EFFECT OF PREWEANING MILK LEVELS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF CALVES DIFFERING IN GROWTH POTENTIAL

By

Gary Lynn Crosthwait

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1974

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
July, 1983

EFFECT OF PREWEANING MILK LEVELS ON FEEDLOT
PERFORMANCE AND CARCASS CHARACTERISTICS
OF CALVES DIFFERING IN
GROWTH POTENTIAL

Thesis Approved:

Keith Lusby
Thesis Adviser

Charles A. Hibberd

Donald W. Horn

Norman N. Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to express my sincere appreciation to Dr. Roger D. Wyatt and Dr. Keith S. Lusby for their support, advice and assistance during the course of this project.

Grateful acknowledgment is also given to Dr. Rich Hintz and Dr. Gerald W. Horn for their helpful suggestions and critical evaluation while serving on the guidance committee.

Special thanks are extended to Dan Hoskins, Andrew Stelting and Jack Eason at the Southwestern Livestock and Forage Research Station for help in caring for the experimental cattle and maintaining necessary records.

Appreciation is also extended to Kent Barnes, Steve Peterson, Roy Ball and other graduate students for their assistance and encouragement with this project.

A very special thanks is extended to the author's wife, Linda, and children, Matthew and Brian, for their understanding, encouragement, and cooperation during the course of this program of study.

TABLE OF CONTENTS

Chapter	Page

LIST OF TABLES

Table | Page

CHAPTER I

INTRODUCTION

Maximum profit should be the goal of any enterprise. The dilution of fixed operating costs by increasing output per unit of input is one method of obtaining this goal. Therefore, in cow-calf operations, management techniques which contribute to increasing calf weaning weight have been emphasized.

Research results indicate that calf weaning weights increase with increasing levels of milk production by their dams. The infusion of dairy breeding into beef herds provides a means of raising milk production faster than through selection within beef breeds, and has received attention as an alternative for increased productivity.

The effects of previous milk levels and calf type upon subsequent feedlot performance and carcass desirability must be considered when this method is to be employed. The salability of calves from this production strategy will depend upon their utility.

The objectives of the experiments reported in this manuscript were to determine the effects of three widely differing preweaning milk levels on postweaning feedlot performance and carcass characteristics of calves of three biological types.

CHAPTER II

REVIEW OF LITERATURE

This review has been organized into two parts: (1) the effects of dairy breeding upon calf feedlot performance and carcass desirability and (2) the effects of previous nutritional regime upon subsequent calf growth and efficiency.

Influences of Dairy Breeding on Calf Performance and Carcass Traits

The genetic makeup of animals within and across breeds has a marked effect on their performance and efficiency. It has been assumed that the breeds of cattle selected primarily for beef production are superior to the milk or dairy breeds in performance and efficiency for the production of lean tissue. Cole et al. (1963) compared Hereford, Angus, Brahman, Brahman-cross, Holstein and Jersey steers in a comparative feeding and slaughter trial. The steers averaged 5 months of age at the trial beginning and each was slaughtered when it reached an off-feed weight of approximately 900 pounds or at the age of 20 months, whichever was reached first. Holstein steers gained the fastest of all breeds, but Jerseys were the second lowest in daily gains. Holstein carcasses graded lowest and had the least marbling and external finish of all breeds. Jersey carcasses combined the greatest amount of kidney fat with next to the lowest carcass grade and amount of external finish.

Patterson et al. (1972) reported that Brown Swiss x Hereford calves gained at the same rate as Hereford calves in the feedlot and weighed the same at slaughter when fed for the same period of time. Hereford calves were more efficient in feed conversion requiring 55 pounds less feed per hundredweight gain than the Brown Swiss x Hereford calves. Eighty-seven percent of the Hereford carcasses graded choice as compared to 14 percent of the Brown Swiss x Hereford carcasses. Hanke et al. (1964), Burroughs et al. (1965), and Minish et al. (1966) reported faster but less efficient gains when dairy calves were compared to British breeds.

Dean et al. (1976a) compared the progeny of Hereford, Hereford x Holstein and Holstein dams fed to an approximately equal slaughter grade. Holstein progeny were 136 pounds heavier initially and 249 pounds heavier at slaughter than Hereford progeny. The calves of the Hereford cows gained 0.18 pounds per day more and required 27 percent less feed per unit of gain than the calves of Holsteins. The Hereford x Holstein offspring were intermediate for these traits. This concurs with later results reported by Wyatt et al. (1977b) that indicated a tendency for feed required per unit of gain to increase as percentage of Holstein breeding increased.

The apparent conflict of results for gains of Holsteins as compared to beef breeds mya be explained by length of the feeding period. The work of Dean et al. (1976a) and Wyatt et al. (1977b) are based on feeding to an approximately equal slaughter grade while the previous data (Cole et al., 1963; Patterson et al., 1972; Hanke et al., 1964; and Minish et al., 1966) resulted from feeding to an equal weight or time end point which would favor the larger, slower maturing Holsteins.

Results reported by Garrett (1971) in two comparative slaughter experiments indicated that Herefords were 20 percent and 12 percent more efficient in converting feed energy above maintenance to energy storage as fat and protein than Holsteins. However, the Herefords were fatter initially and gain made by the beef steers contained more fat. Thus, the difference in efficiency seemed to be related to the fat component of the animals and of the gained tissue.

Branaman et al. (1962) compared beef-type steers to Holsteins fed the same time period in three trials and observed no difference in percent separable lean or fat between the beef and dairy steers. The beef steers graded higher in quality grade. These findings agree with those reported by Cole et al. (1964) showing Holsteins to have the highest percent separable muscle when compared to Hereford or Angus.

Ziegler et al. (1971) and Callow (1961) observed that Holsteins had a higher percent cutability, as compared to beef-type calves due to less external fat. Patterson et al. (1972) and Cole et al. (1963) also found dairy steers to have less external finish than beef steers.

Work by Cole et al. (1964), Minish et al. (1966) and Garrett (1971) showed that Holstein calves were lower in quality and conformation grade than calves of British breeds when fed to an equal slaughter weight. Dean et al. (1976b) reported that calves out of Hereford dams produced carcasses with more muscling, as indicated by more ribeye area per hundredweight of carcass and a higher conformation grade than calves from Hereford x Holstein and Holstein cows.

Wyatt et al. (1977b) indicated a trend for Hereford progeny to have higher cutabilities and carcass conformation scores when compared to Holstein or Hereford x Holstein progeny.

Effect of Preweaning Nutritional Level On Calf Growth and Carcass Parameters

The effect of preweaning milk intake upon subsequent performance and carcass characteristics must be considered when determining the value of using dairy breeding to increase milk production in beef cows. Research at this station, Wyatt et al. (1977b) and Dean et al. (1976a) has shown progeny of beef x dairy breeding to be heavier at weaning and at slaughter, but less efficient in converting feed to gain during the feeding phase. However, the effects of level of milk consumption and genetic potential for growth were confounded in these studies since milk consumption levels did not vary greatly among calves of similar genetic composition.

Early work by Cook et al. (1959) indicated that increasing milk production up to 8000 pounds of milk per year lowered carcass grade in the resulting progeny. This comparison was made on high producing Milking Shorthorn cows and milk production may have already exceeded the practical limits in a beef herd.

Neville et al. (1962) in a trial with Hereford cattle observed that increases in weaning weight due to milk production continued to be present almost to the pound at slaughter. Increased milk production significantly increased carcass grade and weight per day of age of slaughter.

Neville et al. (1962) also reported a positive correlation (.75) between 240-day weight and slaughter weight. This is similar in magnitude to the correlation coefficient of .87 reported by Swiger (1961).

Christian et al. (1965) using progeny from fraternal and identical twin Hereford heifers reported a positive correlation between milk production and weaning weight. As weaning weight increased, average daily gains and proportion of trimmed valuable cuts in the carcass increased significantly. Weaning weight did not influence feed efficiency for the total feedlot phase. However, the heavier weaning calves required more feed per pound of gain during the period immediately following weaning. This may indicate that the heavier weaning calves had a higher daily maintenance requirement. It is also possible that the heaviest calves at weaning were the fattest and that their postweaning gain was more in the form of additional fat tissue which is deposited less efficiently than lean.

Woodward et al. (1959) and Carter and Kincaid (1959) also reported positive associations between weaning weight and subsequent gain. Swiger (1961) found that a good preweaning environment handicapped early postweaning gains but enhanced later gains.

Stuedemann et al. (1968) studied the effect of five nutritional levels from birth to eight months of age on feedlot performance and carcass measurements when fed to a similar weight. Calves were the progeny of Hereford cows allotted into groups on the basis of milk production. The nutritional levels was designated as very restricted, restricted, normal, high, and very high. Average daily feedlot gains of the calves from the various treatment groups were not significantly different. Therefore, calves subjected to the lower planes of nutrition during early life required more days to reach similar weights. Carcass merit was not affected by preweaning nutritional level.

This is in contrast to data reported by Ruby et al. (1948), Heinenann and Van Keuren (1956) and Lawrence and Pearce (1964), which showed a negative correlation between previous plane of nutrition and subsequent body weight gain. It has been generally accepted that the phenomenon known as "compensatory growth", in which animals following a period of restriction tend to compensate with greater average daily gains than animals receiving a liberal ration throughout the feeding period, exists. Coleman et al. (1976) concluded that feedlot gains were independent of animal age and previous nutrition, but rather were related to animal weight upon entering the feedlot.

