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Growth Rates and Milk Production Potential of Sahelian and Red Sokoto Breeds of Goats in Northern Guinea Savannah

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Abstract: The milk production potentials and growth rates of Red Sokoto and Sahelian goats fed basal diets of maize stover and *Digitaria smutsii* (wolly finger grass) supplemented with concentrate was investigated in two separate trials. In experiment 1, ten multi-parous does were allocated to intensive management following kidding. Does were hand-milked twice weekly and the milk production recorded. Body weight changes of dam and kid, milk fat, milk solid were determined weekly over 12 weeks period. The average birth weight of the Sahelian (2.2±0.23 kg) was significantly ($p<0.05$) higher than the Red Sokoto kids (1.0±0.17). At weaning age, the average kid weight of the Sahelian (5.6±0.42 kg) was significantly higher than the Red Sokoto (3.9±0.44 kg). There was no significant difference ($p>0.05$) in daily milk yield and total lactation between the two breeds. The total solids and milk fat of 16.4±0.39 and 3.7±0.13% were significantly ($p<0.05$) higher for the Red Sokoto than the Sahelian (15.1±0.39 and 3.2±0.13%). The second trial was to evaluate the comparative growth of the Sahelian and Red Sokoto breeds of goats. Animals were group-fed based on sex and fed *Digitaria smutsii* hay supplemented with concentrate. The growth trial lasted for 150 days with a 14 day digestibility trial. The Average Daily Gain (ADG) were significantly ($p<0.05$) different for breed, as well as sex. The Red Sokoto (66.9±1.59) kids had higher ADG than the Sahelian (46.6±1.59). Similarly the males of the Red Sokoto (61.9±1.59) had higher ADG than the Sahelian males (46.7±0.59) and the females of both breed. The experiments demonstrated a linear increase in weight gains of Red Sokoto over the Sahelian and a slightly higher milk yield obtained from the Sahelian providing the basis to conclude that the Sahelian goat can adapted and fit into the production systems of Sudan Savannah rural farmers.

Key words: Goats, breed, growth, milk, Guinea Savannah

INTRODUCTION

Livestock production and research in Africa have been geared towards increasing livestock population, rather than raising and intensifying the productivity of individual animals, breeds and species. Even when research is carried out in ruminants it has always been to address the production of cattle and sheep, with little attention to other species like goats (Bogoro *et al*., 1999). Small ruminants are estimated to be about 56.3 million in Nigeria (Blench, 1999) contribute about 30% of all meat (Lebbie, 2004) consumed by the populace in Nigeria; thereby possessing the ability to bridge the gap between demand for animal protein and actual meat supply in Nigeria (Williams, 1990). There are three breeds of goats in Nigeria but only 2 are predominant in the Guinea Savanna, namely the Red Sokoto and the Sahelian. The kids of Red Sokoto goats weigh about 1.5-2.0 kg at birth while adults weigh between 20-35 kg (Osuhor *et al*., 2002). The kids of Sahelian goats weigh between 2.0-2.8 kg at birth and mature adults weigh between 31-50 kg (Akinwole *et al*., 1999). The milk yield of the Sahelian does has been reported to be in the range of 800-1000 g day^{-1} (Cisse *et al*., 2002), when does were supplemented with concentrate at 500 g per animal and 300-660 g day^{-1} for red Sokoto does (Akpa *et al*., 2002) in an agropaostoralist farms.

The above characteristics can still be improved since goats possess peculiar qualities that are not common to other ruminants (Silanikove, 2000). These qualities include selective grazing and browsing, better digestibility of roughage, higher milk production per unit weight and high fecundity, (Negesse *et al*., 2001; Devendra, 2000; Goonewordene *et al*., 1999; Alcaide *et al*., 1997), making them able to survive harsh environment, by utilizing poor quality feed to produce high quality meat and milk

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(Kababya *et al*., 1998). Their relatively low capital investment and low maintenance requirement make goats the most ideal livestock species for the small-scale rural farmer. However since these goats are not reared for milk production purposes, very little is known of their milk production potential except for the few works of Akpa *et al*. (2002), Bogoro *et al*. (1999), Djibrillou *et al*. (1998) and Ehoche and Buvanendran (1983). This study was therefore conducted to determine the growth rate and milk production potential of the Red Sokoto and Sahelian breeds of goats in the northern Guinea Savannah.

