Original Research Article

Growth Performance and Milk Yield in Sahelian × Anglo-Nubian Goats Following Crossbreeding in the Semi-Arid Zone of Mali

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Abstract

The objective of this study was to evaluate the effect of crossbreeding Sahelian Goats (SG) with Anglo-Nubian (AN) bucks on growth performance of kids and milk production of does during the pre-weaning period. Forty four suckled and hand-milked does were randomized and divided into two groups [Sahelian goat (SG; $n = 22$) and Anglo-Nubian × Sahelian goat (ANS; $n = 22$)] and ninety kids of three breeds were allocated to three groups [(SG; $n = 30$), (ANS; $n = 30$) and backcross breeds kids (AN (ANS; $n = 30$)). The does and their offspring were kept in a pen in which they stayed indoor for 45 days before they were allowed to outdoor system as the weather was suitable. Every category received a nutritional supplementation depending on the annual season (rainy, dry cold and dry hot season). The body weight gain of the kids and the average daily milk yield of the does were recorded weekly from parturition to 100 days of age.

The birth weight and live weight of kids were significantly affected by the breed type ($P \leq 0.001$). The body weights of kids were greater in AN (ANS), and ANS group ($P \leq 0.001$), compared to SG at all ages. The growth performance was the greatest in AN (ANS) kids until 30 days (113.70 ± 15.79 g) and until 100 days, 91.23 ± 8.12 g ($P \leq 0.001$). Moderate correlation was found between overall kids birth weight and live-body weight at 60 days of age ($r = 0.52$). Similarly, daily milk yield was highly affected by breed type ($P \leq 0.001$) throughout the observation period, while the effect of sex on daily milk production was not significant. The total milk yield at 100 days has increased of 103% in ANS over SG. Results of this study indicate that crossbreeding Sahelian Goat with Anglo-Nubian goat breed improved their growth rate and milk production.

Keywords: Pure Sahelian Goat; Anglo-Nubian; crossbreeding; growth; milk yield.

INTRODUCTION

Mali is among the major sub-Saharan African countries, which has a large number of livestock, with 8,595,000 sheep and 13,010,000 goats (DNPIA, 2008). Animal husbandry is practiced by about 80% of the rural population of the country. It constitutes the main source of income for more than 30% of the population. The sub-sector of livestock husbandry contributes up to 10% in Gross Domestic Product (DNPIA, 2008). It represents the principal source of supplying animal proteins for the population in Mali. Despite this important stock, small ruminants' husbandry has several constraints that are related to health, feeding, management and genetics. In the strategy of increasing the production of local milk noticed in the Program of Economic and Social Development (PDES), the challenge of production, collecting and processing the local milk should be solved to be self-sufficient in milk consumption.

In Mali, Sahelian goats are found in the arid and semi-arid zones. They have a low carcass yield estimated at 11.5 kg (DNPIA, 2008) and low milk yield estimated to 0.67 liter per day for three months of milking (Tera, 2008). Milk

consumption per capita is estimated to be 10-30 liters per year (Bonfoh, 2005), 60% of the dairy products consumed in Mali were imported (DNS, 1999). The annual meat consumed per person per year is low, 7.8 kg in rural areas (Peterson et al. 2006), and 42 kg in Bamako, the capital city of Mali from which 36 kg (86%) are of bovine meat (Konaré and Temé, 1997). A breeding program on goats can be developed both for meat and milk productions using local indigenous stock through selective breeding or crossbreeding them with exotic and high producing breeds. The genetic improvement of goats should take into account the genotypic and environmental factors, as included in the strategy of local milk valorisation in Mali (DNPIA, 2008).

A part of the goat flock at the Centre Régional de Recherche Agronomique de Kayes /Institut d'Economie Rurale (IER) is undergoing genetic improvement through a crossbreeding program. In order to evaluate the success of such a program, evaluating milk production and offspring growth performance are essential. Therefore this study was conducted to investigate the effect of crossbreeding on growth performance of pure and crossbred kids and milk production of does.

