The effect of weaning crossbred calves at different ages on growth performance

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Abstract

Small scale dairy farmers use extra amount of whole milk for rearing calves. However, this practice is not recommendable and is uneconomical for large-scale dairy farmers. A study was carried out at Holetta Agricultural Research Center to reduce calf milk consumption using early weaning system. Sixty Friesian x Boran and Jersey x Boran crossbred calves were randomly assigned to five age groups as treatments. Calves were bucket fed and weaned at the age of 6, 8, 10, 12 and 14 weeks consuming 118, 164, 210, 248 and 260 liters of milk, respectively. Milk was offered twice daily, in the morning and evening. Starting at two weeks of age, the calves were supplemented with concentrate and hay. Daily dry feed allowance was calculated based on 3% calf's body weight and offered once per day on dry matter basis. Calves were allowed to exercise for one hour every morning. There were no marked differences (P> 0.05) in concentrate and hay intake between treatments, calf sexes and breeds. Calves weaned at 6 and 8 weeks of age had significantly (P <0.05) lower daily body weight gain than calves weaned at 12 and 14 weeks. Calves weaned at 10 weeks of age had similar growth rate with calves weaned at 12 and 14 weeks of age (P > 0.05). Weaning at 10 weeks of ages is recommended for both Friesian x and Jersey x Boran crossbred calves in relation to the reduced amount of milk consumed.

Keywords: calves; milk; weaning; crossbred; growth.

Introduction

Documented information (Etgen *et al*., 1987; Beyene 1992) show that lifetime performances of dairy cows are influenced by the rearing practices at their calf hood, age at which they are weaned, post-weaning management practices, breed, and starter ration and rearing environments. Basically, two types of calf rearing practices are commonly known by a dairy farmer: partial suckling and artificial rearing systems. Partial suckling system is a practice in which calves are allowed to suckle their dams before and after milking while artificial rearing system is a practice in which calves are separated from their dams

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immediately after birth and bucket fed predetermined amount of milk until weaning. However, the choices of alternative rearing practices are determined by scale of the farm, rearing objectives (beef/dairy) and biological and economic considerations.

In Ethiopia, dairy production is dominated by smallholder farmers owing no or a few crossbred dairy cows. Consequently, partial suckling is well known and has been a long-standing tradition under smallholder systems in Ethiopia. Therefore, it is not practically feasible and economically sound to recommend artificial calf rearing practices under such system. On the other hand, artificial calf rearing practice is the rule of thumb, and is an alternative calf rearing options widely used in large-scale dairy farms.

Information on calf rearing practices is limited in Ethiopia. For instances, Little *et al.* (1991) carried out an experiment on the two types of calf rearing practices at the former ILCA, Debre Zeit station in Ethiopia. Both suckled and bucket fed calves were weaned at 94 days of age. But they didn't attempt to reduce weaning age below 94 days. Azage *et al.* (1994) also carried out similar experiment at the same station, but reduced weaning age for both suckled and bucket fed calves to 57 days of age. This experiment also focused on only comparing the influence of the two calf rearing practices on calf growth, but didn't considered ranges of weaning ages within a given calf rearing practices. Furthermore, Azage *et al*. (1990) conducted an experiment on Boran and Freisian x Boran crossbred bulls which were allowed to wean at six and eight months of age. The experiment was aimed at investigating the influence of different weaning ages on the performances of bull calves, but considered neither calf sex nor different weaning ages. However, results of all experiments unequivocally concluded that suckled calves grew faster than bucket fed calves and though differences in the weaning weights seemed to be noticeable at the beginning, these differences are gradually balanced by the mechanism of compensation growth. Therefore, results of these experiments are suggestive of the fact that weaning ages of calves could be further reduced without major effects in bucket fed calves.

Nowadays, interplays of many factors are contributing towards the establishment of large-scale dairy farms in Ethiopia. Favorable economic policy reforms directed towards a liberalized and market-oriented economic system and drivers of change such as rapidly growing urbanization, high population growth rate, changing consumer taste preferences towards safe and quality products are attracting investors into dairy business. Due to their scale of production,

commercial dairy producers are likely to practice artificial calf rearing systems. Therefore, improved and economically as well as biologically efficient calf rearing practices are needed. However, there is a paucity of information on growth performance of early weaned Friesian x Boran and Jersey x Boran crossbred calves. Therefore, this experiment was carried out to investigate growth performances of Friesian x Boran and Jersey x Boran crossbred calves subjected to different weaning ages.

