Comparative Analysis of Partial Suckling and Artificial Dairy Kid Rearing Systems

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Abstract

Forty kids aged 1 – 1.5 months and weighing 2.5 – 8 kg were randomly allocated to two treatments; treatment 1 (Bucket feeding system, BFS) and treatment 2 (partial suckling system, PSS). One half (10 males, 10 females) was allocated to BFS and the other half to PSS. Breed composition of the experimental animal was 20 kids Norwegian x local crosses and 20 Galla goats. The BFS does were milked twice per day (06:30 h and 16:30 h) while PSS does were milked only once per day (16:30 h). Milk yield and surplus (marketable) milk were measured daily for 9 weeks of lactation and kids were weighed weekly during the same period. BFS does produced significantly (P<0.05) higher milk yield (414.96 ± 13.48 g/day) than PSS does (179.23 ± 84.24 g/day. Considering surplus milk, PSS does produced significantly (P<0.05) higher than BFS does which could not even produce enough to feed their kids. The study also showed that crossbred does gave significantly (P<0.01) higher daily milk yield and surplus milk in each treatment compared with Galla does. The kids under PSS had a significantly (P<0.01) better growth rate (42.34 ± 5.46 g/day) than BFS kids (3.92 ± 8.02 g/day) and crossbred kids grew significantly (P<0.05) better (40.09 ± 6.63 g/day) than Galla kids (6.17 ± 7.09g/day). The Gross Margin Analysis (GMA) showed that PSS has a higher gross margin (Shs. 46, 024.9) than BFS (Shs. – 153,825.20). It was concluded that PSS is a better system in terms of surplus (marketable) milk and growth of kids compared with BFS.

Key words: *Bucket feeding, partial suckling, goat kids*

Introduction

Tanzania's goat population is estimated at 8.6 million (MoA, 1994). Out of these approximately 1,500 are dairy goats (Mtenga and Kifaro, 1993). Most goats are indigenous mainly kept for meat production. From a three way crossing of Kamorai (55%), Boer (30%) and indigenous goats (15%) blended goats were developed for dairy production (Das, 1989). Madsen *et al.* (1990) reported a successful introduction of Norwegian Landrace x upgraded Tanzanian dairy goats into rural areas in Morogoro region (Mgeta Division) where the climate is sub-tropical and feed resources are adequate.

In all places where dairy goats have been introduced, it has been apparent that proper management packages for efficient productivity and sustainable progress are lacking.

This has led to low levels of production and high mortality rates. One of the important aspects of management in dairy goat production is kid rearing. The system of kid rearing should be that which ensures kid survival and subsequent sufficient performance. This considers avoidance or reduction of infection risks, providing adequate nutrition and lessening exposure to various hazards. On the other hand, the system should provide for adequate availability of milk, both for home use as well as for sale. It should also be as much as possible less labour demanding.

The methods commonly practiced in kid rearing in most dairy farms are bucket feeding and partial suckling. There have been little efforts to evaluate the performance of goats in terms of kid survival and growth rates including marketable milk obtained when either of the two systems is practiced. The present study was set to establish which of the systems (bucket feeding or partial suckling) would be more economical in terms of kid growth and surplus milk (available for consumption or sale) given similar resources.

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Materials and Methods

The study site

The experiment was conducted at Magadu dairy farm, which is an experimental farm for the Department of Animal Science and Production (DASP) at Sokoine University of Agriculture. The farm is situated 600 m above sea level with a tropical, semi arid climate and an average daily minimum and maximum temperatures of 19.4 and 30.2°C respectively (Madsen *et al.*, 1990). The dry season runs from July to November while short rains usually fall in November to December and long rains from February to June.

Experimental animals and set up of experiment

Forty kids (20female, 20male) aged 1 – 1 ½ months and weighing 2.5 – 8 kg were used in the experiment. Half of the kids were of Galla breed and the other half was a cross of Norwegian x local. Half of the kids (10female, 10male) were randomly selected and assigned to bucket feeding system (BFS) and the other half were assigned to partial suckling system (PSS).