MATERIALS AND METHODS

This research was carried out in the Regional Center of Agronomic Research at Samé in the region of Kayes, located between 14°29' N and 11°34' W. The average rainfall varies from 550 to 900 mm year⁻¹ (DNA, 2007). The vegetation consists of thorny plants and shrubs. The average daily maximum temperature in the city is 35 °C, with temperatures usually peaking in April and May at an average of 46 °C. The seasonal characteristics of the area are rainy season (June–September), dry cold season (October–January), and dry hot season (February–May).

Materials

The study was conducted in a herd of native Sahelian goats, crossbred with Anglo-Nubian buck, imported from the United Kingdom in 2004 within the frame of a cooperative research between ITS /CULS Czech Republic and (IER) of Mali. The animals were crossbred at the Centre Regional de Recherche Agronomique (CRRA) of Samé in the region of Kayes. To evaluate kids' birth weight and their growth performance, ninety kids were randomly selected as follows: 30 Sahelian goats aged 18 months to 2 years, thirty ½ crossbreds of Anglo-Nubian and thirty ¾ AN, Anglo-Nubian buck with females F₁.

Milk yield was determined by hand milking of residual milk after suckling in forty four does divided into two groups as follows: 22 Sahelian goats, and 22 ½ AN crossing offspring of Anglo-Nubian × Sahelian goats. All the goats were identified with plastic ear tags. The equipment and material used, included a scale of 20 kg with a precision of 0.1 kg, a gallows, weighing bags for growth measurement beakers for milk measurement, and feeders and watering tanks. The feeds used as supplements included bush hay, an industrial feed ABH (Aliment Bétail HUICOMA) and cotton seed meal. Two shelters were built in cement; large boxes for the does and small ones for the kids. They had a cage of 40 m² each in solid floor and an open yard of 60 m².

Methods

Management System

The three groups of goats were kept in an extensive system, grazing natural pasture from 9 to 11 a.m. and from 3 to 6 p.m. Besides rangeland grazing, the animals received additional concentrate feed as supplements depending on the season and the animal category. The kids received 100 g of Aliment Bétail Huicoma (ABH), a concentrate mixture of 2/3 of cottonseed cakes and 1/3 of cottonseed meal during the cold dry season, and 100 g of ABH, plus 100 g of bush hay during the hot dry season. Bucks received 200 g of ABH during the cold dry season and 200 g of ABH, plus 100 g of hay during the hot dry season. Milking does received 200 g

of cottonseed meal during the cold dry season and 400 g of cottonseed meal, plus 200 g of bush hay during the dry hot season (Nantoumé et al., 2005).

The habitat was cleaned and disinfected every three months. For prevention, animals were vaccinated yearly against Rinderpest (PPR) and every six months against Pasteurellosis. Internal worms control was done twice per year (once at the beginning of the rainy season and once at the end of the rainy season). External parasites control was done once per month during the rainy season and once every 3 months during the dry season.

Data Collection

Kids were weighed at the latest 12 h after birth to determine their live weight. Growth performance was evaluated for all the kids every week using a scale of 20 kg (precision of 100 g) until the age of 100 days. The first evaluation of milk yield was done in about 7 days after parturition and then weekly measurements followed until 100 days of lactation. The kids were isolated early in the morning in a box until the arrival of their does in the afternoon from pasture. Kids were weighed before suckling to obtain (W1) and weighed again after suckling to obtain (W2). The difference in weight between W2-W1 gave the amount of milk consumed per kid. After the suckling of the kids, the residual milk was hand-milked, measured and added to the milk consumed. The total of these two quantities of milk gives the quantity of milk in the evening. Immediately, the kids were again isolated all night and the same operations were repeated in the next morning before the goats went for grazing at 9 a.m. The total quantity of milk received in the evening added to that of the next morning gave the daily milk production. The partial milk productions were obtained by multiplying the daily production by the interval between consecutive controls. The sums of the partial productions during the whole lactation gave the total milk production of a given lactation (Nantoumé et al., 2005).

