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Factors Affecting Production Traits in Dairy x Beef Cattle

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ABSTRAK

Data-data dari 96 lembu betina kacukan Angus-Holstein telah dianalisis untuk mengkaji kesan-kesan baka bapak kepada anak, aras pemakanan, umur cerai-susu bagi anak dan interaksi-interaksi di antara mereka, ke atas ibu dan anak. Ibu-ibu lembu telah diberi makanan yang mempunyai aras tenaga tinggi atau rendah, manakala anak-anak mereka menerima makanan yang sama hingga umur 224 hari. Baka bapak yang digunakan ialah Guernsey, Longhorn, Brahman, Hereford dan Simmental. Berat ibu dan anak serta jumlah berat makanan telah dicatatkan pada tiap-tiap 28 hari, manakala ukuran badan telah diambil pada tiap-tiap 56 hari. Berat cerai-susu anak menpengaruhi masa biang pertama selepas beranak dan penggunaan "TDN". Umur cerai-susu juga mempengaruhi berat cerai-susu dan penggunaan "TDN" oleh anak. Sehubungan dengan ini, berat badan ibu pada beberapa tahap pengeluaran juga dipengaruhi oleh umur cerai-susu anak.

ABSTRACT

Data from 96 Angus-Holstein crossbred cows were analysed to study the effects of sire breed of calf, nutrition level, weaning age of calf and their interactions on the cows and calves. The cows were assigned to rations either with low or high energy level, while all calves received the same diet until 224 days. Sire breeds used were Guernsey, Longhorn, Brahman, Hereford and Simmental. Body weights of cows and calves together with feed consumptions were taken every 28 days while body measurements were taken every 56 days. Calf weaning age influenced age at first postpartum estrus and TDN consumption of cows. Weaning age also influenced progeny weaning weight and TDN consumption. Similarly, cow body weights at several production periods were influenced by calf weaning age.

INTRODUCTION

Beef production is composed of two phases; cow herd phase or the production of calves, and growth and fattening phase where weight increase is stressed. During establishment of breeding herd consideration must be placed on combinations of germ plasm, mating systems and management systems. This is for the maximization of beef production efficiency. In recent years, crosses among the beef breeds or between the dairy breeds and dual purpose cattle are becoming more common. Decisions regarding crossbreeding involve choice of breeds and crossing schemes, and evaluation of crossbreeding results should include estimation of breed and heterotic effects.

Superior productivity of dairy-beef crossbred cows has been reported for various traits by several authors (Everitt *et al.* 1978; Cartwright 1982). Use of dairy cows as a source of germ plasm to produce a crossbred breeding herd for beef production is being increasingly accepted by cattle producers. Dairy-beef crossbred cows produce more milk and wean heavier calves than beef cows (Spelbring *et al.* 1977).

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Two important concerns involving dairy-beef crossbreds are (1) the effect of large sire breed on calving difficulty and calf mortality, and (2) the consideration of growth, feed intake and feed efficiency of the crossbred calves. It has been shown that body size can have both biological and economic effects on the efficiency of animal production (Dickerson 1978).

Cow size and milk production potential are two important traits in the cow-calf enterprise (Cartwright 1982). The feed requirements for growth and maintenance of the cow herd, a major cost of beef production, are closely related to weights of the individual cow.

Postweaning growth and feed efficiency of calves are important components of the net efficiency of a beef production system. The reverse effect of calf performance on cow performance has also been of concern. Kress *et al.*, (1984) have shown that cows that raised crossbed calves gained less weight from precalving to weaning, had lower condition scores at weaning and experience lower pregnancy rate. They indicated that this is at least partially mediated through calf growth rate, but not through parturition stress.

The objectives of the study on beef production using dairy-beef crossbreds are as outlined :

1. To measure the effect of calf breed on characteristics of the cow.
2. To measure the effect of different cow nutritional levels on the cow and calf performances.
3. To determine the effect of calf weaning age on cow performance.
4. To determine if interaction between cow nutritional level and weaning age exist.

MATERIALS AND METHODS

The study was conducted at the University of Wisconsin Beef Research farm, at Arlington, Wisconsin. Data from 96 Angus-Holstein cows and their progenies, over a six-year period, from 1981 through 1986 were collected and used to study the effects of sire breed on the progeny, level of nutrition, and stage of weaning on production traits of cows and calves. Angus-Holstein crossbred heifers born in the spring of 1981 with known birth dates were purchased from Wisconsin dairy producers. They were purchased as calves and arrived at the university farm before the age of 168 days.

