COMPARISION OF SALERS AND LIMOUSIN FOR POSTWEANING GROWTH AND CARCASS MERIT

By

NEATH NET

Doctor of Veterinary Medicine

Royal University of Agriculture

Phnom Penh, Cambodia

1992

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirement for
the Degree of
MASTER OF SCIENCE
December, 1998

COMPARISION OF SALERS AND LIMOUSIN FOR

POSTWEANING GROWTH AND

CARCASS MERIT

Thesis approved:

Thesis Adviser

Dean of the Graduate College

ACKNOWELDGEMENTS

I would like to express my appreciation to my major adviser, Dr. David Buchanan for his guidance and patience through my study. I would also extend my appreciation to Dr. Archie C. Clutter and Dr. Gerald Q. Fitch for their patience and for being on my committee. I would like to extend my special thank to Dr. Gerald Q. Fitch who is a very helpful coordinator of the Department of Animal Science, and other people of the Department of Animal Science for being friendly.

My appreciation is also extended to US Information Agency and its branch in Phnom Penh, Cambodia for its sponsorship through my study at Oklahoma State University.

I would like to thank to my Dad, Neang Net, my mom Por Heang Lok who worked very hard to raise children and family, and my sisters.

TABLE OF CONTENTS

LIST OF TABLES

CHAPER I

INTRODUCTION

Workers in the beef cattle industries have attempted to improve production efficiency by selection, development of new breeds, and mating systems to maximize benefits from heterosis, breed complementarity through crossbreeding, to match genetic potential, feed resources, environments, and to meet market demands. Thus breed differences in the performance characteristics are among the most important factors in improving beef production efficiency.

Beginning about 40 years ago numerous breeds of beef cattle were imported into North America from different parts of the world, mostly from the European continent (Buchanan, *et al.*1988). Each breed has its own advantages and disadvantages. Cundiff *et al* (1993) indicated that no one breed excelled in all traits that met a breeder's objectives. For instance, Salers cattle have a larger mature size, lower birth weight than Limousin cattle but Limousin cattle have more lean to fat ratio than Salers.

The Salers is a French breed that was originally developed in France about 7000 years ago (Briggs, 1980; Porter, 1991, www.ansi.okstate.edu/breeds/cattle/). Because of its adaptation to harsh conditions, high fertility, potential for rapid growth, calving ease, high production and soundness, semen from a bull was brought into Canada in 1974 (Brigggs,1980, www.ansi.okstate.edu/breeds/cattle/).

Limousin is another French breed that was originally developed in an old province in France called Limousin. Because of its heavy muscling, an excellent carcass ratio of leanness to bone, adaptation to harsh conditions, calving ease, and excellent feed efficiency, the breed was imported into North America in 1969 (Porter 1991).

The objectives of this study were to compare the post weaning growth and carcass merit of Limousin and Salers sired calves.

CHAPTER II

LITERATURE REVIEW

Origin and Characteristics of Salers and Limousin

The *Salers* breed was originally from a district in France called Salers. This breed was developed about 7000 years ago (www.ansi.okstate.edu/breeds/cattle/). This area is one of high plateaus, mountains, and valley parts of France. Salers is believed to have a relationship with *Bos Indicus* like Aubrac and the Gascon. The breed is red with medium or long hair that is often slightly curly. The exposed skin is colored rose-like and the hide is thick. There are also black Salers. The head is triangle-shaped from the front view. The bull has a convex face. Salers are generally horned, but there are also polled bulls. Their horns are quite long and they grow outward and upward, then curve backward and outward. The cattle are also well muscled (Briggs, 1980; Porter, 1991).

The Salers cattle can survive in harsh environments such as rocky mountain, poor soil, and a wide range of temperatures throughout the summer and long winter. (www.ansi.okstate.edu/breeds/cattle/). The mature bull and cow can be as high as 152 cm, and 142 cm tall and as heavy as 1000-1200 kg and 650-800 kg, respectively (Porter, 1991).

Because of high fertility, rapid growth, calving ease, high productivity, and soundness, Salers semen was brought into Canada in 1974 and later into the U.S in 1975. The semen was collected from a bull named Jet (Briggs,1980). Besides the above traits, Salers carcasses have an excellent proportion of meat to bone and high marbling score. Since Salers have many good traits which were intriguing to among commercial beef cattle producers, the American Salers Association was organized in 1974 by 14 innovative and progressive cattlemen in Minneapolis, MN. (www, ansi.okstate.edu/breeds/cattle/). The Salers breed is still contributing to the modern commercial beef cattle business in North America and in some parts of Europe (Briggs,1980; www.ansi.okstate.edu/breeds/cattle/).

The *Limousin* breed was also developed in an old province in France called Limousin in the southern-central part of France. The area is characterized by hills and valleys (Buchanan, *et al.*1988). Limousin might have been domesticated from a wild cattle of Europe called *Aurochs* (Buchanan, *et al.*1988). This breed is wheat-red, with light color around the eyes, muzzle and on the lower legs, under parts and tail switch. The horns grow outward and upward. Limousin is a medium size breed as compared to other European cattle breeds. Limousin are deep-chested and have a strong top-line, well placed tail head and strongly muscled hindquarter. Limousin adapt well to harsh environments. The mature bull and cow weigh 1200 kg and 600 kg respectively (Briggs, 1980 ; Buchanan, *et al.*1988). For several years, there has been a major breed improvement and production scheme in France to increase its genetic merit and to select the best breeding stock. In the 17^{th} and 18^{th} centuries, this breed was primarily developed for draft and meat production.

Because of heavy muscling, an excellent carcass ratio of lean meat to bone, adaptation to hard conditions, excellent feed efficiency, a Limousin bull was brought into

Canada in 1969 and later many of these purebreds were imported into North America (Porter, 1991; www.ansi.okstate.edu/breeds/cattle/). After the first Limousin was introduced into North America, the North America Limousin Foundation (NALF) was formed. The Limousin breed grew rapidly and in 1987 the NALF had almost 50,000 registrations (Buchanan, *et al.*1988). Over 1 million Limousin have been registered through the organization. This is one of the most numerous continental breeds in the U.S (www.ansi.okstate.edu/breeds/cattle/).

Importance of Phenotypic Characteristics in Beef Cattle

Birth Weight

Birth weight is one of the factors that influence survival and growth rates of the animals. Singh (1972) reported that birth weight significantly influenced pre-weaning growth and weaning weight. This finding is consistent with the finding of Gregory (1996) who found that calves born at a heavier birth weight resulted in a heavier weight at day 200. Moreover, they also noted that calves born at a heavier birth weight had a greater carcass weight. However, an unacceptable birth weight can also contribute to increase in dystocia (Singh, 1972; Gregory,1996; Threif ,1997).

Preweaning

Pre-weaning growth occurs from birth to weaning and indirectly influences weaning weight and post-weaning growth (Pahnish, *et al.*1971). Lymber (1994) indicated that selection for increased pre-weaning growth rate resulted in increased live weight at all ages and that selection for increased pre-weaning growth had improved the biological efficiency of feed use.

Weaning Weight

Weaning weight is very important for cow-calf producers because it reflects calf growth ability that influences post weaning growth (Bair *et al.* 1972). Besides, it is used to evaluate the differences in mothering ability of cows and to measure differences in growth potential of calves. Kress (1972) indicated that there was a positive correlation between weaning and post-weaning weights. Cattlemen frequently use weight at 205 days of age for evaluating growth rate in weaned calves; however, Bair *et al.* (1972) used 305 days to obtain weaning weight in his study of Angus-Holstein crossbred herd in attempt to utilize more efficiency the relatively high and persistent milk production.

Post-weaning Growth

Post-weaning growth covers the period from weaning to slaughter (Acker,1998). This growth is very important because it influences carcass production. In evaluating post-weaning growth, yearling weights of calves are needed since yearling weight is important to predict yield of retail-trimmed, boneless beef. Yearling weight is adjusted to 365, 452 or 550 day weight (Beef Improvement Federation, 1990). Carvalheira *et al.* (1995) evaluated post-weaning growth of Africander and Loundim cattle by utilizing 550 day adjusted weight. As indicated by Gregory (1996), heavier slaughter weights produce heavier carcass weights. This suggests that there is a correlation between post-weaning growth and carcass weight.