Experimental Design and Statistical Analysis

The statistical analysis was done using the General Linear Model (GLM) procedure in SAS software package (SAS, 2002) for a completely randomized design (CRD) with the variables birth weight, live weight gain and milk yield as affected by breed type, litter size and sex. The treatments were analyzed for their significance using analysis of variance (ANOVA). The least significant differences (LSD) test at 95% level of confidence method was used to compare the means (birth weight of kids, growth performance and milk production of does). All the values are the average of replicates from 90 kids and 44 milking does. For the conversion of weight to an age, the method of linear

Table 1: Mean values and ($\pm$ SEM) for body weight of kids at various ages as affected by breed type, litter size and sex (kg)

Effects	N	Body weight			
		Birth weight	30 days	60 days	100 days
Mean	90	2.66 $\pm$ 0.29	5.47 $\pm$ 0.44	8.18 $\pm$ 0.57	11.37 $\pm$ 0.67
Breed type					
SG	30	2.40 $\pm$ 0.34 ^c	4.71 $\pm$ 0.29 ^c	7.38 $\pm$ 0.48 ^c	10.46 $\pm$ 0.63 ^c
½ AN	30	2.70 $\pm$ 0.33 ^b	5.40 $\pm$ 0.38 ^b	7.74 $\pm$ 0.77 ^b	11.63 $\pm$ 0.41 ^b
¾ AN	30	2.90 $\pm$ 0.39 ^a	6.31 $\pm$ 0.65 ^a	9.43 $\pm$ 0.82 ^a	12.02 $\pm$ 0.97 ^a
Litter size					
Single	75	2.73 $\pm$ 0.62 ^a	5.54 $\pm$ 1.26 ^a	8.30 $\pm$ 1.98 ^a	11.53 $\pm$ 2.77 ^a
Twins	15	2.33 $\pm$ 0.55 ^b	5.14 $\pm$ 0.94 ^b	7.56 $\pm$ 1.62 ^b	10.60 $\pm$ 2.28 ^b
Sex					
Female	44	2.52 $\pm$ 0.53 ^b	5.32 $\pm$ 1.16 ^b	7.88 $\pm$ 1.89 ^b	11.03 $\pm$ 2.68 ^b
Male	46	2.81 $\pm$ 0.68 ^a	5.62 $\pm$ 1.28 ^a	8.47 $\pm$ 1.96 ^a	11.70 $\pm$ 2.77 ^a

Mean values within the same column with different superscript letters differ significantly at 0.05, 0.01 and 0.001 level of probability.

interpolation and CORR were used to convert the birth weight and growth, average daily gain (ADG) at birth 30 days, 60 days and 100 days; as well as daily milk production from parturition to day 100.

RESULTS

Effect of Genotype on Birth Weight and Live Weight of Kids

Live weights of kids are shown in Table 1. Among all kids, ¾ AN were heavier than ½ AN and SG, likewise ½ AN kids were heavier than SG kids. The difference between breed type was highly significant ($P \leq 0.001$) during the pre-weaning period. This increase in the live body weight was the result of an increase in milk production, essential for growth of kids. The higher body weights found in ½ AN and ¾ AN kids (Table 1) were probably attributed to the hybrid

vigour of the Anglo-nubian sire genotype with high growth potential.

The body weight of kids increased markedly with age to reach an average weight of more than four times of birth weight. There was a fair relationship between birth weight and body weight ($r = 0.54$) at 30 days, ($r = 0.52$) at 60 days and at 100 days ($r = 0.42$) for all kids, ($P \leq 0.001$), see Fig.1. The relationship between kids growth rate and milk yield is usually strong during the first weeks of lactation when they are more dependent on suckling. The means of the live body weight of kids at the ages of 30, 60 and 100 days as affected by breed type, litter size and sex are shown in Table 1.

Effect of Litter Size on Birth Weight and Live Weight of Kids

Another important criterion affecting the live weight and growth rate of kids is the litter size. In Table 1 birth weights

Figure 1. Relationship between birth weight and live-weight at 100 days.

