a load cell, and receiving equipment to identify the radio signal from the tag transponder carried by the lambs (Hyun and Ellis, 2002). These electronic feeders allow access to feed ad libitum 24 h per day, but were equipped with a protective crate, or race, that only allowed one lamb to eat at a time. This crate was at the entrance of the feeder and protected lambs on all sides except the rear. When a lamb entered a feeder, the time, the weight of the feed trough, lamb identification number, and feeder number were recorded. Upon exiting the feeder, weight of the feed trough and time were recorded again. In brief, only one animal could consume feed at a given time, and feed consumption was monitored throughout the day. Each animal was identified upon entering the feeding unit and feed was weighed at entry and exit, with measurements of any feed dispensed during the animal's occupancy of the feeder (Gipson et al., 2006). The data were stored electronically at the feeder until it was downloaded to a computer daily. This allowed feed intake to be measured on an individual basis. The individual lambs were weighed approximately every two weeks in order to determine feed efficiency.

Male lambs were split into groups of 10 by bodyweight and assigned to 4.6 m x 9.0 m feed pens with free access to water as well as shade. These groups of 10 contained lambs of both breeds, and were strategically combined to include lambs most similar in size, but different in sire.

Initially the lambs were allowed an adaptation period of 2 wk in order for the lambs to become accustomed to the feeders. During this time the lambs' feed intake was measured and monitored. Lambs were fed a commercially prepared pelleted diet to eliminate sorting. The diet had a minimum of 12% crude protein. This feed was tested to ensure correct protein levels twice each year. In addition, the energy content of the feed used in the study was tested and monitored. The lambs were individually removed from the study when they reached a finish weight of 61 kg.

The pelleted feed was analyzed by the Dairy One forage testing laboratory in Ithaca, New York., twice each year of the trial. In 2009, the first feed sample was rated at 19% crude protein and had total digestible nutrients of 72%. The second feed sample in 2009 was rated at 14.2% crude protein and 70% total digestible nutrients. When the feed was tested the first time in 2010 the results showed a crude protein level of 16.9% and total digestible nutrients of 70%. The analysis of the second sample in 2010 showed crude protein at 13.7% and total digestible nutrients of 70%. The crude protein values for both years of the trial consistently exceeded the minimum protein contents of the pelleted feed, and the level of total digestible nutrients was very consistent. In 2009, the feed had a mean crude protein level of 16.6% and mean total digestible nutrients of 71%; in 2010 the mean crude protein level was 15.3% and mean total digestible nutrients were 70%.

Table 2 shows the mean and standard deviation of weight of the lambs by breed at each weigh date for the 2009 portion of the trial.

Table 2. Mean and standard deviation of weight of Dorper and Rambouillet ram lambs at weigh dates for 2009.

Year=2009	N	Dorper Mean Body Weight, kg	N	Rambouillet Mean Body Weight, kg
4/17	24	27.7±2.5	26	26.8±3.5
4/27	24	28.6±2.9	26	27.6±3.4
4/30	24	30.1±3.4	26	29.2±3.5
5/4	24	32.3±3.0	26	31.4±3.5
5/11	22	34.1±3.1	26	33.2±3.9
6/1	23	41.9±4.2	26	40.8±4.1
6/15	23	46.6±3.8	26	46.2±4.3
6/29	23	51.3±4.2	26	50.9±4.2
7/13	23	56.1±4.9	26	55.9±4.5
7/20	23	57.7±4.9	26	57.5±4.3
7/27	17	58.5±3.7	19	58.7±3.4
8/3	17	59.7±4.1	19	60.9±3.9
8/11	16	62.1±5.1	18	62.9±3.0
8/17	5	58.2±5.3	5	60.9±0.5
8/24	5	61.0±5.3	5	61.2±1.6
8/31	5	62.9±4.9	5	63.8±3.0

Table 3 shows the mean and standard deviation of weight of the lambs by breed at each weigh date for the 2010 portion of the trial.

Table 3. Mean and standard deviation of weight of Dorper and Rambouillet ram lambs at weigh dates for 2010.