Objective

To identify most appropriate and biologically as well as economically feasible weaning age in crossbred calves

Materials and methods

Location

This study was carried out at Holeta Agricultural Research Center, which is located at about 40 km west of the capital city, Addis Ababa. Holetta represents typical central highland areas of Ethiopia with an altitude of about 2400 masl. It receives an average annual rainfall of 1000 mm. It has an annual average temperature of about 18^{0}C.

Calves

Sixty F_1 crossbred calves were randomly grouped into five milk-feeding treatments, based on their sex (30 males and 30 females), and breed (30 Friesian x Borans and 30 Jersey x Boran crosses). The calves were randomly assigned to the experimental treatment groups at birth. Pre-experimental calf weights in different treatment groups were almost similar.

Milk feeding

All calves were bucket fed colostrums ad-lib per day, for the first 4 days. The daily amount was offered in equal parts at 7 am and 5 pm. After 4 days of age, all calves were offered whole milk until their respective weaning age (Table 1). Calves were weaned at 6, 8, 10, 12 and 14 weeks of age for treatments 1, 2, 3, 4 and 5, respectively (Table 2).

Table1. Classification of calves in the experiment

Treatments	Weaning ages (weeks)	Calf sex		Calf breed	
		Males	Females	FBO	JBO
1	6	6	6	6	6
2	8	6	6	6	6
3	10	6	6	6	6
4	12	6	6	6	6
5	14	6	6	6	6

FBO=Friesian x Boran
JBO= Jersey x Bora

Table 2. Liquid diet offered up to weaning

Treatments	Weaning Ages (weeks)	Colostrum (L)	Whole milk (L)
1	6	12	118
2	8	12	164
3	10	12	210
4	12	12	248
5	14	12	260

Dry feeds

A calf starter ration containing 15% wheat bran, 40% wheat middling, 30% noug cake (*Guizotia abyssinca*), 10% meat meal, 4% bone meal and 1% salt was used with natural pasture hay as roughage. Calves were trained to consume dry feeds from the 7th day to the 13th day of life. Concentrate was offered in plastic buckets, while hay was offered in troughs. Feed intake was measured starting from the 14th day of age and the amounts of concentrate and hay offered and refused each day was measured. Type of hay used was harvested from natural grass pasture. It was offered dry by weighing the daily allowance. Dry feed was offered once per day at 10 a.m. with a daily dry feed allowance of 3% of weekly body weight on DM basis, at a ratio of 40:60 for concentrate: hay. Feed allowance continued till 24 weeks post weaning.

Exercise

All calves were allowed to exercise outdoor every morning from 9 – 10 a.m. in the fenced calf exercise area, except during heavy rainy days and during cold weather. The calves could also make free movement within their individual pen.

Housing

The calves were reared in a calf house with corrugated iron for both roof and walls. There was free air movement with a partial opening between the roof and the wall. The floor was paved with concrete and slated with water drainage strips. The calves were housed in individual stall with two feed troughs, one for concentrate (concentrate was fed using pail kept in this trough) and the other for hay. The stalks were cleaned and the bedding changed twice per day. The floor was washed once per week. The calves were offered water *ad lib* twice per day with plastic buckets. A water trough was also used in the calves exercise area.

Measurements

Body weights were recorded at birth and every two-week thereafter until post weaning. Daily milk offered was also recorded. There was no milk refusal.

