SOME EFFECTS OF PARTIAL SUCKLING ON MILK YIELD, REPRODUCTION AND CALF GROWTH IN CROSSBRED DAIRY CATTLE IN NORTH EAST COASTAL TANZANIA

M.J. BRYANT
Department of Agriculture,
The University of Reading,
Reading, United Kingdom

Y.N. MSANGA
Livestock Research Centre,
Ministry of Agriculture,
Tanga, United Republic of Tanzania.

Abstract

SOME EFFECTS OF PARTIAL SUCKLING ON MILK YIELD, REPRODUCTION AND CALF GROWTH IN CROSSBRED DAIRY CATTLE IN NORTH EAST COASTAL TANZANA.

Two experiments are described where a progeny of *Bos taurus* x *Bos indicus* crossbred cows were reared by partial suckling or bucket rearing (Experiment I), and partially suckled calves were weaned at 12 or 24 weeks of age (Experiment II). The results of Experiment I suggest that calf rearing method had no significant effect in the yield of milk extracted from the cows by hand milking although there were effects on the shape of the lactation curve. Cows showed similar patterns of live weight and body condition losses and gains and there were no significant effects on the length of the post partum interval. Suckled calves were lighter at weaning ($P < 0.01$) but there were no differences in live weight between treatments at 52 weeks of age. The main advantage of partial suckling was that the calves took advantage of residual milk which was estimated as 28-29% of the total yield. The results from Experiment II suggest that there were no advantages in terms of milk yield or calf growth by extending the suckling period to 24 weeks. The post partum intervals observed in Experiment II were substantially longer than those in Experiment I, possibly because of greater live weight/body condition losses experienced by cows in the second experiment.

1. INTRODUCTION

Calf rearing in smallholder dairying systems is frequently by means of restricted suckling. In north east coastal Tanzania, a survey [1] found that 90% of respondents reared calves in this way. Calves were suckled on average for 4.6 months, with a range of 3 to 10 months. The same survey found that restricted suckling was practiced in various forms. The calf was allowed to suckle to initiate milk letdown, the cow was then milked out and the calf allowed to suckle again to remove residual milk (i.e. milk not able to be removed from the udder by the process of milking). A simplified version of this method was to allow the calf to suckle only after the cow had been milked out. An alternative practice was to allow the calf to suckle one quarter throughout milking.

Numerous advantages are claimed for rearing calves by restricted suckling: these include increased milk production, increased lactation persistency and increased lactation length, reduced incidence of mastitis and reduced risk of calf diarrhoea [2]. The relative magnitude of the advantages of restricted suckling must depend on the form it takes and the genotype of the cows. Restricted suckling where the calf may be required to initiate milk letdown and maintain the lactation, such as appears to be essential in *Bos indicus* cows, is clearly of considerable advantage [3]. Calf stimulation is not essential for milk letdown and persistency in *Bos taurus* nor the majority of crossbreds arising from mating between *Bos*

taurus and *Bos indicus* breeds. With such cattle, restricted suckling where the calf makes use of only residual milk remaining in the udder after the cow has been milked out, is likely to be the practice that tenders the most advantage. Calves may then be reared on a source of milk that is not available for sale nor the cow keeper's own consumption; hence calf rearing does not compete directly with milk extraction for human use, with possible advantages to the calf. Calf and cow health may also benefit.

This paper describes two studies, of the effects of partial suckling where calves were allowed only residual milk, on the productivity of crossbred dairy cows and their calves. The objectives were to firstly, quantify the likely benefits to be gained from partial suckling in smallholder dairy production systems and secondly to establish if age at weaning the calf might influence productivity.

2. MATERIALS AND METHODS

The experiments were carried out at the Tanga Livestock Research Centre situated on the north east coast of Tanzania (5°S, 39°E) at an altitude of 66 m. The mean annual rainfall ranges from 1100 to 1400 mm and is bimodal in its pattern of distribution.

