Research Application Summary

Development of management practices for sustainable improvement of dairy goat productivity in Tanzania

Chenyambuga, S.W.[1], Komwihangilo, D.M.[2], Ndemanisho, E.E.[1], Mary Jackson[1] & Damas Msaki, T.[1]
[1]Department of Animal Science and Production, Sokoine University of Agriculture, P. O. Box 3004, Morogoro, Tanzania
[2]National Livestock Production Research Institute, P. O. Box 202, Mpwapwa, Tanzania
Corresponding author: chenyasw@yahoo.com; chenya@suanet.ac.tz

Abstract

This study was carried out to evaluate the performance of dairy goats introduced in rural areas of Babati and Kongwa districts, Tanzania. In addition, the study was aimed at developing good quality and cheap supplementary feed rations based on locally available feed resources for use by small-scale goat farmers. The diets tested were based on sunflower seed cakes (SFSC), *Melia azedarach* leaf meal (MLM) and *Ficus* spp leaf meal (FLM) as protein sources. These diets were fed to does for 90 days and their effect on milk production and growth performance of growers assessed. The average number of dairy goats per household was 7.45 in Babati and 4.25 in Kongwa. The main breeds kept in the villages were Toggenburg and Saanen. Lactation performance and reproductive performance of the two breeds were not significantly (P=0.05) different. Overall, lactation length, open period and dry period were 5.6, 3.7 and 1.9 months, respectively. Mean lactation milk yield was 254.0 l while average daily milk yield was 1.45 l/day. Age at first kidding and kidding intervals were 13.2 and 9.4 months, respectively. Lactating does supplemented with diets containing SFSC, MLM and FLM as protein sources produced significantly ($P \leq 0.001$) more milk (3.11 – 3.77 l/day and total milk yield of 279.98 – 339.33 l) than those under farmers' practice (1.94 l/day and total yield of 174.99 l). Similarly the weight gain (6.58 – 8.92 kg) and growth rate (72.67 – 119.89 g/day) of growers supplemented with the three diets were significantly higher than those under farmers' practice (56.36 g/day and 5.09 kg mean weight gain). It is concluded that the performance of Toggenburg and Saanen under village conditions is not significantly different, implying that both breeds can be used for milk production in rural areas. Supplementation of the dairy goats with diets containing SFSC and MLM significantly improved the growth performance and milk production of dairy goats in rural.

Key words: Feed rations, improved goat breeds, lactation performance, reproductive performance, supplementation

Résumé

Cette étude a été réalisée pour évaluer la performance des chèvres laitières introduites dans les zones rurales des districts de Babati et de Kongwa, en Tanzanie. En outre, l'étude visait à développer des rations alimentaires supplémentaires de bonne qualité et bon marché en fonction des ressources alimentaires localement disponibles pour l'utilisation par les petits éleveurs des chèvres. Les régimes alimentaires testés étaient basés sur des gâteaux de graines de tournesol (SFSC), la farine de feuilles de *Meliaazedarach* (MLM) et la farine de feuilles de *Ficus* spp (FLM) comme sources de protéines. Ces régimes alimentaires ont nourri les daines pour 90 jours et leur effet sur la production laitière et les performances de croissance des producteurs ont été évalués. Le nombre moyen de chèvres laitières par ménage était de 7,45 à Babati et 4,25 à Kongwa. Les principales races élevées dans les villages étaient Toggenburg et Saanen. La performance de lactation et celle de reproduction des deux races n'étaient pas significativement différentes (P = 0,05). Dans l'ensemble, la durée de lactation, la période d'ouverture et la période sèche étaient de 5,6, 3,7 et 1,9 mois, respectivement. Le rendement moyen de lait de lactation était 254,0 l alors que la moyenne de la production laitière journalière était de 1,45 l / jour. L'âge à la première mise-bas et des intervalles de mise-bas étaient 13,2 et 9,4 mois, respectivement. Les daines de lactation ayant des rations alimentaires supplémentaires contenant SFSC, MLM et FLM comme sources de protéines ont produit de façon significative (P d" 0,001) plus de lait (3,11 à 3,77 l / jour et une production laitière totale de 279,98 à 339,33 l) que celles sous la pratique des agriculteurs (1,94 l / jour et une production laitière totale de 174,99 l). De même, le gain de poids (6,58 à 8,92 kg) et le taux de croissance (de 72,67 à 119,89 g / jour) des producteurs avec comme suppléments les trois régimes alimentaires, étaient significativement plus élevés que ceux sous la pratique des agriculteurs (56,36 g / jour et 5,09 kg comme gain de poids moyen). Il est conclu que la performance du Toggenbourg et du Saanen dans les conditions du village n'est pas significativement différente ; ce qui implique que les deux races peuvent être utilisées pour la production du lait dans les zones rurales. La supplémentation des chèvres laitières avec des régimes alimentaires contenant SFSC et MLM a considérablement amélioré la performance de croissance et de la production de lait de chèvres laitières dans les régions rurales.