Mature Weight

Mature weight is one factor that is needed to consider in production efficiency and is defined as the weight that the point of body weight equilibrium for cattle feed forage diet or the point at which the protein accretion ceases (Owen *et al.*1995). Several papers have been published with emphasis on estimating mature weight and growth curves for weight through maturity. Brown *et al.* (1972) reported that early maturing females were characterized by lighter body weight at a younger age (4months), and smaller mature weight than late maturing females. This is due to the negative correlation between mature weight and maturity. Singh (1972) reported that mature weight had an effect on birth weight. Heavier cows tended to wean heavier calves and the calves grew faster resulting in heavier weaning weight than the calves born from lighter weight cows. However, if weight and advanced age are used eventually the weight will increase but the proportion of carcass decreases as age increases (Brooker *et al.* 1994). This is because of more fat deposition. The fast growing calves having large mature size tend to be leaner than lighter weight calves at early age (Owen *et al.*1995). The mature weight or size has a direct effect on carcass merits

Environmental Effects

Environmental effects are ones that affect uniformity of animal production because they influence heritability and repeatability of animals. Many workers and animal commercial industries try to come up with ways to minimize these effects on their livestock.

Sex of Calf

Bull calves are generally heavier at all ages. Bair *et al.* (1972) and Hassen *et al.* (1994) reported that there was a significant effect of calf sex on preweaning, weaning, and post weaning weights of the calves. Hollis (1972) also found that sex of calf had an effect on birth weight. Sex also influences carcass weight and quality. Bair *et al.* (1972) described that heifers had lighter carcass weight than steers at slaughter age. Abraham *et al.* (1980) noted that both cutability and marbling scores were higher for steers than for heifers. Both fat thickness and adjusted fat thickness were lower for steers than for heifers. In addition, Cornforth (1980) and Fortin (1980) showed that steers' muscle fiber size was smaller than that of heifers. The muscle percentage of steers was higher than that of heifers.

Age of Dam

Age of dam has been reported by several workers to have an effect on birth weight, weaning weight, post-weaning and carcass weights. Massay *et al.* (1981), who studied interaction effects involving sire, breed of dam and age of dam on performance characteristics in Limousin cattle, noted that there was a significant effect of dam age on birth weight, pre weaning growth, weaning weight at 205 days. This finding agrees with the finding of Bair *et al.* (1972) who reported that there was a significant effect of age of dam on different stages of calf growth and carcass weight. They further found that increased calf weight and carcass weight per day were associated with increased dam age during early production and subsequently this effect decreased as cows got older (9 years old) except for 2- , 3- , 10-, 11-, years old class. Robinson (1980) also found that age of dam did not affect post-weaning weight in beef cattle and suggested that selection effectiveness for weight at 205 days would be reduced by 20% due to the negative correlation between maternal effect and direct effects.

Year-Season of Birth

Year-season has been postulated by many researchers to have an effect on birth weight, weaning weight, and cow performance (Oviedo *et al.* 1994). Moreover, they observed that cows calving early in one calving season would produce calves with heavier weaning weight than cows calving late. McDonald (1972) found that the calves born late in calving season had heavier birth weight than the ones born early in calving season. Bair *et al.* (1972) added that year and season also had an effect on carcass weight per day during growing period. However, Hollis *et al.*(1972) showed that there was a year-season effect on birth weight, weaning weight, fat thickness, yield grade but not on post weaning growth and rib eye area.

Genetic Effects

Sire Breed

Several workers have shown that breeds of sire were a source of variation of all growth and carcass characteristics. Brooker *et al.* (1994) and Abraham *et al.* (1980) agreed that sire breeds had significant effects on live weight, hot carcass weight, marbling score, kidney pelvic heart, yield grade, quality grade, fat thickness, and firmness of lean. The greatest difference between sire breeds for hot carcass weight was 10.2 % while only 2.8 % was observed between crossbreeds. Rodriguez–Almeida *et al.* (1995) suggested that there were not equal phenotypic variances among sire breeds. However, Murray *et al.* (1994), who studied sire and dam breed influence calf performance, noted that there were not a large difference between the Angus and Simmental sire breeds for birth weight, pre-weaning average daily gains, weaning weight and weaning ratio. Cundiff (1970), who studied crossbreeding cattle for beef production, reported that there was not a significant difference between calves sired by Angus, Hereford and Shorthorn for post weaning gains. Cundiff *et al.* (1993) also noted that there were significant differences among all sire breeds including Salers and Limousin for all growth and carcass characteristics of calves. Growth and carcass traits reported by some researchers are shown in Table 2.

Dam Breed

There are two categories of dam breed, the purebred dam and crossbred dam. Murray *et al.* (1994) noted that dam breed was not a significant source of variation of birth weight, preweaning, weaning weight, weight ratio and average daily gain. However, Cundiff *et al.* (1993) reported that there was a significant dam breed effect on birth weight, weaning weight of calves. The difference between these two findings may be because of different types of dam breed used in their studies, and differences in environment which vary from one location to another location.

Sire Within Breed

Sires have been noted by many researchers to have an effect on performance of animals. Murray *et al.* (1994) reported that there were significant differences between sires within the Angus breed for adjusted birth weights of calves but not significant differences within the Simmental breed. These suggestions are consistent with the findings of Hollis (1972) who compared criteria for selecting introduced beef sires and also with those of Carvaheria (1995) who compared body weights and growth of Limdim and Africander cattle in southern Mozambique. Wilson *et al.* (1972) illustrated a significant effect of sire on carcass weights of Angus and Hereford cattle. Their findings were also consistent with the findings of Thrief *et al.* (1970).

Interaction Effects

Besides the main effects, some interaction effects have been reported to have effects on birth weight, weaning weight, pre- and post-weaning growth, and carcass characteristics. Hollis (1972) reported that there was an interaction effect between herd and year-season on birth weight, weaning weight and condition scores of the calves. Massay *et al.*(1981) also noted that an interaction effect between sire and breed of dam was a source of variation in birth weight, preweaning average daily gain, adjusted 205-day weaning weight, yearling weight, and adjusted 365-day weight. An interaction effect between age of dam and breed of dam has also been reported. Brown *et al.* (1972) observed that there was no interaction effect between sire and herd on live weight and carcass weight. Furthermore, Bair *et al.* (1972) revealed that sex and age of dam was not a source of variation for growth rates and carcass weights of calves.

Heterosis Effects

Heterosis is one of the most important factors in commercial animal production because heterosis uses the advantages of paternal or maternal performance or both and refers to any favorable departure from additive in crossbred population (Sheridan,1981). Heterosis can generally be categorized for three major types of traits. Reproductive, growth and carcass traits or based on mating situation, heterosis can be classified into individual, maternal and paternal heterosis effects (Buchanan *et al.*1993).

Individual Heterosis

This heterosis is referred to as hybrid vigor, the improvement in performance that is not attributable to either paternal, maternal or sex linkage effect. In other words, individual heterosis is the hybrid vigor for a direct component of a trait that is the effect of an individual's genes on its own performance that results in better performance than parent lines (Bourdon, 1998). The advantage of individual heterosis is that it corrects the inbreeding depression resulting from mating individuals that are related. Urick *et al.* (1970) studied individual heterosis effects on postweaning trait among lines of Hereford cattle and found that the line crossed bulls showed a marked advantage over straight-line bulls for all weights. The percent heterosis for bulls obtained was 4.9, 6.7, 7.3, 6.4, 5.6, 5.3, 5, and 4.9 for weaning weight, initial weight (weight of the beginning of feeding in the experiment) period 1 through period 6 and final weight - the weight of 196 days of the experiment. The percent heterosis for gains from period 1-6 were 13, 1.4, 0.3, 2.5, 2.2 and 4.9 respectively. The percent heterosis for heifers obtained was 9, 9.4, and 6.6 for weaning weight, 12 months, 18 months of age and for gains from weaning to 12 months, from weaning to 18 months and from 12-18 months were 6.6, 9.5, 3.7 percent respectively. Cundiff (1970) reported that individual heterosis effects were significant for carcass weight. Also individual heterosis effects did influence carcass traits such as boneless closely trimmed, or retail product adjusted for age.