Similarly, 32 does from the two breeds were divided into two groups and each group assigned to each of the two rearing systems. The does whose kids were partially suckled were allowed to stay with their kids in a pen for the whole night. They were separated from their kids during the day and milked once per day (in the evening, 16:30 h). Their kids were therefore allowed to suckle the whole night with no milk feeding during the day. The does whose kids were bucket fed were never joined to their kids at all and were milked twice per day, morning (6:30 h) and evening (16:30 h). The kids were fed lukewarm milk (36 - 40°C) at 10% body weight per day in two meals, in the morning (7:00 h) and evening (17:00 h). Concentrates were given to all kids at a rate of 300 g/kid/day supplied around noon. The kids were allowed to graze between 8:00 h and 11:0h daily.

All the does were put to graze immediately after morning milking (8:00 h) to noon (12:00 h), then rested and provided with drinking water for 2 hours and then put back to grazing in the afternoon (14:00 h) till evening milking (16:30 h) daily. During milking, each doe was supplied with 400 g of concentrate. As a result, PSS animals received 400 g per doe per day while the BFS ones received 800 g per doe per day since the former were milked once and the latter were milked twice per day. All animals were dewormed before the experiment. They were then familiarized to the two feeding (rearing) systems for the first seven days before the data collection period.

Data collection

The kids were weighed at the beginning of experiment and thereafter weighed weekly using a weighing balance. Milk yield for the two groups of goats was recorded daily throughout the experimental period. Surplus milk from the BFS group was computed as daily yield less milk fed to the kid per doe, whereas for the PSS the yield per doe (evening milking) was considered marketable surplus.

Price per litre of milk and price per kilogram of live weight of weaned young goat, waged labour cost, feed cost and treatment cost were collected from the sales record book. This information was used to analyze the economics of the two systems.

Data analysis

Data on growth of kids, milk yield and surplus milk produced by dams under different rearing systems were analyzed using GLM procedure of SAS (1988) assuming the following model.

For kid growth:

$$Y_{ijkl} = \mu + B_i + S_i + T_k + (BS)_{ij} + (BT)_{ik} + (ST)_{jk} + (BST)_{ijk} + e_{ijkl}$$

Where:

Y_{ijkl} = kid's growth rate observed on the i^{th} kid in the k^{th} treatment, j^{th} sex and i^{th} breed.
μ = Overall mean effect
B_i = Effect of the i^{th} breed
S_j = Effect of the j^{th} sex
T_k = Effect of k^{th} treatment
$(BS)_{ij}$ = Effect of breed - sex interaction
$(BT)_{ik}$ = Effect of breed - Treatment interaction
$(ST)_{ik}$ = Effect of sex - Treatment interaction
$(BST)_{ijk}$ = Effect of breed - sex - treatment interaction
(e_{ijkl}) = Random error effect

For milk yield: $Y_{ijk} = \mu + B_i + T_j + (BT)_{ij} + E_{ijk}$

Where:
Y_{ijk} = Yield observed on the k^{th} animal in the i^{th} breed and j^{th} treatment.
μ = Overall mean
B_i = Effect of the i^{th} breed
T_j = Effect of the j^{th} treatment
$(BT)_{ij}$ = Effect of Breed - Treatment interaction
e_{ijk} = Random error effect

The economics of the two systems were compared using Gross Margin Analysis based on the following function:
GM = GR – TVC

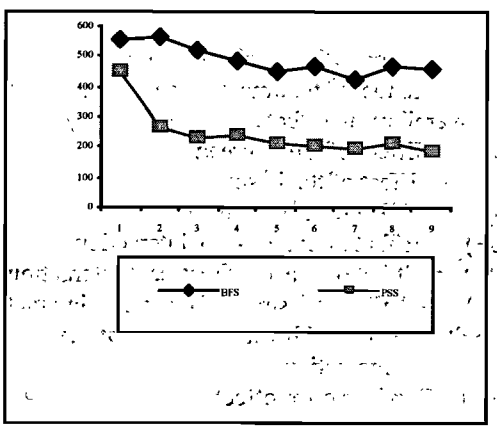
Whereby:
GM = Gross margin
GR = Gross revenue
TVC = Total variable costs.