CHAPTER III

EFFECT OF LOW AND HIGH PREWEANING MILK LEVELS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF TWO CALF TYPES

Summary

The effects of two preweaning milk intakes on the feedlot performance and carcass characteristics of calves of two different growth potentials was determined. Calf types were established by breeding Angus bulls to Hereford cows (AxH) and Charolais bulls to Holstein cows (CxHol). A reciprocal cross-fostering scheme allowing calves of similar type to consume a low (Hereford) and high (Holstein) milk level was used. During the preweaning portion of the trial, cows and calves were managed in two groups; either on tall grass native range or in a completely confined drylot system. At weaning, the calves were placed in a feedlot and fed to an estimated carcass grade of low choice. Calves raised on native range were group-fed in the feedlot phase, while calves reared in drylot were confined and fed individually. They were then slaughtered and carcass data collected. Among AxH calves, the high level of milk resulted in an average increase ($P < .05$) in initial feeding weight (weaning weight) of 103 pounds and tended to increase slaughter weights. CxHol calves on high milk levels were initially 109 pounds heavier ($P < .05$) on the average

than their counterparts on low milk and tended to be heavier at slaughter. CxHol calves were heavier ($P < .05$) than AxH at slaughter and produced heavier carcasses. Average daily gains and feed efficiency tended to be poorer for calves that had previously received the high milk level. AxH calves were more efficient than CxHol in converting feed to gain. CxHol calves produced heavier ($P < .05$) carcasses in all cases than did AxH. Group-fed calves which received the high preweaning milk level produced heavier carcasses ($P < .05$) than those which received the low milk level.

Introduction

Increased calf weaning weight is a principal goal in most commercial cow-calf operations. The importance of milk consumption by calves as a factor influencing weaning weight has been well documented (Knapp and Black, 1941; Gifford, 1953; Velasco, 1962; Pinney, 1963). Beef x dairy crossbreeding (Cundiff, 1970) can increase the milk production of beef cows more rapidly than selection within a beef breed. Several studies have investigated the feedlot performance and carcass desirability of beef-dairy crossbred calves (Dean et al., 1976; Garrett, 1971; Cole et al., 1964; Minish et al., 1966; Wyatt et al., 1977b). However, the effects of increased milk consumption and dairy breeding on feedlot performance and carcass traits were not clear because the effects of milk level were confounded with genetic differences for growth rate potential in calves. Few studies have reported the effects of various preweaning milk levels on feedlot performance and carcass characteristics of calves of similar genetic composition.

This experiment was conducted to compare the effects of a low and high preweaning milk level upon the feedlot performance and carcass characteristics of calves of two biological types.

Materials and Methods

Forty Angus x Hereford and Thirty-six Charolais x Holstein calves were used to determine the feedlot performance and carcass characteristics of calves of two biological types raised from birth to weaning on two levels of milk intake. The two calf types were established by mating Angus (A) bulls to Hereford (H) cows and Charolais (C) bulls to Holstein (Hol) cows. A system was employed whereby calves of similar type could be exposed to a low (Hereford) and high (Holstein) level of milk consumption.

This design was accomplished using the reciprocal cross-fostering scheme described by Wyatt et al. (1977a). Approximately one-half of the calves produced by Hereford cows (AxH) were raised by Holstein cows and one-half of the calves produced by Holstein cows (CxHol) were raised by Hereford cows. Thus, within each calf breed (AxH and CxHol) one was the recipient of a low level of milk (10 to 11 pounds per day) while another group received a high milk level (21 to 24 pounds per day.

During the preweaning phase of the trial, the cows and calves were allotted to one of two management systems. Cows and calves were maintained either on tall grass native range or confined in drylot from shortly after the birth of the calves to weaning as described by Barnes (1977). Cows received a post-calving winter supplement level calculated to allow a 20 percent winter weight loss including weight loss at calving. Supplement levels were based on earlier work on cow size and milk production levels at this station (Kropp et al., 1973). Calves were born in December, January, and February and weaned at 240 ± 7 days of age. Drylot calves were creep-fed while range calves received only grazed forage.

Calves were grafted onto foster dams within 12 hours following birth. Parturition was induced in some cows by administration of 40 milligrams of dexamethazone (Azium[1]) within 10 days of their projected calving date to allow scheduling of the cross-fostering program.

At weaning, calves were fasted for six hours, weighed, photographed, and vaccinated for blackleg, parainfluenze-3 and infectious bovine rhinotracheitis. Skeletal size was estimated from 2" x 2" slides taken with each calf behind a grid at weaning and prior to slaughter. Height was defined as the distance from the hip (tuber coxae) to the floor and length as the horizontal distance from the point of the shoulder (dorsal anterior humerus) to the hip. The hip and point of shoulder were marked with contrasting chalk prior to photographing to facilitate more accurate measurement.

Calves were placed directly into the feedlot at weaning. Calves from drylot cows were individually-fed ad libitum in single pens with a covered feeding area so that individual feed intake could be measured. Calves from range cows were group-fed ad libitum in a barn with a covered feeding area and an outside loafing area. Group-fed calves received a 75 percent concentrate diet (Table I) while individually-fed calves received a 95 percent concentrate, whole corn based diet shown in Table II. Each calf was fed to an estimated

---

[1]Azium brand, Schering Corporation, Bloomfield, New Jersey 07003.

TABLE I

RATION COMPOSITION FOR GROUP-FED CALVES

Ingredient	Internat'l Ref. No.	Unit	Amount
Ground Corn	4-04-992	%	60.2
Cottonseed Hulls	1-01-599	%	15.0
Alfalfa Hay	1-00-108	%	10.0
Cottonseed Meal	5-01-621	%	8.0
Sugarcane Molasses	4-04-696	%	5.0
Urea, mn 45% nitrogen	5-05-070	%	1.0
Calcium phosphate, dibasic	6-01-080	%	.5
Salt, NaCl	6-04-152	%	.3
Chlortetracycline	8-01-224	mg/lb	7.0
Vitamin A		IU/lb	3089.0

TABLE II

RATION COMPOSITION FOR INDIVIDUALLY-FED CALVES

Ingredient	Internat'l Ref. No.	Unit	Amount
Whole Corn	4-02-992	%	87.0
Cottonseed Hulls	1-01-599	%	5.0
Supplement, pelleted		%	8.0
COMPOSITION OF SUPPLEMENT			
Soybean Meal	5-04-612	%	50.0
Urea, mn 45% nitrogen	5-05-070	%	10.0
Cottonseed Meal	5-01-621	%	19.8
Wheat Middlings	4-05-205	%	3.5
Salt, NaCl	6-01-080	%	4.5
Potassium Chloride, KCl	6-03-756	%	3.3
Calcium Carbonate, $CaCO_3$	6-01-069	%	7.5
Trace Mineral[a]		%	.64
Chlortetracycline	8-01-224	mg/lb	48.0
Vitamin A		IU/lb	1545.0

[a]Trace mineral premix composition (%): zinc, 16; iron, 12; magnesium, 3; manganese, 6; copper, 1; cobalt, .30; iodine, .60; potassium, 1.0.

quality grade of low choice based on visual estimates of apparent fat thickness. Final weights and photographs were taken after a 12 hour fast.

Group-fed calves were slaughtered in a commercial packing plant and carcasses were chilled for 72 hours before quality grade, marbling score, maturity, conformation score, and kidney, heart and pelvic (KHP) fat were estimated by a USDA grader. Individually-fed calves were slaughtered at the Oklahoma State University Meat Laboratory and were evaluated in the carcass by a staff member. Rib eye area (REA) and backfat thickness were measured from a tracing at the 12th-13th rib separation on each carcass. Carcass grades were based on the Official U.S. Standards for Grades of Carcass Beef (1973).

In this study, different numbers of animals were present for various treatment groups. Not all calves were available for analysis of treatments with milk level and calf type as factors. Data for each management system (group-fed and individually-fed) were subjected to least squares analysis using the statistical analysis system designed to Barr and Goodnight (1972). Where no significant interaction occurred between biological type and milk levels, means were pooled for milk levels and breed types. Where a significant interaction ($P < .15$) was detected, a t-test was used to determine breed and milk level effects (Snedecor and Cochran, 1967).

Results and Discussion

Feedlot Performance

The feedlot performance of group-fed and individually-fed AxH and CxHol calves is shown in Tables III and IV. Initial weight (weaning

TABLE III

EFFECT OF LOW AND HIGH PREWEANING MILK LEVELS AND BREED UPON FEEDLOT PERFORMANCE

Item	AxH Low	AxH High	CxHol Low	CxHol High	S.E.[a]
GROUP-FED					
Number of calves	14	9	9	12	
Initial wt., lbs.	497	602	551	662	14.9
Slaughter wt., lbs.	848	894	1226	1244	27.9
Days fed	152	136	289	250	9.4
Average daily gain, lbs.	2.29	2.14	2.39	2.47	0.12
Feed conversion, lbs.[b]	7.93	9.14	8.79	10.70	--
Slaughter ht., inches	42.1[c]	43.2[c]	50.2[d]	43.4[e]	0.49
Slaughter length, inches	32.0	32.5	36.6	38.6	0.75
INDIVIDUALLY-FED					
Number of calves	8	9	9	6	
Initial wt., lbs.	477	577	525	632	16.4
Slaughter wt., lbs.	877	907	1262	1323	30.4
Days fed	158	139	267	273	13.4
Average daily gain, lbs.	2.58	2.39	2.60	2.62	0.17
Feed Conversion, lbs.[b]	6.79	7.14	8.61	8.80	0.48
Slaughter ht., inches	43.1	44.3	50.5	48.2	1.14
Slaughter length, inches	32.2	34.3	36.4	36.8	1.62

[a]Standard errors are approximate due to unequal subclass numbers.
[b]Pounds feed per pound of gain.
[cdef]Means without a common superscript are different ($P < .05$).