Maternal Heterosis

This heterosis is referred to as the hybrid vigor that uses the effect of the dam's genes to influence its own performance through the environment provided by the dam (Bourdon, 1998, Sheridan,1981). McDonald (1972), who studied the effect of maternal heterosis on birth weight, preweaning ADG and weaning weight of the three-way cross calves, found that the estimated maternal hterosis on birth weight, preweaning ADG and weaning weight were 1.5, 5.4, and 4.7 % respectively. However, that amount was somewhat greater than when comparing inbred *vs* linecross-calf performance. Cundiff (1970) showed that the maternal heterosis effects were greatest for birth weight, pre-weaning growth and weaning weight, but smallest for postweaning growth and carcass merits. However, Pahnish (1970) reported that the advantages in postweaning growth shown by beef crossed with Brown Swiss were largely reflected by maternal heterosis effect. Gregory *et al.* (1987) observed that maternal heterosis had small effects on carcass traits associated with composition and these effects were not significant. The means of estimation of the heterosis effects for steers and heifers with age held constant were 2, and 10 kg, respectively.

Paternal Heterosis

This heterosis is referred to the hybrid vigor that uses any advantage of crossbred sire *versus* purbred sires to influence its own performance (Sheridan,1981). It generally, however, influences conception rate. Kress *et al.* (1996) presented that there was a paternal heterosis effect on pregnancy rates of yearling heifers exposed to natural mating service. The paternal heterosis effect calculated for pregnancy rate was 4.2 %. Their finding was consistent with the finding of Meadows *et al.* (1994).

Table 1 Heterosis in beef cattle for growth and carcass traits

Trait	Heterosis %	
	Individual	Maternal
Birth weight	2.7	1.6
Weaning weight	4.7	4.2
Postweaning weight AGD (feedlot)	3.9	-1.4
Postweaning weight AGD (pasture)	6.4	-0.85[a]
Yearling weight (feedlot)	3.8	2.9
Yearling weight (pasture)	4.5	1.2[a]
Loin eye area	2.8	2.02[a]
quality grade	0.7	2[a]
Dressing	0.6	1.32[a]
Cutability	0.6	-0.2[a]

Sources:

Buchanan *et al.* (1993). Animal Breeding: Principles and Applications.

[a] Gregory *et al.* (1987). Maternal heterosis and grand maternal heterosis effects in beef cattle. J. Ani. Sci.65:1180 -1194.

Carcass Merit of Limousin and Salers

Lott *et al.* (1991) compared carcass merit of the calves sired by Angus, Salers and Charolais and found that carcass merits of the calves sired by Salers were between that of calves sired by Angus and Charolais. The least squares means for fat thickness, rib eye area, and yield grade for calves sired by Angus, Salers and Charolais were 1.08 cm, 70.6 cm^2, 3.0 ; 1.04 cm, 76.1 cm^2, 2.7 and 0.77 cm, 75.2 cm^2, 2.4, respectively. Buchanan *et al.* (1987) reported that Limousin sired calves had an advantage in dressing percent comparing to the calves sired by Charolais, Gelbvieh, Angus, Hereford, Brahman and Simmental breeds but not Chianana. Rib eye area and fat thickness were better for calves sired by Limousin, Charolais, Chianana, Gelbvieh and Simmental than that of calves sired by Brahman and Hereford. However, the tenderness and juiciness for Limousin calves were slightly less than that of Angus, Hereford, Maine Anjou and Simmental. The taste panel favor of Limousin was intermediate in values of other above breeds. Rib eye area, fat thickness and yield grade were 85.15 cm^2, 1.07cm and 2.4 respectively. Cundiff *et al.* (1993) estimated fat thickness, rib eye area and yield grade of Salers were 1.04 cm, 76.5515 cm^2 , 3.1 and of Limousin were 1.00cm, 79.9315 cm^2, 2.8 respectively.

Table 2 Growth and Carcass Traits of Limousin and Salers Sired Calves

Trait	Breed	
	Limousin	Salers
Birth Weight / kg.	35.74 [a]	34.4 [b]
Weaning Weight / kg.	213.38 [a]	225 [b]
Yearling Weight / kg.	419.50 [a]	497.1 [b]
Average Daily gain / kg.	1.11 [a]	1.36 [b]
Carcass Weight	303.18	321.36
Rib eye area /cm^2	85.15 [a]	76.1 [b]
Fat thickness /cm	1.07 [a]	1.04 [b]
Yield grade /score	2.4 [a]	2.7 [b]
Dressing Percent %	61.7	61.7
Marbling Score	5.15	4.77
Kidney Pelvic & Heart Fat %	3.54	3.57
Retail Product %	71.5	70.0

Sources:

[a] Buchanan *et al.* (1988). Evaluation of the North American Limousin. Bulletin B-1786.

[b] Lott *et al.* (1991). Effect of Angus, Charolais, and Salers sires on birth, weaning and carcass traits of calves. J. Ani Sci. 69:197. Suppl.1.

Cundiff *et al.* (1993). Breed comparisons in the germplasma evaluation program at MARC.

CHAPTER III

MATERIALS AND METHODS

Source of Data

All calves used in this study were part of the beef cattle research herd located at the North Lake Carl Blackwell Research Range west of Stillwater, OK. The climate of the research center was temperate with four seasons. The average minimum and maximum temperature during winter was -2 to 11 °C, and spring was 9.5 to 22 °C, fall 10 to 20.5 °C, and summer was 20.5 to 32.5 °C. The annual rainfall approximately 100 cm (McCarter, 1989). The data were collected from 403 calves (225 steers and 178 heifers) born during 1986 through 1988 from 11 different crossbreed cows. Cows were inseminated artificially and randomly from semen of either Salers or Limousin purebreds. Semen from 36 different bulls of either Salers or Limousin (12 bulls in 1986, 11 bulls in 1987 and 13 in 1988) was denoted by sire region, and sire registry numbers for the use from 1986 through 1988. The 11 dam crossbreeds were ½ Hereford - ¼ Angus – ¼ Brahman, ½ Angus - ½ Hereford, ½ Angus - ¼ Brahman - ¼ Hereford, from project OK 1503 and ½ Simmental – ½ Angus, ½ Simmental – ½ Hereford, ½ Brown Swiss - ½ Angus,½ Brown Swiss - ½ Hereford, ½ Jersey - ½ Angus, ½ Jersey - ½ Hereford, ½ Angus - ½ Brahman, and ½ Hereford - ½ Brahman from project OK 1777. Calves born in spring were put on feeding trial in fall and taken off from the trial in spring while those born in fall were put on feeding trial in late spring and removed from the trial in winter.

Natural pasture in the research center mainly comprises native and predominant grass in the southern mid - grass prairies (Schizacharium Scorporrious, Bothriochloa Saccharriodes, Boutelous Curtipandula and Angropogon Gerardii). Additionally, in some periods of spring and summer bermudgrass (cynadon dactylon) monoculture pasture were available. Supplemental protein and hey were fed to calves during winter and early spring. The mount, type of supplement and duration for which the calves were fed depended on cost, ingredient, forage availability, and weather conditions. Therefore, feeding varied from year to year. In general, however, protein supplementation began in late November or early December and continued through early May.

Herd Management

Cows and their calves were maintained in separate pastures determined by sex of calf. All calves were weighed, tagged, dehorned and bull calves were castrated within 24 hours of birth. Calves were raised on native range or on bermudagrass pastures until weaning at an average age of 205 days. Weaning occurred in early October and early June when calves reached on average age of approximately 205 and 240 days for spring and fall born calves, respectively. Weaning of fall born calves was delayed approximately 35 days to allow calves and cows to take advantages of spring forage production before weaning.

Measurements

After weaning, all calves were transported to a commercial feedlot and managed in the regular manner in the place of that feedlot. Calves were weighed upon entry and secondly after the feeding period was completed to the average daily gain (ADG) for evaluating post-weaning growth rate. Carcass data were obtained after a minimum of a 48-hour chill. The data recorded were hot carcass weight (HCWT) in kg, marbling score (MBL), quality grade(QG), yield grade(YG), fat thickness (FACT) in cm , rib eye area (REA) in cm^2, and kidney pelvic heart fat (KPH) in %. All carcass traits were evaluated based on Specifications of USDA by OSU meat specialists. Information from Tables 3, 4 and 5 were used in evaluation of marbling, quality grade, and yield grade. Hot carcass weight was obtained at post-harvest. Marbling was evaluated visually in the rib eye muscle area between 12^{th} and 13^{th} ribs by meat specialists. The numerical score ranges from 2.9 (practically devoid) to 10.9 (abundant). Score 4 and 5 are slight and small flecks of fat in lean. Quality grades vary in the number of degrees of marbling within a grade. Quality grades were evaluated based on maturity, marbling, color, firmness and texture of lean by meat specialists. Fat thickness was measured at the 12^{th} rib, perpendicular to the outside fat at a point ¾ of the length of the rib eye muscle. The scores range from 1 (black color, extremely soft firmness, and very coarse texture) to 7 (light cherry color, very firm and very fine texture). Rib eye area was measured at the 12^{th} rib by using a grid or a rib eye tracing and compensating polar planimeter. Percentage of kidney, pelvic and heart fat was used to evaluate fat in the kidney knob, pelvic, and heart area as a percentage of the carcass weight. Yield grade was calculated by the formula as indicated in Beef Improvement Federation Guidelines (1990).