Mots clés: Races de chèvres améliorées, performance de lactation, performance de reproduction, rations alimentaires, supplémentation

Background

Goat keeping is important in smallholder agriculture in Tanzania, and is mainly based on local breeds. Local goat breeds have low growth rates of 5-7 g/day (Payne, 1990), small mature size of 20-25 kg (NEI, 1999) and low carcass weights (6 to 13 kg) (Chenyambuga *et al*., 2004). They also have low milk production potentials such that they seldomly reach milk production levels beyond the needs of their kids. Improvement of the genetic potential of the local breeds through crossbreeding has been shown to result in animals that can give reasonable returns for the money spent in raising them. Crossbred goats have high growth rates, are bigger in size and have better reproductive performance. Consequently, goat improvement strategies have been based on the introduction of improved breeds or their crosses. The distribution of these breeds has been carried haphazardly without taking into consideration the environmental conditions in rural areas.

Another problem facing goat keeping in Tanzania is poor nutrition. The improved goat breeds usually depend on natural pasture from communal grasslands for their food throughout the year. These pastures are limited both in quantity and quality, particularly during the dry season (Doto *et al*., 2004) resulting in growth fluctuations. The aim of this study was to develop good quality feed rations using locally available feed resources as supplementary diets for lactating does and growing goats.

Literature Summary

Goats have a potential to contribute to poverty alleviation and household food security in sub-Saharan Africa (Winrock International, 1992). In Tanzania, most goat breed (98%) are indigenous, mostly raised by agro-pastoralists and pastoralists in semi-arid environments. The indigenous goats are of low genetic potential in terms of traits of economic importance (growth rates, mature size and milk production) (Payne, 1990; NEI, 1999). Consequently development strategies for improvement of goat productivity depend on improved pure exotic breeds or their crosses. . Exotic breeds and their crosses have high production potential of milk (Eik *et al*., 1985), high growth rates and better reproductive performance (Das and Sendalo, 1991).

One of the problems facing the livestock industry in Tanzania is low productivity. Poor nutrition in terms of low energy, protein and mineral intake is the main cause of low productivity of goats. Feeding of goats in Tanzania is based on natural pastures, standing hay and crop residues. These are of low nutritive value

and animals reared on these feeds have problems meeting even their maintenance needs (Komwihangilo *et al*., 2005a). Since supplies of commercial concentrates and agro-industrial by-products are limited and expensive, other supplements with high protein and/or mineral contents and locally available have to be sought. Leguminous tree leaves can be appropriate alternative protein and energy sources to conventional oil cakes. These are mainly multipurpose trees like *Leucaena leucocephala* leaf meal (Ndemanisho *et al*., 1998) and *Moringa oleifera* leaf meal (Sarwatt *et al*., 2002). However, due to agronomic requirements and climatic differences in various locations of the tropics, Leucaena or Moringa trees are not widely distributed. Komwihangilo *et al*. (2005b), Ntakwendela *et al.* (2002) and have shown that indigenous trees and shrubs could be used to replace conventional oil cakes**.**

Study Description

The study was carried out in Babati and Kongwa districts located in the semi-arid areas of central Tanzania. In each district four villages with pure exotic dairy breeds or their crosses were selected for the study. In Babati district the villages selected were Gijedaboshka, Haraa, Gijedabung and Himiti. In Kongwa districts the villages selected were Mlanga, Ibwaga, Sagara and Mkoka.