Table 2: Means values and ($\pm$ SEM) for average daily gain at various ages as depending upon particular factors

Effects	N	Average daily gain (g)		
		until 30 days	until 60 days	until 100 days
Mean	90	93.62 $\pm$ 16.17	91.97 $\pm$ 10.44	87.11 $\pm$ 7.18
Breed type				
SG	30	77.10 $\pm$ 10.25 ^c	83.03 $\pm$ 8.33 ^b	80.73 $\pm$ 7.01 ^b
½ AN	30	90.06 $\pm$ 15.97 ^b	84.06 $\pm$ 13.96 ^b	89.36 $\pm$ 4.84 ^a
¾ AN	30	113.70 $\pm$ 15.79 ^a	108.8 $\pm$ 10.30 ^a	91.23 $\pm$ 8.12 ^a
Litter size				
Single	75	93.58 $\pm$ 23.74	92.92 $\pm$ 22.72	87.97 $\pm$ 20.70 ^a
Twins	15	93.80 $\pm$ 18.24	87.20 $\pm$ 19.60	82.80 $\pm$ 18.13 ^b
Sex				
Female	44	93.29 $\pm$ 21.45 ^b	89.43 $\pm$ 21.22 ^b	85.15 $\pm$ 20.23 ^b
Male	46	95.93 $\pm$ 22.96 ^a	94.39 $\pm$ 21.72 ^a	88.97 $\pm$ 20.18 ^a

Mean values within the same column with different superscript letters differ significantly at 0.05, 0.01 and 0.001 level of probability.

show that single born kids were heavier than multiple born ($P < 0.001$). The difference between singles and twins was significant ($P \leq 0.001$), at birth day, 60 and 100 days. Live birth weight of kids was 17.16% greater in singles compared with twins.

Effect of Sex on Birth Weight and Live Weight of Kids

Another important criterion that affects the live weight and growth intensity of kids is the effect of sex. The difference between sexes was highly significant ($P < 0.001$) in live body weight at birth, 60 and 100 days. Males were heavier than females, 2.81 ± 0.68 kg vs. 2.52 ± 0.53 kg at birth, and sex affected body weight at 30 days ($P \leq 0.01$), see Table 1. That difference was probably due to the fact that the gestation period in does carrying a male is usually slightly longer than in those carrying a female. The results of heterosis were higher (+21) and

(+15) for ¾ AN compared to SG at birth and at 100 days, respectively.

Average Daily Gain (ADG)

Effect of Breed Type on Average Daily Gain of Kids

Breed type of kids affected average daily gain of kids at 30, 60 and 100 days significantly ($P \leq 0.001$). Crossbred kids ½ AN and ¾ AN showed had growth rate in all investigated variables as compared with the pure Sahelian kids (Table 2). That performance was probably due to the hybrid vigour of the crossing offspring. The highest ADG was recorded in ¾ AN kids at all ages of the experiment period. But the difference between ½ AN and ¾ AN at 100 days was not significant; that was due to the decrease of the result of heterosis in ¾ AN. The results showed that, ADG decreased to 35 % vs. 72 % over SG from birth to 100 days for ½ AN and ¾ AN, respectively (Fig. 2).

Figure 2. Growth curve of kids as depending upon genotype.

Table 3: Mean values and ($\pm$ SEM) for daily milk yield at various ages of kids, as depending upon particular factors

Effect	N	Daily milk production (liter)			
		At 1 st control	At day 30	At day 60	At day 100
Mean	44	194.7 $\pm$ 0.2	99.36 $\pm$ 0.52	93.23 $\pm$ 0.50	13.63 $\pm$ 0.13
Breed type					
SG	22	0.30 $\pm$ 0.06 ^b	0.84 $\pm$ 0.05 ^b	0.73 $\pm$ 0.04 ^b	0.60 $\pm$ 0.07 ^b
½ AN	22	0.76 $\pm$ 0.05 ^a	1.87 $\pm$ 0.06 ^a	1.73 $\pm$ 0.07 ^a	0.81 $\pm$ 0.09 ^a
Litter size					
Single	40	0.52 $\pm$ 0.24 ^b	1.43 $\pm$ 0.57 ^b	1.22 $\pm$ 0.51 ^b	0.70 $\pm$ 0.13
Twins	4	0.64 $\pm$ 0.18 ^a	1.53 $\pm$ 0.44 ^a	1.30 $\pm$ 0.54 ^a	0.78 $\pm$ 0.02
Sex					
Female	23	0.53 $\pm$ 0.2	1.39 $\pm$ 0.51	1.25 $\pm$ 0.51	0.73 $\pm$ 0.14
Male	21	0.53 $\pm$ 0.26	1.32 $\pm$ 0.54	1.20 $\pm$ 0.51	0.68 $\pm$ 0.12