Table 3 Marbling and Intramuscular Fat

Marbling	score	Intramuscular fat, %
Abundant	10.9	
Moderately abundant	9.9	
Slightly Abundant	8.9	10.13
Moderate	7.9	7.25
Modest	6.9	6.72
Small	5.9	5.04
Slight	4.9	3.83
Trace	3.9	2.76
Practically devoid	2.9	

Source: Beef Improvement Federation, 1990

Table 4 Quality Grade

Score	Color	Firmness	Texture
7	Light cherry	Very firm	Very fine
6	Cherry red	Firm	Fine
5	Slightly dark red	Moderately firm	Moderately fine
4	Moderately dark red	Slightly soft	Slightly fine
3	Dark red	Soft	Slightly coarse
2	Very dark red	Very soft	Coarse
1	Black	Extremely soft	Very coarse

Source: Beef Improvement Federation, 1990

Table 5 Total Retail Product

Yield Grade	Total Retail Product, %
1.7	70.9
2.3	67.9
2.7	64.9
3.2	63.1
3.7	60.6
4.2	59.1
4.7	57.3
5.5	55.1

Source: Beef Improvement Federation, 1990.

Statistical Analysis.

Least squares procedures were implemented using the GLM procedure of SAS version 6.1 (1989-96). Mixed models were used to analyze the data. Dependent variables used in statistical analyses were ADG, HCWT, MBL, FACT, REA, KPH, QG, and YG.

<u>Statistical model for post weaning growth</u>

$Y_{ijklmn} = \mu + b_i + a_j + (ba)_{ij} + S_{k(ij)} + d_{l(j)} + g_m + (bd)_{il(j)} + (bg)_{im} + (ag)_{jm} + (dg)_{lm(j)} +$

$(bag)_{ijm} + e_{ijklmn}$

$i = 1, 2 \quad j = 1, 2, 3 \quad k = 1, 2, 3 \ldots 36 \quad l = 1, 2, 3 \ldots 11 \quad m = 1, 2$

where Y_{ijklmn} = the n^{th} observation of ADG of the calf from i^{th} sire breed, j^{th} year, k^{th} sire, l^{th} dam and m^{th} sex.

μ = a population mean of ADG.

b_i = the effect of i^{th} sire breed (fixed effect).

a_j = the effect of j^{th} year-season (fixed effect).

$S_{k(ij)}$ = the effect of k^{th} sire (random effect) which is nested within breed and year.

$d_{l(j)}$ = the effect of l^{th} dam (fixed effect) which is nested within year.

g_m = the effect of m^{th} sex (fixed effect).

$(bd)_{il(j)}$ = the interaction effect of sire breed i levels and dam breed nested within year-season effect(fixed effect).

$(bg)_{im}$ = interaction effect of sire breed i levels and gender m levels(fixed effect).

$(ag)_{jm}$ = interaction effect of year-season j levels and gender m levels(fixed effect)

$(dg)_{lm(j)}$ = interaction effect of dam breed level l nested within year-season and gender level m (fixed effect).

$(bag)_{ijm}$ = interaction effect of sire breed level I, year-season level j and gender level m (fixed effect).

e_{ijklmn} = the random error and under assumption that $e_{ijklmn} \sim N(0, \sigma^2)$

σ^2 = variance error.

Statistical model for carcass characteristics

$$Y_{ijklmn} = \mu + b_i + a_j + (ba)_{ij} + S_{k(ij)} + d_{l(j)} + g_m + (bd)_{il(j)} + (bg)_{im} + (ag)_{jm} + (dg)_{lm(j)} + (bag)_{ijm} + (bdg)_{im(j)} + e_{ijklmn}$$

i = 1, 2 j = 1, 2, 3 k = 1, 2, 3…36 l = 1, 2, 3 …11 m = 1, 2

where Y_{ijklmn} = the nth observation of ADG of the calf from ith sire breed, jth year, kth sire within breed, lth dam breed and mth sex.

μ = a population mean of ADG.

b_i = the effect of ith sire breed (fixed effect).

a_j = the effect of jth year-season (fixed effect).

$S_{k(ij)}$ = the effect of kth sire (random effect) which is nested within breed and year.

$d_{l(j)}$ = the effect of lth dam (fixed effect) which is nested within year.

g_m = the effect of mth sex (fixed effect).

$(bd)_{il(j)}$ = the interaction effect of sire breed i levels and dam breed nested within year-season effect.

$(bg)_{im}$ = interaction effect of sire breed i levels and gender m levels(fixed effect).

$(ag)_{jm}$ = interaction effect of year-season j levels and gender m levels(fixed effect)

$(dg)_{lm(j)}$ = interaction effect of dam breed level l nested within year-season and gender level m (fixed effect).

$(bag)_{ijm}$ = interaction effect of sire breed level i, year-season level j and gender level m (fixed effect).

$(bdg)_{im(j)}$ = interaction effect of sire breed level i, dam breed level l and gender level m (fixed effect).

e_{ijklmn} = the random error and under assumption that $e_{ijklmn} \sim N(0, \sigma^2)$

σ^2 = variance error

CHAPTER IV

RESULTS AND DISCUSION

Post-weaning Growth

Results from least squares analysis of variance for post-weaning growth rate are presented in Table 6.1 and 6.2, and the least squares means are displayed in Table 7.1 and 7.2. The post-weaning growth rate of calves was not significantly influenced by sire breed (P=0.656), and sire (P=0.443). The post-weaning growth rates of calves sired by Limousin and Salers were 1.271 and 1.263 kg per day, respectively. However, environmental effects of year-season, dam breed, and sex had highly significant effects on post-weaning growth rate of the calves (P<0.0001). The least squares means for post-weaning ADG of fall 1987, fall1988, and spring 1989 were 1.341, 1.260 and 1.120 kg, respectively. The difference between fall 1987 and fall 1988, and fall 1987 and spring 1989 were 6 % and 16.48 % respectively and the difference between fall 1988 and spring 1989 was 11.11 %. The least squares means for post-weaning ADG for steers and heifers were 1.375 and 1.160 kg respectively.

The mean post-weaning growth rates of calves sired by Limousin and Salers in the present study are slightly higher than the estimation of Buchanan *et al.* (1988) and Lott *et al.* (1991) which were 1.110 and 1.360 kg for Limousin and Salers, respectively (Table 2). Cundiff *et al.* (1993) reported that there was a significant sire breed effect on post-weaning growth of calves while in the present study no sire breed effect was observed across each sex of calf (P=0.413 for heifers and P=0.086 for steers) Table 6.2. This difference may be because the different types of dam breed used in the presence of study and Cundiff 's study. As mentioned in chapter 3 that only 11 different types of cross cows were used while 93 different types of cross cows were used in the project of Cundiff *et al.* (1993). The least squares means estimated for postweaning growth rate of calves sired by Salers and Limousin were 0.054 lower and 0.12 kg higher than those estimated by Cundiff *et al.* (1993).

As shown by many researchers, year-season influenced performance of cattle due to the variation in environment and nutrition availability from year to year. Year-season effects were found in this study across each sex of calf (Table 6.2, P=0.0026 for heifer and P<0.0001 for steer). The fall born calves in 1987 grew faster than spring born calves in 1989 by 16.48 %. This was probably because fall born calves took advantage over spring born calves through more feed availability, and an approximate 35-day extension. Even though calves in 1987 and 1988 were born in the same season, the growth rates of the calves born in 1987 were still higher than that of calves born in 1988 by 6 % . This was due to the fact that more feed in 1987 was available than in 1988 to feed the calves.

Sex was observed by many workers to have effect on many traits. In this study, sex was determined to have an effect on postweaning growth of the calves (P<0.0001). This finding agrees with the finding of Lott *et al.* (1991) and many others. The steer calves grew faster than heifer calves by 0.215 kg per day.