2.1. Experimental designs

Experiment I compared the effects of partial suckling to bucket rearing. Thirty-six cows were allocated alternately at calving to treatments 'partial suckling' (PS) or 'bucket rearing' (BR). Experiment II compared the effects of partial suckling to 12 or 24 weeks after calving. Thirty-six cows were allocated alternately at calving to treatments 'suckling to 12 weeks' (S12) or 'suckling to 24 weeks' (S24).

2.2. Animals and management

The cattle used in the experiments were crosses from Holstein and Jersey bulls on East African Zebu cows. The level of *Bos taurus* inheritance in the cows varied from 50 to 87.5%. The calves were a result of *inter se* mating. The cows grazed improved pastures from 0730 to 1500 h and for a further hour after afternoon milking, daily. They were subsequently confined to night paddocks. Morning milking occurred at 0600 h. Cows received 2 kg of a concentrate, consisting of 680 g maize and wheat brans, 200 g rice mill feed, 80 g copra cake and 40 g dried leucaena per kg fresh weight, at each milking throughout the lactation. All milking was by hand. Cows were dried off either at 308 days after calving, when they were 7 months pregnant or when the daily milk yield fell below 1 L for 7 consecutive days, which ever was the sooner.

New-born calves had free access to their dams on the first day of life. Bucket-reared calves were fed 2 L of colostrum after each milking for the following three days and 2 L of fresh milk after each milking from day 5 to weaning. Suckled calves were allowed to suck their dams for 1 h twice daily for days 2 to 4. From day 5 the calves were allowed to suckle residual milk from their dams for 30 min after the cow had been milked out. All calves were housed in covered yards and allowed free access to pasture daily. From 12 weeks of age the calves grazed under the supervision of a herdsman. At 6 months of age the calves were separated by sex.

Calves in Experiment II but not in Experiment I received a concentrate supplement, consisting of 700 g maize bran and 300 g copra cake, per kg fresh weight. Calves were individually penned overnight and offered the concentrate from week 2, starting at 200 g/day

with weekly increments of 100 g/day to a maximum offer of 1 kg/day. Concentrate feeding ceased when the calves were 24 weeks of age.

2.3. Measurements

Daily milk yield was measured volumetrically throughout the cows' lactations. Cows were weighed and body condition score (BCS) taken immediately after calving and thereafter at 2 week intervals up to 24 weeks (Experiment I) or 40 weeks (Experiment II) after calving using a defined 0-5 point scale with half points [4, 5]. Calves were weighed at birth, thereafter at weekly intervals up to 24 weeks and thereafter at 4-week intervals up to 52 weeks of age. Concentrate consumption was measured by collecting refusals daily and drying at 100°C to establish dry matter remaining (Experiment II only).

The cows were observed daily in the presence of a vasectomized bull in order to detect signs of oestrus behaviour. Oestrus cows were mated by a nominated bull at a supervised service if the cow had shown a previous oestrus or if the cow had calved 45 days or more previously. Pregnancy was determined by rectal palpation two months following mating.

2.4. Statistical analysis

Most analyses were carried out using general linear model procedures [6]. Models included the factors genotype, calf rearing method, lactation number, season of calving and sex of calf, if appropriate. In some instances, rainfall during the month of calving and live weight or BCS at calving or another time point were included as covariates. Due to lack of observations in some classes, body condition scores could not be analyzed using linear model procedures and therefore, descriptive statistics were used. Data for reproductive traits had a skewed distribution and log transformation was applied before analysis.

3. RESULTS

All calves survived up to weaning although some cows and calves contracted anaplasmosis and East Coast fever during the course of the experiment.

