

INFLUENCE OF PARTIAL SUCKLING OF CROSSBRED DAIRY COWS ON MILK OFFTAKE AND CALF GROWTH IN THE ETHIOPIAN HIGHLANDS

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SUMMARY

The effects of implementing a restricted suckling regime with crossbred dairy cows have been examined in the Ethiopian highlands. Calves were allowed to suckle their dams for two minutes before each milking until weaning and this system was compared with the common practice of rearing by bucket feeding.

Restricted suckling significantly increased calf growth rate to weaning, from 0.31 to 0.53 kg/d ($P < 0.01$). No differences in calf growth post-weaning occurred, so that the 20 kg difference in liveweight that had been achieved by the restricted suckled calves by the time of weaning persisted until the calves were nine months old, when observations ceased.

Total milk offtake was not significantly affected by treatment, although that obtained from the partially-suckled animals over their whole lactation exceeded that from the other treatment by 15%. Partial suckling delayed return to oestrus post partum but this was offset to some degree by fewer services per conception, hence calving interval was not significantly increased. Voluntary feed consumption was similarly unaffected and it is concluded that restricted suckling offers tangible advantages for adoption by smallholders using crossbred cows in dairy production systems.

INTRODUCTION

Exotic dairy breeds, in particular the Friesian, when crossed with the local zebu breeds have been utilised for many years in Ethiopia to increase milk production (Schaar, Brannang and Meskel, 1981; AACM, 1984). Several studies have shown that such F1 animals have yielded approximately 2,000 kg milk per lactation under research institute-type conditions (Kiwuwa, Trail, Kurtu, Worku, Anderson and Durkin, 1983), and rather less in cooperative dairy farms where daily yields have approximated 5 kg/d during lactation (AACM, 1984; Anon, 1986).

While the presence of the calf is generally recognised as necessary to stimulate milk letdown in zebu cows, the recommendation is that these crossbred cows are not suckled other than immediately after parturition and the calves are reared by bucket feeding. Current Ministry of Agriculture (MOA) recommendations are that calves receive *ad libitum* colostrum for the first four days followed by 212 kg whole milk over the following 80 days until they are weaned (Alemu, 1983). In practice, however, wide variations to this regime are encountered, calves often receiving well over 300-500 kg milk up to weaning, which may not occur before

six months of age (AACM, 1984), and frequently the calf is removed at birth and the cow is not even suckled at that stage.

In tropical countries many experiments in dairy enterprises have demonstrated beneficial responses to partial suckling regimes in such traits as milk production, calf growth and survival, udder health and reproductive performance (Ugarte, 1975; Alvarez, Saucedo, Arriaga and Preston, 1980; Preston, 1983). This paper reports an experiment to investigate the potential benefits of restricted suckling of crossbred cows in the Ethiopian highlands with special emphasis on maximising the efficiency of resource utilisation.

MATERIALS AND METHODS

Cattle and treatments

At ILCA's Debre Berhan station, 13 mature F1 Friesian × Boran cows averaging 430 (± 9.7 s.e.) kg liveweight *post partum* and sixth lactation were randomly allocated to one of two treatments at calving in which the calves were either partially suckled (six) or reared by bucket feeding (seven). The regimes were as follows:

1. Partial suckling. The calves had complete access to their dams for 24 hours after birth and received *ad libitum* maternal colostrum/milk for the next three days. They were allowed to suckle for five minutes before each of the two daily milkings until they were 14 days old and thereafter allowed to suckle for two minutes before each milking until weaning at 94 days of age.

2. Bucket rearing. This is the standard procedure that has been adopted at Debre Berhan since 1980 in which the calves suckle for 24 hours as above and are then housed separately. The cows are hand milked and all of their colostrum/milk is given to their calves for the next three days. Subsequently they receive a proportion of the milk extracted, three litres a day for 30 days, four l/d for the next 30 days, two l/d for 15 days then one l/d for 15 days until weaning at 94 days, giving a total 90-day allowance of 255 litres. This system is very similar to that recommended by the MOA (212 l over 80 days; Alemu, 1983).

Before weaning the calves were given *ad libitum* access to grass hay and a complete mineral lick in their pens and, after weaning, an additional daily allowance of one kg noug cake each (the residue of *Guizotia abyssinica* seed after oil extraction) with free access to a molasses-urea block. The cows were stall-fed with *ad libitum* grass hay and molasses/urea block plus 2 kg noug/day. The blocks were made at ILCA using a cold setting process and consisted of molasses 42%, urea 10%, cement 15%, triple superphosphate 3%, salt 5% and wheat bran 25%.