At 168 days of age, the commencement of the test, all heifers were individually fed a high energy diet to ensure rapid growth and early attainment of puberty. All heifers received this high energy diet (Table 1) from the start of the test until first calving.

TABLE 1.
Ration fed to crossbred cows

Feed ingredients	Diet (kg)	
	High	Low
Oats	181.82	-
Linseed meal	45.45	-
Red Clover hay	681.82	909.09
Trace mineralized salt	Free choice	
Percent TDN	60.75	55.00

All heifers were bred by artificial insemination at their pubertal estrus to either Longhorn or Guernsey bulls. Sire breed determination was by random assignment at the onset of puberty. As the heifer expressed her pubertal estrus, a flip of a coin decided the breed of bull for that heifer. The next heifer expressing estrus was assigned to the opposite breed. Pregnancy diagnosis was done by rectal palpation.

At calving, the cows within each sire group were randomly assigned in replicates to either high or low energy diet (Table 1). The goal was to feed the animals on high 120% and those on low 80% of NRC (1971) TDN requirements. Trace mineralised salt was provided to the cows ad libitum. The nutrients were assumed to be adequate for maintenance and production.

An additional treatment was early vs late weaning of calves, again determined by random assignment. At 28 days postpartum, calves were randomly removed from one half the cows of each breed of sire-feed level group. The other half of the cows were assigned to nurse until 224 days postpartum.

Once a cow was assigned to high or low nutritional level and early or late weaning, she stayed in that classification until the end of the experiment. Cows assigned to low energy ration remained on low energy ration throughout; those assigned to high energy ration were changed to the low energy ration at the first postpartum estrus. Cows assigned to high energy ration received high energy ration again from second and third calvings to first postpartum estrus. Each cow was assigned to an individual self feeder to which she was tied twice daily for two hours in the morning and two hours in the afternoon. Weighed quantities of feed were placed in each self-feeder and at 28-day intervals, unconsumed feed was weighed back, subtracted from the total for the period, and refed unless a ration change was designated.

For the second parity, cows within nutritional level-weaning group were randomly mated by artificial insemination to either Polled Hereford or Brahman bulls, while for the third parity a similar procedure was done using either Brahman or Simmental bulls. A large number of sires in each group were used in order to obtain representative samples of the Guernsey, Longhorn, Brahman, Hereford and Simmental population. All females were bred at the first postpartum and succeeding estrus periods until conception.

Removal of cows from the study was due to either reproductive failure or death. All progeny in the early weaned group were individually fed hay-grain mixture (Table 2), until 224 days of age. They were tied to individual self-feeders for the same periods as their dams. Calves that were weaned at 224 days postpartum received creep feed beginning at 28 days of age. Feed consumption of the calves was also recorded.

Out of 91 heifers that were bred for the first parity, only 65 weaned a calf. The other 26 heifers had dead calves at birth or the calves died shortly after. Data from these 26 cows was eliminated from the analyses even if they weaned a calf at a later parity as the data from these cows would not be indicative of the system of production. Only 45 cows from the total of 65 cows that weaned their first calf weaned a second calf; 34 cows weaned calves in all three parities. Cows that had first and third calf crops but not a second were dropped from the analyses because they were not indicative of the system.

TABLE 2
Ration fed to crossbred calves

Feed ingredients	Amount (kg)
Rolled oats	272.73
Cracked corn	90.91
Wheat bran	90.91
Linseed meal	181.82
Red Clover hay	272.73
Crumbled aurofac	6.82
Vitamin A and D	6.82
Trace mineralized salt	4.54
Percent TDN	70.24

All animals were weighed every 28 days and body measurements were taken every 56 days. Within 28 days prior to each calving and within 12 hours following parturition, weights and body measurements of the cows were taken.