MATERIALS AND METHODS

The study was conducted in October of 2005, at the National Animal Production Research Institute (NAPRI), Shika, Ahmadu Bello University, Zaria, Nigeria. Shika is situated in the Northern Guinea Savannah between latitudes 11 and 12° N and between longitudes 7 and 8° E; at an elevation of 650 m above sea level; with a mean annual rainfall of 1150 mm falling between May and October.

Experiment 1: Ten does, 5 Sahelian and 5 Red Sokoto goats aged between 2 and 3 years and with average live weight of 21.02±0.54 kg were used for the study in a completely randomized design where breed was the treatment. Goats were synchronized with progesterone sponges and hand-mated. Two weeks prior to kidding, does were housed in individual till the end of the experiment.

Animals were fed concentrate at 08:00 h until completely consumed before offering maize stover and water *ad libitum*. Animals were fed maize stover at the rate of 1 kg per head and concentrate at 2% of the combined dam and kid weight. Maize stover was collected from harvested maize fields and chopped to about 6 in length before storage. The composition of the concentrate consisted of the following ingredients: maize (26.1%); wheat offal (27.8%); cottonseed cake (43.1%); bone meal (2%) and salt (1%). Prior to the study the dams grazed the range land.

The kids were allowed to suckle their dams for a week before the experiment commenced. Milk production was estimated by twice-weekly hand-milking of does for a period of 12 weeks; on the night preceding the milking, kids were separated from their dams for 12 h. The next morning does were completely hand-milked and milk recorded (Akpa *et al*., 2002; Ehoche and Buvanendran, 1983). The recorded milk was multiplied by 2 since it was a collection over a period of 12 h to obtain the daily milk yield (Bencini *et al*., 2003). Weekly live weights of both does and kids were recorded; representative samples of the maize stover, concentrate and milk were recorded weekly for chemical analysis. The feeds and faecal samples were analysed for Dry Matter (DM), Nitrogen (N) and ash while milk samples were analysed for total solids and fat according to AOAC (1990) procedures.

Experiment 2: At kidding the birth weight of kids were monitored until when they were weaned at 3 months of age. At the age of 5 months, 27 kids, comprising 18 and 9 kids of Sahelian and Red Sokoto breeds with initial weight of 14.8±115 and 12.9±1.15 kg, respectively were involved in a growth trial that lasted 150 days. Animals were in 3 groups of 5 males and 4 females and fed according to sex. Animals were blocked according to weight and then group fed with a maximum of 3 animals per pen. Mineral licks manufactured by Whitebarn Limited, Winsford, UK and water and mineral licks were provided *ad libitum*.

Kids were fed 4% of their body weight, with *Digitaria smutsii* as the basal diet consisting of 50% of the ration and concentrate was offered at 08:00 h, as that in experiment 1. *Digitaria smutsii* was cultivated on station and baled for storage.

Kids were weighed for 2 consecutive days prior to commencement of the experiment, the average of which was recorded as the initial weight. On the day of weighing kids were weighed in the morning prior to feeding. The weekly live weights were used to adjust the quantity of feed to be offered and the trail lasted 150 days.

At the end of the growth trial, animals were moved into metabolism crates and allowed to adjust to the crates for 3 days. Data on feed offered, feed refused and feed intake were recorded for 7 consecutive days. Daily faeces was collected from individual goats for each group, weighed and about 10% of the original weighed faeces was sub-sampled and bulked.

The feed intake, average daily gain and digestibility coefficient data were analysed using the General Linear Model (GLM) procedures in the Statistical Analysis System (SAS, 2000). Proc Mixed procedures of SAS (2000) were used for the repeated measures analysis of the milk yield data. The difference between treatments means were tested using pair-wise difference, PDIFF. Differences were considered significant at $p<0.05$.