TABLE IV

FEEDLOT PERFORMANCE OF AxH AND CxHOL CALVES POOLED BY MILK LEVEL AND CALF TYPE (LEAST SQUARE MEANS)

	Milk Level		Breed		Probabilities		
Item	Low	High	AxH	CxHol	Milk x Type	Low vs. High	AxH vs. CxHol
GROUP-FED							
Number of calves	23	21	23	21			
Initial weight, lbs.	524	632	549	606	.87	.01	.01
Slaughter weight, lbs.	1037	1069	871	1235	.64	.30	.01
Days fed	220	193	143	270	.26	.01	.01
Average daily gain, lbs.	2.34	2.30	2.21	2.43	.41	.77	.14
Feed Conversion, lbs.[a]	8.27	10.03	8.40	9.88	---	---	---
Slaughter height, in.	*	*	*	*	.02	*	*
Slaughter length, in.	34.3	35.5	32.2	37.6	.38	.17	.01
INDIVIDUALLY-FED							
Number of calves	17	15	17	15			
Initial weight, lbs.	500	604	527	598	.84	.01	.01
Slaughter weight, lbs.	1069	1115	892	1292	.63	.16	.01
Days fed	213	206	148	270	.43	.65	.01
Average daily gain, lbs.	2.59	2.50	2.48	2.61	.59	.67	.52
Feed Conversion, lbs.[a]	7.75	7.80	6.98	8.69	.87	.59	.01
Slaughter height, in.	46.8	46.3	43.7	49.4	.20	.70	.01
Slaughter lenght, in.	34.3	35.6	33.2	36.6	.66	.51	.08

[a] Pounds feed per pound of gain

weight) increased an average of 108 pounds ($P < .01$) among group-fed and individually-fed calves as the preweaning milk intake level was increased. CxHol calves were heavier ($P < .01$) than AxH calves. These heavier initial weights were a reflection of higher preweaning milk intakes and larger mature size of the CxHol calves.

The additional preweaning weight gain of calves receiving the higher milk level is consistent with results reported by Neville et al. (1952) and previous research at this station (Kropp et al., 1973; Holloway et al., 1975; Wyatt et al., 1977c).

Slaughter weights tended to be heavier among calves receiving the higher preweaning milk level. AxH calves exposed to the high preweaning milk level, averaged 38 pounds heavier at slaughter than those receiving the low milk level. CxHol calves receiving the higher preweaning milk level averaged 39 pounds heavier at slaughter than their low milk level counterparts. CxHol calves were heavier ($P < .01$) at slaughter than AxH calves. This is a result of feeding the larger breeds to the same physiological endpoint.

Average daily gains in the feedlot were not affected by previous milk level consumption. Group-fed CxHol calves tended ($P < .14$) to have higher daily gains than AxH calves. This trend was not evident among the individually-fed calves. These results are in contrast to other work which shows that the larger, later-maturing breeds grow faster (Cole et al., 1963; Hanke et al., 1964; and Minish et al., 1966). However, much of the previous work compared breeds fed to an equal weight basis instead of to a common physiological maturity point as in the present study.

Group-fed calves that had previously received the high preweaning milk level took less days ($P < .01$) to reach slaughter grade than those consuming the low preweaning milk level. This was not evident among the individually-fed calves. AxH calves from both groups required less days ($P < .01$) to reach slaughter grade than CxHol calves. This is a reflection of their lighter slaughter weights but similar gains in the feedlot as compared to the CxHol calves.

Statistical analysis of feed efficiency was appropriate only for the individually-fed calves. Among group-fed calves, there was a trend toward increased feed required per pound of gain for both AxH and CxHol calves from the high milk level group as compared to their low level counterparts. Individually-fed calves followed this trend although differences between treatment means were not significantly different.

Individually-fed AxH calves were more efficient than the CxHol calves ($P < .01$) requiring an average of 1.7 less pounds of feed to produce a pound of gain. This agrees with early findings at this station (Dean et al., 1976a and Wyatt et al., 1977b) that indicated a decreasing efficiency of gain as percentage of Holstein breeding increased.

A calf type x milk interaction occurred in the group-fed CxHol calves with those exposed to the low milk level being taller ($P < .02$) than the calves on the high preweaning milk level. This is the reverse of the situation at weaning when the CxHol high milk level calves were taller ($P < .01$). Thus, the low level group-fed CxHol calves increased more in height from weaning to slaughter. This trend was also evident among individually-fed CxHol calves.

CxHol calves were longer ($P < .01$) at slaughter than AxH calves. This is expected due to the larger mature size associated with these breeds.

Carcass Characteristics

The effects of previous milk level and calf type on carcass characteristics of group-fed and individually-fed calves are shown in Tables V and VI, respectively. Carcasses from CxHol calves were heavier ($P < .01$) in all cases than those from AxH.

Group-fed calves which received the high preweaning milk level produced heavier carcasses ($P < .02$) than those which received the low milk level. Individually-fed calves which received the high milk level also tended ($P < .08$) to follow this pattern.

Preweaning milk level had little effect on ribeye area among calves of either type. CxHol calves from both group-fed and individually-fed groups had larger ($P < .03$) ribeye areas than AxH calves. However, if expressed as ribeye area per hundredweight of carcass weight, the AxH calves appear to be heavier muscled.

Evidence of external fat thickness was one of the criteria used to estimate carcass grade in the live animal and therefore determine time of slaughter. Some control was thus exercised over fat thickness in the carcass. Group-fed CxHol calves had less fat thickness ($P < .05$) over the rib than AxH calves. There was no difference among individually-fed calves.

Cutability of group-fed calves was affected by preweaning milk level. Calves that received the high preweaning milk level had a lower ($P < .01$) percent of trimmed retail cuts. This difference was not significant among individually-fed calves. Group-fed CxHol calves had higher ($P < .01$) cutabilities than AxH calves. The difference was

TABLE V

EFFECT OF LOW AND HIGH PREWEANING MILK LEVELS AND BREED UPON CARCASS CHARACTERISTICS

Item	AxH		CxHol		S.E.[a]
	Low	High	Low	High	
GROUP-FED					
Number of calves	14	9	9	12	
Hot carcass wt., lbs.	537	584	761	807	17.4
Backfat, inches	0.79	0.90	0.60	0.62	0.05
Ribeye area, sq. in.	10.1	10.2	12.9	13.7	0.34
KHP (%)[b]	3.29[f]	3.44[f]	2.72[g]	3.58[f]	0.16
Cutability (%)	47.8	45.7	49.3	48.5	0.45
Marbling score[c]	12.0	10.9	12.9	13.0	0.87
Conformation score[d]	8.3	8.8	7.7	7.7	0.24
Carcass grade[e]	7.1[f]	6.3[g]	7.4[f]	7.6[f]	0.26
INDIVIDUALLY-FED					
Number of calves	8	9	9	6	
Hot carcass wt., lbs.	538	559	801	851	19.2
Backfat, inches	0.67	0.66	0.51	0.72	.08
Ribeye area, sq. in.	10.3	10.5	12.1	11.3	0.55
KHP fat (%)[b]	2.87[f]	3.03[f]	2.67[f]	3.50[g]	0.21
Cutability (%)	48.8	48.8	48.9	46.4	0.86
Marbling score[c]	10.1	13.7	11.7	13.5	1.27
Conformation score[d]	8.4	8.3	7.7	7.7	0.27
Carcass grade[e]	6.4	7.5	6.6	6.8	0.48

[a]Standard errors are approximate due to unequal subclass numbers.
[b]Kidney, Heart, and Pelvic fat.
[c]10 = slight -, 11 = slight, 12 = slight +, 13 = small -
[de]6 = high good, 7 = low choice, 8 = average choice
[fghi]Means without a common superscript are different ($P < .05$).

TABLE VI

CARCASS CHARACTERISTICS OF AxH AND CxHOL CALVES POOLED BY MILK LEVEL AND CALF TYPE (LEAST SQUARE MEANS)

Item	Milk Level		Breed		Probabilities		
	Low	High	AxH	CxHOL	Milk x Type	Low vs. High	AxH vs. CxHol
GROUP-FED							
Number of calves	23	21	23	21			
Hot carcass weight, lbs.	649	695	561	784	.99	.02	.01
Backfat, inches	0.69	0.76	0.84	0.61	.39	.21	.01
Ribeye area, sq. in.	11.5	12.0	10.2	13.3	.39	.20	.01
KHP fat (%)[a]	*	*	*	*	.08	*	*
Cutability (%)	48.5	47.7	47.1	48.8	.23	.01	.01
Marbling Score[b]	12.5	11.9	11.5	12.9	.57	.60	.18
Conformation Score[c]	8.0	8.2	8.5	7.7	.33	.35	.01
Carcass grade[d]	*	*	*	*	.12	*	*
INDIVIDUALLY-FED							
Number of calves	17	15	17	15			
Hot carcass weight, lbs.	670	705	549	826	.47	.08	.01
Backfat, inches	0.59	0.69	0.67	0.61	.23	.29	.57
Ribeye area, sq. in.	11.2	10.9	10.4	11.7	.35	.65	.03
KHP fat (%)[a]	*	*	*	*	.13	*	*
Cutability (%)	48.9	47.7	48.8	47.9	.19	.18	.20
Marbling Score[b]	10.9	13.6	11.9	12.6	.49	.05	.58
Conformation Score[c]	8.0	8.0	8.3	7.7	.92	.89	.03
Carcass grade[d]	6.5	7.2	7.0	6.7	.38	.17	.60

[a]Kidney, Heart and Pelvic fat

[b]10 = slight -, 11 = slight, 12 = slight +, 13 = small -

[cd]6 = high good, 7 = low choice, 8 = average choice

not significant among individually-fed calves.