Statistical Analyses

The statistical model used in analyzing the data collected on the cows was

$$Y_{ijkl} = \mu + b_i + r_j + w_k + (br)_{ij} + (bw)_{ik} + (rw)_{jk} + e_{ijkl}$$

Y_{ijkl} = observation from the l^{th} cow of the k^{th} weaning group within the j^{th} ration level and i^{th} sire breed of calf

μ = overal mean

b_i = effect of the i^{th} sire breed of progeny (Longhorn, Guernsey; Brahman, Hereford; or Brahman, Simmental)

r_j = effect of the j^{th} ration (high or low in TDN)

w_k = effect of the k^{th} weaning group (early or late weaning)

$(br)_{ij}$ = effect due to the interaction of the i^{th} breed of sire and the j^{th} ration level

$(bw)_{ik}$ = effect due to the interaction of the ith breed of sire and the k^{th} weaning group

$(rw)_{jk}$ = effect due to the interaction of the j^{th} ration and the k^{th} weaning group

e_{ijkl} = random error, normally and independently distributed

The linear statistical model used in analyzing the data collected on the progeny was

$$Y_{ijklm} = \mu + b_i + r_j + w_k + s_l\ (br)_{ij} + (bw)_{ik} + (bs)_{il} + (rw)_{jk} + (rs)_{jl} + (ws)_{kl} + e_{ijklm}$$

Y_{ijklm} = observation from the m^{th} individual of the l^{th} sex from the k^{th} weaning group, j^{th} ration level and i^{th} sire breed.

μ = overall mean

b_i = effect of the i^{th} breed of sire (Longhorn, Guernsey; Brahman, Hereford; or Brahman, Simmental)

r_j = effect of the j^{th} ration level (high or low in TDN)

w_k = effect of the k^{th} weaning group (early or late)

s_l = effect of the l^{th} sex of calf (male or female)

$(br)_{ij}$ = effect due to the interaction between i^{th} breed of sire and the j^{th} ration level.

$(bw)_{ik}$ = effect due to the interaction between the i^{th} breed of sire and the k^{th} weaning group

$(bs)_{il}$ = effect due to the interaction between the i^{th} breed of sire and the l^{th} sex of calf

$(rw)_{jk}$ = effect due to the interaction between the j^{th} ration level and the k^{th} weaning group

$(rs)_{jl}$ = effect due to the interaction between the j^{th} ration level and the l^{th} sex of calf

$(ws)_{kl}$ = effect due to the interaction between the k^{th} weaning group and the l^{th} sex of calf

e_{ijklm} = random error, normally and independently distributed

The linear model was used to analyze data on cows with at least two calf crops. This was done in order to determine the various factors that affect the system of beef production under two energy levels and two weaning times for the calves. Cows without a third calf were tested for effects in the first and second parities only while those with three calf crops were tested for effects in all parities. In all attempt to improve the model, a covariate, age at calving or days open was added to the model for testing TDN consumption of cows.

Feed consumption was expressed as kg TDN, body weights were expressed in kg and measurements were expressed in cm. The total TDN consumption of cows was calculated with date of first conception of the first parity as the starting point and 224 days postpartum of the first, second or third parities as the end point for the respective parities. For the calves, total TDN consumption was calculated from 56 days of age to 224 days of age.

RESULTS AND DISCUSSION

Cow Reproductive Performance

Heifers on both high and low energy levels were fed the high energy ration from the start of the experiment until first calving. This was an attempt to induce puberty in the heifers as early as possible. It was hypothesized that the high level of nutrition coupled with early weaning might result in efficiency differences by shortening the time to first calving and rebreeding intervals.

The effects of levels of postpartum ration and calf suckling were the two major factors determining calving interval. Calving interval and feed intake of the cow and calf along with calf weight, influence efficiency. Table 3 shows some reproduction characteristies of the cows. The heifers reached puberty at an early age of 322 days and first calving occurred at an average age of 627 days. Fifty three percent of the heifers conceived at the first service. The remainder, with the exception of two, required two to three services before they conceived. The two exceptional heifers took approximately 124 days and six or seven services before they settled.