Besides main effects, year-season by sex was observed (P=0.017). The effect of year-season varied and depended upon the sex effect (Table 6.2).

Table 6.1 Mean Squares (MS) and Degrees of Freedom for Postweaning Growth Rates of Calves Sired by Limousin and Salers.

	Postweaning Average Daily Gain (kg/day)	
Source	df	MS
Breed (B)	1	0.004
Year-Season (YS)	2	0.490***
B*YS	2	0.010
Sire/B*YS	42	0.021
Dam Breed(DB)/YS	14	0.085***
Sex (Sx)	1	3.013***
B*DB /YS	14	0.0142
B*Sx	1	0.0630
YS*Sx	2	0.084*
DB*Sx /YS	14	0.018
B*YS*Sx	2	0.022
Error	307	0.020

* P<0.05 or P<0.025
** P<0.01
*** P<0.0001

Table 6.2 Mean Squares (MS) and Degrees of Freedom for Postweaning Growth Rates of Calves Sired by Limousin and Salers Separated by Sex.

	Postweaning Average Daily Gain (kg/day)			
	Breed		Year-Season	
Sex	df	MS	df	MS
Heifer	1	0.014	2	0.151*
Steer	1	0.061	2	1.460***

* P<0.05
*** P<0.0001

Table 7.1 Least Squares Means (LSM), and Standard Error (SE) for Breed, Sex and Year-Season Effects on Postweaning Growth Rates of Calves sired by Limousin and Salers.

		Postweaning Average Daily Gain (kg/day)
Effect	n	LSM ± SE
Breed		
Limousin	208	1.271 ± 0.01
Salers	195	1.263 ± 0.01
Year-Season		
Fall 1987	169	1.341 ± 0.01[a]
Fall 1988	109	1.260 ± 0.01[b]
Sping 1989	125	1.200 ± 0.02[c]
Sex		
Heifer	178	1.160 ± 0.01[d]
Steer	225	1.376 ± 0.01[e]

[a, b, c, d, e] indicate significant differences ($P<0.05$).

Table 7.2 Least Squares Means (LSM), and Standard Error (SE) for Breed by Sex and Year-Season by Sex Effect on Postweaning Growth Rates of Calves Sired by Limousin and Salers.

	Postweaning Average Daily Gain (kg/day)	
Effect	sex	LSM ± SE
Breed		
Limousin	heifer	1.148 ± 0.02[a]
Limousin	steer	1.394 ± 0.01[b]
Salers	heifer	1.170 ± 0.02[a]
Salers	steer	1.357 ± 0.01[b]
Year-Season		
Fall 1987	heifer	1.205 ± 0.02[c]
Fall 1987	steer	1.477 ± 0.02[d]
Fall 1988	heifer	1.144 ± 0.02[e]
Fall 1988	steer	1.375 ± 0.02[f]
Spring 1989	heifer	1.127 ± 0.02[e]
Spring 1989	steer	1.275 ± 0.02[e]

a, b, c, d, e, f indicate significant differences ($P<0.05$).

Carcass Characteristics

Results from least squares analysis of variance for hot carcass weight, marbling, quality grade, fat thickness, kidney pelvic and heart fat percentage and yield grade are presented in Table 8.1 to 8.4. Least squares means for these traits are also shown in Table 9.1 to 9.5. The results indicated that sire breed did not affect many carcass traits. Only rib eye area (P=0.03) was influenced by sire breed. Year-season significantly influenced almost all carcass traits (P<0.001) except fat thickness (P=0.32). Sire within breed effect was also detected to influence carcass traits in this study (P<0.05) except hot carcass weight (P=0.051) and kidney, pelvic and heart fat percentage (P=0.15). However, dam breed was detected to have an effect on some carcass traits, hot carcass (P<0.0001), rib eye area (P=0.005) and quality grade (P=0.009). Sex was observed to influence only hot carcass weight (P<0.0001) and yield grade (P=0.011).

Carcass characteristics of animals vary and depend upon several factors that can affect them. Those factors are genetic potential among or within breeds, sex, nutrition, and other environmental factors (Acker, 1998).

Sire breed had an effect on several carcass traits. This finding is consistent with the findings of Cundiff *et al.*(1993) except for hot carcass weight, quality grade, marbling, and yield grade (P>0.05). The least squares means estimated by Cundiff *et al.* (1993) for hot carcass weights of Salers and Limousin were 321.36 and 303.18 kg which were 33 and 50.47 kg lower than the estimations of the present study. Hot carcass weights of calves sired by Salers and Limousin were not significantly different could be the fact that growth rates of the calves sired by Limousin and Salers were not significantly different. Secondly, since the growth rate and hot carcass weight were strongly correlated (r =705, Table 10), hot carcass weight might not be significantly influenced by sire breed. Quality grade and marbling are highly correlated (r =0.889, Table 10). The effect of sire breed on fat thickness, rib eye area, and yield grade varied and differed among each year-season (Tables 8.5, 9.4 and 9.5). The highest significant differences between these two breeds for fat thickness, rib eye area, and yield grade were in fall 1987.

Year-season was found to have a significant effect on all carcass traits in this study (P<0.001) expect fat thickness (P=0.32). This was due to the fact that the variation of environmental conditions, nutrition availability from year to year could affect carcass merit of animals (Acker, 1998). However, the effect of year-season on fat thickness, rib eye area and yield grade varied from year-season to year-season across each sire breed (Tables 8.5, 9.4 and 9.5).

Sire within breed had an effect (P<0.05) on carcass traits in this study except for hot carcass weight (P=0.051) and kidney, pelvic and heart fat percentage (P=0.15). This result agrees with the finding of Lott *et al.* (1991) and Cundiff *et al.* (1993) except for hot carcass weight and pelvic and heart fat percentage. However, dam breed was detected to have effect on some carcass traits such as hot carcass (P<0.0001), rib eye area (P =0.005) and quality grade (P =0.01). As indicated earlier that dam breed had an effect on post-weaning growth and hot carcass weight and postweaning growth were correlated, thus dam breed could influence carcass weight.

A sex effect was also observed in this study, but not for all carcass traits. Only hot carcass weight (P<0.0001), yield grade (P<0.01) were influence by a sex effect. This finding is similar to that of Lott *et al.* (1991) and others. Hot carcass weight of steer was 34.42 kg heavier than that of heifer. This because the hot carcass weight is strongly correlated with the average daily gain.

There were also some interaction effects. Sire breed x year-season effect influenced rib eye area (P=0.008), yield grade (P=0.024), and fat thickness (P=0.02). This indicates that the effect of year-season or sire breed depends on each other as shown in Tables 8.5, 9.4 and 9.5. The results from Table 8.5 indicate that there was a significant effect of year-season in 1987 on fat thickness, rib eye area, and yield grade of calves sired between these two breeds. Sire breed by dam breed and by sex interaction was also observed to have an effect on marbling (P=0.03) and quality grade (P=0.018). Other interaction effects were not observed as significant sources of variation in this study.

Table 8.1 Mean Squares (MS) and Degrees of Freedom for Hot Carcass Weight and Marbling Score of Calves Sired by Limousin and Salers.

	Hot Carcass Weight (kg)		Marbling Score
Source	df	MS	MS
Breed (B)	1	2478.70	1.36
Year-Season (YS)	2	13134.15***	2.54***
B*YS	2	439.91	0.07
Sire/B*YS	42	1114.35	0.41*
Dam Breed (DB)/YS	14	3268.61***	0.39
Sex (Sx)	1	78190.80***	0.03
B*Dam /YS	14	479.24	0.36
B*Sx	1	1882.18	0.49
YS*Sx	2	938.8	0.10
DB*Sx /YS	14	913.35	0.27
B*YS*Sx	2	154.41	0.02
B*Sx*DB/YS	14	1167.76	0.47*
Error	293	782.55	0.25

* P≤0.05 or P<0.025
** P<0.01
*** P<0.0001

Table 8.2 Mean Squares (MS) and Degrees of Freedom for Quality Grade and Fat Thickness of Calves Sired by Limousin and Salers.