Revenues were derived from sales of milk and live goats (Weaner kids), whereas total variable costs were on concentrates, labour and disease/parasite treatments.

Results

Effects of treatments and breed on milk yield and surplus milk

The yield of milk was consistently higher for the group on bucket feeding system compared with that on partial suckling system (Figure 1). As it could be expected, the yield declined over time. The mean milk yield of the BFS group was significantly (P<0.01) higher than that of the PSS group.



BFS = Bucket feeding system; PSS = Partial suckling system

Fig. 1: Pattern of daily milk yield for the two treatment Groups

Results in table 1 show that surplus or marketable milk was significantly (P<0.01) influenced by treatments (-156.5 ± 13.4 and 179.2 ± 84.0 for BFS and PSS, respectively). It was also influenced by breed (-126.5 ± 84.0 and 149.2 ± 13.5 for Galla and Norwegian-Tanzania crosses, respectively, Table 2).

Table 1: LS means of milk yield and surplus milk (g ± s.e.) for the two treatments

	BFS	PSS
DMY[1]	414.96 ± 13.48[a]	179.23 ± 84.24[b]
WMY[2]	2725.38 ± 91.86[a]	1174.43 ± 574.29[b]
SMY[3]	-156.52 ± 13.44[a]	179.23 ± 84.01[b]

[1]Daily milk yield, [2]Weekly milk yield, [3]Surplus milk yield

Least square means of weekly milk yield (WMY), daily milk yield (DMY) and surplus milk yield (SMY) for the two breeds (Table 2) show that crosses (Norwegian x Tanzanian) gave significantly (P<0.01) higher WMY, DMY and SMY than the Galla goats.

Table 2: LS means of milk yield and surplus milk (g ± s.e.) by he two goat breeds

	Galla	Norwegian X Tanzania
DMY[1]	159 ± 84.2[a]	435.2 ± 13.6[b]
WMY[2]	1035.9 ± 574.2[a]	2863.9 ± 92.5[b]
SMY[3]	-126.5 ± 84[a]	149.2 ± 13.5[b]

[1]Daily milk yield, [2]Weekly milk yield, [3]Surplus milk yield

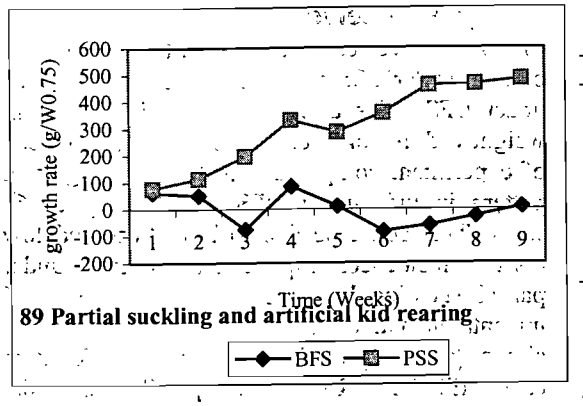
Table 3: LS Means of daily weight changes for the two treatments

Treatments	Daily weight changes g/day±se	$G/W^{0.75}$±se
BFS[1]	3.92±8.02[a]	61.68±55.69[a]
PSS[2]	42.34±5.46[b]	338.43±37.74[b]

[1]Bucket feeding system, [2]Partial suckling system

Effects of treatments and sex of kids on growth performance

Kids on partial suckling grew consistently faster than those on bucket feeding (Figure 2) and the mean growth for the former was significantly (P<0.01) higher (42.34 g/day, 338.43 $g/W^{0.75}$) than that of the latter (3.92 g/day, 61.68 $g/W^{0.75}$). In both breeds, i.e. Galla and Norwegian X Tanzania crosses, males grew significantly higher than females (Table 4).