Table 4 shows the analysis of variance for the characteristics of the cows in the first parity. As expected, there was no significant effect of the factors on age at puberty, interval from first estrus to conception or gestation period. This was expected because all the heifers were treated alike precalving, except for the breed of bulls to which they were mated. In addition,

TABLE 3
Overall means and standard deviatings (days) for various characteristics of cows

Characteristics	Mean	SD
First Parity		
Age at 1st estrus	322	44
1st estrus to conception	23	34
1st gestation	282	4
Second Parity		
1st calving to 1st post-partum estrus	58	27
1st postpartum estrus to conception	35	45
2nd gestation	285	5
Third Parity		
2nd calving to 1st postpartum estrus	51	34
1st postpartum estrus to conception	45	64
3rd gestation	288	6

TABLE 4
Mean squares for various characteristics of cows in the first parity

Source	df	Mean Squares[a]		
		Age at 1st estrus	1st estrus to conception	Gestation period
Sire breed (1)	1	181	776	22
Ration level (2)	1	2625	29	40
Weaning group (3)	1	461	2426	64
1 x 2	1	4	811	22
1 x 3	1	2	1487	13
2 x 3	1	2530	181	2
Residual	27	1930	1176	17

[a]No effect was significantly different from zero

sire breed did not have a significant influence. This could be explained by the fact that Longhorn and Guernsey breeds used were both medium-sized bulls.

Feeding a high energy ration to heifers enabled them to reach puberty early, and in turn, calve early. This was demonstrated in the first parity where pubertal estrus was expressed at an average age of 322 days and calving occurred at an average age of 627 days. This pubertal age was attained at an earlier age than some straigthbreds (Laster *et al.*, 1972; Wiltbank *et al.*, 1969) or even some crossbreds (Brooks *et al.*, 1985; Morgan, 1981; Laster *et al.*, 1979). A high proportion of the heifers (54%) conceived at first breeding. Similarly age at calving was less than that reported by Brown *et al.* (1984) on Holstein crossbred cows. It is stressed that the conditions applied in this study were rather unique. Few attempt pregnancy at the pubertal estrus.

Interval from calving to postpartum estrus was shorter in the third parity than in the second (51 vs 58 days) but interval from calving to conception was longer in the third parity than in the second parity (96 vs 93 days). These periods were longer than those observed by Kress *et al.* (1984). In the second postpartum, cows nursing calves took longer than those whose calves were weaned early, to exhibit estrus. This could be attributed to the stress that the cows experienced in nursing their calves. As indicated by Kress *et al.* (1984) crossbred calves demanded more from their dams than straightbred calves. The age at second calving was less than that observed by Brown *et al.* (1984).

In the third parity, among the factors tested only sire breed influenced ($p<.05$) the period from first postpartum estrus to conception, and gestation length (Table 5). Cows bred to Simmental bulls took an average of 51 days longer to conceive than those bred to Brahman bulls, but Brahman-sired calves were gestated six days longer than Simmental-sired calves. This could be attributed to the fact that Bos indicus calves are generally gestated longer than Bos taurus calves (Long, 1980).

Cow TDN Consumption

The availability of self-feeders for each cow in the experiment enabled the study on feed consumption. Since the variable of interest was nutrient consumption of the individual animals, and not the quantity of feed consumed, total digestible nutrient (TDN) was analyzed. Calculation of total TDN consumption posed some overlap in the measurement of the feed

TABLE 5
Mean squares for various characteristics of cows in the third parity

Source	df	Age at first post-partum estrus	First postpartum estrus to conception	Gestation period
Sire breed (1)	1	219	19162 *	256 *
Ration level (2)	1	1822	10495	96
Weaning group (3)	1	54	88	35
1 x 2	1	176	10801	23
1 x 3	1	224	1190	3
2 x 3	1	40	3520	148
Residual	27	1170	4118	424

* significant at .05 level

TABLE 6
Least squares means and standard errors (kg) for TDN consumption of cows with three parities (34 cows)

	1st parity		2nd parity		3rd parity	
	Mean	SE	Mean	SE	Mean	SE
Overall	3308	50	6392	114	9606	175
Sire breed[a]						
Sire 1	3195	81	6224	151	9200	263
Sire 2	3374	68	6592	196	10028	270
Ration level						
High	3339	78	6567	197	9798	282
Low	3230	71	6249	150	9430	239
Weaning group						
Early	3115	81	5785	179	8586	278
Late	3454	68	7031	165	10642	254
Ration level × weaning group						
High early	3176	119	5890	282	8833	434
late	3501	103	7243	261	10764	370
Low early	3054	111	5679	222	8340	342
late	3406	88	6820	201	10521	338

[a] Sire 1: 1st parity = Guernsey; 2nd parity = Brahman; 3rd parity =Brahman
Sire 2: 1st parity = Longhorn; 2nd parity = Hereford; 3rd parity = Simmental

consumed. However, these overlaps were consistent in all parities and will not bias the analyses in any of the parities. From Table 6 it could be observed that there was a consistent increase in TDN consumption from the first to the third parity.