3.1. Milk yield

Aspects of milk yield are shown in Table I. There was no statistical difference in milk yield from calving to 12 weeks, from 13 to 24 weeks or for the full lactation between BR and PS cows in Experiment I or the suckled cows in Experiment II. The residual milk taken by calves was calculated from previously published conversion factors [7, 8], from the conversion ratio established from the bucket reared calves in Experiment I, and from the ME requirements for growth of the calves [9]. The estimates ranged from 2.2 to 2.6 L/day and the mean result represented 28 to 29% of total milk yields in suckled cows in both Experiments I and II. For the purposes of calculating total milk yield in Experiment II, the residual milk taken by calves from 13 to 24 weeks was calculated as 29% of the total yield, as in the period from calving to 12 weeks. Table I also shows estimated milk yields that include milk extracted by hand milking plus milk extracted by the calves. Clearly, partial suckling increases the extraction of milk compared to bucket rearing, and allowing calves to suckle to 24 weeks further increases milk production. The advantage of partial suckling becomes compelling when milk yield is presented as 'offtake', used here to describe the volume of milk that may be consumed by the cowkeeper or sold. In the case of bucket reared calves

some extracted milk must be given to the calves. In Experiment I the advantage of partial suckling was to provide an additional 365 L of milk as offtake.

TABLE I. EFFECTS OF BUCKET REARING COMPARED TO PARTIAL SUCKLING (EXPERIMENT I) AND PARTIAL SUCKLING TO 12 WEEKS COMPARED TO PARTIAL SUCKLING TO 24 WEEKS (EXPERIMENT II) UPON LEAST SQUARES MEANS (STANDARD ERRORS) OF VARIOUS MEASUREMENTS OF MILK YIELD (L)

	Experiment I		Experiment II	
	Bucket rearing (BR)	Suckle 12 weeks (S12)	Suckle 12 weeks (S12)	Suckle 24 weeks (S24)
Daily milk yield				
0-12 week	6.5 (± 0.41)	6.2 (± 0.41)	6.3 (± 0.4)	5.7 (± 0.5)
13-24 week	5.7 (± 0.43)	5.5 (± 0.30)	6.6 (± 0.4)	5.7 (± 0.5)
Lactation yield				
milked	1563 (± 104.6)	1592 (± 88.1)	1806 (± 102.0)	1705 (± 129.1)
suckled (estimate)*	-	202	210	412
total (estimate)	1563	1794	2016	2118
offtake**	1227	1592	1806	1705

* For methods of estimate see text

** Offtake is defined as milk that may be consumed by the cowkeeper or sold

The lactation curves for PS and BR cows of Experiment I are shown in Figure 1. It can be seen that PS cows achieved a more modest peak yield that was maintained to a greater extent than BR cows. Lactation persistency (P) was estimate using the expression P = A-B/B, where A is milk yield for the first 180 days and B is the milk yield for the first 90 days [10, 11]. Covariance analysis showed that the rearing method was a significant source of variation ($P < 0.001$) in persistency. The lactation curves for S12 and S24 cows in Experiment II are shown in Figure 2. Lactation curves of both groups of cows were very flat once peak yield was achieved, except for marked secondary peaks in daily yield following weaning at both 12 and 24 weeks. There was no significant difference in persistency in Experiment II. Lactation length was not affected by rearing method in either experiment.