AxH calves had higher ($P < .05$) conformation scores than CxHol calves. This is consistent with other work that shows reduced muscling and conformation with the infusion of dairy breeding (Wyatt et al., 1977b and Dean et al., 1976b). Quality grade was not consistently influenced by preweaning milk level among calves of either breed combination.

Data from this trial indicates that increasing milk levels can increase weaning weights and that this extra weight advantage is possibly continued through the feedlot until slaughter. However, if the higher milk levels are obtained through the infusion of larger, later maturing dairy breeding, the resulting calves require a longer feeding period with less efficient gains when fed to a low choice grade. Therefore, the feasibility of producing and feeding beef x dairy calves from heavier milking dams will depend on the value of the extra gain produced as compared to the cost of feeding more feed per pound of gain for longer time periods.

CHAPTER IV

EFFECT OF MEDIUM AND HIGH MILK LEVELS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF TWO CALF TYPES

Summary

The effect of two levels of preweaning milk intake on the postweaning feedlot performance and carcass characteristics of calves of two widely differing growth potentials was determined. The calf types were produced by mating Charolais x Angus (CxA) bulls to Hereford x Holstein (HxHol) cows and Charolais bulls to Holstein cows. This was followed by a reciprocal cross-fostering scheme whereby calves of each breed combination were exposed to a medium (HxHol) or high (Holstein) level of milk. In this study, a smaller than anticipated difference between the medium and high levels of milk production was observed due to a lower than normal milk production by the Holstein cows. During the preweaning portion of the trial, the cows and calves were managed as two separate groups. One group grazed tall grass native range and the other was confined in a drylot system. At weaning, the calves were placed in a feedlot and fed to an estimated carcass grade of low choice at which point they were slaughtered and carcass information collected. Calves raised on native range were group-fed in the feedlot while those raised in drylot were confined and fed individually. The high level of milk consumption had no apparent effect on initial

weights, slaughter weights or hot carcass weights in this trial. Also average daily gains, days to reach slaughter grade, and feed efficiency were not affected by milk level ($P > .05$).

CxHol calves were heavier ($P < .05$) initially and at slaughter ($P < .01$) than CAxHHol calves. Individually-fed CxHol calves had higher ($P < .05$) average daily gains than the CAxHHol calves.

Introduction

Increasing weaning weight in cow-calf operations by increasing milk yield with the infusion of dairy breeding has received considerable attention in recent years (Kropp et al., 1973; Holloway et al., 1975; Wyatt et al., 1977c). Several studies have investigated the feedlot performance and carcass traits of beef-dairy crossbred calves. However, in most studies, the effects of increased milk consumption on calf performance were not clear, because milk level effects were confounded with genetic differences for growth rate potential in the calves. There are few data available regarding the effects of various preweaning milk levels on performance of calves of similar types.

The objective of this study was to compare the effect of a medium and high preweaning milk level upon the feedlot performance and carcass characteristics of two distinctly different calf types.

Materials and Methods

Fifty-six calves were used to study the feedlot performance and carcass characteristics of calves of two growth potentials that had been exposed to two preweaning milk levels. The two calf types were produced by mating Charolais x Angus (CxA) bulls to Hereford x Holstein

(HxHol) cows and Charolais bulls to Holstein cows. A system was designed whereby calves of similar growth potential could receive a medium (HxHol) and a high (Holstein) level of milk consumption.

A reciprocal cross-fostering scheme described by Wyatt et al. (1977a) was used. Approximately one-half of the calves produced by HxHol cows (CAxHHol) were reared by Holstein cows and one-half of the calves produced by Holstein cows (CxHol) were reared by HxHol cows. Thus, within each calf type (CAxHHol) one-half were the recipient of a medium level of milk while one-half received a high milk level.

During the preweaning phase of the trial, the cows and calves were allotted to one of two management systems. Cows and calves were maintained either on tall grass native range or confined in drylot from birth to weaning as described by Barnes (1977). Cows received a post-calving winter supplement level calculated to allow a 20 percent winter weight loss including weight loss at calving. Supplement levels were based on earlier work on cow size and milk production levels at this station (Kropp et al., 1973; Holloway et al., 1975; Wyatt et al., 1977c). Calves were born in December, January, and February and weaned at 240 ± 7 days of age. Drylot calves were creep-fed while range calves received only grazed forage.

Calves were grafted on to foster dams within 12 hours following birth. Parturition was induced in some cows by administration of 40 milligrams of dexamethazone (Azium[1]) with ten days of their projected calving date to allow scheduling of the cross-fostering program.

At weaning, calves were fasted for six hours, weighed,

---

[1]Azium brand, Schering Corporation, Bloomfield, New Jersey 07003.

photographed, and vaccinated for blackleg, parainfluenza-3 and infectious bovine rhinotracheitis. Skeletal size was estimated from 2" x 2" slides taken with each calf behind a grid at weaning and prior to slaughter. Height was defined as the distance from the hip (tuber coxae) to the floor and length as the horizontal distance from the point of the shoulder (dorsal anterior humerus) to the hip. The hip and point of the shoulder were marked with contrasting chalk prior to photographing to facilitate more accurate measurement.

Calves were place directly into the feedlot at weaning. Calves from drylot cows were individually-fed ad libitum in single pens with a covered feeding area so that individual feed intakes could be measured. Calves from range cows were group-fed ad libitum in a barn with a covered feeding area and an outside loafing area. Group-fed calves received a 75 percent concentrate ration (Table VII) while individually-fed calves were fed a 95 percent concentrate, whole corn based ration (Table VIII). Each calf was fed to an estimated quality grade of low choice based on visual estimates of apparent fat thickness. Final weights and photographs were taken after a 12 hour fast.

Group-fed calves were slaughtered in a commercial packing plant and carcasses were chilled for 72 hours before quality grade, marbling score, maturity, conformation score, and kidney, heart and pelvic (KHP) fat were estimated by a USDA grader. Individually-fed calves were slaughtered at the Oklahoma State University Meat Laboratory and were evaluated in the carcass by a staff member. Rib eye area (REA) and backfat thickness were measured from a tracing at the 12th-13th rib separation on each carcass. Carcass grades were based on the Official U.S. Standards for Grades of Carcass Beef (1973).

TABLE VII

RATION COMPOSITION FOR GROUP-FED CALVES

Ingredient	Internat'l Ref. No.	Unit	Amount
Ground Corn	4-04-992	%	60.2
Cottonseed Hulls	1-01-599	%	15.0
Alfalfa Hay	1-00-108	%	10.0
Cottonseed Meal	5-01-621	%	8.0
Sugarcane Molasses	4-04-696	%	5.0
Urea, mn 45% nitrogen	5-05-070	%	1.0
Calcium Phosphate, dibasic	6-01-080	%	.5
Salt, NaCl	6-04-152	%	.3
Chlortetracycline	8-01-224	mg/lb	7.0
Vitamin A		IU/lb	3089.0

TABLE VIII

RATION COMPOSITION FOR INDIVIDUALLY-FED CALVES

Ingredient	Internat'l Ref. No.	Unit	Amount
Whole Corn	4-02-992	%	87.0
Cottonseed Hulls	1-01-599	%	5.0
Supplement, pelleted		%	8.0
COMPOSITION OF SUPPLEMENT			
Soybean Meal	5-04-612	%	50.0
Urea, mn 45% nitrogen	5-05-070	%	10.0
Cottonseed Meal	5-01-621	%	19.8
Wheat Middlings	4-05-205	%	3.5
Salt, NaCl	6-01-080	%	4.5
Potassium Chloride, KCl	6-03-756	%	3.3
Calcium Carbonate, $CaCO_3$	6-01-069	%	7.5
Trace Mineral[a]		%	.64
Chlortetracycline	8-01-224	mg/lb	48.0
Vitamin A		IU/lb	1545.0

[a]Trace mineral premix composition (%): zinc, 16; iron, 12; magnesium, 3; manganese, 6; copper, 1; cobalt, .30; iodine, .60; potassium, 1.0.

In this study, different numbers of animals were present for various treatment groups. Not all calves were available for analysis of different variables. Data for each management system was considered a 2x2 factorial arrangement of treatments with milk level and calf type as factors. Data for each management system (group-fed and individually-fed) were subjected to least squares analysis using the statistical analysis system designed by Barr and Goodnight (1972). Where no significant interaction occurred between biological type and milk levels, means were pooled for milk levels and breed types. When a significant interaction was detected, a t-test was used to determine breed and milk level effects (Snedecor and Cochran, 1967).

Results and Discussion

Feedlot Performance

Feedlot performance data of group-fed and individually-fed CAxHHol and CxHol calves are shown in Tables IX and X. Initial weights (weaning weights) were heavier ($P < .05$) for CxHol than for CAxHHol calves. There was no consistent trend for initial weights to be affected by preweaning milk level. This may be due to there being no significant difference in milk intakes due to lower than expected milk production by the Holstein cows. Apparently the cumulative effects of six consecutive lactations under native range conditions or on a low quality forage in drylot reduced the milking ability of the Holstein cows.