Year=2010	N	Dorper Mean Body Weight, kg	N	Rambouillet Mean Body Weight, kg
4/22	27	29.3±5.1	26	27.7±4.3
4/29	27	30.9±5.3	26	28.9±4.2
5/13	27	36.5±5.6	26	34.8±5.4
5/20	27	39.2±5.9	26	37.5±5.0
6/3	27	46.5±6.4	26	34.7±6.2
6/10	27	46.5±6.4	26	44.7±6.2
6/17	27	48.3±6.6	26	46.6±6.2
6/24	27	50.9±6.7	26	48.9±6.2
7/2	27	52.6±6.5	26	50.8±6.3
7/9	27	55.9±7.0	26	53.9±6.1
7/16	27	57.6±6.5	26	55.9±6.1
7/23	27	59.7±6.5	26	57.5±6.0
7/26	27	60.4±6.4	26	58.5±6.2
8/2	12	57.1±4.4	13	56.5±3.8
8/9	12	58.3±4.8	13	57.3±3.2
8/16	12	60.2±5.0	13	59.7±4.2

Data Editing and Statistical Analysis.

Feed intake records were edited to remove records from lambs that did not complete the test. Three lambs were removed in 2009 for health issues. One lamb was removed in 2010 because he began removing feed from the trough with his hooves and wasted excessive amounts of feed. Equipment malfunctions resulted in 1 feeder pen each year with records with a high rate of errors. Methods for dealing with errors without having to discard all data were studied by Casey et al. (2005) in a swine feeding trial. In the 2009 trial, the feeder errors appear to primarily be the result of incorrect recording of the amount of feed dispensed into the trough. In the 2010 trial, the feeder errors were the result of the feeder failing to dispense feed for a period of time. After a failure, lambs would try to enter the feeding race when another lamb was present. In order to prevent lambs from trying to enter the feeding race when another lamb was present at the feeder that had failed, the lambs were offered feed in another trough until such time that they would not try to enter the feeding race when another lamb was present. Because this happened several times on a single feeder in 2010, the data from that feeder was excluded from further analysis. Therefore, the data used to analyze feed conversion efficiency were only from 4 feeder pens in each year. Feed and gain data from 77 days on feed for 2009 and 64 days on feed for 2010 were used to analyze feed conversion efficiency.

Data from both sets of lambs were analyzed in a mixed model with fixed effects of: birth type, initial weight, and breed of dam, and a random effect for sire of lamb. Data were analyzed using SAS PROC MIXED (SAS institute, Cary, NC).

Results and Discussion

Table 4 shows the mean and standard deviation of the amount consumed per day by each respective breed for both 2009 and 2010. In addition, it shows the average and standard deviation of time spent in the feeders by the Rambouillet and Dorper lambs. In 2009, the Dorper lambs stayed in the feeder slightly over an hour and a half each day and consumed an average of 2.57 kg of feed per day. The Rambouillet lambs stayed in their feeder 4.41 minutes less than their Dorper counterparts and consumed 2.44 kg of feed on average per day. In 2010, the Dorper lambs stayed in the feeder slightly under an hour and a half per day and consumed an average of 2 kg of feed per day. The Rambouillet lambs stayed in the feeder approximately 1 hour and 22 minutes per day and consumed an average of 1.86 kg per day.

Table 5 shows the time spent eating per lamb per day in 2009. The ranges are broken into 1,000 second intervals. Very few observations were recorded where a lamb spent less than 1 hour per day or more than 3 hours per day in the feeder. Approximately 60 percent of the observations occurred where the lamb spent between 4500 and 6500 seconds in the feeder.

Table 6 shows the time spent eating per lamb per day in 2010. The ranges are again broken into 1,000 second intervals and again very few of the observations were recorded where a lamb spent less than 1 hour per day or more than 3 hours per day in the feeder. In 2010, over 65 percent of all the observations occurred where the lamb spent between 4500 and 6500 seconds in the feeder.

Table 4. Mean and standard deviation of amount consumed per day and time spent in feeders.