BFS = Bucket feeding system; PSS = Partial suckling sytem

Fig. 2: Mean growth rates of kids

Table 4: LS mean kid growth rates of the two sexes of two breeds

	Galla	N XT crosses
	$g/W^{0.75} \pm$ s.e	
Males	90.17 ± 58.04	611.72 ± 70.64
Females	3.88 ± 0.44	94.45 ± 57.80

Economics of the systems

Calculations of Gross Margin (GM) for the two kid rearing systems revealed that for BFS the margin was negative (Tshs – 153,825.20) while that of PSS was substantially positive (Tshs. 46,024.90). Table 5 presents the contributions to the revenue made by various items while Table 6 shows the contributions of various items to costs.

Contribution of feeds to total variable costs (TVC) in BFS was higher than that of labour and disease treatment. Moreover, this contribution of feeds in BFS (54.2%) had a higher cost (TShs 88,783.20) compared with the cost of feeds in PSS (TShs 59,525.10). This was due to the fact that more supplementation of concentrate/feeds was done in BFS, since concentrate feeding was done at milking, BFS animals being milked twice per day. The labour required to look after the does was similar in both BFS and PSS, hence not included in the calculations of GMs. Only labour required for feeding the kids in the BFS group was considered.

Table 5: Contribution of various items to gross revenue

Item	Contributed revenue			
	BFS[1]		PSS[2]	
	Tshs	%	Tshs	%
Surplus milk	-37,052,00	-372.5	42,300.00	40
Weaned kids	47,000.00	472.5	63,000.00	60
Total	9,948.00	100	105,300.00	100

[1]Bucket feeding, [2]Partial suckling

Table 6: Contributions of variable inputs to total variable cost (TVC)

Item	Contributed cost			
	BFS		PSS	
	TSh	%	Tsh	%
Concentrates	88,783.20	54.2	59,525.10	100
Labour	72,275.00	44.1	-	-
Treatments	2,715.00	1.7	-	-
Total	9,948.00	100	105,300.00	100

Discussion

Health status and kids mortality rate

It was observed that bucket fed kids had more health problems such as worm infestations (4 kids died of helminthiasis) and pneumonia than partially suckled kids. Diarrhoea was also a common problem in the bucket – fed group. The possible reasons for this diarrhoea could be poor hygiene and incorrect milk temperature. As suggested by Troccon (1985), cited by Havrevoll (1988), in order to avoid digestive upsets in goat kids the artificially fed milk should be provided in adequate amounts and correct temperature and clean hygienic conditions.

Overall mortality rate was about 12.5% and was evenly distributed between sexes. The figure is within the inevitably acceptable loss of 20% under extensive management suggested by Devendra and McLeroy (1987). However, the mortality rate in the present study was lower than the 44.5% reported by Eik *et al.* (1988) and 14.3% reported by Rutakulemberwa *et al.* (1990) for dairy goats at Magadu research unit. The probable reason for low mortality in the present study could partly be due to the currently improved disease control program, hygiene and housing system at Magadu. Inclusion of Galla breed in the experiment, which is more resistant to diseases than other dairy breeds, might have contributed to this low mortality rate. Of the 4 kids that died of helminthiasis under BFS, 3 were

crosses (Norwegian-Tanzanian local) while 1 was of a Galla breed.

Milk yield and surplus (marketable) milk

The results from the present study show that does under bucket feeding produce more milk than those under partial suckling but less surplus milk compared with the latter. This is in agreement with the findings by Rutakulemberwa *et al.* (1990). Although the milk yield was higher in bucket feeding system, a large quantity of it was used up in feeding the kids. Similar observations were made by Peris *et al.* (1996) realising residual milk of 11.1 and 9.2% of total milk in suckling and milking groups of goats, respectively. It is also known that with partial suckling, more milk may be produced due to the stimulatory effect on milk secretion system brought about by kids suckling directly from the dams (Ruvuma *et al.*, 1988).