CxHol calves were heavier ($P < .01$) at slaughter, averaging 132 pounds heavier than CAxHHol calves. This is consistent with other work at this station (Wyatt et al., 1977b) showing the larger, later

TABLE IX

EFFECT OF MODERATE AND HIGH PREWEANING MILK LEVELS AND BREED UPON FEEDLOT PERFORMANCE

Item	CAxHHol Moderate	CAxHHol High	CxHol Moderate	CxHol High	S.E.[a]
GROUP-FED					
Number of calves	9	8	8	6	
Initial wt., lbs.	568	637	649	661	20.3
Slaughter wt., lbs.	926[c]	1089[d]	1164[e]	1114[de]	28.0
Days fed	176[c]	198[d]	209[d]	186[c]	7.2
Average daily gain, lbs.	2.06	2.30	2.49	2.48	0.16
Feed conversion, lbs.[b]	11.80	9.98	7.97	9.26	--
INDIVIDUALLY-FED					
Number of calves	6	6	6	7	
Initial wt., lbs.	589	561	647	622	18.6
Slaughter wt., lbs.	998	1028	1179	1121	32.4
Days fed	201[cd]	210[cd]	218[c]	197[d]	6.5
Average daily gain, lbs.	2.07	2.24	2.37	2.60	0.15
Feed conversion, lbs.[b]	9.13	8.38	9.11	7.89	0.59
Slaughter ht., inches	45.2	43.8	48.4	47.8	0.61
Slaughter length, inches	32.9	32.8	34.0	32.2	1.09

[a]Standard errors are approximate due to unequal subclass numbers.
[b]Pounds of feed per pound of gain.
[cdef]Means without a common superscript are different.

TABLE X

FEEDLOT PERFORMANCE OF CAxHHOL AND CxHOL CALVES POOLED BY MILK LEVEL AND BREED

Item	Milk Level: Moderate	Milk Level: High	Breed: CAxHHol	Breed: CxHol	Probabilities: Milk X Type	Probabilities: Low vs. High	Probabilities: CAxHHol vs. CxHol
GROUP-FED							
Number of calves	17	14	17	14			
Initial weight, lbs.	608	651	604	655	.20	.08	.05
Slaughter weight, lbs.	*	*	*	*	.01	*	*
Days fed	*	*	*	*	.02	*	*
Average daily gain, lbs.	2.27	2.38	2.17	2.48	.53	.56	.12
Feed conversion, lbs.[a]	9.99	9.67	10.94	8.52	---	---	---
INDIVIDUALLY-FED							
Number of calves	12	13	12	13			
Initial weight, lbs.	618	591	575	634	.95	.17	.01
Slaughter weight, lbs.	1088	1078	1013	1153	.23	.75	.01
Days fed	*	*	*	*	.04	.39	.74
Average daily gain, lbs.	2.22	2.42	2.15	2.48	.83	.22	.05
Feed conversion, lbs.[a]	9.12	8.12	8.76	8.40	.71	.12	.68
Slaughter height, in.	46.8	45.8	44.5	48.1	.58	.16	.01
Slaughter length, in.	33.5	32.5	32.9	38.1	.49	.44	.86

[a]Pounds feed per pound of gain

maturing breeds to be heavier when fed to the same grade or fatness end point.

A milk x calf type interaction was observed for the group-fed CAxHHol calves with the high preweaning milk level calves being heavier ($P < .01$) at slaughter than the moderate level calves. Average daily gain of individually-fed CxHol calves was higher ($P < .05$) than for the CAxHHol calves. The group-fed CxHol also tended ($P < .12$) to have higher daily gains. Average daily gains were not affected by preweaning milk level in this trial.

There were no consistent trends among breed types or preweaning milk level affecting feed conversion or time to slaughter. This is contrary to other trials done at this station (Dean et al., 1977a and Wyatt et al., 1977b), but as previously discussed may be due in part to the unexpected similarity in milk levels.

Carcass Characteristics

The effects of previous milk level and calf type on carcass characteristics of group-fed and individually-fed calves are shown in Tables XI and XII. CxHol calves produced heavier ($P < .02$) carcasses than CAxHHol. This is consistent with data from previous trials at this station (Dean et al., 1976b) which showed the larger breeds to produce heavier carcasses when fed to a common fatness or grade end point.

Carcasses from group-fed CAxHHol calves that received the high milk level were 108 pounds heavier ($P < .01$) than the same breed calves receiving the moderate milk level. This was not evident in CxHol group-fed calves or any of the individually-fed groups.

TABLE XI

EFFECT OF MODERATE AND HIGH PREWEANING MILK LEVELS AND BREED UPON CARCASS CHARACTERISTICS

Item	CAxHHol Moderate	CAxHHol High	CxHol Moderate	CxHol High	S.E.[a]
GROUP-FED					
Number of calves	9	8	8	5	
Hot carcass wt., lbs.	589[f]	697[g]	728[g]	685[g]	20.8
Backfat, inches	0.69	0.74	0.50	0.57	0.07
Ribeye area, sq. in.	10.6	10.9	11.9	11.8	0.40
KHP fat (%)[b]	3.47	3.38	3.31	3.00	0.14
Cutability (%)	47.9	47.3	48.8	49.0	0.50
Marbling score[c]	11.3	12.5	9.9	8.0	0.90
Conformation score[d]	8.5	8.5	7.9	8.0	0.24
Carcass grade[e]	7.0	7.5	6.1	6.3	0.36
INDIVIDUALLY-FED					
Number of calves	6	6	6	7	
Hot carcass wt., lbs.	592	624	708	695	19.2
Backfat, inches	0.58	0.77	0.38	0.50	0.07
Ribeye area, sq. in.	9.9	9.1	12.1	10.7	0.36
KHP fat (%)[b]	2.87	3.10	2.88	3.16	0.17
Cutability (%)	48.6	46.6	50.2	48.3	0.50
Marbling score[c]	14.0	16.5	10.3	11.0	1.53
Conformation score[d]	8.2	8.3	7.5	8.5	0.37
Carcass grade[e]	7.2	8.8	6.3	6.5	0.54

[a]Standard errors are approximate due to unequal subclass numbers.

[b]Kidney, Heart, and Pelvic fat.

[c]10 = slight -, 11 = slight, 12 = slight +, 13 = small -

[de]6 = high good, 7 = low choice, 8 = average choice

[fghi]Means without a common superscript are different.

TABLE XII

CARCASS CHARACTERISTICS OF CAxHHOL AND CxHOL CALVES POOLED BY MILK LEVEL AND BREED

Item	Milk Level		Breed		Probabilities		
	Moderate	High	CAxHHol	CxHol	Milk X Type	Low vs. High	CAxHHol vs. CxHOL
GROUP-FED							
Number of calves	17	13	17	13			
Hot carcass weight, lbs.	*	*	*	*	.01	*	*
Backfat, inches	0.54	0.65	0.71	0.54	.88	.45	.03
Ribeye area, sq. in.	11.3	11.3	10.8	11.8	.64	.85	.03
KHP fat (%)[a]	2.23	1.95	2.07	2.10	.51	.24	.13
Cutability (%)	48.3	48.0	47.6	48.9	.46	.68	.03
Marbling Score[b]	10.6	10.6	11.9	9.3	.27	.95	.02
Conformation Score[c]	8.2	8.3	8.5	7.9	.82	.82	.06
Carcass grade[d]	6.6	6.9	7.3	6.2	.66	.47	.02
INDIVIDUALLY-FED							
Number of calves	12	13	12	13			
Hot carcass weight, lbs.	650	659	608	702	.26	.63	.01
Backfat, inches	0.48	0.63	0.67	0.44	.61	.05	.01
Ribeye area, sq. in.	11.0	9.9	9.5	11.4	.37	.01	.01
KHP fat (%)[a]	1.41	2.47	1.83	2.05	.86	.16	.86
Cutability (%)	49.4	47.5	47.6	49.3	.90	.01	.01
Marbling Score[b]	12.2	13.7	15.3	10.6	.56	.33	.01
Conformation Score[c]	7.8	8.4	8.2	8.0	.24	.17	.59
Carcass grade[d]	6.8	7.6	8.0	6.4	.21	.14	.01

[a]Kidney, Heart and Pelvic fat

[b]10 = slight -, 11 = slight, 12 = slight +, 13 = small -

[cd]6 = high good, 7 = low choice, 8 = average choice

Evidence of external fat thickness was one of the criteria used to estimate carcass grade in the live animal and therefore determine time of slaughter. Some control was thus exercised over fat thickness in the carcass. CxHol calves from both group-fed and individually-fed groups had less ($P < .03$) external fat cover than the CAxHHol calves. Within the group-fed calves, previous milk level had no effect on fat thickness. Individually-fed calves that received the moderate milk level had less fat thickness than the high milk level treatment. Kidney, heart and pelvic fat was not affected either by breed or preweaning milk level in this trial.

Ribeye areas were larger ($P < .03$) for CxHol calves than for CAxHHol for both group-fed and individually-fed calves. Milk level had no effect among group-fed calves, but among individually-fed calves, the low milk level calves had larger ribeye areas ($P < .01$) than their low level counterparts.

The combined larger ribeye areas and less fat cover of the low milk level individually-fed calves gave then an advantage ($P < .01$) of higher cutability percentages than the high milk level groups. This was not evident among group-fed calves. CxHol calves had a greater ($P < .03$) percent cutability in all cases than CAxHHol. This was attributable to larger ribeye areas and less fat cover over the twelfth rib.