Statistical analysis

One calf, which refused dry feed after weaning at 42 days, was removed from the experiment and was replaced by another newborn calf. Ten calves that have died during pre-weaning periods were also replaced by other calves. Randomized Complete Block Design with a factorial arrangement was used. Main factors were treatments and breeds, which were blocked by calf sex. A regression equation was fitted to the bi-weekly live weight values to calculate the average live weight gain over the periods of 0 – 14 weeks. Daily body weight gain and final body weight attained at 6 months of age were subjected to analysis of covariance method, using the General Linear Models (GLM) procedures of SAS (SAS, 2002). Statistical model used to analyze the data is expressed as

$$Y_{ijke}=T_i+B_j+S_k+e$$

Where,

Y_{ijke} = An observation for i^{th} treatment, j^{th} breed, and k^{th} sex
T_i = Treatment effect
B_j = Breed effect
S_k = Calf Sex effect
e = random error

Results and Discussion

Early weaned calves had higher concentrate intake ($p < 0.05$) than late weaned calves during pre-weaning period, however, this difference diminished during post weaning period (Table 3). There were differences ($P < 0.05$) in concentrate intake between calf breeds during pre weaning periods. Friesian crossbred calves had higher daily concentrate intake than Jersey crosses. This may be due to size differences between the two. In agreement with the current result, Khalili *et al*. (1992) also reported that larger calves adapt to dry feeding at an earlier age than smaller sized calves. Concentrate intake was not influenced by calf sex ($p > 0.05$). All calves in each treatment had attained recommended levels of concentrate intake at their respective weaning age. This finding is in agreement with earlier studies by Leaver and Yarrow (1972) who suggested that weaning could be successfully undertaken when Friesian or other similar sized calves are consistently consuming 40 g dry feed per day. They also reported that calves were consuming about 400 g concentrates per day when they were about 7 to 8 weeks old. However, in our study

calves weaned at 6 and 8 weeks of age consumed 552 and 546 grams per day, respectively. Calves weaned at 10, 12 and 14 weeks of age consumed only 320, 341 and 372 grams /head/day, respectively, at 8 weeks of age. The low level of concentrate intake might be attributed to the relatively high level of milk offered to these groups, since they were not weaned early. This finding is in agreement with earlier reports of Khalili *et al*. (1992) who indicated that calves that consumed higher amount of milk had lowered concentrate intake. Similar results were also reported in Leaver and Yarrow (1972) and Fallon and Harte (1986).

Table 3. Least squares means (±SE) of calf starter intake

Variables	Number	Concentrate intake (Kg)	
		98 days	180 days
Overall mean	60	31.2	69.1
Treatments			
1	12	34.1±2.04[a]	61.4±4.17
2	12	32.7±2.04[ab]	62.2±4.17
3	12	32.3±2.04[ab]	74.6±4.17
4	12	29.5±2.04[ab]	74.5±4.17
5	12	27.3±2.04[b]	73.0±4.17
Calf sex			
Males	30	32.3±1.29	69.8±2.60
Females	30	30.1±1.29	68.5±2.68
Crosses			
Jersey	30	28.3±1.29[b]	63.8±2.64[b]
Friesian	30	34.1±1.29[a]	74.5±2.64[a]
R^2		0.31	0.26
C.V.%		22.7	20.9

Means with different superscripts are different (P<0.05)

Hay intake was relatively similar for all calves during pre-weaning period, however calves weaned at 6 weeks of age had numerically, but not statistically (P>0.05), the least hay intake during post weaning period (Table 4). Hay intake during early life didn't vary (P>0.05) between weaning groups. As for concentrate, hay intake was also higher for Friesian crosses than for Jersey crosses up to 98 days of age, probably attributed to size differences. Breed difference for hay intake was significant (P<0.05) during pre-weaning rearing period. Roy (1980) and Khalili *et al.* (1992) also suggested that size attributed for intake differences.

Table 4. Least squares means (±SE) of hay intake (Kg)

Weaning days			
Variables	**Number**	**98 days**	**180 days**
Overall mean	60	30.6	64.0
Treatments			
1	12	31.7±2.86	56.2±4.50 [b]
2	12	31.3±2.86	58.2±4.50[ab]
3	12	27.8±2.86	65.0±4.50 [ab]
4	12	30.8±2.86	69.8±4.50 [ab]
5	12	31.4±2.86	71.3±4.50[a]
Calf sex			
Males	30	31.3±1.80	66.4±2.81
Females	30	29.9±1.80	61.8±2.81
Crosses Jersey			
Friesian	30	27.9±1.80[b]	61.2±2.86
	30	33.3±1.80[a]	67.0±2.86
R^2 C.V.%			
	0.11		0.19
	32.4		24.5