The results obtained from different analyses for TDN showed that regardless of the energy levels fed, cows nursing calves consumed more feed than those that weaned their calves early. The higher TDN requirement by the nursing cows was to meet their body requirements for maintenance as well as for milk production for suckling calves. The average TDN consumption for the entire productive life of the cows was 9606 kg. In the first parity, for the period between conception of the first calf and 224 days postpartum of the first calf, the average amount of TDN was 3308 kg or 34.4%. For the second parity, the amount of TDN consumed from 224 days postpartum of the first calving to 224 days postpatrum of the second calving, was 3084 kg or 32.1%. For the third parity, the amount consumed from 224 days postpatrum of the second calving to 224 days postpartum of the third calving was 3214 kg, or 33.5%. From this method of partitioning the feed consumption for the various parities, it was observed that the TDN consumption in each time period was almost the same.

Table 7 shows that in all the parities, weaning group significantly influenced (p<.01) TDN consumption. Cows whose calves were weaned earlier were better utilisers of TDN, than cows suckling calves through 224 days. They consumed significantly less feed whether in the high or low energy diet. This illustrated that cows nursing calves required additional feed due to the higher demand by the cows for their body maintenace and for milk production in nursing the calves, as supported by Marshall *et al.* (1976). In the third parity, sire breed also influenced (p<.05) cow TDN consumption. Cows having Brahman-sired calves consumed less feed than those carrying Simmental-sired calves (9200 vs 10028 kg).

TABLE 7
Mean squares for TDN consumption of cows with three parities

Source	df	Mean Squares		
		1st Parity	2nd Parity	3rd Parity
Sire Breed (1)	1	2354	9730	50625 *
Ration level (2)	1	887	7243	10831
Weaning group (3)	1	8698 **	120054 **	313634 **
1 x 2	1	307	3996	23
1 x 3	1	214	1521	8295
2 x 3	1	13	858	1135
Residual	27	844	4408	10443

* Significant at .05 level
** Significant at .01 level

Progeny Weights and TDN Consumption

Due to calf deaths and incomplete data on some of the calves analyses of weights and TDN consumption of progeny were done on data gathered from 29 cows only. Birth weight of calves increased from an average of 35 kg in the first parity to 41 kg in the second and 45 kg in the third parity. Brown *et al.* (1984) observed a similar trend in Holstein-beef crossbred calves. However, none of the factors tested had a significant effect on birth weight. This should be expected as the calves belonged to the same dam breed, and all the sire breeds, except for Simmental, were considered medium-sized.

Average weaning weights of calves were 233 kg, 260 kg and 261 kg in the first, second and third parities, respectively. Weaning age and sex were the main effects that had influence on the weaning weights (Table 8). In all parities, calves that were suckling were heavier at 224 days than those that were weaned early. This could be explained by the suckling calves getting most of their body requirements from the large amount of milk produced by the crossbred dams. For the effect of sex, male calves grew faster than female calves, and were thus heavier at 224 days, as was found by Barlow *et al.* (1978) in Angus cattle.

TABLE 8
Mean squares for progeny weaning weight

Source	df	Mean Squares 1st Parity	2nd Parity	3rd Parity
Sire breed (1)	1	46	264	198
Ration level (2)	1	14	34	549
Weaning group (3)	1	17832 **	18810 *	28749 **
Sex (4)	1	2253 *	10440 **	2169
1 x 2	1	1674	18	7
1 x 3	1	2588 *	67	921
1 x 4	1	12	32	2
2 x 3	1	2794 *	10	12
2 x 4	1	86	3	251
3 x 4	1	263	4	23
Residual	18	415	929	1555

* Significant at .05 level
**Significant at .01 level

TABLE 9
Mean squares for progeny TDN comsumption

Source	df	Mean Squares [a] 1st Parity	2nd Parity	3rd Parity
Sire breed (1)	1	70	53	36
Ration level (2)	1	34	22	121
Weaning group (3)	1	2377 **	7993 **	3726 **
Sex (4)	1	156	542 **	8
1 x 2	1	95	54	78
1 x 3	1	72	127	2
1 x 4	1	4	9	3
2 x 3	1	344 *	40	235 *
2 x 4	1	143	129	43
3 x 4	1	80	51	7
Residual	18	48	47	56

* Significant at .05 level
** Significant at .01 level
[a] computed values x .01

Calves that were weaned early consumed significantly ($p<.01$) more TDN than those that were nursed until 224 days (Table 9). This is evident because suckling calves still need a large portion of their body requirements supplied by the dam's milk, while the early weaned calves were totally dependent on creep feed.

