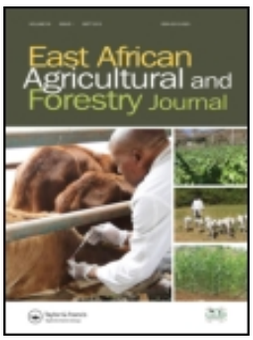

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Comparison of Production Performance and Tolerance to Helminthosis of Toggenburg and Norwegian Crossbred Goats Under Smallholder Production Systems in Tanzania

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ABSTRACT

This study was carried out to compare the growth rate, lactation performance and tolerance to gastrointestinal nematode infection of Toggenburg and Norwegian breeds in Kongwa district, Tanzania with a semi-arid environment and Mvomero district with a sub-humid environment. Milk production of does, nematode eggs per gramme of faeces (EPG) and packed cell volume (PCV) were recorded for one year in 57 Toggenburg crosses and 72 Norwegian crosses raised by 107 small-scale farmers in the two districts. Kid body weights and mortality were recorded for 65 kids. Kid birth weights of Norwegian crosses (3.07 ± 0.13 kg) and Toggenburg crosses (2.91 ± 0.14) were not significantly different ($P > 0.05$). The growth rate of Norwegian crossbred kids from birth to one year (54.26 ± 4.33 g/day) was lower than that of Toggenburg crossbreds (61.50 ± 4.38 g/day). Toggenburg crossbred does produced slightly higher average daily milk yield (0.81 ± 0.08 l/day) compared to Norwegian crossbred does (0.64 ± 0.09 l/day). Norwegian crosses had higher mean EPG (211.78 ± 0.02) and lower PCV (23.93 ± 0.96%) than the Toggenburg crosses (129.51 ± 0.02 EPG and 26.71 ± 0.99% PCV). It is concluded that the Toggenburg crosses are relatively better suited to the smallholder production environments in rural areas of Tanzania compared to the Norwegian crosses.

KEYWORDS

Dairy goats; growth rate; milk production; nematode infection

Introduction

Dairy goat production has been adopted as an intervention strategy for poverty reduction and improving the livelihoods of rural poor households in developing countries (Devendra, 2013). In recognition of the importance of dairy goats to poor farming households, the government of Tanzania introduced several dairy goat breeds, namely, Saanen, Alpine, Anglo-Nubian and Toggenburg in the country in the early 1960s (Das and Sendalo, 1991). These goats were imported mainly from Europe and kept in research stations and missionary centres. Smallholder dairy goat production in rural areas started

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to be promoted in the 1980s as one way of mitigating the problem of malnutrition and improving the living conditions of poor families. It was envisaged that helping the rural poor people, especially women, to successfully raise dairy goats can have a very significant impact on their income, social status and even on the local environment (De Vries, 2008). However, the distribution of these breeds to the rural areas did not take into consideration the environmental conditions in these areas to enable the genotype to be matched with the right environment. This study was carried out to assess the growth performance, lactation performance and tolerance to gastrointestinal nematode infection of Toggenburg and Norwegian breeds in Kongwa district with a semi-arid environment and Mvomero district with a sub-humid environment.

Materials and methods

Location of the study

The study was conducted in Masinyeti and Ihanda villages of Kongwa district, Dodoma region and Kunke and Wami-Luhindo villages of Mvomero district, Morogoro region. Kongwa district is located between latitude 5°30′ and 6°0′ south and longitude 36°15′ and 36° east within semi-arid areas and has an annual rainfall ranging from 400 to 800 mm and temperatures that vary from 18 to 34°C. Mvomero district is located in the sub-humid zone and lies between latitudes 8° and 10° south and longitudes 28° and 37° east. The district receives an annual rainfall of 600–2000 mm and has temperatures that range from 18 to 30°C.