RESULTS

The ingredients and chemical composition of supplement and hay showed that the dry matter content of the maize stover, hay and concentrate were 97.7, 93.6 and 95.6%, respectively. Also the organic matter was

Table 1: Least square means (M±SE) of live weight and milk yield of Red Sokoto and Sahelian goats fed maize stover supplemented with concentrate

Parameter	Red Sokoto	Sahelian	Average
Mean dam weight (kg)	20.8±1.97	20.9±1.97	20.8±1.97
Mean birth weight (kg)	1.0±0.23[b]	2.2±0.23[a]	1.6±0.23
Mean weaning weight (kg)	3.9±0.44[b]	5.6±0.42[a]	4.7±0.39
Mean kid weight (kg)	3.4±0.12[b]	4.3±0.11[a]	3.9±0.11
Female kid (kg)	2.8±0.21[b]	4.2±0.11[a]	3.4±0.15
Male kid (kg)	3.8±0.11[b]	4.4±0.11[a]	4.1±0.11
Milk yield (mL)	135.9±17.46	134.7±17.52	135.3±17.52
Total solids (%)	16.4±0.39[a]	15.1±0.39[b]	15.7±0.39
Milk fat (%)	3.7±0.13[a]	3.2±0.13[b]	3.5±0.13
Total milk yield (L)	24.5±0.65	23.3±0.66	23.9±0.65

[ab]: Means (M±SE) in the same row bearing different superscript letter(s) differ significantly ($p<0.05$)

89.6, 85.7 and 90.2%, meanwhile the corresponding values for crude protein were 4.1, 7.7 and 20.6% for maize stover, hay and concentrate, respectively. The least square means for live weight, milk yield, fat, total solids of the dams and the live weight of kids are shown in Table 1. The average daily milk production was 135 and 134 mL for the Sahelian and Red Sokoto breeds of goats, respectively. Although, through out the lactation period the Sahelian goats produced slightly more milk than the Red Sokoto, there was no significant difference ($p>0.05$) between the 2 breeds at any time during the observation (Fig. 1). The effect of week was highly significant and does attained their peak production at week 5. The live weight of the Sahelian does was 21.0±0.5 kg which was not significantly ($p>0.05$) different from the live weight of 21.1±0.5 kg for the Red Sokoto does ($p>0.05$). Two weeks into lactation period, both breeds of goats showed a decrease of 8.3% in live weight, reaching maximum weight loss by the 9th week, with a decrease of 17.4%. Thereafter there was a slight weight gain but this gain was not comparable to the weight of the does during their 1st week in lactation. The birth weight of the kids was significantly higher ($p<0.05$) in the Sahelian kids (2.2±0.23 kg) than the Red Sokoto kids (1.0±0.23 kg) (Table 1). The growth rate of the kids increased consistently from the 1st week until when they were weaned at the 12th week.

Table 1 also demonstrated that the Red Sokoto goats had significantly ($p<0.05$) higher milk total solids (16.4%) and milk fat (3.7%) than the Sahelian with corresponding values of 15.1 and 3.2%. The milk fat (Fig. 2) gradually increased from beginning of lactation, peaked at the 7th week, there after maintaining a plateau up to the 10th before declining to the initial levels at onset lactation.

The birth weight and weaning weights of the female kids were significantly ($p<0.05$) lower than the male kids. The Sahelian kids had significantly ($p<0.05$) higher birth weights (2.2±0.23 kg) than the Red Sokoto kids