		Quality Grade	Fat Thickness (cm)
Source	df	MS	MS
Breed (B)	1	0.81	0.03
Year-Season (YS)	2	1.51**	0.24
B*YS	2	0.05	0.92*
Sire/B*YS	42	0.35*	0.22**
Dam Breed (DB)/YS	14	0.52**	0.10
Sex (Sx)	1	0.03	0.28
B*Dam /YS	14	0.25	0.15
B*Sx	1	0.69	0.01
YS*Sx	2	0.03	0.03
DB*Sx /YS	14	0.14	0.18
B*YS*Sx	2	0.16	0.10
B*Sx*DB/YS	14	0.48*	0.11
Error	293	0.24	0.13

* $P \leq 0.05$ or $P<0.025$
** $P<0.01$
*** $P<0.0001$

Table 8.3 Mean Squares (MS) and Degrees of Freedom for Kidney, Pelvic and Heart Fat and Rib Eye Area of Calves Sired by Limousin and Salers.

	Kidney Pelvic and Heart Fat		Rib Eye Area(cm^2)
Source	df	MS	MS
Breed (B)	1	0.14	467.64**
Year-Season (YS)	2	3.05***	851.56***
B*YS	2	0.19	308.02*
Sire/B*YS	42	0.21	101.83**
Dam Breed (DB)/YS	14	0.23	143.94**
Sex (Sx)	1	0.05	201.85
B*DB /YS	14	0.08	38.23
B*Sx	1	0.00	58.83
YS*Sx	2	0.03	70.28
DB*Sx /YS	14	0.12	37.08
B*Y*Sx	2	0.18	34.38
B*Sx*DB/Y	14	0.07	73.70
Error	293	0.17	62.82

* $P<0.05$ or $P<0.025$
** $P<0.01$
*** $P<0.0001$

Table 8.4 Mean Squares (MS) and Degrees of Freedom for Yield Grade of Calves Sired by Limousin and Salers.

	Yield Grade	
Source	df	MS
Breed (B)	1	1.95
Year-Season (YS)	2	3.00**
B*YS	2	2.07*
Sire/B*YS	42	0.54*
Dam Breed (DB)/YS	14	0.23
Sex (Sx)	1	2.24*
B*DB /YS	14	0.31
B*Sx	1	0.05
YS*Sx	2	0.81
DB*Sx /YS	14	0.35
B*YS*Sx	2	0.02
B*Sx*DB/YS	14	0.29
Error	309	0.34

* P<0.05 or P<0.025
** P<0.01
*** P<0.0001

Table 8.5 Mean Squares (MS) and Degrees of Freedom for Fat Thickness, Rib Eye Area, and Yield Grade of Calves Sired by Limousin and Salers Separated by Year-Season.

	Breed	
Year-Season	df	MS
	Fat Thickness (cm)	
Fall 1987	1	1.12**
Fall 1988	1	0.57*
Spring 1989	1	0.16
	Rib Eye Area (cm^2)	
Fall 1987	1	629.05**
Fall 1988	1	64.85
Spring 1989	1	488.66**
	Yield Grade	
Fall 1987	1	5.66***
Fall 1988	1	0.46
Spring 1989	1	0.89

* $P<0.05$
** $P<0.01$
*** $P<0.0001$

Table 9.1 Least Squares Means (LSM) and Standard Error (SE) for Hot Carcass Weight and Marbling Score of Calves Sired by Limousin and Salers

		Hot Carcass Weight (Kg)	Marbling Score
Effect	n	LSM ± SE	LSM ± SE
Breed			
Limousin	208	332.98 ± 2.46	4.51 ± 0.04
Salers	195	339.32 ± 2.52	4.66 ± 0.04
Year-Season			
Fall 1987	169	343.32 ± 2.34[a]	4.44 ± 0.04[g]
Fall 1988	109	321.80 ± 3.10[b]	4.77 ± 0.05[h]
Spring1989	125	343.34 ± 3.43[a]	4.56 ± 0.06[i]
Sex			
Heifer	178	318.44 ± 2.38[c]	4.60 ± 0.04
Steer	225	353.86 ± 2.08[d]	4.58 ± 0.04
Breed	Sex		
Limousin	heifer	312.50 ± 3.78[e]	
Limousin	steer	353.47 ± 3.11[f]	
Salers	heifer	324.38 ± 4.02[e]	
Salers	steer	354.26 ± 3.16[f]	

[a, b, c, e, f, g, h, i,] indicate significant differences ($P<0.05$).

Table 9.2 Least Squares Means (LSM) and Standard Error (SE) for Quality Grade and Fat Thickness of Calves Sired by Limousin and Salers

Effect	n	Quality Grade LSM ± SE	Fat Thickness (cm) LSM ± SE
Breed			
Limousin	208	3.26 ± 0.04	1.08 ± 0.03
Salers	195	3.38 ± 0.04	1.42 ± 0.03
Year-Season			
Fall 1987	169	3.44 ± 0.04[a]	1.01 ± 0.03[c]
Fall 1988	109	3.34 ± 0.05[a]	1.10 ± 0.04[d]
Spring1989	125	3.17 ± 0.06[b]	1.08 ± 0.04[c]
Sex			
Heifer	178	3.33 ± 0.05	1.23 ± 0.03
Steer	225	3.31 ± 0.04	1.27 ± 0.03

[a, b, c, d,] indicate significant differences ($P<0.05$).

Table 9.3 Least Squares Means (LSM) and Standard Error (SE) for Kidney, Pelvic and Heart Fat, Rib Eye Area and Yield Grade of Calves Sired by Limousin and Salers.

		Kidney, Pelvic Heart Fat	Rib Eye Area(cm^2)	Yield Grade
Effect	n	LSM ± SE	LSM ± SE	LSM ± SE
Breed (B)				
Limousin	208	2.10 ± 0.04	91.73 ± 0.69[c]	2.28 ± 0.05
Salers	195	2.06 ± 0.04	89.08 ± 0.73[d]	2.45 ± 0.05
Year-Season				
Fall 1987	169	2.28 ± 0.04[a]	93.62 ± 0.72[e]	2.17 ± 0.05[i]
Fall 1988	109	1.99 ± 0.04[b]	87.96 ± 0.88[f]	2.43 ± 0.06[j]
Spring 1989	109	1.96 ± 0.05[b]	89.64 ± 0.97[f]	2.50 ± 0.06[j]
Sex				
Heifer	178	2.10 ± 0.04	89.49 ± 0.78[g]	2.27 ± 0.05[k]
Steer	225	2.06 ± 0.04	91.32 ± 0.58[h]	2.46 ± 0.04[l]

[a, b, c, d, e, f, g, h, i, j, k, l] indicate significant differences ($P<0.05$).

Table 9.4 Least Squares Means (LSM) and Standard Error (SE) for Fat thickness, and Rib Eye Area of Calves Sired by Limousin and Salers Separated by Year-Season.

		Fat thickness (cm)	Rib Eye Area(cm^2)
Effect	Year-Season	LSM ± SE	LSM ± SE
Breed			
Limousin	Fall 1987	0.91 ± 0.05[a]	95.89 ± 1.03[e]
Limousin	Fall 1988	1.18 ± 0.05[b]	87.07 ± 1.16[f]
Limousin	Spring 1989	1.13 ± 0.06[b]	92.24 ± 1.39[g]
Salers	Fall 1987	1.10 ± 0.05[b]	91.34 ± 1.00[g]
Salers	Fall 1988	1.01 ± 0.06[a,b]	88.85 ± 1.32[f]
Salers	Spring 1989	1.04 ± 0.06[a,b]	87.04 ± 1.36[f]

[a, b, c, d, e, f, g] indicate significant differences ($P<0.05$).

Table 9.5 Least Squares Means (LSM) and Standard Error (SE) for Yield Grade of Calves Sired by Limousin and Salers Separated by Year-Season.

Effect	Year-Season	Yield Grade LSM ± SE
Breed		
Limousin	Fall 1987	1.95 ± 0.08^{a}
Limousin	Fall 1988	2.51 ± 0.09^{b}
Limousin	Spring1989	2.38 ± 0.10^{b}
Salers	Fall 1987	2.38 ± 0.07^{b}
Salers	Fall 1988	2.36 ± 0.09^{b}
Salers	Spring 1989	2.61 ± 0.10^{b}

[a, b] indicate significant differences ($P<0.05$).

Table 10 Partial Correlation Coefficients from the Error SS&CP Matrix/Prob>|r|

	HCWT	MBL	QG	KPH	FACT	REA	ADG	YG
HCWT		0.0462	0.0774	0.0007	0.2845	0.4411	0.7051	0.2562
MBL			0.8847	0.1691	0.1058	-0.0782	-0.0321	0.1656
QG				0.1691	0.1078	-0.0740	-0.0346	0.1609
KPH					0.1933	-0.1406	-0.0188	0.3572
FACT						-0.1248	0.2174	0.7606
REA							0.2980	-0.5924
ADG								0.1957
YG								

Correlation greater than 0.1205 is different than zero (P<0.05).