Experimental procedure

A total of 29, 28, 21 and 29 small-scale farmers from Kunke, Wami-Luhindo, Ihanda and Masinyeti villages (107 in total) were trained on improved goat husbandry practices, including feeding systems, housing, feeds and feed compounding, breeding, health management and record keeping. After the training, each farmer constructed a raised slated goat house using locally available materials. A total of 72 Norwegian crosses (65 females, 7 males) and 57 Toggenburg crosses (52 females, 5 males) were distributed to the 107 farmers between March and April 2012. In each village, half of the farmers received Norwegian crosses and the other half received Toggenburg crosses. The crossbred goats were crosses of Toggenburg with the Small East African (SEA) goats (75% Toggenburg blood and 25% SEA blood) and Norwegian goats with the SEA goats (75% Norwegian blood and 25% SEA blood).

For each breed, one buck was shared between 10 farmers, each one keeping one female goat. Before distribution to the project farmers, all animals were ear-tagged for identification and screened to determine their health status with regard to gastrointestinal nematode infection. Before the beginning of data collection, all goats were treated with an anthelmintic drug (Ivomec®) to control endoparasites and sprayed with acaricides to control ectoparasites. All goats were kept indoors under zero grazing and managed according to individual farmer's conditions. Each farmer observed heat signs for the female goat: if the animal was found to be in heat it was taken to the buck of the respective breed for mating.

Data collection on kidding, milk production and kid growth

A weighing scale for measuring live body weight, a calibrated cup for measuring milk production and a record card for data recording were distributed to each farmer. Upon kidding, the birth weight of the kid(s) was taken using the weighing scale and daily milk production for each doe was measured using the calibrated cup and recorded after each milking by the farmer. Data on kidding, kid weights at births, monthly weights, kid deaths and daily milk production were routinely collected by each farmer. The research team made monthly visits to the research sites to collect data recorded by farmers on goat kidding, body weight measurement and milk production. Body weights of the offspring were measured at birth and then every month up to 12 months and used for evaluation of growth performance.

Collection of data on gastrointestinal nematode infestation

Gastrointestinal nematode infestation was monitored in all animals from June 2012 to April 2013. During this period, field visits were made by the research team every month and faecal samples were collected from the rectum of each animal. Each faecal sample was placed in a separate polythene bag, labelled and and stored in a cool box and transported within 24 hours to the laboratory at Sokoine University of Agriculture (SUA) where they were stored at 4°C until analysis. The presence of gastrointestinal nematode eggs in faeces was determined using the McMaster counting technique (Hansen and Perry, 1994). The number of eggs counted in the McMaster slide was multiplied by 100 and expressed as nematode eggs per gramme of faeces (EPG). Animals with a medium (500–1000 EPG) to high rate (>1000 EPG) of infestation were treated. In addition to faecal sampling, blood samples from each animal were collected from the jugular vein using 10 ml vacutainer tubes containing ethylenediaminetetraacetic acid (EDTA). Packed cell volume (PCV) and haemoglobin concentration (HB) were determined as complementary tests for nematode infestation.

Results and discussion

Table 1 shows the mean milk production and lactation period for the different breeds in different villages. The average daily milk yield, total milk production and lactation period did not differ ($P > 0.05$) between the breeds, but differed among the villages. On average, the Toggenburg crosses produced 22.26 litres more than the Norwegian crossbred goats, indicating that the Toggenburg goats are superior to the Norwegian goats in terms of milk production. The average daily milk yield observed in the project villages for Toggenburg does is lower than the mean milk yield of 1.7 and 2.2 litre/day reported for Toggenburg goats in Babati, Tanzania (Jackson *et al.*, 2014) and Meru, Kenya (Ahuya *et al.*, 2003), respectively. Similarly, the average daily milk yield of Norwegian does is lower than the mean yield of 1.0 and 0.9 litre/day reported for pure and 75% Norwegian goats, respectively, in Mgeta, Tanzania (Safari *et al.*, 2008). The difference between the current study and previous studies could be due to differences in the ages of the animals, management and environmental conditions. Normally milk production is lower during the first lactation and it increases gradually from the first to the fourth lactations. The goats in the