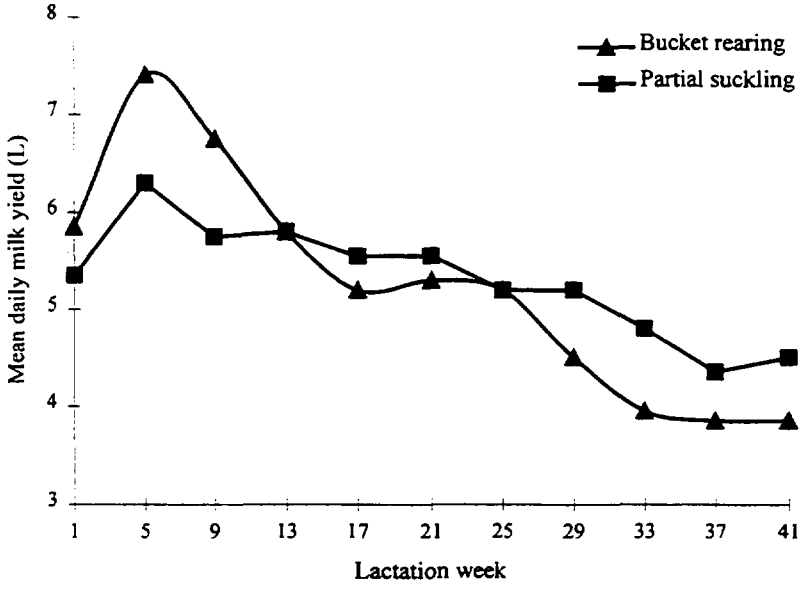

FIG.1. LSM daily milk yield (L) throughout lactation in Experiment I.

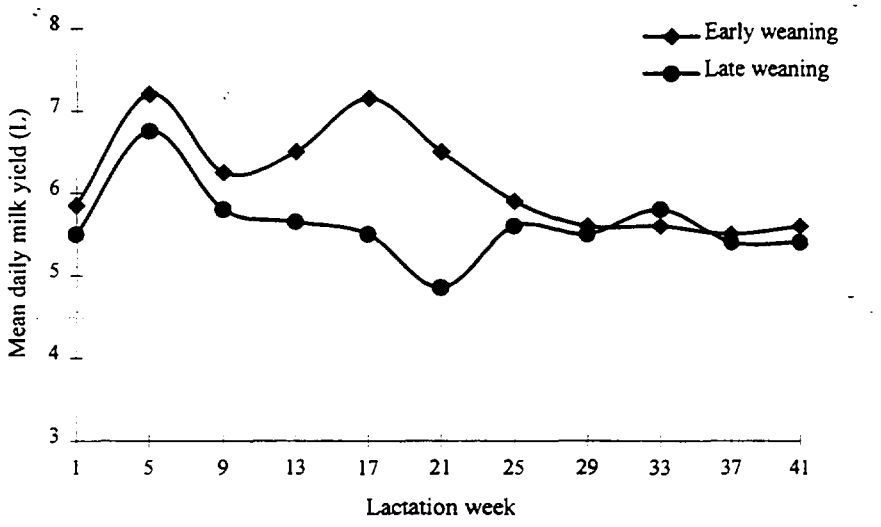

FIG.2. LSM daily milk yield (L) throughout lactation in Experiment II.

3.2. Changes in live weight and BCS

Changes in live weight and body condition score of the cows in Experiment I up to 24 weeks of lactation are shown in Figures 3 and 4, respectively. All cows lost live weight immediately after calving. Cows in the bucket rearing group tended to maintain weight until week 16 when live weight began to increase. Cows in the suckling group gained weight during the first 12 weeks of lactation but suffered a loss following weaning of the calves. There were no significant differences in live weight changes between treatments. The BCS of the cows declined to 12 weeks from when they started to improve again. There were only slight, non-significant differences between rearing methods. Condition score at calving and at weaning, when included as a covariate in the models, contributed significantly ($P < 0.001$) to the variance. There was a negative relationship between BCS at the beginning of the period and the loss in condition that occurred during the period.