A household survey was conducted between August and September 2011 to collection information from small scale dairy goat farmers. In each village 10 farmers were randomly selected making a sample size of 40 per district. The information was collected through a structured questionnaire after pretesting. Data were collected on demographic variables, breeds kept, goat feeds and feeding practices, health management, breeding practices, lactation performance, reproductive performance and challenges faced by farmers. The profitability of dairy goat enterprise in the study area is presented in a study byJackson *et al*. (these proceedings).

Commonly used feed resources for goats were determined and representative samples collected from each village. These were taken for chemical composition (AOAC, 1990) in a laboratory at Sokoine University of Agriculture. Three diets were formulated: the first was based on sunflower seed cakes (SFSC) as a source of protein while the second and third diets were based on *Melia azedarach* leaf meal (MLM) and *Ficus spp* leaf meal (FLM), respectively, as protein sources. These diets were fed to dairy goats in two feeding trials in the research

villages, each for 90 days. The first trial evaluated the effects of these diets on growth rate of the growers (weaned kids) while the second trial assessed diet effects s on milk yield of lactating does. The three diets were evaluated against the farmers' practice. In the trial, Eight growing goats and six lactating does were randomly allocated to each treatment in the first and second trials, respectively. Details of this experiment are given in a study by Msaki *et al*. (these proceedings).

Research Application

This study assessed the management practices, reproductive performance and lactation performance of dairy goats (pure exotic breeds and their crosses) kept in rural areas in order to identify and recommend appropriate genotypes to small-scale farmers in semi-arid environments. Three breeds of dairy goats were identified in these villages: Toggenburg, Saanen and Anglo-Nubian. These were introduced in the area by development agencies and NGOs. Mean (± se) number of dairy goats per household was 7.45 ± 1.01 in Babati and 4.25 ± 0.37 in Kongwa. The main reasons for keeping dairy goats were milk production (98.8%), income generation (93.3%) and provision of manure (77.5%). Dairy goats contributed 32.1 and 27.7% of household income in Babati and Kongwa districts, respectively.

Table 1 shows the management practices in the study area. The main goat management system was zero grazing (cut and carry system) with most farmers (92.5%) keeping goats in raised slated houses. The basal diet for dairy goats was mainly grasses from natural pastures, supplemented with maize bran, sunflower seed cake, crop residues and tree/shrub leaves. The majority (70%) of the farmers provide drinking water to their goats once per day. With regard to breeding, the majority (68.8%) of the farmers used bucks provided by development/research projects for mating with their does. Some farmers (20%) reported that they select breeding bucks based on the performance of the dams of the bucks, although majority (41.3%) depended on project decisions.

The reproductive and Lactation performance of Toggenburg and Saanen breeds did not differ significantly ($P = 0.05$) for daily milk yield and lactation milk yield between breeds (Table 2). However, lactation milk yield of Saanen was slightly higher than that of Toggenburg by 25.21 litres. Both daily milk yield and lactation milk yield were not significantly affected by birth type but were significantly ($P \leq 0.001$) influenced by blood level. In both breeds lactation milk yield increased with increase in

Table 1. Management practices for dairy goats in the study areas.