The calves started at almost similar birth weights. By 224 days, calves that were nursed till 224 days consumed less TDN but had heavier weaning weights. Although there was no significant difference between birth weights of male and female calves, the male calves grew faster and were significantly heavier at 224 days. Brown *et al.* (1975) found that male calves were significantly heavier at birth, gained faster and graded higher than female calves, weaned at about seven months of age. Marshall *et al.* (1976) observed that calf sex and age were the only factors significantly influencing weaning weight.

Cow Body Weights, Heights and Weight-Height Ratios

The average cow weight at the start of the experiment was 157 kg and by 504 days they had an average weight of 458 kg (Table 10). The cow weights at first, second and third prepartum (within 28 days of the respective calvings) were 566, 615 and 666 kg, respectively. These weights indicated an increasing trend of about 50 kg from the first to the third prepartum. The overall weight increase for the cows over the entire period, from six months to 224 days postpartum of the third calving, was 468 kg. There was a linear increase in weight from six months to first prepartum. From first postpartum to 224 days postpartum of third calving, there was an overall increase in weight, with the peaks occurring at prepartum of each calving. All the cows lost weight after calving until 112 days postpartum, after which they would start to gain again until the next prepartum. During the productive periods of the cows, the lightest weights were observed at 112 days postpartum.

TABLE 10
Means and standard deviations (kg) for cow body weights

Body weight at	Mean	SD
168 days	157	18.8
336 days	314	25.9
504 days	458	36.0
1st prepartum	566	69.7
1st calving	506	66.0
112 days of 1st postpartum	488	57.3
224 days of 1st postpartum	520**	64.7
2nd prepartum	615	53.3
2nd calving	540	57.5
112 days of 2nd postpartum	555	55.5
224 days of 2nd postpartum	585*	62.5
3rd prepartum	666	68.6
3rd calving	592	63.3
112 days of 3rd postpartum	604*	61.3
224 days of 3rd postpartum	625**	74.2

* significant at .05 level
**significant at .01 level

There was no significant difference in cow weights from the start of the experiment until 12 days postpartum of the first calving. Cows that were nursing calves throughout this period lost 45 kg more than cows that weaned their calves early. Weaning group only affected ($p<.05$) 112-day weights in the third parity (Table 11). Cow weights at 224 days postpartum of the first, second and third calvings were greatly influenced ($p<.01$) by weaning group. At these periods, all cows showed improvements in their weights over that at 112 days postpartum. For cow weights at 224 days of first calving, nursing cows lost 61 kg more than cows that weaned their calves at 28 days. At a similar time in the second calving, early-weaning cows gained 73 kg more than nursing cows while in the third calving, early-weaning cows gained 80 kg more weight than nursing cows. At this time, most cows were already pregnant, although at varying stages. The lighter body weights of nursing cows was due to the higher demand by the suckling crossbred calves, as indicated by Kress *et al.* (1984).

The heifers were bred at pubertal estrus and all subsequent estrus cycles, until they conceived, to shorten the period from birth to first calving. First calving was observed when the average age of the cows was 22 months, when they were still in their rapidly growing stage. This is supported by Brown and Brown (1971) who indicated that the growth curve of cows started to plateau at the age of 30 months.

For cow height, a significant ($p<.05$) effect of sire breed of the calf was attributed to sampling, and not a real effect. No other factor influenced cow height although Brooks *et al.* (1985) found that ration level influenced cow height.