Table 1. Effect of breed and location on milk production of dairy goats

Factor	Lactation period (days)	Mean daily milk yield (litres/day)	Milk production per lactation period (litres)
Breed			
Norwegian (n = 21)	103.87 ± 11.45^{a}	0.64 ± 0.09^{a}	82.32 ± 11.78^{a}
Toggenburg (n = 25)	104.12 ± 9.55^{a}	0.81 ± 0.08^{a}	104.58 ± 9.83^{a}
$P > F$	0.9865	0.1504	0.1565
Village			
Ihanda (n = 12)	73.08 ± 10.76^{b}	0.50 ± 0.09^{b}	36.1 ± 11.1^{b}
Masinyeti (n =23)	93.23 ± 6.40^{b}	0.66 ± 0.05^{b}	62.9 ± 6.59^{b}
Kunke (n =7)	63.17 ± 16.44^{b}	0.47 ± 0.13^{b}	35.0 ± 16.9^{b}
Wami-Luhindo (n =4)	186.50 ± 21.52^{a}	1.29 ± 0.16^{a}	239.8 ± 22.1^{a}
$P > F$	0.0003	0.0014	0.0001

[a,b] Means with different letters in the same column within the same factor differ significantly ($P \leq 0.05$).

research villages were either in the first or second lactation. It is anticipated that in subsequent lactations, milk production will increase to the levels comparable to those observed elsewhere. Moreover, Meru, Babati and Mgeta are highland areas with cool temperature and adequate rainfall; hence, their climatic conditions could be more favourable for raising dairy goats compared to the semi-arid condition in the research villages.

Lactation length was not different ($P > 0.05$) between Toggenburg and Norwegian crosses. The mean lactation length of 3.5 months observed in the present study is lower than the lactation length of 7.5 months reported by Ahuya *et al.* (2003) in the Toggenburg breed and 10 and 8 months observed by Safari *et al.* (2008), respectively, in Norwegian goats. The difference in lactation length might be due to differences in management, nutrition, genotype (breed purity) and physical environment.

Table 2 shows the growth performance of Toggenburg and Norwegian crossbred kids in the research villages. The results show that among the kids born, 74.7% were born single and 25.3% were twins. The mean birth weight of single kids was not significantly different ($P > 0.05$) from that of twins. Similarly, the overall growth rate of singles was not significantly ($P > 0.05$) different from that of twins. The mean birth weight of Norwegian kids

Table 2. Effect of breed, location, sex and type of birth on growth performance of dairy goats

Factor	Birth weight (kg)	Growth rate to 90 days (g/day)	Growth rate to 180 days (g/day)	Overall growth rate (g/day)
Breed				
Norwegian (n = 33)	3.07 ± 0.13	$114.40^{a} \pm 6.81$	$24.22^{b} \pm 11.55$	54.26 ± 4.33
Toggenburg (n = 32)	2.91 ± 0.14	$89.88^{b} \pm 7.02$	$71.97^{a} \pm 11.71$	61.50 ± 4.38
$P > F$	*0.3753*	*0.0087*	*0.0025*	*0.3088*
Village				
Ihanda (n = 18)	3.00 ± 0.13	97.56 ± 6.94	42.15 ± 12.61	$59.04^{a} \pm 4.16$
Kunke (n = 10)	3.22 ± 0.20	113.70 ± 10.18	7.11 ± 17.94	$43.85^{b} \pm 7.24$
Masinyeti (n = 31)	2.90 ± 0.10	104.38 ± 5.44	74.89 ± 9.58	$70.76^{a} \pm 4.63$
Wami (n = 6)	2.84 ± 0.26	92.94 ± 13.60	68.24 ± 26.44	–
$P > F$	*0.4777*	*0.4885*	*0.0122*	*0.0426*
Sex				
Female (n = 25)	2.95 ± 0.14	$91.16^{b} \pm 7.39$	48.03 ± 12.08	56.05 ± 12.39
Male (n = 40)	3.03 ± 0.11	$113.13^{a} \pm 5.89$	48.16 ± 10.39	55.01 ± 10.58
$P > F$	*0.6107*	*0.0103*	*0.9923*	*0.6610*
Birth type				
Single (n = 46)	3.04 ± 0.10	109.97 ± 5.15	58.79 ± 9.34	60.84 ± 3.15
Twins (n = 19)	2.93 ± 0.15	94.32 ± 8.02	37.41 ± 13.15	54.92 ± 4.34
$P > F$	*0.5002*	*0.0699*	*0.1349*	*0.2851*

[a,b] Means with different letters in the same column within the same factor differ significantly ($P \leq 0.05$).

was slightly higher compared to that of Toggenburg, but not significantly different ($P > 0.05$). However, the growth rate of Norwegian kids from birth to one year of age was significantly lower ($P \leq 0.05$) than that of Toggenburg kids.