Measurements and observations

- (i) Milk yield. The total quantities of milk obtained at each milking were measured. For the partially-suckled cows this figure represented milk offtake for human consumption; in the case of cows whose calves were bucket reared the quantity given to the calves was deducted to produce a figure for milk offtake. This continued for the complete lactation which was terminated due either to advancing pregnancy or when milk yields approached one l/day. No attempt was made to measure the quantities of milk consumed by the partially-suckled calves.

- (ii) Feed intake. Daily measurements were made of hay consumed by each animal, and bulked weekly samples of hay offered and refused were kept for dry matter (DM) determination and subsequent chemical analysis (Table I). The

TABLE I
Nutrient concentrations in grass hay fed and refused

Component	Fed		Refused	
	Mean	s.e.	Mean	s.e.
	g/kg			
N	10.2	0.24	11.1	0.15
P	1.7	0.08	2.0	0.16
Ca	6.4	0.28	6.5	0.45
Mg	2.6	0.30	2.0	0.14
Na	0.34	0.05	1.11	0.26
K	13.6	0.60	12.6	0.90
	mg/kg			
Cu	8.9	0.70	8.6	0.84
Zn	40	3.6	44	3.0
Fe	1006	102.0	1563	191.2
Mn	245	13.0	258	19.6
NDF (%)	65.9	0.63	64.1	0.74
IVDMD (%)	63.1	0.90	62.0	0.94

quantity offered was varied to allow for at least 20% residue to ensure *ad libitum* intake as far as possible. The molasses blocks given to each cow were regularly weighed and replaced as necessary so that rates of consumption could be calculated. All noug offered was consumed.

(iii) Body weight. Weekly measurements of body weight before feeding were made on cows and calves until nine months of age; rates of body weight gain of individual calves were determined by linear regression of weight on time.

(iv) Oestrus/conception. The cows were allowed out of their stalls three times per day into an adjacent concrete yard for exercise and watering. A bull was with them on these occasions, oestrus and service were recorded and calving interval established.

(v) Statistical analysis. The significance of treatment differences in results was established using the Student's t-test.

RESULTS AND DISCUSSION

Calf growth

The mean weight of both groups of calves at birth was 25 kg. During the pre-weaning period the partially-suckled calves grew significantly more rapidly than those that were bucket reared (0.53 *v* 0.31 kg/d; $P < 0.01$; Table II), with the result that at weaning they were 20 kg heavier (72 *v* 52 kg; $P < 0.01$). Both groups of calves grew at virtually the same rate after weaning (Table II), so that the liveweight difference established by the time of weaning persisted. At nine months of age when observations on calves ceased the mean weights of these groups were respectively 148 and 126 kg.

The improved calf performance produced by a partial suckling regime occurs usually through a combination of reduced calf mortality and morbidity and improved nutrition, which are clearly related. In the course of this work no mortalities occurred and clinical disease was observed in only two calves, both in the bucket-reared group. These animals respectively received treatment for

TABLE II

Productivity characteristics of crossbred cows and their calves subjected either to a partial suckling regime or one of bucket rearing in the Ethiopian highlands

Milk offtake	Partial suckling		Bucket rearing	
	Mean	s.e.	Mean	s.e.
Pre-weaning (l)	459.6	43.9	455.9	55.8
Whole } (l)	1894.1	139.9	1644.6	146.7
Lactation } (l/d)	5.6	0.43	5.4	0.48
Lactation length (d)	341	13.6	305	13.7
(Range)	(301-383)		(271-368)	
Calf growth				
Birth—weaning (kg/d)	0.53	0.026	0.31	0.043 ²
Weaning—6 months (kg/d)	0.36	0.018	0.35	0.032
Weaning—9 months (kg/d)	0.42	0.029	0.41	0.046
Hay + block intake				
(kg DM/cow/d)	13.25	0.24	13.14	0.52
Reproductive data				
Calving—oestrus (d)	101	18.2	41	5.5 ¹
Services/conception	1.3	0.21	1.9	0.34
Calving interval (d)	391	14.6	335	13.3

^{1,2} Significant at $P < 0.05$ and $P < 0.01$ respectively.

pneumonia and diarrhoea which occurred when they were six to seven weeks old; their recoveries were satisfactory but they were the slowest growing animals of their group during the pre-weaning, but not post-weaning period. However, the mean growth rate of their companions during the pre-weaning period (0.37 kg/d) remained significantly below that of the partially-suckled calves ($P < 0.01$).