Weight-height ratio is a good estimate of the physical condition of a cow (Klosterman *et al.*, 1968), for it measures the degree of fatness or freshness (Kress *et al.*, 1969). They found that fat cows (with higher values in the weight-height ratio) were inefficient in energy utilization while cows taller at withers were slightly more efficient than shorter cows. The significant influence of weaning group on the ratio at 112 days postpartum of the first calving was attributed to the larger weight loss by cows

TABLE 11
Mean squares for cow body weight at different production periods

Source	df	Mean Squares		
		1st prepartum	1st calving	112 days of 1st postpartum
Sire breed (1)	1	5783	3988	4930
Ration level (2)	1	303	3870	68
Weaning group (3)	1	3926	1511	8382
1 x 2	1	2013	2025	2422
1 x 3	1	1414	1553	4021
2 x 3	1	3331	3128	3061
Residual	27	5356	4705	3325

Source	df	224 days of 1st postpartum	2nd prepartum	2nd calving
Sire breed (1)	1	5952	6224	9432
Ration level (2)	1	219	259	29
Weaning group (3)	1	29179 **	1895	3961
1 x 2	1	11	230	938
1 x 3	1	5231	2163	858
2 x 3	1	3067	344	4
Residual	27	3610	3126	3480

** significant at .01 level

Source	df	112 days of 2nd postpartum	224 days of 2nd postpartum	3rd prepartum
Sire breed (1)	1	1811	449	9487
Ration level (2)	1	713	660	519
Weaning group (3)	1	6728	37873 **	13208
1 x 2	1	3	225	16
1 x 3	1	1645	1269	3461
2 x 3	1	3280	218	3837
Residual	27	3154	2968	4304

Source	df	3rd calving	112 days of 3rd postpartum	224 days of 3rd postpartum
Sire breed (1)	1	8778	5261	71
Ration level (2)	1	776	504	213
Weaning group (3)	1	12787	14904 *	47366 **
1 x 2	1	2166	993	61
1 x 3	1	5017	1310	609
2 x 3	1	6622	966	1079
Residual	27	3239	3439	4708

* significant at .05 level
** significant at .01 level

that were nursing than those that weaned their calves early (475 vs 503 kg), while the heights of the cows in both groups were at an average of 126 cm. In all production periods, the differences in ratios between cows that weaned their calves early and nursing cows, were attributed to the differences in cow body weights. Cows that weaned their calves early had heavier body weights at all production periods, than nursing cows, while their wither heights were the same or very similar.

CONCLUSION

In this study, sire breed of calves affected ($p<.05$) the interval from first postpartum estrus to conception and gestation period in the third parity only. The cows took 51 days longer to be conceived by Simmental than by Brahman bulls, but they carried Brahman-sired calves six days longer through gestation, than they did for Simmental-sired calves. Brahman-sired calves were 7 kg heavier at birth but were 10 kg lighter at weaning than Simmental-sired calves.

Sire breed significantly ($p<.05$) influenced cow TDN consumption in the first and third parities. In the first parity, cows carrying Longhorn-sired calves consumed more TDN than cows carrying Guernsey-sired calves. There was, however, no significant difference in birth weight of calves by the two bull breeds. In the third parity cows bred to Brahman bulls performed better than those that were bred to Simmental bulls.

Although Wiltbank *et al.* (1969) found that there was a significant effect of feeding level on age at puberty of Hereford crossbreds, this study did not permit the expression of such difference. This was due to the design of the experiment where the difference in ration level existed only during the period from calving to first postpartum estrus. This period was as short as 17 days for some cows.

Calf weaning age was the single most important factor that affected cow productive performance. For TDN consumption, cows that weaned their calves early consumed less than those that weaned their calves at 224 days. It could be generalized that for cows that weaned their calves early, the TDN consumption was for their own body requirement, while for those cows that nursed their calves through 224 days the TDN consumption was also utilized for milk production.

Calf TDN consumption was greater when they were weaned early as compared to those weaned at 224 days. This is expected since calves that were weaned early thrived solely on creep feed. Calves that were suckling consumed the creep feed as a supplement. Furthermore, the large quantity of milk produced by the Angus-Holstein crossbred dams would be sufficient to provide for the growing calves.

The effect of calf weaning age on cow weight at several production periods was significant ($p<.01$). This is evident inspite of the fact that the cows that weaned their calves early consumed less TDN. This demonstrates the fact that the crossbred calves demanded more from their dams.

From this study it could be stated that a beef production system which practises early weaning of calves should be preferred. Calves could be weaned at 56 days instead of 28 days, to ensure better survivability of the calves. As long as the heifers are fed high energy level feed early postweaning, to enable them to express estrus early, energy level of the ration after first calving does not make any difference. This condition will hold as long as the nutritional requirements of the cows are still met.

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