Variable	Levels	Frequency	Percentage
Type of house	Raised floor	74	92.5
	Normal ground floor	6	7.5
Feeding system	Zero grazing	77	96.3
	Tethering	2	2.5
	Free grazing	1	1.3
Supplementary feeds	Maize bran	18	22.5
	Maize bran and sunflower seed cake	17	21.25
	Crop residues	15	18.75
	Tree/shrub leaves	30	37.5
Frequency of watering	Once per day	56	70
	Twice per day	12	15
	Ad-libitum	10	12.5
	Once per two days	1	1.3
	Thrice per day	1	1.3
Source of breeding buck	Hired	11	13.8
	Project	55	68.8
	Own	14	17.5
Criteria for selecting breeding bucks	Dam performance	28	35
	Shape/conformation	16	20
	Size	3	3.75
	Colour	1	1.25
	Project decision	33	41.25

the level of exotic blood. Does of pure breeds produced more milk (392.44 litres) than those with 75% (207.22 litres) and 50% exotic blood levels (157.77 litres). Results showed that age at first kidding, kidding interval, lactation length, open period and dry period did not differ significantly (P = 0.05) between breeds, birth type and blood levels. Overall the lactation length was 5.6 months while the open period and dry period were 3.7 and 1.9 months, respectively. On average, goats kidded for the first time at the age of 13.2 months and had a kidding interval of 9.4 months.

Table 3 compares the effects of supplementing a diet containing sunflower seed cakes (SFSC) and diets containing *Melia azedarach* leaf meal (MLM) and *Ficus spp* leaf meal (FLM) as protein sources. The results show that lactating does which were supplemented with the three diets had significantly ($P \leq 0.001$) higher average daily milk yield (3.19 - 3.62 litres/day) and total milk yield (286.78 - 325.81 litres) than the control

Table 2. Least squares means ± se for lactation and reproductive performances of Toggernburg and Saanen breeds in Kongwa district.

Variable	Factor	Levels	Toggenburg	Saanen
Daily milk yield (litre/day)	Blood level	50	0.90 ± 0.10 [a]	1.00 ±0.16[a]
		75	1.22 ± 0.07[a]	1.40 ± 0.16[a]
		100	1.98±0.17[a]	2.18±0.05[a]
	Type of birth	Single	1.38±0.08[a]	1.43±0.10[a]
		Multiple	1.36± 0.10[a]	1.62± 0.09[a]
Overall			1.37 ± 0.07[a]	1.53 ± 0.07[a]
Total lactation milk yield (litre)	Blood level	50	155.69± 25.96[a]	165.00± 40.75[a]
		75	206.83 ± 19.28[a]	235.34 ± 43.20[a]
		100	361.51 ±43.63[a]	399.41 ± 15.17[a]
	Type of birth	Single	239.83 ±20.41[a]	254.43± 26.18[a]
		Multiple	242.85 ±26.67[a]	278.74 ±22.88[a]
Overall			241.37 ± 17.93[a]	266.58 ± 19.96[a]
Lactation length (months)	Blood level	50	5.84±0.34[a]	5.50±0.53[a]
		75	5.53±0.25[a]	5.63±0.56[a]
		100	4.93±0.43[a]	6.06±0.19[b]
	Type of birth	Single	5.63±0.26[a]	5.86±0.34[a]
		Multiple	5.23±0.28[a]	5.59±0.29[a]
Overall			5.44 ±0.20	5.73±0.26
Dry period (months)	Blood level	50	1.79±0.24[a]	2.00±0.37[a]
		75	2.22±0.17[a]	2.47±0.39[a]
		100	2.34±0.31[a]	1.77±0.14[a]
	Type of birth	Single	2.07±0.18[a]	2.06±0.24[a]
		Multiple	2.16 ± 0.20[a]	2.11 ± 0.21[a]
Overall			1.86±0.11[a]	2.0±0.11[a]
Open period	Blood level	50	108.34±9.79	105.00±15.39
		75	109.81±7.28	115.84±16.33
		100	119.43±12.70	112.01±5.73
	Type of birth	Single	114.34±7.64	121.79±9.89
		Multiple	110.82±8.24	100.11±8.65
Overall			112.53±5.84	110.95±7.54
Age at first kidding (months)	Blood level	50	11.98±0.57[a]	14.00±0.90[a]
		75	13.11±0.44[a]	12.88±0.98[a]
		100	14.02±0.74[a]	13.45±0.33[a]
	Type of birth	Single	12.97±0.44[a]	13.33±0.57[a]
		Multiple	13.11±0.48[a]	13.56±0.51[a]
Overall			13.04±0.34[a]	13.44±0.44[a]
Kidding interval (months)	Blood level	50	8.43±0.45[a]	9.50±0.72[a]
		75	9.54±0.33[a]	9.83±0.76[a]
		100	9.62±0.59[a]	9.30±0.26[a]
	Type of birth	Single	9.32±0.35[a]	9.38±0.46[a]
		Multiple	9.06±0.38[a]	9.71±0.40[a]
Overall			9.19±0.27[a]	9.54±0.35[a]