Mean values within the same column with different superscript letters differ significantly at 0.05, 0.01 and 0.001 level of probability.

Effect of Litter Size and Sex on Average Daily Gain of Kids

No effects of Litter size on average daily gain until 30 and 60 days of kids' age were observed (Table 2), however, the average daily gains of kids until 100 days of life were significant ($P \leq 0.01$).

The effect of sex on average daily gain until 30, 60 and 100 days of life (Table 2) showed that the differences between males and females were statistically significant ($P \leq 0.05 - 0.01$). Average daily gain until 30 days of age in males was 2.83% higher than in females, and by 100 days the difference between the ADGt of males and females was 4.49 % higher in favour of males.

Milk Yield

Effect of Genotype

The total milk yield at 100 days was 67 l in SG versus 135 l in ½ AN. Fig. 3 showed that ½ AN, had a higher peak a longer lactation persistence period (4th week until week 10) than SG. That is probably due to the hybrid vigour of

F1 offspring. Additional improvement by the sire Anglo-Nubian, milk yield in ½ AN was increased to 103 % over that of SG.

Daily milk yields at birth were 0.30 ± 0.06 l and 0.76 ± 0.05 l, respectively, for Sahelian goat and ½ AN does, difference between breed-type was highly significant ($P < 0.001$) throughout the experimental period. This tendency was maintained until 100 days with 0.60 ± 0.07 l and 0.81 ± 0.09 l respectively, for SG and ½ AN (Table 3). The means of daily milk production at various periods of lactation, as affected by genotype, litter size and sex of kid are shown below.

Effect of Litter Size and Sex of the Offspring

Litter size affected milk yield until day 60 ($P < 0.001$) when does with twins produced more milk than those with single kids (Table 3). At the end of the experiment, the daily milk yields were similar until 100 day. The average daily milk yields were 0.52 ± 0.24 l and 0.64 ± 0.18 l for does with single kids and those with twins respectively, at fourth control. The daily milk yield increased to 36% for does with

Figure 3. Lactation curve of Sahelian goat (SG) and crossbreed 1/2 AN.

twins over those with single kids until 60 day. In the present study, sex had no influence on daily milk yield during all period of investigation (Table 3).

DISCUSSION

Birth Weight and Body Weight Effect of Genotype of Kids

In the semi-arid zone, breeders used to breed Sahelian goat like dual purpose animal, as for milk as for meat for the household needs; this current work exactly deals with that dual purpose. Breed type had a highly significant effect on birth weight and live weight at all pre-weaning periods. These results are in agreement with Mike et al. (2008) for SG kids, and Ngere (1973) who found birth weight of 2.3 ± 0.45 kg, and 9.8 ± 1.9 kg at weaning for the Nungua Blackhead goats. Additionally, according to Dmitriez et al. (1989) kids of Don does weighed 2 kg at birth and 14 kg at weaning; Banda (1999) found for local and crosses goat kids in Malawi, 2.77 ± 0.08 kg at birth and $13 \text{ kg} \pm 0.41 \text{ kg}$ at 17 weeks. Lower birth weights were found by Cissé et al. (2002) with 1.55 - 1.82 kg for Sahelian goats in the rainy season and 1.28 ± 0.01 to 1.5 kg in the dry season. The values of this study were in contrast from 5.6 ± 0.42 kg at weaning in Sahelian goat reported by Mankun et al. (2008). The progressively increased live weight of kids with age during the pre-weaning period is comparable to that published by Wijeratne (1968) with $r = 0.57$, between birth weight and one-year-old live weight for Indian meat goat; Salah (1989) observed a moderate correlation between birth weight and body weight at different ages of Aardi goat in Saudi Arabia.