Year=2009	Dorper	Rambouillet
Mean amount consumed per day, kg	2.6±1.4	2.4±1.1
Mean time in feeder, sec	5736±2037	5412±2233
Year=2010	Dorper	Rambouillet
Mean amount consumed per day, kg	2.0±0.7	1.9±0.9
Mean time in feeder, sec	5217±2046	4960±1933

Table 5. Distribution of time spent eating per day per lamb in Dorper and Rambouillet ram lambs for 2009.

Range, s	Frequency	Percent	Cumulative Percent
<500	1	0.02	0.02
1500	53	1.13	1.15
2500	117	2.50	3.65
3500	439	9.37	13.02
4500	877	18.72	31.74
5500	1059	22.60	54.34
6500	874	18.66	73.00
7500	537	11.46	84.46
8500	277	5.91	90.37
9500	200	4.27	94.64
10500	120	2.56	97.20
11500	64	1.37	98.57
12500	27	0.58	99.15
13500	21	0.45	99.59
14500	4	0.09	99.68
15500	5	0.11	99.79
16500	3	0.06	99.85
>17500	7	0.15	100.00

Table 6. Distribution of time spent eating per day per lamb in Dorper and Rambouillet Ram lambs for 2010.

Range, s	Frequency	Percent	Cumulative Percent
<500	26	0.47	0.47
1500	88	1.59	2.05
2500	149	2.68	4.74
3500	675	12.16	16.90
4500	1326	23.89	40.79
5500	1323	23.83	64.62
6500	987	17.78	82.40
7500	482	8.68	91.08
8500	233	4.20	95.28
9500	120	2.16	97.44
10500	47	0.85	98.29
11500	40	0.72	99.01
12500	14	0.25	99.26
13500	11	0.20	99.46
14500	8	0.14	99.60
15500	7	0.13	99.73
16500	8	0.14	99.87
>17500	7	0.13	100.00

Jenkins and Leymaster (1987) reported mean time spent in a feeder of 6452 sec/day and 6994 sec/day when 11 lambs were in a feeder pen where 1 lamb could eat at a time. The lambs in the present study spent less time in the feeder/day as compared to the results reported by Jenkins and Leymaster (1987). Cammack et al. (2005), reported a mean time/day in the feeder of approximately 7000 sec/day. Differences between studies may be due to breed, feeder and pen design, or other environmental factors.

Table 7 provides the means and standard deviations of several descriptive statistics for the 2009 portion of the trial, prior to data editing.

Table 7. Mean and standard deviation of descriptive statistics of Dorper and Rambouillet ram lambs for 2009.

Year=2009	Dorper N=22	Rambouillet N=25
Total Gain, kg	32.1±3.4	32.4±3.5
Total Feed, kg	253.5±51.8	243.6±44.40
Start Age, days	99.7±4.5	95.8±6.7
Start Weight, kg	32.2±3.0	31.3±3.5
Final Age, days	197.4±13.2	195.9±20.6
Final Weight, kg	64.3±2.4	63.7±2.3
Day On Feed, days	95.9±14.7	97.4±14.3

Table 8 provides the means and standard deviations of several descriptive statistics for the 2010 portion of the trial, prior to data editing.

Table 8. Mean and standard deviation of descriptive statistics of Dorper and Rambouillet ram lambs for 2010.

Year=2010	Dorper N=28	Rambouillet N=24
Total Gain, kg	32.0±3.6	32.3±3.0
Total Feed, kg	197.7±47.5	180.9±45.2
Start Age, days	90.6±10.3	84.9±8.1
Start Weight, kg	30.8±5.2	29.0±4.3
Final Age, days	190.1±15.4	183.5±12.5
Final Weight, kg	62.8±4.8	61.3±4.8
Day On Feed, days	98.5±10.7	97.6±10.7

For the 2009 portion of the trial average daily gains were analyzed using fixed effects of breed, feeder, starting weight, and birth type. The time frame was designated from start date to July 20, 2009, when the lambs began to be taken off test. During this time period none of these factors, most notably breed, were found to have a statistically significant effect. The Dorper lambs gained an average of 329 g/d and had a standard error of 13 g/d. The Rambouillet lambs gained an average of 340 g/d and had a standard error of 12 g/d. In the same time period feed conversion efficiency was analyzed, again using the fixed effects of breed, feeder, starting weight, and birth type. None of these factors were found to have a statistically significant effect. Both breeds, Dorper and Rambouillet, had the same feed conversion efficiency of 0.147 and had standard errors of 0.005 and 0.004, respectively.