On the evidence of the differential incidence of clinical disease it is probable that part of the difference in performance was related to the promotion of more robust, healthier calves by the partial-suckling regime. Problems with hygiene associated with bucket rearing of calves are well-recognised as a cause of impaired performance (Preston, 1983).

Lactation performance

The mean total milk offtakes up to weaning were virtually identical between treatments (459.6 *v* 455.9 l, Table II).

Following removal of the calves from the partially-suckled group at weaning the volume of milk extracted from these cows increased by almost three l/d over the next 20 days, producing a curve for the balance of lactation that remained above that of the other group. Further, the persistency of lactation in these animals was such that their mean lactation length was 36 days longer (Table II), which is practically and economically significant in this husbandry system where cows are milked for as long as possible, and whole lactation yield is regarded as a very important criterion (Kiwuwa *et al.*, 1983). Although this difference was not statistically significant the lactations of all partially-suckled cows exceeded 300 days whereas only 42% of the bucket-reared group did so. The combination of these factors resulted in an approximately 250 l greater milk offtake over the whole lactation (Table II), while by the 270th day of lactation the milk offtake advantage from the partial suckling regime was approximately 70 litres.

The mean daily milk offtakes during the whole lactation were 5.6 and 5.4 l for the partially-suckled and bucket-reared treatments respectively (Table II). While no attempt was made in this experiment to measure the quantity of milk consumed by the partially-suckled calves, total milk production of the cows with bucket-reared calves was measured over the whole lactation (i.e. offtake plus calf allowance) and averaged 6.25 l/d (± 0.49 s.e.).

Because of the significantly greater calf growth, total milk production by the partially-suckled cows would have been greater via the stimulatory effect of suckling on milk production (Everett and Phillips, 1971), offset slightly by the possible health advantage enjoyed by the partially-suckled calves noted above and their probably more efficient utilisation of milk mediated through oesophageal groove reflex effects (Ørskov, 1982). These yields substantially exceed those recorded from cooperative farms mentioned above where greater quantities of concentrates are normally fed (AACM, 1984; Anon, 1986); this is probably related to less rigorous attention to various management and health aspects of husbandry.

Reproduction, body weight and feed intake

Partial suckling significantly increased the interval from calving to first post partum oestrus (101 *v* 41 days; $P < 0.05$; Table II), but was associated also with a tendency towards fewer services per conception (1.3 *v* 1.9; Table II), so that the mean calving interval while 36 days longer was not statistically significantly affected (Table II). The mean calving intervals of 391 and 355 days observed constitute a substantial improvement over the 430 to 460 days recorded earlier on smallholder cooperative dairy farms and experimental stations (Kiwuwa *et al.*, 1983; AACM, 1984).

In the eight to 11 months that elapsed between calving and the point three months before the next calving (to minimise the confounding effect of the uterus and foetus), all cows gained weight slowly by 50 ± 7.3 kg (s.e.) and 41 ± 10.2 kg for the partially-suckled and bucket-reared groups respectively, i.e. at approximately 0.15 kg/day.

There was no difference in feed intake between these groups; during lactation the mean intakes of DM from hay plus block were 13.25 and 13.14 kg/d (Table II). When the daily allowance of noug cake is taken into account these animals were consuming feed DM at a rate approximating 3.3 to 3.5% liveweight and any extra concentrate would tend to replace rather than supplement the roughage in the diet. The ration as consumed approximated 16% concentrate (12% noug; 1.5% wheat bran; 2.5% molasses). Clearly greater levels of production can be achieved with higher levels of dietary concentrate; average daily yields of some 9 l, with annual production around 3,400 l have been recorded from Ethiopian state dairy farms using 60% concentrate diets (AACM, 1984) but in those cases the cows were 75% Friesian. Economic considerations will have a major bearing on decisions to adopt diets of this type.

The results in Table I show no evidence of selection in the quality of hay consumed, since there were no significant differences between compositional parameters of the hay offered and that consumed (except in the case of Na, consistent with contamination of the residues by saliva and block, and of Fe, due presumably to a concentration of contaminating dust and soil in the residues as the hay was consumed). The hay fed in this experiment contained marginal concentrations of N, P and Cu, and inadequate Na (Table I), so that appropriate

supplementation is required if acceptable levels of animal production are to be obtained. The blocks and noug cake were clearly sufficient for this to be achieved, and the results of Little, Anderson and Durkin (1987) showed that *ad lib.* block in the absence of supplementary noug was inadequate to provide for milk production and body weight maintenance in cows fed hay of comparably low quality.