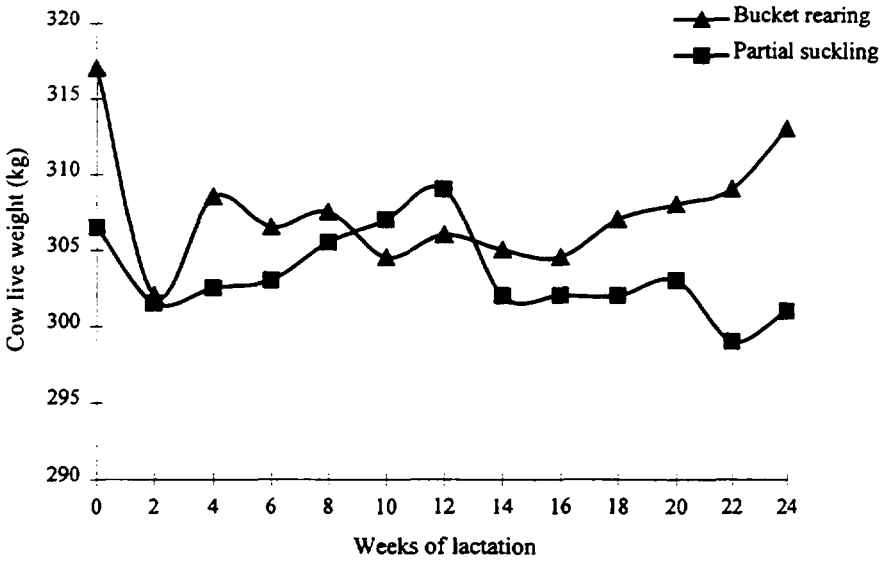

FIG.3. LSM cow live weights (kg) during first 24 weeks of lactation in Experiment I.

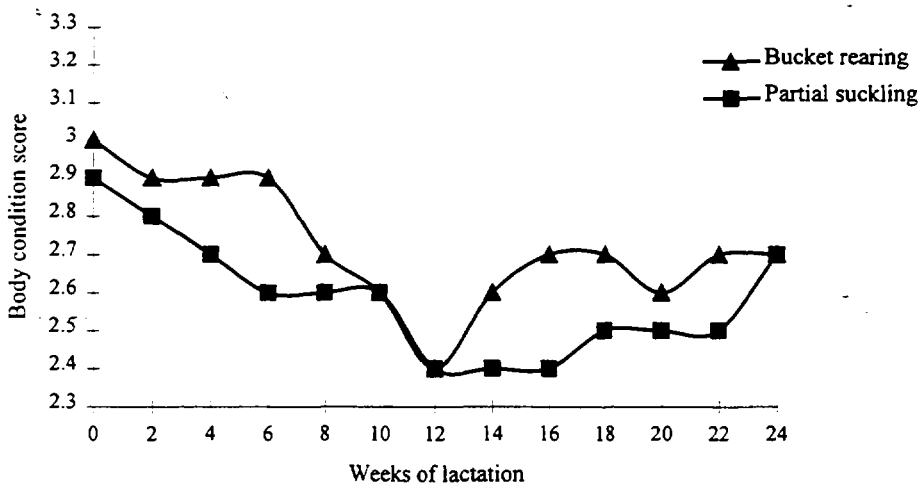

FIG.4. Mean cow body condition score during first 24 weeks of lactation in Experiment II.

Figures 5 and 6 show changes in live weight and BCS, respectively, to 40 weeks of lactation of the cows in Experiment II. Cows in Experiment II continued to lose live weight until later in lactation than cows in Experiment I and although some gains occurred subsequently, neither S12 nor S24 cows had regained their calving live weights by 40 weeks of lactation. S24 cows had a mean net loss of 15.3 kg compared to 7.0 for S12 cows, which was not significant. Mean BCS of both S12 and S24 cows declined during lactation, stabilizing from approximately 24 weeks of lactation. BCS had not returned to post-calving score by week 40 of lactation. As in Experiment I, BCS at the start of a period was negatively related to change in body condition during that period.