Table 9 shows the total average daily gain, feed conversion efficiency, and the respective standard errors for the two breeds from May 4, 2009 through July 20, 2009.

Table 9. Mean and standard deviation of total average daily gain and feed conversion efficiency of Dorper and Rambouillet ram lambs from May 4, 2009 to July 20, 2009.

Year=2009	Dorper N=17	Rambouillet N=20	*p*-value
Total ADG, g	329±13	340±12	0.58
Feed Conversion Efficiency	0.147±0.005	0.147±0.004	0.99

For the 2010 portion of the trial, total average daily gains were analyzed using fixed effects of breed, feeder, starting weight, and birth type. In 2010 the time frame was designated from start date to July 2, 2010, when the lambs began to be taken off test. For total average daily gain none of these fixed effects were found to be statistically significant. The Dorper lambs gained an average of 350 g/d and had a standard error of 20 g/d. The Rambouillet lambs gained an average of 344 g/d and had a standard error of 22 g/d. In the same time period feed conversion efficiency was analyzed, again using the fixed effects of breed, feeder, starting weight, and birth type. For feed conversion efficiency, feeder and start weight were found to have a statistically significant (p<0.05) effect; however, the actual impact of these two factors was very small. The Dorper lambs had a feed conversion efficiency of 0.172 with a standard error of 0.006 and Rambouillet lambs had a feed conversion efficiency of 0.170 with a standard error of0 .007. Table 10 shows the total average daily gain and feed conversion efficiency and standard errors of the two breeds from April 29, 2010 through July 2, 2010.

Table 10. Mean and standard deviation of total average daily gain and feed conversion efficiency of Dorper and Rambouillet ram lambs from April 29, 2010 to July 2, 2010.

Year=2010	Dorper N=20	Rambouillet N=22	*p*-value
Total ADG, g	350±20	344±22	0.82
Feed Conversion Efficiency	0.172±0.006	0.170±0.007	0.77

Both 2009 and 2010 results are similar to those found by Notter et al. (1984), as he studied growth patterns and feed efficiency of available breeds over a range of feeding levels and physiological intervals. In his study he found that Rambouillet lambs had feed conversion efficiency of 0.125 from 35 to 140 days of age, and feed conversion efficiency of 0.172 from 22 to 38 kg of body weight. The lambs in the present study started the feeding trial at an average body weight near 30 kg and both breeds of lambs had a feed conversion efficiency of 0.147 in 2009 and 0.172 in 2010. It is interesting to note that the Rambouillet lambs in Notter's study had similar feed conversion efficiency at the 22 to 38 kg interval (0.172) as did both breeds of lambs in the present study in the 2010 trial period.

In the present study total average daily gain and feed conversion efficiency were measured for 77 days on feed in 2009, from the beginning of the post weaning trial May 4, through July 20, when lambs began to reach the target weight. In 2010, total average daily gain and feed conversion efficiency were measured for 64 days on feed in 2010, from the beginning of the post weaning trial on April 29 through July 2, when lambs began to reach the target weight.

When studying the effects of the callipyge gene, Jackson et al. (1997) reported feed conversion efficiency of 0.185 for Rambouillet ram lambs when measured from weaning (approximately 4 months) to 54.5 kg. These same ram lambs had a mean average daily gain of 350 g/d. Both of these figures are consistent with those found in the current study although the feed conversion efficiency is somewhat higher, possibly due to the lambs in Jackson's study being shorn prior to the trial to improve performance.