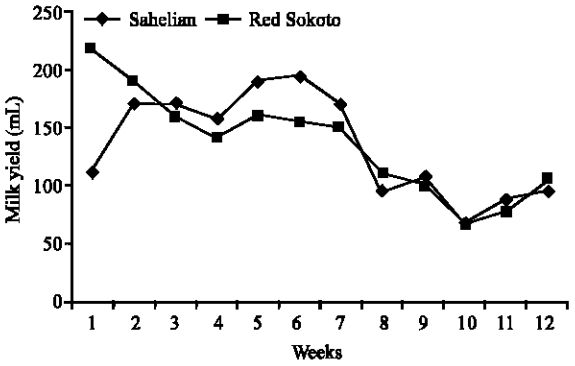

Fig. 1: Milk yield of Sahelian and Red Sokoto goats

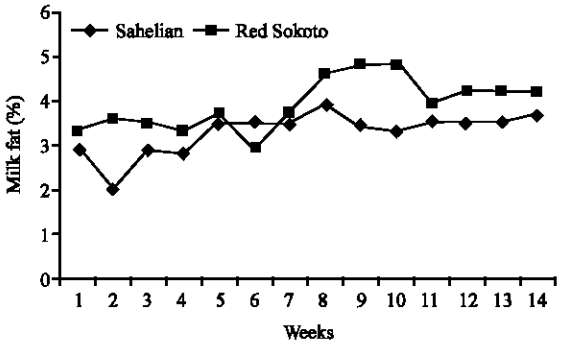

Fig. 2: Milk fat concentration of the Sahelian and Red Sokoto goats

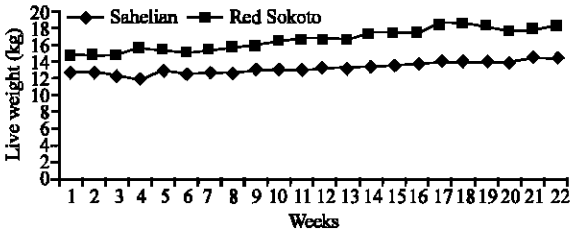

Fig. 3: Post-weaning growth performance of Sahelian and Red Sokoto Kids

(1.0±0.23 kg) (Table 1). The birth weight of the Sahelian males (2.5±0.23 kg) was statistically higher ($p<0.05$) than of the Red Sokoto males (1.5±0.23 kg), this differences was also observed with the females, where the Sahelian females (1.6±0.23 kg) showed statistically higher birth weight than their Red Sokoto counterparts (1.0±0.23 kg) (Table 2). Male kids recorded higher weight changes than the females. For both variables there were breed and sex effects with Red Sokoto significantly ($p<0.05$) out performing the Sahelian (Fig. 3) in terms of average daily gain but the reverse is the case in terms of birth weight of kids. The males had significantly ($p<0.05$) higher birth weight, weaning and average daily gain than the females.

Table 2: The Least square means (M±SE) of birth weight, weaning weight and weight change of Red Sokoto and Sahelian breeds of goats fed *Digitaria smutsii* supplemented with concentrate

Parameters	Red Sokoto	Sahelian	Red Sokoto female	Red Sokoto male	Sahelian female	Sahelian male
Birth weight (kg)	1.0±0.23^{b}	2.2±0.23^{a}	1.0±0.23^{b}	1.5±0.23^{ab}	1.6±0.23^{ab}	2.5±0.23^{a}
Initial weight (kg)	14.8±1.15^{a}	12.9±1.15^{b}	13.6±1.29^{b}	15.8±1.29^{a}	11.9±0.81^{b}	13.4±1.09^{b}
Final weight (kg)	18.9±1.79^{a}	14.4±1.79^{C}	16.7±2.29^{b}	19.6±2.01^{a}	12.6±1.18^{C}	16.3±1.70
Average daily gain (g day^{-1})	66.9±1.59^{a}	46.6±1.59^{b}	44.9±1.59^{b}	61.9±1.59^{a}	40.4±1.59^{b}	46.7±0.59^{b}

^{ab}: Means (M±SE) in the same row bearing different superscript letter(s) differ significantly ($p<0.05$)

The intake (g) and digestibility coefficient of dry matter, organic matter and crude protein are (818.8 and 75.6), (763.2 and 76.4) and (120.4 and 55.2), respectively for the Sahelian. The corresponding values for the Red Sokoto are (657.4 and 78.1), (613.3 and 78.6) and (99.6 and 63.8).

DISCUSSION

The milk yield recorded in this study is lower than that reported by Ehoche and Buvanendran (1983), Djibrillou *et al.* (1998), Cisse *et al.* (2002) and Greyling *et al.* (2004) but similar to that reported by Tendonkeng-Pamo *et al.* (2006) where West Africa dwarf does were fed multipurpose leguminous tree leaves.