Table 3. Effects of supplementing diets containing sunflower seed cake and indigenous tree leaf meal as sources of protein on milk yield of lactating does and growth performance of weaned kids of Saanen and Toggenburg breeds.

Parameter	Factor		Saanen	Toggerburg
Average milk yield (litre/day)	Diet	Control	1.94±0.26[a]	1.24±0.13[b]
		FLM	3.19±0.15[a]	3.00±0.15[a]
		MLM	3.54±0.12[a]	2.56±0.26[b]
		SFSC	3.62±0.15[a]	3.53±0.18[b]
Overall			3.07±0.08[a]	2.58±0.09[b]
Total milk yield (litre)	Diet	Control	174.99±23.11[a]	111.59±11.83[b]
		FLM	286.78±13.39[a]	270.17±13.29[a]
		MLM	318.86±10.54[a]	230.42±23.37[b]
		SFSC	325.81±13.09[a]	317.92±16.29[a]
Overall			276.61±8.01[a]	232.52±8.60[b]
Body weight gain (kg)	Sex	Male	5.88±0.84a	8.35±0.63a
		Female	8.59±0.57a	8.23±0.81a
	Diet	Control	4.64±1.32a	5.54±0.75a
		FLM	6.58±0.87a	7.68±0.89a
		MLM	8.79±0.87a	9.09±0.89a
		SFSC	8.92±0.85a	10.84±1.32a
Overall			7.23±0.51a	8.29±0.49a
Average daily gain (g/day)	Sex	Male	64.99±9.39a	92.19±7.08a
		Female	94.95±6.40a	91.25±9.06a
	Diet	Control	51.51±14.77a	61.21±8.32a
		FLM	72.67±9.77a	84.98±9.95a
		MLM	96.92±9.70a	100.80±9.99a
		SFSC	98.78±9.55a	119.89±14.71a
Overall			79.97±5.65a	91.72±5.55a

animals (1.94 litre/day and.174.99 litres). Among the supplementary diets, the highest average daily milk yield (3.77 litres/day) and total milk yield (339.33 litres) were observed on the does supplemented with a diet containing SFSC, followed by those on the diet containing MLM (3.38 litres/day and total yield of 304.50 litres) and FLM (3.11 litres/day and total yield of 279.98 litres). Similarly the weight gain (6.58 – 8.92 kg) and growth rate (72.67 – 119.89 g/day) of weaned kids supplemented with the three diets were significantly higher than those under farmers' practice (the control group) (56.36 g/day average growth rate and 5.09 kg mean weight gain). The mean growth rate (109.34 d/day) and weight gain (9.88 kg) of weaned kids supplemented with the diet containing SFSC was higher than that of kids supplemented with diets containing MLM and FLM as sources of protein.

In conclusion the study has shown that the performance of Toggenburg and Saanen under village conditions is not significantly different, implying that both breeds can be used for milk production in rural areas. The study further revealed that dairy goats raised in rural areas are kept under zero grazing system and depend on natural pastures and are rarely supplemented with concentrate diets. Consequently their milk production levels are low. Supplementation of the dairy goats with diets containing SFSC, MLM and FLM significantly improved the growth performance and milk production of dairy goats. Interestingly, the weight gain, growth rate and milk production observed on dairy goats fed MLM based diet was not significantly different from that of goats supplemented with sunflower seed cake, indicating that MLM can be used as protein source in goat diets to replace oil cakes.