Brown et al. (1987) reported post weaning feed efficiencies during fixed time periods of 0.137 and 0.149, for two lines of Targhee lambs in 1985 and post weaning feed efficiencies of 0.160, 0.172, and 0.163 in three lines of Targhee lambs in 1986. In Brown et al. (1987) the post weaning lambs were fed a diet consisting of 30% wheat, 69% alfalfa hay and 1% NaCl with added trace minerals. His results are similar to those in the current study despite the differences in breed makeup and the lower quality, lower energy diet.

Cammack et al. (2005) found mean average daily gains of 418 g/d with a standard deviation of 81 g/d for ½ Colombia, ¼ Hampshire, and ¼ Suffolk terminal sire composite ram lambs. This is 69-89 g/d better than the rams in the present study, possibly due to the lambs' terminal composite breed make up. These composite ram lambs were on feed for approximately 42 days, somewhat less than the present study. The lambs in the present study were fed in San Angelo, Texas in the months of May, June, and July where the normal average daily temperatures are 72, 78, and 82 degrees, respectively; the normal daily maximum temperatures for May, June, and July are 83, 89, and 92 degrees, respectively (NOAA 2011).

Conclusion

With both total ADG and FCE being so close in this study it seems that neither the Dorper nor the Rambouillet offer a significant advantage in terms of economic impact from an increase in feed efficiency, at least over the interval that we compared the two breeds. As Snowder and Van Vleck (2003) state, an increase in profitability of lamb production is dependent on reducing input costs and/or increasing production output. Because a large number of lambs in the United States are conditioned for slaughter in feedlots, cost of feed is an important economic input factor whereas lamb growth rate is an important economic output factor. Any reduction in feed intake or increase in feed efficiency without compromising growth rate or carcass quality can have a significant positive economic impact on lamb production.

As stated by Terrill (1953), profitable animal production depends on income and expenses. Factors such as growth and carcass composition affect income. Expenses such as feed costs can be decreased when feed efficiency is improved. More productive animals can positively influence profit with improved feed efficiency and feed conversion ratio (Terill, 1953). With current cash corn prices for March 2011 at $6.63/bushel versus March 2001 at $2.15/bushel according to the Texas Department of Agricultural Economics (2011), it is clear that feed cost and thus feed conversion efficiency is more important than ever.

This study has shown that feed efficiency is similar between the Dorper and Rambouillet lambs. Over the post weaning period (77 d in 2009 and 63 d in 2010) there was no advantage shown by either breed. Although no difference was found in post weaning feed conversion between Dorper and Rambouillet lambs, differences may exist in other economically important traits such as carcass composition, reproduction, longevity, parasite resistance, or adaptability to environment. In addition, differences in feed conversion ratio may vary with alternate energy levels in the feed.

LITERATURE CITED

Bradford, G. E. 2003. Breeding and Selection Chapter. Pages 1–80 in SID Sheep Production Handbook. American Sheep Industry Association, Inc. C&M Press, Denver, CO.

Brown, D. L., M. R. Dally, M. R. Schwartz, and G. E. Bradford. 1987. Feed efficiency, growth rates, body composition, milk production and milk composition of Targhee sheep selected for increased weaning weight. J. Anim. Sci. 65:692–698.

Cammack, K. M, K. A. Leymaster, T. G. Jenkins, and M. K. Nielsen. 2005. Estimates of genetic parameters for feed intake, feeding behavior, and daily gain in composite ram lambs. J. Anim. Sci. 83:777-785.

Casey, D. S., H. S. Stern, and J. C. M. Dekkers. 2005. Identification of errors and factors associated with errors in data from electronic swine feeders. J. Anim. Sci. 83:969-982.

Cloete, S. W. P., M. A. Snyman, and M. J. Herselman. 2000. Productive performance of Dorper sheep. Small Rumin. Res. 36:119–136.

Elstein, D. 2002. Estimating farm animals' feed efficiency. Accessed April 1, 2009. http://www.ars.usda.gov/is/pr/2002/021224.htm .

Fahmy, M. H., J. M. Boucher, L. M. Poste, R. Gregoire, G. Butler, and J. E. Comeau. 1992. Feed efficiency, carcass characteristics, and sensory quality of lambs, with or without prolific ancestry, fed diets with different protein supplements. J. Anim. Sci. 70:1365-1374.