CAxHHol in the group-fed calves had higher ($P < .05$) conformation scores than the CxHol calves. This is consistent with previous research (Cole et al., 1964 and Garrett, 1971) that shows a trend for a decrease in muscling as the amount of dairy breeding increases.

Individually-fed calves did not follow this pattern. Milk levels had no effect ($P < .05$) on conformation scores of either breed combination.

Carcass quality grades were lower ($P < .05$) for CxHol calves than for CAxHHol. Since the cattle were intended to be slaughtered at the same grade, the CxHol calves were apparently not fed sufficient days to reach the same grade as indicated by the CxHol calves having less fat cover.

These results are inconclusive with respect to the effect of milk level because of no difference in milk intakes due to the lower than expected milk production by the Holstein cows. The infusion of dairy breeding did increase slaughter and carcass weights. The desirability of this strategy to increase milk production in beef herds will depend upon the efficiency and profitability of increasing production.

CHAPTER V

EFFECT OF LOW AND MODERATE PREWEANING MILK LEVELS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF TWO CALF TYPES

Summary

The effect of two preweaning milk intakes on the feedlot performance and carcass characteristics of calves of two different growth potentials was determined. Calf types were established by breeding Angus bulls to Hereford cows and Charolais x Angus (CxA) bulls to Hereford x Holstein (HxHol) cows. The experimental design was effected using a reciprocal cross-fostering scheme allowing calves of similar type to consume a low (Hereford) and moderate (HxHol) milk level. During the preweaning portion of the trial, the cows and calves were managed as two separate groups. One group grazed tall grass native range and the other was completely confined in a drylot system. At weaning, the calves were placed in a feedlot and fed to an estimated carcass grade of low choice. Calves raised on native range were group-fed in the feedlot while those raised in drylot were confined and fed individually. They were then slaughtered and carcass data was collected. Group-fed calves exposed to the moderate preweaning milk level were heavier ($P < .01$) initially and at slaughter ($P < .05$) than those receiving the low preweaning milk level. Breed type did not affect initial or slaughter weights. AxH calves had

greater ($P < .01$) daily gains and required fewer ($P < .01$) days to reach slaughter grade than CAxHHol calves. Preweaning milk level did not affect average daily gain.

Introduction

Increased calf weaning weight is a principal goal in most commercial cow-calf operations. The importance of milk consumption by calves as a factor influencing weaning weight has been well documented (Knapp and Black, 1941; Gifford, 1953; Velasco, 1962; Pinney, 1963). Beef x dairy crossbreeding (Cundiff, 1970) can increase the milk production of beef cows more rapidly than selection within a beef breed. Several studies have investigated the feedlot performance and carcass desirability of beef-dairy crossbred calves (Dean et al., 1976; Garrett, 1971; Cole et al., 1964; Minish et al., 1966; Wyatt et al., 1977b). However, the effects of increased milk consumption and dairy breeding on feedlot performance and carcass traits were not clear, because the effects of milk level were confounded with genetic differences for growth rate potential in calves. Few studies have reported the effects of various preweaning milk levels on feedlot performance and carcass characteristics of calves of similar genetic composition.

This experiment was conducted to compare the effects of a low and moderate preweaning milk level upon the feedlot performance and carcass characteristics of calves of two biological types.

Materials and Methods

Sixty-eight calves were used to study the feedlot performance and carcass characteristics of calves of two growth potentials that had been exposed to two preweaning milk levels. The two calf types were produced by mating Charolais x Angus (CxA) bulls to Hereford x Holstein (HxHol) cows and Angus bulls to Hereford cows. A system was designed whereby calves of similar growth potential could receive a medium (HxHol) and a low (Hereford) level of milk consumption.

A reciprocal cross-fostering scheme described by Wyatt et al. (1977a) was used. Approximately one-half of the calves produced by HxHol cows (CAxHHol) were reared by Hereford cows and one-half of the calves produced by Hereford cows (AxH) were reared by HxHol cows. Thus, within each calf type (CAxHHol and AxH) one was the recipient of a medium level of milk (14 to 18 pounds per day) while another group received a low milk level (9 to 11 pounds per day).

During the preweaning phase of the trial, the cows and calves were allotted to one of two management systems. Cows and calves were maintained either on tall grass native range or confined in drylot from birth to weaning as described by Barnes (1977). Cows received a post-calving winter supplement level calculated to allow a 20 percent winter weight loss including weight loss at calving. Supplement levels were based on earlier work on cow size and milk production levels at this station (Kropp et al., 1973; Holloway et al., 1975; Wyatt et al., 1977c). Calves were born in December, January, and February and weaned at 240 ± 7 days of age. Drylot calves were creep-fed while range calves received only grazed forage.

Calves were grafted onto foster dams within 12 hours following birth. Parturition was induced in some cows by administration of 40 milligrams of dexamethazone (Azium[1]) within 10 days of their projected calving date to allow scheduling of the cross-fostering program.

At weaning, calves were fasted for six hours, weighed, photographed, and vaccinated for blackleg, parainfluenza-3 and infectious bovine rhinotracheitis. Skeletal size was estimated for 2" x 2" slides taken with each calf behind a grid at weaning and prior to slaughter. Height was defined as the distance from the hip (tuber coxae) to the floor and length as the horizontal distance from the point of the shoulder (dorsal anterior humerus) to the hip. The hip and point of shoulder were marked with contrasting chalk prior to photographing to facilitate more accurate measurement.

Calves were placed directly into the feedlot at weaning. Calves from drylot cows were individually-fed _ad libitum_ in single pens with a covered feeding area. Calves from range cows were group-fed _ad libitum_ in a barn with a covered feeding area and an outside loafing area. Group-fed calves received a 75 percent concentrate ration (Table XIII), while individually-fed calves received a 95 percent concentrate, whole corn based diet (Table XIV). Each calf was fed to an estimated quality grade of low choice based on visual estimates of apparent fat thickness. Final weights and photographs were taken after a 12 hour fast.

Group-fed calves were slaughtered in a commercial packing plant and carcasses were chilled for 72 hours before quality grade, marbling score, maturity, conformation score, and kidney, heart and pelvic (KHP) fat were estimated by a USDA grader. Individually-fed calves were

---

[1]Azium brand, Schering Corporation, Bloomingfield, New Jersey 07003.

TABLE XIII

RATION COMPOSITION FOR GROUP FED CALVES

Ingredient	Internat'l Ref. No.	Unit	Amount
Ground Corn	4-04-992	%	60.2
Cottonseed Hulls	1-01-599	%	15.0
Alfalfa Hay	1-00-108	%	10.0
Cottonseed Meal	5-01-621	%	8.0
Sugarcane Molasses	4-04-696	%	5.0
Urea, mn 45% nitrogen	5-05-070	%	1.0
Calcium phosphate, dibasic	6-01-080	%	.5
Salt, NaCl	6-04-152	%	.3
Chlortetracycline	8-01-224	mg/lb	7.0
Vitamin A		IU/lb	3089.0

TABLE XIV

RATION COMPOSITION FOR INDIVIDUALLY-FED CALVES

Ingredient	Internat'l Ref. No.	Unit	Amount
Whole Corn	4-02-992	%	87.0
Cottonseed Hulls	1-01-599	%	5.0
Supplement, pelleted		%	8.0
COMPOSITION OF SUPPLEMENT			
Soybean Meal	5-04-612	%	50.0
Urea, mn 45% nitrogen	5-05-070	%	10.0
Cottonseed Meal	5-01-621	%	19.8
Wheat Middlings	4-05-205	%	3.5
Salt, NaCl	6-01-080	%	4.5
Potassium Chloride, KCl	6-03-756	%	3.3
Calcium Carbonate, $CaCO_3$	6-01-069	%	7.5
Trace Mineral[a]		%	.64
Chlortetracycline	8-01-224	mg/lb	48.0
Vitamin A		IU/lb	1545.0

[a]Trace mineral premix composition (%): zinc, 16; iron, 12; magnesium, 3; manganese, 6; copper, 1; cobalt, .30; iodine, .60; potassium, 1.0.

slaughtered at the Oklahoma State University Meat Laboratory and were evaluated in the carcass by a staff member. Rib eye area (REA) and backfat thickness were measured from a tracing at the 12th-13th rib separation on each carcass. Carcass grades were based on the Official U.S. Standards for Grades of Carcass Beef (1973).

In this study, different numbers of animals were present for various treatment groups. Not all calves were available for analysis of different variables. Data for each management system were considered a 2x2 factorial arrangement of treatments with milk level and calf type as factors. Data for each management system (group-fed and individually-fed) were subjected to least squares analysis using the statistical analysis system designed by Barr and Goodnigh (1972). Where no significant interaction ($P < .15$) occurred between biological type and milk levels, means were pooled for milk levels and breed types. When a significant interaction was detected, a t-test was used to determine breed and milk level effects (Snedecor and Cochran, 1967).