Means with different superscripts are different (P<0.05)

Least square means of calves daily body weight gains during pre- and post-weaning periods are presented in Table 5. Calves weaned at 12 and 14 weeks of age showed higher ($P < 0.05$) growth performance than those weaned at six and eight weeks of age during both pre- and post-weaning periods. Calves weaned at 10 weeks of age had intermediate growth rate between the two extremes. They started to vary in body weight ($P < 0.05$) starting at 8 weeks of age. At 14 weeks of age, calves weaned at 10, 12 and 14 weeks of age had significantly higher body weight than calves weaned at 6 weeks of age. This finding is in agreement with Azage *et al*. (1981) and Khalili et al. (1992) who suggested the importance of giving higher level of milk to increase live weight gain of calves.

Table 5. Least squares means (±SE) of calf daily weight gains at different ages

Variables	Number	Body weight gains (g)		
		pre-weaning gain	Post-weaning gain	Birth to 6 months
Overall mean	60	306.62	311.02	308.95
Treatments				
1	12	255.08±24.49^{c}	268.33±32.2^{b}	250.17±22.81^{b}
2	12	301.25±24.49^{ab}	295.17±32.17^{ab}	289.33±22.81^{ab}
3	12	335.42±24.49^{ab}	269.7±32.17 ^{b}	304.50±22.81^{ab}
4	12	368.50±24.49^{a}	349.67±32.17^{ab}	355.33±22.81^{a}
5	12	332.50±24.49^{a}	372.17±32.17^{a}	331.30±22.81^{a}
Sex				
Males	30	341.2±24.49^{a}	313.53±20.35	312.36±14.44
Females	30	295.90±24.49^{b}	308.50±20.35	299.36±22.81
Crosses				
Jersey	30	277.67±15.49^{b}	268.43±20.35^{b}	263.76±15.08^{b}
Friesian	30	359.43±15.49^{a}	353.60±20.35^{a}	348.495±14.09^{a}
R2		0.50	0.25	0.40
C.V.%		24.94	36.01	25.41

Means with different superscripts are different (P<0.05)

There was no difference (P > 0.05) either in total weight gain or daily weight gain between calf sexes (Table 6). However, significant difference was observed between calf breeds at 6 months of age. Friesian crossbred calves had significantly higher growth rate than Jersey calves starting from 4 weeks of age, which is in agreement with Monteiro (1975), who indicated that Jerseys were less effective than Friesians in transferring feed into weight gain.

Table 6. Least squares means (±SE) of calf body weight attained at different ages

Variables		Number	Body weights attained (Kg)	
			pre-weaning (98 days)	Post-weaning (180 days)
	Overall mean	60	57.7	81.7
	Treatments			
	1	12	50.3±2.4[b]	70.3±4.15[b]
	2	12	55.6±2.4[ab]	78.2±4.15[ab]
	3	12	59.0±2.4[a]	80.5±4.15[ab]
	4	12	62.9±2.4[a]	90.8±4.15[a]
	5	12	61.0±2.4[a]	88.5±4.15[a]
	Sex			
	Males	30	59.2±1.5	83.9±2.6
	Females	30	56.4±1.5	79.4±2.7
	Crosses			
	Jersey	30	52.2±1.5[b]	72.0±2.62[b]
	Friesian	30	63.3±1.5[a]	91.3±2.62[a]
	R2	0.54		0.45
	C.V.%	14.3		17.6

Means with different superscripts are different (P<0.05)

Conclusion

Calves weaned at 6 weeks of age had lower growth performance in all the early growth traits. However, weaning at 10 weeks of age didn't affect early growth traits and consequently had similar performances with calves weaned at 14 weeks of age. Therefore, taking into consideration both biological efficiencies as well as economic benefits gained from reduced milk consumptions by calves, weaning at 10 weeks of age is recommended. However, this experiment was carried out using conventional calf starter ration composed of hay from natural pasture and ingredients admixed from industrial by-products. Therefore, we further recommend that using more nutritious calf starter ration there is still a possibility of reducing weaning ages to below 10 weeks of age.

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