Effect of Litter Size

Litter size affected birth weight significantly. In congruence with our results, Tera (2008) reported 2.8 kg for singles and 2.1 kg for twins for $\frac{1}{2}$ AN type; whereas $\frac{3}{4}$ AN kids weighed 3.4 kg for single in Kayes; additionally, they are in the range summarized by Devendra (1985) for single borns from 1.8 to 4.4 kg and twins from 1.6 to 4.2 kg, for tropical goats. Sangaré and Pandey (2000) found in Sahelian goat in Mali that kids born as single were heavier than those born as twins ($P \leq 0.05$). These birth weights were in the range found by Mehta et al. (1997), with 2.88 ± 0.03 kg, 2.88 ± 0.06 kg, and 2.05 ± 0.01 kg, respectively, in Sirohi, Jamnapari and Cheghu goats. In comparison with this study, single born kids were heavier than multiple born, as they had better conditions for growth in the uterus of their mothers as compared to multiple kids Afzal et al. (2004). He also concluded that single kids weighed 3.69 ± 0.06 kg, and twins 3.37 ± 0.06 kg.

The larger live weights from birth to 100 days of all singles over twins were in congruence with the results of Tera (2008) with 11.5 kg for single 12.6 kg for $\frac{1}{2}$ AN and $\frac{3}{4}$ AN respectively, at 90 days in the Kayes.

Effect of Sex of the Offspring

The greater weights of males over females in the present study ($P < 0.001$), were similar to those found by Mehta et al. (1997) and Salah et al. (1989) who remarked that male kids were heavier than female kids; that difference was probably due to the fact that the gestation period of does carrying males is usually slightly longer (1-2 days) than of those carrying female.

The birth weight was greater than that obtained by Wilson (1991) for Sahelian goat in agro pastoral system in Mali, with 2.3 kg and 2.1 kg for males and females, respectively; Makun et al. (2008) found 2.5 ± 0.23 kg for males and 1.6 ± 0.23 kg for females in the Savannah in Guinea for Sahelian. This result was confirmed by Sangaré and Pandey (2000) for Sahelian goats. Similar results were obtained by Tera (2008) in Kayes, where males $\frac{1}{2}$ AN as $\frac{3}{4}$ AN kids were heavier than females, their weights being for $\frac{1}{2}$ AN kids 2.6 kg and 2.2 kg, respectively, for males and females; $\frac{3}{4}$ AN kids weighed 3.7 kg and 3.2 kg, respectively, for males and females. Additionally, Mike et al. (2008) concluded that sex had significant effect in all periods of growth in SG; Afzal et al. (2004) reported that for males 3.48 ± 0.06 kg and 3.29 ± 0.03 kg for females. In congruency with Vargas et al. (2007), male kids of Creole goat were heavier than females, respectively, with 3.21 ± 0.1 kg vs. 2.73 ± 0.13 kg. The result of heterosis for $\frac{3}{4}$ AN was greater than which reported by Gebrelul et al. (1994), with (+6) at birth for Nubian X Nubian $\times$ Alpine; (+11) for Boer $\times$ Spanish X Spanish; but comparable for Nubian X Alpine $\times$ Nubian, at six months, and Boer $\times$ Spanish X Spanish at 90 days with (+16).

Average Daily Gain (ADG) Effect of Kid Genotype

The breed type affected ADG from birth to 100 days, for all kids. Lower average daily gain was reported by Makun et al. (2008) who concluded that the growth rate of Sahelian kids increases from first week until 12th week. This study was in congruence with Ngere (1973) who found 90 ± 2 g for Nungua black head; Nusz et al. (2008) in supplemented Boer kid with (68 ± 22 g), but in contrast with results obtained by Makun et al. (2008) for Spanish goat kids (36 ± 16 g/day- 40 ± 12 g/day). These results were within the range of ADG stated by Cissé et al. (2002) which were 88 g to 100 g and 62 g to 75 g/day, respectively, in the first and the second month.