Results and Discussion

Feedlot Performance

The feedlot performance of group-fed and individually-fed AxH and CAxHHol calves is shown in Tables XV and XVI. Initial weight (weaning weight) increased an average of 96 pounds ($P < .01$) among group-fed calves as the preweaning milk intake level increased. The individually-fed calves also tended to be heavier for calves exposed to the higher milk level. The apparent differences in initial weight between breed types were not significant when comparing calves receiving

TABLE XV

EFFECT OF LOW AND MODERATE PREWEANING MILK LEVELS AND BREED UPON FEEDLOT PERFORMANCE

Item	AxH		CAxHHol		
	Low	Moderate	Low	Moderate	S.E.[a]
GROUP-FED					
Number of calves	15	8	8	7	
Initial wt., lbs.	513	598	492	598	17.5
Slaughter wt., lbs.	948	998	984	1056	26.6
Days fed	172[c]	169[c]	229[d]	208[e]	5.0
Average daily gain, lbs.	2.57	2.40	2.15	2.21	0.11
Feed conversion, lbs.[b]	7.61	9.47	8.88	9.42	--
Slaughter ht., inches	44.9	44.4	--	48.1	0.92
Slaughter length, inches	31.9	31.1	--	35.5	0.73
INDIVIDUALLY-FED					
Number of calves	8	7	8	7	
Initial wt., lbs.	460	465	423	488	20.7
Slaughter wt., lbs.	907	946	917	947	32.2
Days fed	192	192	238	237	4.9
Average daily gain, lbs.	2.36	2.52	2.10	1.93	0.12
Feed conversion, lbs.[b]	7.67[c]	7.04[c]	7.91[cd]	8.79[d]	0.37
Slaughter ht., inches	43.8	44.0	50.4	51.1	0.73
Slaughter length, inches	31.3	31.3	34.3	35.4	0.70

[a]Standard errors are approximate due to unequal subclass numbers.
[b]Pounds feed required per pound of gain.
[cdef]Means without a common superscript are different ($P < .05$).

TABLE XVI

FEEDLOT PERFORMANCE OF AxH AND CAxHHOL CALVES
POOLED BY MILK LEVEL AND BREED

Item	Milk Level		Breed		Probabilities		
	Low	Moderate	AxH	CAxHHol	Milk X Type	Low v. High	AxH vs. CAxHHol
GROUP-FED							
Number of calves	23	15	23	15			
Initial weight, lbs.	503	598	556	545	.59	.01	.58
Slaughter weight, lbs.	966	1027	973	1020	.71	.05	.12
Days fed	*	*	*	*	.11	*	*
Average daily gain, lbs.	2.36	2.30	2.48	2.18	.33	.62	.02
Feed conversion, lbs.[a]	8.05	9.45	8.26	9.13	-	-	-
Slaughter height, in.	-	46.3	44.7	-	-	-	-
Slaughter length, in.	-	33.3	31.5	-	-	-	-
INDIVIDUALLY-FED							
Number of calves	16	14	15	15			
Initial weight, lbs.	442	477	463	456	.16	.11	.75
Slaughter weight, lbs.	912	947	927	932	.88	.30	.87
Days fed	215	215	192	238	.95	.88	.01
Average daily gain, lbs.	2.22	2.22	2.43	2.01	.20	.98	.01
Feed conversion, lbs.[a]	*	*	*	*	.06		
Slaughter height, in.	47.1	47.5	43.9	50.8	.72	.61	.01
Slaughter length, in.	32.8	33.4	31.3	34.9	.52	.48	.01

[a]Pounds feed per pound of gain

a similar milk level. The additional preweaning weight gain of calves at higher milk levels agrees with findings of Barnes (1977) and Wyatt et al. (1977a).

Slaughter weights were heavier among group-fed calves receiving moderate preweaning milk levels. AxH calves exposed to the moderate preweaning milk level averaged 48 pounds heavier at slaughter than those receiving the low milk level. CAxHHol receiving the higher preweaning milk level averaged 51 pounds heavier at slaughter than their low milk level counterparts. Individually-fed calves followed this trend although the differences in weight were not significant ($P < .30$). Breed type did not significantly affect slaughter weights.

Preweaning milk level did not affect average daily feedlot gain of calves of either breed type. AxH calves, both group and individually-fed had higher ($P < .01$) daily gains than CAxHHol regardless of previous milk level. Group-fed and individually-fed AxH calves required fewer days ($P < .01$) to reach slaughter grade than their CAxHHol contemporaries. Preweaning milk level did not significantly affect days fed for individually-fed calves. Group-fed calves receiving the moderate preweaning milk level reached slaughter grade ($P < .04$) an average of 12 days sooner than their low level counterparts. Earlier trials in this study have shown variable results with the effect of previous milk level on days required to reach a low choice slaughter grade.

Statistical analysis of feed efficiency was appropriate only for individually-fed calves. AxH calves required less ($P < .01$) feed per pound of gain than did the CAxHHol calves. This agrees with earlier findings at this station and other work (Hanke et al., 1964;

Burroughs et al., 1966; and Minish et al., 1966) showing that the dairy breeds were less efficient. This occurred even when comparing breeds fed to an equal time or weight end point as opposed to an equal grade end point as at this station.

Carcass Characteristics

The effects of previous milk level and calf type on carcass characteristics of group-fed and individually-fed calves are shown in Tables XVII and XVIII. Hot carcass weights of the group-fed calves receiving the moderate milk level averaged 54 pounds heavier ($P < .05$) than calves from the low preweaning milk level group.

AxH had more ($P < .01$) backfat than CAxHHol calves at slaughter from the group-fed and individually-fed groups. Group-fed calves that had received the low preweaning milk level had an average of 0.14 inches less ($P < .03$) backfat than calves exposed to the moderate preweaning milk level. Apparent differences for individually-fed calves were not significant ($P < .28$), but followed this trend.

Individually-fed CAxHHol calves had larger ($P < .01$) ribeye areas than AxH calves. The differences between calf types for ribeye areas were not significant for group-fed calves. Milk level did not affect ribeye areas of either breed combination.

Group-fed CAxHHol had 1.9 percentage units greater ($P < .03$) cutabilities than AxH calves. This is consistent with other results from other studies at this station indicating higher cutabilities or more pounds of lean beef from the larger, later maturing breeds. Missing data cells made it impossible to calculate cutabilities for individually-fed CAxHHol.

TABLE XVII

EFFECT OF LOW AND MODERATE PREWEANING MILK LEVELS AND BREED UPON CARCASS CHARACTERISTICS

Item	AxH		CAxHHol		S.E.[a]
	Low	Moderate	Low	Moderate	
GROUP-FED					
Number of calves	15	8	8	7	
Hot carcass wt., lbs.	598	633	589	662	23.9
Backfat, inches	0.85	0.92	0.54	0.76	0.05
Ribeye area, sq. in.	10.97	11.50	11.39	11.42	0.38
KHP fat (%)[b]	3.63[fg]	3.33[f]	3.41[f]	4.05[g]	0.17
Cutability (%)	46.0[f]	46.5[f]	49.3[g]	47.0[f]	0.55
Marbling score[c]	10.9	11.67	12.17	12.10	0.96
Conformation score[d]	8.4	8.5	7.6	7.5	0.30
Carcass grade[e]	7.3[f]	7.5[f]	8.1[g]	7.2[f]	0.35
INDIVIDUALLY-FED					
Number of calves	8	7	8	7	
Hot carcass wt., lbs.	554	583	--	--	14.2
Backfat, inches	0.89	1.00	0.37	0.43	0.07
Ribeye area, sq. in.	8.7	9.2	11.9	10.2	0.66
KHP fat (%)[b]	2.94	3.41	3.25	3.50	0.28
Cutability (%)	46.4	45.4	--	--	0.44
Marbling score[c]	10.6	10.6	10.0	--	1.12
Conformation score[d]	7.5	7.8	7.0	7.0	0.37
Carcass grade[e]	9.0	8.8	9.3	6.5	0.39

[a]Standard errors are approximate due to unequal subclass numbers.

[b]Kidney, Heart and Pelvic fat.

[c]10 = slight -, 11 = slight, 12 = slight +, 13 = small -

[de]6 = high good, 7 = low choice, 8 = average choice

[fghi]Means without a common superscript are different ($P < .05$).

TABLE XVIII

CARCASS CHARACTERISTICS OF AxH AND CAxHHOL CALVES POOLED BY MILK LEVEL AND BREED

Item	Milk Level		Breed		Probabilities		
	Low	Moderate	AXH	CAxHHol	Milk X Type	Low vs. High	AxH vs. CAxHHol
GROUP-FED							
Number of calves	23	15	23	15			
Hot carcass weight, lbs.	593	647	615	626	.48	.05	.69
Backfat, inches	0.70	0.83	0.88	0.65	.21	.03	.01
Ribeye area, sq. in.	11.2	11.5	11.2	11.4	.56	.50	.68
KHP fat (%)[a]	*	*	*	*	.03	*	*
Cutability (%)	*	*	*	*	.12	*	*
Marbling Score[b]	12.2	11.9	11.3	12.8	.35	.79	.19
Conformation Score[c]	8.0	8.0	8.5	7.6	.77	.93	.02
Carcass grade[d]	*	*	*	*	.12	*	*
INDIVIDUALLY-FED							
Number of calves	16	14	15	15	-		
Hot carcass weight, lbs.	-	-	568	-	-	-	-
Backfat, inches	0.63	-	0.94	-	-	.28	.01
Ribeye area, sq. in.	-	-	8.9	-	-	.59	.01
KHP fat (%)[a]	2.00	-	2.08	-	-	.15	.48
Cutability (%)	-	-	45.9	-	-	-	-
Marbling Score[b]	17.3	-	17.6	-	-	-	-
Conformation Score[c]	7.3	-	7.6	0	-	.50	.13
Carcass grade[d]	9.1	-	8.8	-	-	.05	.15

[a]Kidney, Heart and Pelvic fat

[b]10 = slight -, 11 = slight, 12 = slight +, 13 = small -

[cd]6 = high good, 7 = low choice, 8 = average choice

Carcass conformation scores for group-fed AxH were higher ($P < .02$) than those for CAxHHol. Individually-fed AxH also tended ($P < .13$) to have higher conformation scores. Other trials in this study and previous work (Dean et al., 1976; and Wyatt et al., 1977b) have shown a decline in muscling with increasing increments of dairy breeding. There was no consistent trend by type or milk level upon marbling scores or quality grade.