CHAPTER V

CONCLUSION

There were only small differences between calves sired by Salers and Limousin for post weaning growth, but there were significant differences between year-seasons, dam breed, sex of the calves. The effect levels of year-season varied and depended on each sex. Overall, the steer calves grew faster than heifer calves by 15.64%. Year-season by sex interaction effects also were observed.

Only rib eye area was found to be significantly different between the two breeds. Year-season had a significant effect on almost carcass traits except fat thickness. But the effect of year-season on rib eye area, fat thickness, and yield grade varied and depended on each sire breed. Sire within breed, dam breed, and gender of calf were observed to be significant for some carcass characteristics (Table 8.1 through 8.4). The results from this study indicate that the Limousin breed had an advantage over Salers for rib eye area. This indication was the same as the suggestions of Lott *et al.* (1991) and Cundiff *et a.l* (1993).

CHAPTER VI

IMPLICATIONS

Based on the present study the two breeds were not significantly different for most traits. However, the estimation of hot carcass weight of the Salers heifers was heavier than that of the Limousin heifers by 11.88 kg and the estimation of hot carcass weight of the Salers steers was heavier than that of the Limousin steers by 0.8 kg. Cundiff *et al.* (1993) reported that hot carcass weight of the Salers steers was heavier than that of the Limousin steers by 18.18 kg. Wagner *et al.* (1998) indicated that the base value of carcass weight of beef cattle was $2.35/kg and the price of beef based on the quality. Thus the different values between these two breeds were $27.87 for heifers and $1.88 for steers. Even though results did not indicate that the two breeds were significantly different, the actual values showed that the Salers breed brought about more income than the Limousin breed. However, more study is further needed to look at the comparison for the economic efficiency between the two breeds. Factors that should be taken into account such as management cost, production cost, and net return in either medium or large scale production.

CHAPTER VII

SUMMARY

Salers and Limousin are breeds that were originally developed in France several hundreds year ago. Historically Salers is believed to have a relationship with *Bos Indicus* like Aubrac and the Gascon while Limousin is believed to have a relationship with a wild cattle of Europe called *Aurochs.* Both breeds are adapted well to harsh conditions, rapid growing, and heavy muscling. Salers have not been previously studied very much

Therefore, the objective of this project was to compare these two breeds for post-weaning growth and carcass traits.

All calves used in this study were part of the beef cattle research herd located at the North Lake Carl Blackwell Research Range west of Stillwater. Data were collected from 403 calves (225 steers and 178 heifers) born during 1986 through 1988 from 11 different types of crossbreed cows. Cows were inseminated artificially with semen from either Salers or Limousin purebreds. Semen from 36 different bulls of either Salers or Limousin (12 bulls in 1986 , 11 bulls in 1987 and 13 in 1988) was randomly chosen from high breeding value group and assigned to cows within breed group in each breeding season.

Cows and their calves were maintained in separate pastures grouped by sex. All calves were weighed, tagged, dehorned and bull calves were castrated within 24 hours of birth. Calves were raised on native pastures or on bermudagrass pastures until weaning at an average age of 205 days. Weaning occurred in early October and early June when calves reached on average age of approximately 205 and 240 days for spring and fall born calves respectively. Weaning of fall born calves was delayed approximately 35 days to allow calves and cows to take advantages of spring forage production before weaning. Following weaning calves were transported to a commercial feedlot. They were weighed upon entry, grouped by sex and managed by personnel at the feedlot. The calves were removed from the feedlot when the feedlot managers thought they would have High Select and Low Choice Quality Grade. All calves were weighed again after feeding trial was completed obtain average daily gain for evaluating postweaning growth rate. Carcass data recorded were hot carcass weight in kg, marbling score, quality grade, yield grade, fat thickness in cm , rib eye area in cm^2, and kidney pelvic heart fat percentage. All carcass traits were measured and evaluated based on specifications indicated in BIF Guidelines (1990).

Least squares procedures were implemented using the GLM procedure of SAS version 6.1 (1989-96). Mixed models were used to analyze the data. The results suggested that there were a small difference between calves sired by Salers and Limousin for post weaning growth, but there were significant differences between year-season, dam breed, sex of calf. The effect levels of year-season varied and depended on each sex of calf. Overall, the steer calves grew faster than heifer calves by 15.64 %. Year-season by sex interaction effect was observed.

Only rib eye area was found to be significantly different between the two breeds. Year-season had a significant effect on almost carcass traits except fat thickness. But the effect of year-season on rib eye area, fat thickness, and yield grade varied and depended on each sire breed. Sire within breed, dam breed, and gender of calf were observed to be significant for some carcass characteristics. Based on this study, the results indicated that the Limousin breed had an advantage over Salers for rib eye area. This indication was the same as suggestions of Lott *et al.* (1991) and Cundiff *et al.* (1993).

Even though the two breeds were not significantly different for most traits, the estimation of hot carcass weights of the Salers heifers was heavier than that of the Limousin heifers by 11.88 kg and the estimation of hot carcass weights of the Salers steers was heavier than that of the Limousin steers by 0.8 kg. Cundiff *et al.* (1993) reported that hot carcass weights of the Salers steers were heavier than that of the Limousin steers by 18.18 kg. Wagner *et al.* (1998) indicated that the base value of carcass weight of beef cattle was $2.35/kg and the price of beef based on quality. The different values between these two breeds were $27.87 for heifers and $1.88 for steers. Even though results did not indicate that the two breeds were significantly different, the actual values showed that the Salers breed brought about more income than the Limousin breed. However, more study is further needed to look at the comparison for the economic efficiency between the two breeds. Factors that should be taken into account such as management cost, production cost, and net return in either medium or large scale production.

LITERATURE CITED

Abraham, H. C, Murphey, C. E, Cross, H. R, Smith, G. C, and Franke, W. J 1980. Factors affecting beef carcass cutability: An evaluation of the USD yield grades for beef. J. Anim. Sci. 50: 841 - 850.

Acker, Duane. 1998. Animal Science and Industry 4th Edition, Page 161-171.

Bair, L. G, Wilson, L. L, and Zeigler, J. H. 1972. Effect of calf sex and age of dam on pre and post weaning performance of calves from Anus- Holstein crossbred herd. J. Anim. Sci. 35:1155-1159.

Beef Improvement Federation Publication, Six Edition- May 1990. Oklahoma State University, Stillwater, Oklahoma. Page: 13-15.

Bourdon, M Richard.1998. Understanding Animal Breeding. Page 350 - 367.

Brigges, Hilton M.1991. Modern breeds of livestock. 4th Edition :170-74; 182-83.

Brinks, J. A Knapp, B. W, Urick, J. J, and Pahnish, O. F.1972. Heterosis in preweaning maternal traits among lines of Hereford cattle. J. Anim. Sci. 34: 14-20.

Brooker, E . H, Thompson, C. E, Skelly, G. C, Duke, J. K, Murray, J. A and Worrel, M. A.1994. Carcass characteristics of crossbreed and straight-breed beef cattle. J. Anim. Sci. 72:26-97 suppl.1994.

Brown, J. E, Brown, C. J, and Butts, W. T. 1972. Relationship among weights, gains and earliness of maturing Hereford and Angus females. J. Anim. Sci. 35:507-517. L

Buchanan, D. S, Danell, D. K, Frahm, R. R, Vanderwert, W. 1988. Agri. Exp. Station, Division of Agri. Okl. St. Univ. Evaluation of the North America Limousin. Bulletin B-786:1- 25.

Buchanan, D. S, Archie C. Clutter, Sarah L. North Cutt and Daniel Pomp 1993. Animal Breeding: Principles and Application 4th Edition Page 60.

Camifled, P. K, Brown, A. H, Jr., Jonhson, Z. B, Lewis, P. K, and Brown, C. J. 1994. Effect of growth type on weight-age and carcass data of beef steer developed on pasture and in feedlot. J. Anim. Sci. 72:26-97 suppl.1994.

Carvalheira, J. G. V, Blake, R. W, Pollak, E. J, and Van Soest, P. J. 1995. Comparison of Loudim and Africander cattle in South Mozambique for body weight and growth. J. Anim. Sci. 73:3527-3533.