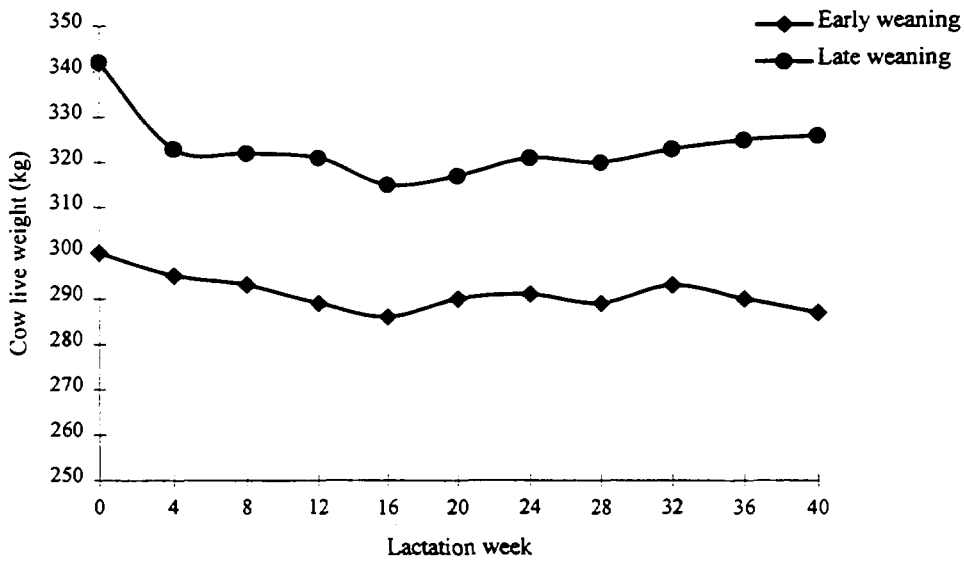

FIG.5. LSM cow live weights (kg) throughout lactation in Experiment II.

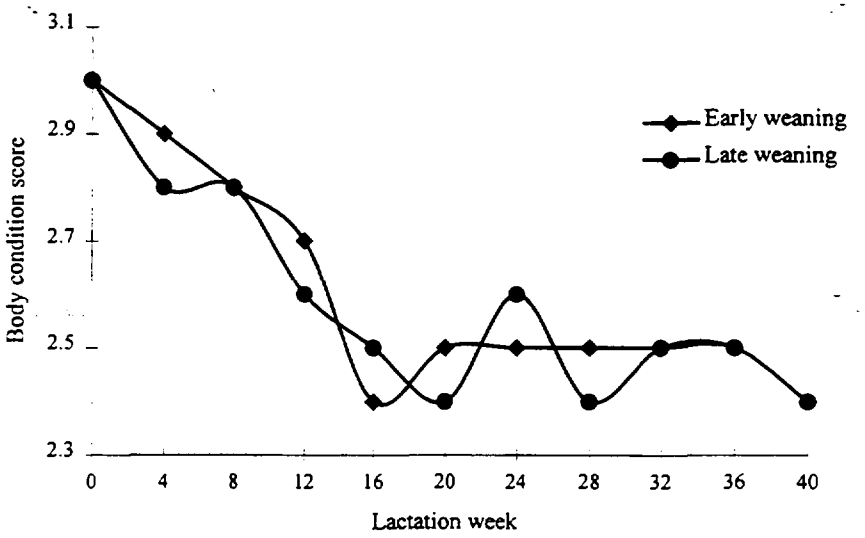

FIG.6. Mean cow body condition score throughout lactation in Experiment II.

3.3. Oestrus, insemination and conception

Days from calving to first oestrus, first insemination and conception are shown in Table II. Of the 36 cows that started in Experiment I, one from each rearing treatment did not show oestrus behaviour. Thirty-three cows had conceived up to the end of the study. Differences between BR and PS cows were small and non-significant, although there was a trend for BR cows to show oestrus, be inseminated and conceive earlier than PS cows.