The observed difference in milk yield with respect to breeds in favour of Norwegian crosses was obviously due to the fact that the crosses have higher milk production potential than the Galla goats which are dual purpose. The mean daily milk yield (435.19 g/day) from the crosses was lower than that reported by Moshi (1998) which ranged between 500 to 3500 g/day per doe. Similarly, the surplus milk yield per doe for crosses under PSS (368.10 g/day) and that under BFS (-69.76 g/day) were very low compared to that of Rutakulemberwa *et al.* (1990) for the same crossbred goats. The negative surplus milk in BFS implies that the milk obtained was not even enough for kids' requirements. Another source of milk was necessary to satisfy the kids. There was also a general decrease in weekly milk yield from first week to last week of study. This is in disagreement with observations made by Rutakulemberwa *et al.* (1990) and Terjer (1991). Rutakulemberwa *et al.* (1990) observed increase in milk yield from first week to weaning and Terjer (1991) observed progressive milk increase with maximum yield in the fifth week of lactation. Low and poor concentrate supplementation and poor quality dry pastures due to dry period during the study might have been the reasons for general decrease in weekly milk yields. The findings from this study concur with that of Linzer and Peaker (1971) cited by Gall (1981) that feed quantity and quality fed to lactating does play a major role to quantity and quality of milk produced.

Kid growth performance

The study revealed that the growth performance of kids under PSS was higher than that of kids under BFS. Kids under PSS were increasing in weight with minor fluctuations up to the last week of experiment compared with the zigzag growth pattern in kids under BFS observed up to 6th week. This could be due to low stress and low disease incidences experienced by kids under partial suckling but also due to sufficient and uncontaminated milk suckled by these kids. A similar trend of growth was observed by Ruvuma *et al.* (1984) and Ruvuma *et al.* (1988) for partial suckling kids and Hadjipanoyiotou and Louca (1976) for continuous suckling kids. However, the results do not agree with those of Rutakulemberwa *et al.* (1990) who found no significant difference between BFS and PSS in terms of growth of the kids. The results by Rutakulemberwa *et al.* (1990) might have probably been due to the small number of kids used in the study.

The study generally showed that male kids performed better than female ones in both treatments (systems). This concurs with the study by Hammond *et al.* (1971) who established that males normally grow faster than females. However, the weight gains under the present study were lower than those obtained by Rutakulemberwa *et al.* (1990) for cross breeds (i.e. 104.7 g/day and 90.5 g/day for PSS and BFS, respectively) and by Devendra (1966) cited by Gall (1981). Poor nutrition (low energy and protein) resulting from feeding on poor quality pastures of dry season might have been a reason for low weight gain in the present study.

Economics of the systems

It was observed that rearing goat kids under BFS is more expensive and leads to more economic losses than PSS. This is due to the fact that BFS is time consuming and more labourious than PSS (labour was 44.1% of TVC under BFS). Natural rearing has been advocated to be of distinct advantage in that the labour involved in attending the herd is reduced to a minimum (Wilson *et al.*, 1985).

In the present study, the high cost of concentrates experienced during the study period led to negative gross margin (GM) to BFS and low GM to PSS. It is generally understood that unless concentrate feeds are relatively cheap and justified by increased milk yield, there will always be little profit in feeding concentrates (Devendra

and McLeroy, 1987). Contrary to the recommendation that goat milk's selling price must be approximately twice that of cow's milk for profitable production, the price of goat milk during the present study was the same as cow's milk. Under such circumstances profitability is likely to be very low.

Conclusion

The study showed that partially suckled does (milked once per day) produce significantly more surplus (marketable) milk than the twice a day milked does (with bucket-fed kids). Further the study revealed that the system positively influenced surplus milk, kid survival and growth rate. The system (PSS) generated more income through milk and live goat sales than the other. It should also be noted that this system requires less labour input than artificial rearing hence making it more economical. It is therefore proper to recommend a partial suckling system in raising goat kids.

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