Recommendation

The use of *Melia azedarach* leaf meal as source of protein in place of expensive oil cakes should be promoted. This will lower the feed costs and make dairy goat production in rural areas more economical. There is also need to train dairy goat farmers in rural areas develop feeding strategies for dairy goats using locally available feed resources and also to on feed formulations.

Acknowledgement

This study was financed by the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM). The authors acknowledge the cooperation and assistance rendered by farmers and Extension Officers in the study villages.

References

AOAC.1990. Official methods of analysis. 4th Edition. Association of OffcialOfficial Analytical Chemists. Washington D.C.

Chenyambuga, S.W., Mtenga L.A. and Kifaro, G.C. 2004. Carcass characteristics of indigenous goats in Tanzania: A review. In: *Proceedings of the 31st Scientific Conference of Tanzanian Society of Animal Production* 31: 202- 211

Das S.M. and Sendalo, D.S.C. 1991. Small Ruminant Research Highlights in Tanzania. Ministry of Agriculture, Livestock Development and Cooperatives, Daar es Salaam, Tanzania. 40pp..

Doto, S.P., Weisbjerg, M.R., Hvelplund, T., Kimambo, A.E., Mgheni, D.M., Mtenga, L.A., Laswai, G.H., Madsen, J. and Petersen, P.H. 2004.The Tanzania Feedstuff Table for Ruminants. In: *Proceedings of the 31st Scientific*

Coference of Tanzanian Society of Animal Production, 31:46 -50

Eik, L.O.,Mtenga, L.A. and Olsen, O.H.E. 1985. Preliminary results on some economic traits in Norwegian and Tanzanian x Saanen goats. *TSAP conference series* 12:129 -142.

Komwihangilo, D.M., Chenyambuga, S.W., Temu, V.W. and Mushi, D. 2005a. Developments and challenges for sustainable productivity of goats in mixed production systems of East Africa. *Annals of Arid Zone* 44(3/4):297-314.

Komwihangilo, D.M., Chenyambuga, S.W., Lekule, F.P., Mtenga, L.A. and Muhikambele, V.R.M. 2005b). Comparison of indigenous browses and sunflower seed cake supplementations on intake and growth performance of dual-purpose goats fed Buffel grass (*Cenchrus ciliaris*) hay. *Asian-Australasian Journal of Animal Sciences* 18(7): 966 - 972.

Ndemanisho, E.E., Mtenga, L.A., Kimbi, E.F.C., Kimambo, A.E. and Mtengeti, E.J. 1998. Substitution of dry *Leucaena leucocephala* (DLL) leaves for cotton seed cake (CSC) as a protein supplement to urea treated maize stover fed to dairy weaner goats. *Animal Feed Science and technology* 73:365 - 374.

Netherlands Economic Institute (NEI). 1999. Tanzania livestock sub-sector study – Final Report. Agricultural Economics and Rural Development Division, Rotterdam, November 1999. 122pp.

Ntakwendela, L., Mtenga, L.A., Pereka, A.E, Chenyambuga S.W., Laswai, G., Kimambo, A.E. and Muhikambele, V.R.M. 2002. Effects of substituting sunflower seed cake with *Acacia tortilis* pods as protein source in supplementary diets of Small East African goats. *Tanzania Journal of Agricultural Sciences* 5:39-48

Payne, W.A.J. 1990. An introduction to animal husbandry in the tropics. 4th Ed. Longman Scientific and technical.

Sarwatt, S.V., Kapange, S.S. and Kakengi, A.M.V. 2002. Substituting sunflower seed-cake with *Moringa oleifera* leaves as a supplemental goat feed in Tanzania. *Agroforestry Systems* 56:241 -247.

Winrock International, 1992. Assessment of animal agriculture in sub-Saharan Africa. Winrock International Institute for Agricultural Development, Arkansas, USA. 125pp.