TABLE II. EFFECTS OF PARTIAL SUCKLING COMPARED TO BUCKET REARING (EXPERIMENT I) AND PARTIAL SUCKLING TO 12 WEEKS COMPARED TO PARTIAL SUCKLING TO 24 WEEKS (EXPERIMENT II) ON LEAST SQUARES MEANS (LOG LEAST SQUARES MEAN ± SE) OF DAYS FROM CALVING TO FIRST OESTRUS, FIRST INSEMINATION AND CONCEPTION

	Experiment I		Experiment II	
	Bucket rearing (BR)	Suckle 12weeks (S12)	Suckle 12weeks (S12)	Suckle 24weeks (S24)
Calving to first oestrus	47 (1.6 ± 0.11)	57 (1.8 ± 0.06)	120 (2.1 ± 0.06)	158 (2.2 ± 0.09)
Calving to first insemination	74 (1.9 ± 0.07)	81 (1.9 ± 0.06)	144 (2.2 ± 0.04)	158 (2.2 ± 0.09)
Calving to conception	115 (2.1 ± 0.08)	126 (2.1 ± 0.08)	198 (2.3 ± 0.05)	239 (2.4 ± 0.07)

All cows in Experiment II showed oestrus but the post partum period was prolonged in comparison to Experiment I. S12 cows were on average 38 days earlier to reach first oestrus, although the difference was not statistically significant. Five cows, two from S12 and three from S24, failed to conceive. Of the remainder, S12 cows conceived on average 41 days earlier than S24 cows but the difference was not statistically significant.

3.4. Live weight gains of the calves

Changes in live weight of the calves over the first year of life are shown in Figures 7 and 8 for Experiments I and II, respectively. In Experiment I, BR calves were significantly ($P < 0.01$) heavier at weaning than PS calves but differences resulting from the rearing treatment had largely disappeared by 52 weeks of age. In Experiment II, the calves from S12 and S24 treatments grew along similar pathways. S12 calves consumed more concentrate supplement ($P < 0.05$) than S24 calves from 13 to 24 weeks and were thus able to maintain similar live weight gains to their contemporaries allowed to suck up to 24 weeks of age.

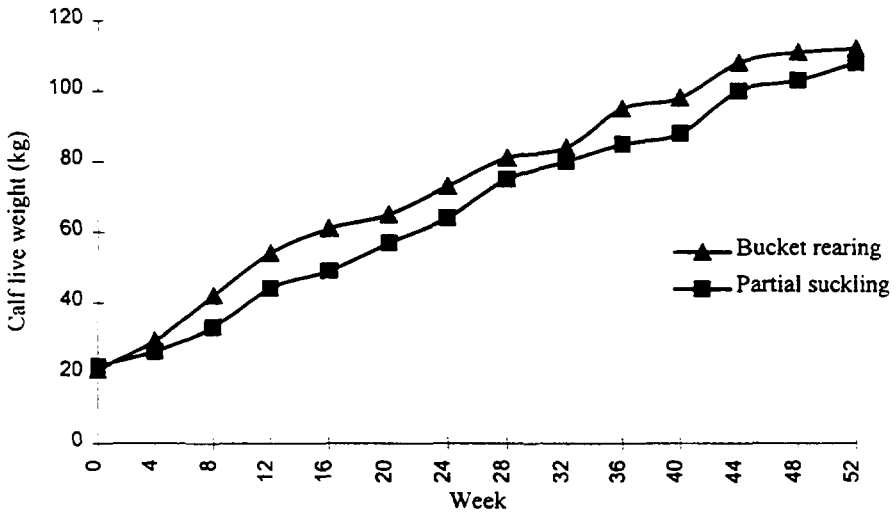

FIG.7. LSM calf live weight (kg) to one year of age in Experiment I.