Gipson, T. A , A. L. Goetsch, G. Detweiler, R.C. Merkel, and T. Sahlu. 2006. J. Small Rum. Res. 65:161-169.

Huyn,Y. and M. Ellis. 2002. Effect of group size and feeder type on growth performance and feeding patterns in finishing pigs. J. Anim. Sci. 80:568-574.

Jackson, S. P., R. D. Green, and M. F. Miller. 1997. Phenotypic characterization of Rambouillet sheep expressing the callipyge gene: I. Inheritance of the condition and production characteristics. J. Anim. Sci.75:14-18.

Jenkins, T. G. and K. A. Leymaster. 1987. Feeding behavior characteristics of intact male lambs as affected by number of lambs in a pen with restricted access to the feed stall. J. Anim. Sci. 65:422-430.

Koch R. M., L. A. Swiger, D. Chambers, and K. E. Gregory. 1963. Efficency of feed use in beef cattle. J. Anim. Sci. 22: 486-494

Lewis, R. M. and G. C. Emmans. 2010. Feed intake of sheep as affected by body weight, breed, sex, and feed composition. J. Anim Sci. 88: 467-480.

Leymaster, K. A. and T. G. Jenkins. 1993. Comparison of Texel- and Suffolk-sired crossbred lambs for survival, growth, and compositional traits. J. Anim. Sci. 71: 859-869.

Lupton, C. J. 2008. ASAS centennial paper: Impacts of animal science research on United States sheep production and predictions for the future. J. Anim. Sci. 86:3252-3274.

Milne, C. 2000. The history of the Dorper sheep. J. Small Rum. Res. 36:99–102.

Nation Oceanic and Atmospheric Administration. 2011 Accessed April 1, 2011. www.srh.noaa.gov.

Notter, D. R., C. L. Ferrell, and R. A. Field. 1984. Effects of breed and intake level on growth and feed efficiency in ram lambs. J. Anim. Sci.58:560-576.

Phillips, R. W. 1936. The efficiency of feed utilization in lambs. Am. Soc. Anim. Prod. 1936a :161-163.

Robison, O. W. and J. M. Berruecos. 1973. Feed efficiency in swine. I. A comparison of measurement periods and methods of expressing feed efficiency**.** J. Anim. Sci. 37: 643-649.

Schoeman, S. J. 2000. A comparative assessment of Dorper sheep in different production environments and systems. J. Small Rum. Res. 36:137-146.

Snowder, G. D. and S. K. Duckett. 2003. Evaluation of the South African Dorper as a terminal sire breed for growth, carcass, and palatability characteristics. J. Anim. Sci. 81:368-375.

Snowder, G. D. and L. D. Van Vleck. 2003. Estimates of genetic parameters and selection strategies to improve the economic efficiency of postweaning growth in lambs J. Anim. Sci. 81:2704-2713.

Terrill, C. E. 1953. The relation between sale price and merit in Columbia, Targhee and Rambouillet rams. J. Anim. Sci. 12:419-430.

Texas Department of Agricultural Economics. 2011. Corn North of the Canadian River.

Acessed March 31, 2011. http://agecoext.tamu.edu/resources/basis-data/.

Wildeus, S. 1997. Hair sheep genetic resources and their contribution to diversified small ruminant production in the United States. J. Anim. Sci. 75:630-640.

VITA

Jessup Clayton Yeaman was born on February 25, 1986, in Huntsville, Texas, the son of Jeff and Melanie Yeaman. The author was raised in Rocksprings, Texas, and was homeschooled there by his mother until his graduation in 2004. After receiving a Bachelor of Science degree in Animal Science from Texas A&M University in 2008, the author was employed by the Texas AgriLife Extension Service as an extension assistant, under Dr. Frank Craddock, while simultaneously beginning graduate school at Angelo State University. Upon completion of the graduate program at Angelo State University in 2011, the author accepted a position with Texas AgFinance, in Uvalde, Texas.