It is concluded that the adoption of a partial suckling regime can confer marked benefits in smallholder dairy systems in terms of calf performance, certainly without penalty to milk offtake for human consumption. In the present work, milk offtake slightly increased on both 270 days and whole lactation bases and further work in this area appears justified to examine the influence of such factors as variations in suckling regimes, in types and amounts of supplementary feeds supplied and the effect of different basal roughage quality.

ACKNOWLEDGMENTS

The work of Ato Woldeab W/Mariam, Ato Zelleke Kebede and the staff of the ILCA dairy barn at Debre Berhan is gratefully acknowledged.

Accepted for publication January 1990

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INFLUENCE D'UNE TETEE PARTIELLE DE VACHES LAITIÈRES CROISÉES SUR LA PRODUCTION DE LAIT ET LA CROISSANCE DU VEAU DANS LES HAUTES TERRES D'ETHIOPIE

Résumé—Les effets de la mise en oeuvre d'un régime de tétée limitée sur des vaches laitières croisées ont été étudiés dans les Hautes Terres éthiopiennes. Les veaux ont pu téter leur mère pendant deux minutes avant chaque traite jusqu'au sevrage. Cette méthode a été comparée avec la pratique habituelle d'alimentation au seau. La tétée limitée a augmenté significativement le taux de croissance du veau jusqu'au sevrage: de 0,31 à 0,53 kg/jour pour $P < 0,01$). Aucune différence n'a été constatée dans la croissance après le sevrage, et les 20 kg de différence de poids vif acquis au moment du sevrage se sont maintenus jusqu'à l'âge de neuf mois, époque à laquelle les observations ont cessé. La production totale de lait n'a pas été affectée de façon significative par cette technique bien que celle obtenue avec des animaux tétés partiellement pendant toute la durée de leur lactation ait dépassé de 15 p. 100 celle obtenue par la méthode traditionnelle. La tétée partielle a retardé le retour des chaleurs après le part, mais cette situation a été compensée, dans une certaine mesure, par un nombre moins

élevé de saillies par fécondation. De ce fait, l'intervalle entre vêlages n'a pas augmenté de façon significative. De même, la consommation volontaire d'aliments n'a pas été perturbée et l'on peut conclure que la tétée limitée offre des avantages tangibles pour les petits fermiers utilisant des femelles croisées dans leurs systèmes de production.

INFLUENCIA DEL AMAMANTAMIENTO RESTRINGIDO EN LA PRODUCCION DE LECHE Y EN EL CRECIMIENTO DE LAS CRIAS DE VACAS LECHERAS CRUZADAS, EN LAS MESETAS DE ETIOPIA

Resumen—Se estudió el efecto de implementar un régimen de amamantamiento restringido en vacas lecheras cruzadas, en las mesetas de Etiopía. Las crías amamantaron durante dos minutos diarios antes de cada ordeño hasta el destete, siendo comparado el sistema con la práctica común de alimentación con balde. El amamantamiento restringido incrementó significativamente la tasa de crecimiento hasta el destete, de 0.31 a 0.53 kg/d ($P < 0.01$). No se presentaron diferencias en la tasa de crecimiento después del destete, de manera que los 20 kg de diferencia en peso vivo observado al destete, se mantuvo hasta que los terneros alcanzaron los nueve meses de edad y la observación terminó. La producción de leche no se afectó sensiblemente por los tratamientos, aunque la que se obtuvo de los animales con amamantamiento restringido a lo largo de la lactación, fue superior en un 15% a aquella obtenida de los animales con tratamiento diferente. El amamantamiento restringido prolongó los días abiertos post-partum, pero ésto fue subsanado debido a que se requirieron menos servicios por concepción en las hembras con este tratamiento. El consumo voluntario de alimentos no se afectó, concluyéndose, que el amamantamiento restringido ofrece ventajas para pequeños ganaderos que exploten vacas lecheras cruzadas.

BOOK REVIEW

Salamon's Artificial Insemination of Sheep and Goats. G. Evans and W. M. C. Maxwell. Butterworths. 1987. 194 pp. Soft back, £21.95. ISBN 0-409-49177-2.

This is an excellent and practical book describing all the techniques necessary for implementing a sheep or goat artificial insemination programme. Detailed methods of collection, handling and processing of semen are given, as well as descriptions of the various methods to control oestrus and ovulation and of insemination of females. Recent advances in the freezing of goat semen and laparoscopic insemination techniques of sheep are covered. The basic anatomy and physiology of reproduction of the two species are dealt with.

The book is eminently suitable for veterinarians, animal scientists and managers of small ruminant breeding flocks in the tropics and subtropics. Although the book deals with advanced technology, its simple style and clear illustrations make it easy to understand and follow as a field-manual.

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