Higher milk yield of between 300-1000 g day^{-1} was reported for these breeds of goats by Malau-Aduli *et al.* (2003) and Akpa *et al.* (2002). This difference in milk yield in this present study may be explained by the difference in method of milk collection and the type of breed used. In the study of Ehoche and Buvanendran (1983) oxytocin was administered to the dams prior to milk, which would have greatly enhanced the milk expressed from the udder. Djibrillou *et al.* (1998) used double weighing of the kid while Greyling *et al.* (2004) used improved breeds of goats. Prasad and Sengar (2002), Mia *et al.* (1994) and Eknaes *et al.* (2006), in their separate studies showed that genetic make-up and nutritive intake of different breeds of goats greatly influenced the milk yield and its composition. The maize stover provided to the dams was of low quality, which may have required treatment to provide the available nutrient that will support production as confirmed by Makun *et al.* (2001). Therefore, the poor digestibility of maize stover may have limited the nutrients available to the does to support higher milk production.

There was a general loss in the body weight across breeds following parturition and lactation. The rate of weight loss was however similar among breeds. The loss in body weight could generally be attributed to mobilization of body fat, which was stored during the dry period. It has been reported that an estimated 64 g day^{-1} is lost from day 11 to 37 postpartum (Eknaes *et al.*, 2006), but in this present study the weight loss was persistent throughout the lactation probably due to the fact that maize stover could not supply the required energy to support milk production consequently body protein and fat had to be mobilized to sustain milk production.

The persistent milk production in spite of the poor quality roughage may be attributed to the efficiency of utilization of protein which provides the energy for milk and consequently results in depleting the body reserve of the dam. It will therefore seem that the goats in this study although receiving low quality roughage are able to sustain milk production through mobilization of body reserves in the form of protein and fat. The continuous mobilization of body reserves is evident, since the does were unable to recover their initial weight after kidding. This was in contrast with the works of Greyling *et al.* (2004) where does were able to improve on their weight loss towards the end of the 12 week study.

The mean values of milk fat and milk solid of the goat in the present study were similar to those earlier reported by Prasad and Sengar (2002) and Greyling *et al.* (2004), where the milk fat increased with advancing lactation. They, however contrast that of Djibrillou *et al.* (1998) and Eknaes *et al.* (2006) where milk fat decreased with advancing lactation. The differences in pre-weaning kid weight between the two breeds in this study is more of a function of the maternal characteristics of the does as has been reported earlier by Goonewordene *et al.* (1999). The Sahelian kids are larger boned animals which gave them an advantage over the Red Sokoto kids which are medium boned animals (Mavrogenis and Papachristoforou, 2000).

The results of the second experiment showed that the male kids were born heavier than the females and this corroborates the reports of Pfeffer and Rodehutscord (1998). The males of both breeds also grew faster than the females, similar to the earlier study of Al-Nakib *et al.* (1996) and Santra and Karim (1999). Even though the Sahelian kids consumed more feed, the Red Sokoto grew faster than them, to the extent that their weaning weights were comparable. This could possibly be due to the inherent breed differences or environmental adaptation as have earlier been reported by Tuah *et al.* (2005). The Sahelian breed is found in the arid regions where they thrive better; however in the Savannah where the study was carried out, they were less able to thrive less in comparison to the indigenous Red Sokoto goats. In the arid regions the Sahelian goat feeds on browses and shrubs, which usually contain more protein and are available all year round to support them during the dry spells (Aganga and Monyatsiwa, 1999; Papachritou *et al.*, 1999). The Red Sokoto are already adapted to the

Guinea Savannah so that even when they consume less feed they are able to utilize it for maximum gains, while the Sahelian were yet to adjust to the benefit of the available feeds. The works of various scientists demonstrated that browses and shrubs are able to sustain and improve goat productivity in the arid regions (Hatendi *et al*., 1992; Ahmed and Nour, 1997; Aganga and Monyatsiwa, 1999; Papachritou *et al*., 1999). The faster growth rate of the Sahelian kids prior to weaning can be harnessed in breeding programmes in respect of crossing with other breeds.

It can be inferred that the Sahelian breeds of goats can adapt and thrive in the northern guinea Savannah zone of Nigeria. In conclusion, the study demonstrates the superior performance of the Red Sokoto over Sahelian breeds in terms of growth rate and quality of milk in the study area. It was therefore; recommended that for optimum milk production, dairy goats should be fed good quality forage and concentrate.

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