The average birth weight of male and female kids did not differ significantly ($P > 0.05$), but in terms of growth performance for the first 90 days, male kids had higher ($P \leq 0.01$) growth rates than female kids. The average birth weight and growth rate of Toggenburg kids were lower compared to the birth weight of 3.2–3.6 kg and growth rate of 104–127 g/day reported in Meru, Kenya (Ahuya *et al.*, 2003). For the Norwegian goats, the mean birth weight observed in the present study is slightly higher than (2.5–2.8 kg) but the kid growth rate is lower than the growth rate of 65–118 g/day reported for Norwegian goats in Mgeta (Safari *et al.*, 2008). The differences could be attributed to the differences in climatic conditions and age of the dam.

The effect of breed and location on gastrointestinal nematode infestion is shown in Table 3. Breed had no significant effects ($P > 0.05$) on EPG and HB, but significantly influenced ($P \leq 0.05$) PCV. The Norwegian crosses had slightly higher values for EPG (211.78 ± 0.02) than the Toggenburg crosses (129.51 ± 0.02), while the Toggenburg crosses had higher HB (7.09 ± 0.35 g/dl) and PCV (26.71 ± 0.99%) values than the Norwegian crosses. The higher EPG values observed in the Norwegian crossbred goats compared to the Toggenburg crosses may suggest that the Norwegian goats are more susceptible to gastrointestinal nematodes than the Toggenburg goats. Breed differences with respect to nematode infection in dairy goats have been reported by other studies (Costa *et al.*, 2000). The Toggenburg goats have been in the country for a longer time (since the early 1960s) compared to the Norwegian goats, which were introduced in the late 1980s. Hence, the Toggenburg goats may have adapted better to local conditions and developed traits for tolerance to endemic diseases compared to the Norwegian goats.

Kid mortality rate is shown in Table 3. The results show that kid mortalities of Toggenburg and Norwegian goats were not significantly different ($P > 0.05$). However, the average kid mortality rate in Toggenburg kids was higher by 2.9% compared to that observed in Norwegian kids. The kid mortality rate observed in this study is higher than the recommended kid mortality of 10%. However, the kid mortality rates observed in the research villages are lower than the mortality rate of 17–33% reported for Norwegian goats at Sokoine University of Agriculture farm (Mruttu, 2001).

Table 3. Effect of location and breed on nematode eggs per gramme of faeces (EPG), haemoglobin concentration (HB), packed cell volume (PCV) and kid mortality of dairy goats

	Parameter			
Factor	EPG	HB (g/dl)	PCV (%)	Kid mortality (%)
Village				
Ihanda	184.14 ± 0.03	7.27 ± 0.38	25.52 ± 1.06	22.2
Kunke	96.55 ± 0.02	6.59 ± 0.36	24.39 ± 1.01	22.9
Masinyeti	155.43 ± 0.03	7.12 ± 0.41	24.79 ± 1.16	13.8
Wami-Luhindo	246.46 ± 0.06	7.02 ± 0.62	26.58 ± 1.75	18.18
P > F	*0.6776*	*0.3630*	*0.5706*	*0.2931*
Breed				
Norwegian	211.78 ± 0.02	6.91 ± 0.34	23.93^{b} ± 0.96	16.5
Toggenburg	129.51 ± 0.02	7.09 ± 0.35	26.71^{a} ± 0.99	19.4
P > F	*0.2638*	*0.5856*	*0.0023*	*0.3326*

Conclusions

The study has revealed that Toggenburg goats produce slightly more milk and are relatively more tolerant to nematode infestation than Norwegian goats under the conditions of this study. The poor milk production and growth rates for the two breeds under the study conditions indicate the need to improve management practices in order to improve productivity.

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