These results indicate that calves receiving higher milk levels may produce more live weight gain and heavier carcasses. If fed to an equal grade point as the traditional beef animals, they require more days of feeding with less daily gain and poorer feed conversion.

The economic feasibility of producing and feeding beef x dairy calves from heavier milking dams will depend on the relationship between cost of feeding more feed for longer periods and the value of extra gain produced.

LITERATURE CITED

Barnes, K. C. 1977. Effect of milk intake levels on performance of calves differing in growth potential. M. S. Thesis. Oklahoma State University, Stillwater.

Branaman, G. A., A. M. Pearson, W. T. Magee, Ruth M. Griswold and G. A. Brown. 1962. Comparison of the cutability and eatability of beef and dairy-type cattle. J. Anim. Sci. 21:321.

Burroughs, Wise, W. T. Mealy, E. A. Kline and Frances Carlin. 1965. Summary of three experiments on feedlot performance, marketing considerations and carcass characteristics of Holstein vs. beef bred feeder steers. Iowa Agr. Exp. Sta. R70.

Callow, E. H. 1961. Comparative studies of meat. VII. A comparison between Hereford, Dairy Shorthorn and Friesian steers on four levels of nutrition. J. Agr. Sci. 56:265.

Carter, R. C. and C. M. Kincaid. 1959. Estimates of genetic and phenotypic parameters in beef cattle. III. Genetic and phenotypic correlations among economic character. J. Anim. Sci. 18:331.

Christian, L. L., E. R. Hauser and A. B. Chapman. 1965. Association of pre-weaning and post-weaning traits with weaning weight in cattle. J. Anim. Sci. 24:652.

Cole, J. W., C. B. Ramsey, C. S. Hobbs and R. S. Temple. 1963. Effects of type and breed of British, Zebu, and dairy cattle on production, palatibility, and composition. I. Rate of gain, feed efficiency and factors affecting market value. J. Anim. Sci. 22:702.

Cole, J. W., C. B. Ramsey, C. S. Hobbs and R. S. Temple. 1964. Effects of type and breed of British, Zebu, and dairy cattle on production. III. Percent wholesale cuts and yield of edible protein as determined by physical and chemical analysis. J. Anim. Sci. 23:71.

Coleman, S. W., F. M. Pate and D. W. Beardsby. 1976. Effect of level of supplemental energy fed grazing steers on performance during the pasture and subsequent drylot period. J. Anim. Sci. 42:27.

Cook, A. C., W. H. Black, Bradford Knapp, Jr. and R. W. Phillips. 1959. Relationship of milk production of Milking Shorthorn dams to the carcass quality of their steer progeny. J. Anim. Sci. 1:345.(Abstr.)

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

Dean, R. A., J. W. Holloway, J. V. Whiteman, D. F. Stephens and Robert Totusek. 1976a. Feedlot performance of progeny of Hereford, Hereford x Holstein and Holstein cows. J. Anim. Sci. 42:1290.

Dean, R. A., L. E. Walters, J. V. Whiteman, D. F. Stephens and Robert Totusek. 1976b. Carcass traits of progeny of Hereford, Hereford x Holstein and Holstein cows. J. Anim. Sci. 42:1427.

Garrett, W. N. 1971. Energetic efficiency of beef and dairy steers. J. Anim. Sci. 32:451.

Gifford, Warren 1953. Milk production of dams and growth of calves. Ark. Agr. Exp. Sta. Bull. 531.

Hanke, H. E., R. E. Smith, O. W. Kalari, A. L. Harvey, W. J. Aunam and L. E. Hanson. 1964. A comparison of feedlot performance and carcass traits of Hereford, Shorthorn and Holstein steers. Minn. Agr. Exp. Sta. M.B.-4.

Heinemann, W. W. and R. W. Van Keuren. 1956. The effect of wintering plane of nutrition on subsequent gain of beef yearling steers on irrigated pastures. J. Anim. Sci. 15:1097.

Holloway, J. W., D. F. Stephens, J. V. Whiteman and Robert Totusek. 1975a. Performance of 3-year-old Hereford, Hereford x Holstein and Holstein cows on range and in drylot. J. Anim. Sci. 40:114.

Knapp, Bradford, Jr., and W. H. Black. 1941. Factors influencing rate of gain of beef calves during the suckling period. Jr. Agr. Res. 63:249.

Kropp, J. R., D. F. Stephens, J. W. Holloway, J. V. Whiteman, Leon Knori and Robert Totusek. 1973. Performance on range and in drylot of two-year-old Hereford, Hereford x Holstein and Holstein females as influenced by level of winter supplementation. J. Anim. Sci. 37:1222.

Lawrence, T. J. and J. Pearce. 1964. Some effects of wintering yearling beef cattle on different planes of nutrition. J. Agri. Sci. 63:5.

Minish, G. L., H. A. Newland and H. E. Henderson. 1966. Varying levels of corn silage and shelled corn for finishing two grades of cattle. Mich. Agr. Exp. Sta. AH-BC-655.

Neville, W. E., M. C. McCullough, O. E. Sell and D. M. Baird. 1952. The effect of three levels of milk feeding to young calves on their growth rate and feed consumption. J. Anim. Sci. 11:772. (Abstr.)

Neville, W. E., Jr., D. M. Baird, H. C. McCampbell and O. E. Sell. 1962. Influence of dam's milk production and other factors on post-weaning performance and carcass characteristics of Hereford cattle. J. Anim. Sci. 21:943.

Official U. S. standards for grades of carcass beef. July 1, 1973. Title 7, Ch. I, P1.53, Sections 53.100-53.105 of the Code of Federal Regulations.

Patterson, T. B., W. W. Cotney and Robert A. Moore. 1972. Brown Swiss, Charolais and Hereford breeding in a grade beef herd - effect on performance and carcass characteristics. Auburn Ag. Exp. Sta. Bulletin 430 p3.

Pinney, D. O. 1963. Effect of extremes in winter nutrition on growth and production performance of beef females. Ph.D. Thesis Oklahoma State University, Stillwater.

Ruby, E. S., C. T. Blunn, E. M. Brouse and M. L. Baker. 1948. Relation of initial weights and subsequent gains of weaning calves. J. Anim. Sci. 7:729.

Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods. (6th Ed.). Iowa State University Press, Ames, Iowa.

Stuedemann, J. A., J. J. Guenther, S. A. Ewing, R. D. Morrison and G. V. Odell. 1968. Effect of nutritional level imposed from birth to eight months of age on subsequent growth and development patterns of full-fed beef calves. J. Anim. Sci. 27:234.

Swiger, L. A. 1961. Genetic and environmental influences on gain of beef cattle during various stages of life. J. Anim. Sci. 20:183.

Velasco, M. 1962. Level of winter feeding of range beef. M. S. Thesis. Oklahoma State University, Stillwater.

Woodward, R. R., F. J. Rice, J. R. Quesenberry, R. L. Hiner, R. T. Clark and F. °. Wilson. 1959. Relationships between measures of performance, body form and carcass quality of beef cattle. U.S.D.A., A.R.S. Bull. 550.

Wyatt, R. D., M. B. Gould, J. V. Whiteman and Robert Totusek. 1977a. Effect of milk level and biological type on calf growth and performance. J. Anim. Sci. 45:1138.

Wyatt, R. D., K. S. Lusby, M. B. Gould, L. E. Walters, J. V. Whiteman and Robert Totusek. 1977b. Feedlot performance and carcass traits of progeny of Hereford, Hereford x Holstein and Holstein cows. J. Anim. Sci. 45:1131.

Wyatt, R. D., K. S. Lusby, J. V. Whiteman, M. B. Gould and Robert Totusek. 1977c. Performance of 4- and 5-year-old Hereford, Hereford x Holstein and Holstein cows on range and in drylot. J. Anim. Sci. 45:1120.

Ziegler, J. H., L. L. Wilson and D. S. Coble. 1971. Comparisons of certain carcass traits of several breeds and crosses of cattle. J. Anim. Sci. 32:446.

VITA 2

Gary Lynn Crosthwait

Candidate for the Degree of

Master of Science

Thesis: EFFECT OF PREWEANING MILK LEVELS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF CALVES DIFFERING IN GROWTH POTENTIAL

Major Field: Animal Science

Biographical:

Personal Data: Born in Ardmore, Oklahoma, September 30, 1952, the son of R. D. and Virginia Crosthwait.

Education: Graduated from Dickson High School, Dickson, Oklahoma, 1970; received the Bachelor of Science degree from Oklahoma State University, Stillwater, Oklahoma, with a major in Animal Science in May, 1974; completed requirements for the Master of Science degree at Oklahoma State University in July, 1983.

Professional Experience: Extension Agent, 4-H for Oklahoma State University Extension Service, 1974-1977; research and teaching assistant in the Department of Animal Science and Industry, Oklahoma State University, Stillwater, Oklahoma, 1977-1978; manager of Hodges Farms, Hennesey, Oklahoma, 1979-1980; livestock specialist, Kerr Foundation, Poteau, Oklahoma, 1981-present.

Professional Organizations: Oklahoma Association of County Extension Agents, Alpha Zeta and American Society of Animal Science.