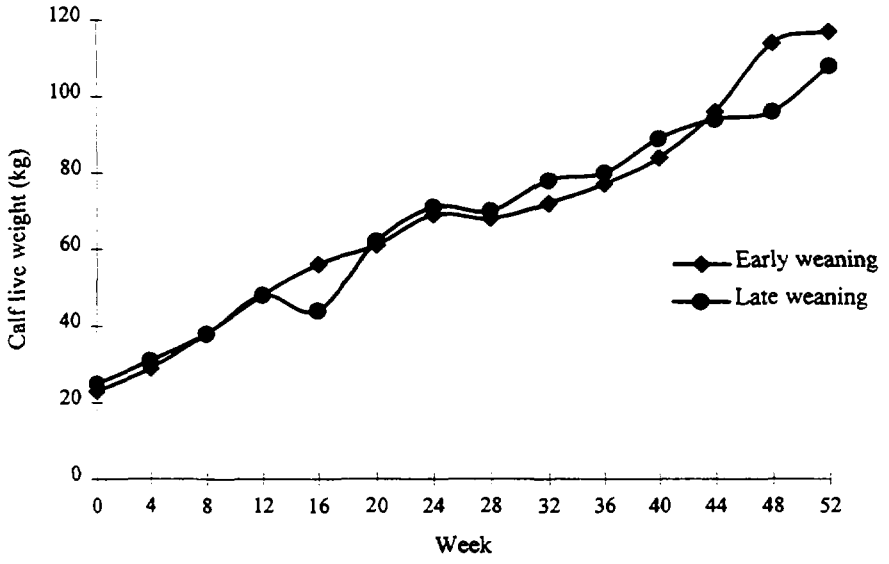

FIG.8. LSM calf live weights (kg) to one year of age in Experiment II.

4. DISCUSSION

There were few significant differences between rearing methods. Restricted suckling was associated with a different shape to the lactation curve suggesting greater persistency and therefore agreeing with some previous findings [12, 13]. However, this was not associated with a longer lactation or greater lactation milk yield for human consumption, as claimed by other workers [14, 15]. Lactation milk yield was increased when milk sucked by calves was taken into account. The estimate of residual milk was similar in both experiments and greater than the range of 10 to 25% quoted elsewhere [16-18], suggesting that cows may learn to 'hold back' milk when they are accustomed to suckling a calf following milking. The major advantage to restricted suckling in this experiment was that calves were reared entirely on residual milk and therefore none of the milk removed from the udder by hand had to be given to calves. With bucket reared calves being given 4 L of milk per day, the increase of saleable milk from suckling cows over cows whose calves were bucket reared was approximately 1.3L. It is probably unlikely that smallholder farmers would be prepared to forego as much as 4 L of saleable milk to feed the calf and so the advantage of restricted suckling is almost certainly an overestimate.

An apparent disadvantage to restricted suckling was the relatively modest gains made by the calves in the first 12 weeks of life. The provision of a concentrate supplement in Experiment II failed to improve matters as the calves ate little up to 12 weeks, while calves continuing to suckle their dams failed to consume substantial quantities up to 24 weeks. Because of compensatory gains, there were no differences in calf live weight at 52 weeks, confirming the finding that generous feeding of calves during the pre-weaning period may be of little advantage in a production environment where the seasonal effects on feed availability are large or variable [19].

A major, well-recognized concern related to partial suckling is the effect of the continuing suckling stimulus on the inhibition of ovulation in the post partum cow. The results from Experiment I were encouraging as the effects of partial suckling on the time taken to first oestrus were negligible compared to bucket rearing. However, post partum anoestrus was substantially extended in Experiment II. Since the cows of Experiment II lost more live weight over a longer period of lactation, it is tempting to suppose that this may be the explanation for the differences on length of the post partum interval between treatments PS in Experiment I and S12 in Experiment II. It is well established that the resumption of reproductive activity is delayed in both *Bos taurus* and *Bos indicus* cows that are in negative energy balance and/or poor body condition [20, 21]. There is also evidence to show that the effects of suckling and nutritional status interact to modify the length of the post partum interval to ovulation and oestrus [22].

In conclusion, it seems that partial suckling releases more milk for human consumption without unduly jeopardizing the growth and welfare of the calf. However, there seems to be little advantage to continue the practice beyond 12 weeks. More research is needed on the interactions between suckling, the nutrition of the cow, and return to ovarian activity.

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