Effect of litter size and sex of kids

Single born kids had greater ADG from birth to 100 days than twins. The results of this work were in agreement with those reported by Sangaré and Pandey (2000), where single born grow faster than twins in Sahelian goats. Accordingly, Kuchtik et al. (2005) demonstrated that the growth rate was significantly higher in males than in females from birth to 90 days for brown short haired goat; but in contrast from him, at the early age until day 30. Similar results were reported by (Sangaré and Pandey, 2000) that sex of kid had no significant effect on growth rate in Sahelian goats in Mali.

Milk Yield

Effect of Genotype

Throughout the experimental period, the breed-type has affected daily milk yield from parturition to 100 days of lactation. These results are consistent with highest milk yield range from 400 g to 1000 g per day reported by Malau Aduli et al. (2003) for Sahelian goat breeds; but in contrast from Pagot (1985) for Sahelian goat, with lower values (70 -180 g) per day during 4-5 months. This finding was in agreement with Missohou et al. (2005) who reported the average daily milk production to be 0.54 ± 0.12 l for the duration of a lactation of 3.6 months for Sahelian goat in Senegal.

The average milk yield documented in this study was, higher than that of Mumba et al. (2003) for indigenous Malawi goats and for Saanen crossbreeds. In contrast, it was lower than that mentioned by Robinet (1967), 140 to 150 l during 200 days in Sahelian goat; but, in agreement with those obtained by Tera (2008) in Kayes-Mali (Banda, 1999) for local goat and their crosses with Boer in Malawi. The peak of daily production was comparable with that claimed, by Cissé et al. (2002) with peaked at week 3 for Sahelian goat doe in Senegal. The comparison of values between SG and their crosses were higher than those reported by Montaldo et al. (1995), for local Mexican goats with high-grade and low-grade Alpine, Saanen and Toggenburg.

Effect of Litter Size and Sex of Kids

The average daily milk yields were greater for does with twins than those with singles. This result was in consistence with that of Macciotta et al. (2005) and Montaldo et al. (1995), who found that goats with two kids at parturition had higher milk yield than those with one kid. The increase of daily milk yield to 36% for twins dam over single once at day 60 in this study, is in the range summarized by Nianogo et al. (1992) from to 47

g to 735 g between first to 14th weeks for Sahelian goat, with a peak of production of 1275 g/head/day. According to Sangaré and Pandey (2000), the milk yield was affected by litter size, that production was 736 g/day for does with twins, vs. 692 g for does with single young during the first 12 weeks of lactation. Similarly to the present study, sex had no influence on daily milk production during the period of investigation.

CONCLUSIONS

The body weight of $\frac{3}{4}$ AN has increased 3% over $\frac{1}{2}$ AN and 15% over SG; likewise that of $\frac{1}{2}$ AN increased to 11 % over SG at day 100; therefore the greater growth performance of $\frac{3}{4}$ AN should be further investigated by the department of agriculture of Mali because of his ADG decrease to 72% over SG vs. 32 % for $\frac{1}{2}$ AN over SG. The $\frac{1}{2}$ AN does had better daily milk production and the highest total milk production throughout this experiment, 103% over SG. This larger milk yield of the $\frac{1}{2}$ AN does could be included in the genetic improvement program for Sahelian goat breeding value, which can be based on offspring from crossing with Anglo-nubian.

Further study should be done on these crossbreds in which some important factors must be included such as season of kidding, age of does, parity, etc. because they may probably influence the growth performance and milk yield from kidding to weaning.

ACKNOWLEDGEMENTS

The authors acknowledge the deanship of the Small Ruminants Program-CRRA/Kayes for technical support, and Seriba Tera, IPR-IFRA for his invaluable help with data collection. Also, thank is due to the personnel of the Institute of Rural Economy (IER/BKO) for administrative support.

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Received for publication: March 13, 2012

Accepted for publication: September 3, 2012

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