Conforth, D. P. 1980. Maturity and its relationship to muscle characteristics of cattle. J. Anim. Sci. 50:75 - 80.

Cundiff, L. V. 1970.Experiment results on crossbreeding cattle for beef production. J. Anim. Sci. 30:694 - 705.

Cundiff, L. V, Ferenc Szabo, Keith E. Gregory, R. M. Koch, M. E. Dikeman, and J. D. Crouse.1993. Breed comparisons in the germplasma evaluation program at MARC. Presented at beef Improvement Federation 25th Anniversary Conference, May 26-29, 1993, Ascheville, North Carolina.

Dearborn, D.D.1987. Greorgy, K. E , Cundiff, L. V and Koch, R. M. Maternal heterosis and grand maternal effects in beef cattle: Pre-weaning traits. J. Anim. Sci. 65:33-42.

Fortin, A. 1980. Effect of feed intake level and influence of breed and sex on the relationship between the physical composition of the bovine carcass and specific gravity. J. Anim. Sci. 50:81-91.

Gaines, J. A. 1970. Richardson, G. V, Carter, R. C, and McClure, W. H. General Combination ability and maternal effects in crossbreeds. J. Anim. Sci. 31:19 - 26.

Gregory, K. E, Dearborn, D. D, Cundiff, L. V, and Koch, R. M. 1987.Maternal heterosis and grandmaternal effects in beef cattle: Post-weaning growth and carcass traits. J. Anim. Sci. 65:1180 - 1194.

Gregory, K. E. 1996. Effects of twinning on dystocia, calf survival, calf growth, carcass traits and cow productivity. J. Anim. Sci. 74:1223 - 1233.

Harvey, Walter R. 1982. Least squares mean analysis of discrete data. J. Anim. Sci. 54:1067-1070.

Hassen, A., William, R. L. 1994. The influence of size groups of cows on the formation of beef lines that tie to the breed data bases. J. Anim. Sci. 72:39.Suppl.

Hiroyuki, H. 1996. Genetic parameters for growth and carcass traits in Japanese Brown cattle estimated from field records. J. Anim. Sci. 74: 2112 – 2116.

Hollis D. Chamman. 1972. Comparison of criteria for selecting introduced beef sires. J. Anim. Sci. 35:321-326.

Koch, R. M. 1972. The role of maternal effects in animal breeding. J. Anim. Sci. 35:1316.

Kress, D. D.1972. Weaning weight related to subsequent most probable production ability in Hereford cows. J. Anim. Sci. 35:327-334.

Kress, D. D, Davis, K. C, Anderson, D. C, Boss, D. L, and Doornbos, D. E. 1996. Paternal and maternal heterosis for pregnancy rate in Hereford and Tarentase Cattle. J. Anim. Sci. 74: 116. Suppl.

Kuehl, Robert. O. 1994. Statistical principles of research and analysis. Page 221-250.

Lott, B. R, Sanders, J. O, Lunt, D. K, and Baker, J. F. 1991. Effect of Angus, Charolais, and Salers sires on birth, weaning and carcass traits of calves. J. Anim. Sci. 69:197. Suppl.1.

Lymber, A. J. 1994. The effects of selection for increased pre-weaning growth rate on the postweaning performance of composite breed steers. Pro. Aust. Soc. Anim. Prod. 20:347.

Lynch, J. M. 1997. Influence of timing of gain on growth and reproduction performance of beef cattle replacement heifers. J. Anim. Sci. 75:1715 - 1722.

Mccarter, Marion Neil. 1989. Use of Brahman Breeding in crossbreeding programs under spring and fall calving management systems to increase production efficiency. Table 2 page 40.

Massay, M. A and Benysbek, L. L. 1981. Interaction involving sires, breed of dam and age of dam for performance characteristics in Limousin cattle. J. Anim. Sci 53: 940-945.

McDonald, R. P, and Turner, J. W. 1972. Estimation of maternal heterosis in preweaning traits of beef cattle. J. Anim. Sci. 35:1146-1153.

Meadows, S. E, Thompson, G. C, Skelley and Worrell, M. A. 1994. Theretical culling procedure of Angus and Angus F_1 dams. J. Anim. Sci. 72:27, Supplement 1.

Murray, J. A, Thompson, C.E, Burns, G. L, Skelly, G. C, and Worrel, M. A 1994. Sire and dam breed influence on calf. J. Anim. Sci. 72:25. Suppl.

Nunez-Dominguez, R, Van Vleck, L. D, and Cundiff, L. V. 1995. Prediction genetic values of sires for growth traits of crossbreed cattle using a multivariate animal model with heterogeneous variance. J. Anim. Sci. 73:2940.1995.

Oklahoma State University, Cattle breeds copy right1996. Animal Science Department's Home page. www.ansi.okstate.edu/breeds/cattle/.

Oviedo, J. A, Salgado, D, and Franke, D. E .1994. The influence of calving date on calf and cow performance. J. Anim. Sci. 72:27 , Supplement 1.

Owen, F.N, Gill, R. Donald, Secrist, David. S, and Coleman, S. W. 1995. Review of some aspects of growth and development of feedlot cattle. J. Anim. Sci. 73:3152-3172.

Pahnish, O. F, Brinks, J. A Knapp, B. W, Urick, J. J, and Wilson, F. S. 1971. Results form crossing beef x beef and breed x dairy breed: post-weaning performance of heifers. J. Anim. Sci. 33: 736 - 743.

Robison, O. W. 1981. The influence of maternal effects on the efficiency of selection. Livest. Prod. Sci., 8: 121-137.

Porter, Valerie. 1991. A handbook to the breeds of the world. Page, 112-113.

Rodriguez-Almeida, F. A, Van Vleck, L. D, and Cundiff, L. V. 1995. Heterogeneity of variance by sire breed, sex and dam breed in 200-and 365-day weights of beef cattle from a top cross experiment. J. Anim. Sci.73:2589.

Sheridan, A. K. 1981. Crossbreeding and heterosis. Animal Breeding Abstract. 49:131-143.

Singh, A. R. 1972. Cow weight and pre-weaning performance of calves. J. Anim. Sci. 31:27-30.

Thrieft, F. A, Kratzer, D. D, Kemp, J. D, Bradey, N. W, and Garrigus, W. P. 1970. Effect of sire, sex and sire x sex interaction on beef cattle performance and carcass traits. J. Anim. Sci. 30:182 -185.

Thrieft, F. A. 1997. Reproductive performance of cows mated to and post-weaning performance of calves sired by Brahman *Vs* alternative subtropical breeds. J. Anim. Sci. 75: 2604 - 2608.

Urick, J. J, Brinks, J. A, Pahnish, O. F, Knapp, B. W, Knapp, W. B, and Riley, T. M. 1970. Heterosis in post-weaning traits among lines of Hereford cattle. J. Anim. Sci. 27:323-330.

Wagner, J.T, Gill, D. R, Strasia, C. A, Dolezal, H. G, Garner, B. A, Owen, F. N, Schutte, B. R, and Martin, J. J. 1998. Animal Science Research Report. Page 46-49.

Wilson, L. L, Rishel, W. H, and Harvey, W. R .1972. Influence of herd, sire and herd x sire interaction on live and carcass characters of beef cattle. J. Anim. Sci. 35:502–506.

2

VITA

Neath Net

Candidate for the degree of

Master of Science

Thesis: COMPARISON OF SALERS AND LIMOUSIN FOR POSTWEANING GROWTH AND CARCASS MERIT.

Major Filed: Animal Science

Biographical:

Personal Data: Born in Phnom Penh, Kingdom of Cambodia on July 06, 1968, the oldest son of Mr. Net, Neang and Por Heang Lok.

Education: graduated from Bak Touk High School, Phnom Penh, Cambodia, September 1988; received veterinarian from the Royal University of Agriculture, Phnom Penh, Cambodia in December 1992; Completed the requirements for the Master of Science degree with a major in Animal Science at Oklahoma State University in December, 1998.

Professional Experience: taught Veterinary Microbiology and Pharmacology at occupational school of Veterinary Medicine at Prek Leap College of Agriculture, Phnom Penh, Cambodia in 1993. Employed as assistant advisor of the Department of Wildlife Conservation, Ministry of Environment, Phnom Penh, Cambodia from 1994 to 1996. Fulbright scholar, Department of Animal Science, Oklahoma State University, Oklahoma, United States of America, 1997 to 1998.