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*¹Tossa I. G., ²Akouédégni C. G., ¹Aboh B. A., ²Adandédjan C., ²mensah G. A. and ³Ogunmodede B. K.

¹ Scientific Direction of National Institute of agricultural research of Benin (INRAB), BP 128 Porto-Novo, Benin.

² Animal Production Department, Faculty of Agricultural Sciences, University of Abomey, 01 BP 526, Cotonou, Benin Republic.

³ Faculty of Agriculture and Forestry in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy, University of Ibadan, Nigeria.

Abstract

The current trials were initiated to help the goat keepers improve the nutritional status of grower goats with other alternative supplements offered by available cotton and *mucuna* seeds and locally made mineral lick. The performances of the growers such as growth rate of 12 months, weight at one year and mortality rate at post-weaning stage of 3 to 12 months were measured. The results showed that treatment effect on dry matter intake by growers was significant. The growers fed the seeds consumed significantly more dry matter than those fed sole palm frond. Treatment effect on digestible dry matter intake was highly significant. The mean digestible dry matter intake by growers in the period of 8 to 12 months ranged between 25.8 g in the control and 39.1 g/kg^{0.75}/day in the *mucuna* seed without salt lick group. Treatment effect was highly significant. The growers fed diets supplemented with the seeds showed higher growth rate than those in the control. The growers fed diets supplemented with the seeds showed higher weight at one year compared to the control. The mean weight at one year varied from 12.0 kg in the growers fed the seed to 14.6 kg in treatments with mineral lick. Use of these sources of protein could help the household in providing feed for their goats especially in the dry season and also in increasing the size of household flocks.

Keywords: Cotton, mucuna, digestibility, intake, West African Dwarf (WAD) goat.

*Corresponding author: Scientific Direction of National Institute of agricultural research of Benin (INRAB), BP 128 Porto-Novo, Benin.

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Introduction

The increase in world population especially in developing countries like Benin calls for urgent improvement in livestock production. It is believed that deficiency of animal proteins is one serious nutritional problem that needs urgent intervention in Benin and other African countries. Small size, slow rate of growth and poor productive and reproductive performance of livestock in Benin are accounted for the poor consumption of protein of animal origin. Average consumption of animal protein in this country is estimated at 4.5g/head/day as against the minimum requirement of 35g/head/day recommended by the Food and Agricultural Organization of the United Nation (Atsu, 2002).

Goats are better adapted to hot environments than sheep and cattle (Coop, 1982; Valez-Nauer *et al.*, 1982), but are more susceptible to heat stress than sheep and cattle, as reflected by a rise in body temperature, outward signs of stress and a reduction in performance (Bianca & Kunz, 1978). Their importance in the livestock economy of people living in subsistence agriculture in the humid zone of West Africa has made them the species of choice for peasant farmers and for the supply of animal protein and other products in the sub-region. In Nigeria, the most popular genotype, i.e. the West African Dwarf (WAD) goat which supplies excellent quality meat, milk, skin and other products, has been adjudged as one of the most prolific in the world, with a remarkably high reproductive potential (Wilson, 1989; Gall *et al.*, 1992).

However, high mortality rate of more than 25% and low growth rate of less than 30 g per day were reported at grower stage (RAMR, 1989; Gbégo and Van den Broek, 1992). Many diseases such as bronco-pneumonia, enteritis diarrhea contagious ecthyma and peste des petits ruminants (PPR) are observed as causes of mortality. Particularly PPR was indicated by farmers as cause of high mortality rate. The most important problem of management of goats as indicated by farmers, is feeding of the growers during the cropping season when the animals are confined. Farmers are obliged to search, cut and carry the feeds from the bush far from the village if one is aware of diversification of the

feeds. All the lands close to, or inside the village are cultivated. Thus, main feed easily collected and offered to goats is the palm frond with the low subsequent performance indicated above. Keeping the growers without a minimum exercise by tethering them all the day and during a long period of the year (6 to 8 months), also appears as a constraint to good feed conversion and health preservation. Moreover, the tethered 3 Towers are exposed to bad weather such as sun and rain, which contribute to disease. Regular cases of injuries are also reported (Koudandé, 1993) particularly on the tethered legs. Legume browses (*Leucaena*, *Gliricidia*, etc) production was tried in the zone. However, low availability of land appeared as a limitation of adoption of this technology. Although some farmers are still producing legume browses in the alley farming system to increase soil fertility and feed the goats, a large proportion of goat owners (about 70%) cannot to produce forage on their small lands. The current trial was initiated to help the goat keepers improve the nutritional status of grower goats with other alternative supplements offered by available cotton and mucuna seeds and locally made mineral lick. Secondly, this trial offered an opportunity to goat keepers to learn the advantages of better management of the animals in shelter, rather than tethering the animals. The performances of the growers such as growth rate re 12 months, weight at one year and mortality rate at post-weaning stage of 3 to 12 months were measured.

Materials and Methods

Diets

The experimental diets (Table 1) were used. These are the palm frond offered sole as control and the palm frond supplemented with the cottonseed, the mucuna seed, or the seeds plus salt lick.

Animals

The growers were purchased at Zouzouvou, the research site of project and also from other villages in the zone. Seven to eight months before the trial started some females in the zone were identified and the owners were informed the animals to be sold to RAMR project for growth trials.

Table 1: Experimental diets fresh matter basis.

Basic ration	Quantity	Supplement
T1 : Palm frond	(2kg/goat / day).	
T2 : Palm frond	(2kg/goat / day).	+ mineral lick, ad libitum
T3 : Palm frond	(2kg/goat / day).	+ cotton seed (240 / goat /day)
T4 : Palm frond	(2kg/goat / day).	+ cotton seed a + mineral lick
T5 : Palm frond	(2kg/goat / day).	+ mucuna seed (200g/goat /day)
T6 : Palm frond	(2kg/goat / day).	+ mucuna seed b+ mineral lick

*T1 IS THE CONTROL.

a: The same level of 240 g as in T3.

b: The same level of 200g as in T5.

However, at the beginning of the experiment, available female growers (32) were not sufficient and the remaining (31) were purchased from other zones of Mono Province in Benin. In reality female growers were required for the trial but 15 extra animals were purchased and reared for replacement in case of high mortality. Therefore, 8 animals were allocated to each of six treatments at initial stage making 48 growers of 7 to 8 months of age. Each of the eight animals in a treatment presented a replicate.

A second growth trial was carried out with the post-weaned progenies of the growers reared to 12 months of age during the first growth trial. The number of growers at initial stage in this trial was 3 to 7 per treatment with a total of 32 weaned kids. A third growth trial was carried out with the post-weaned progenies of the same does in their second kidding stage depending on the available weaned kids per treatment which was 4 to 9. The total number of growers used for the third growth trial was 33 at initial stage. Each grower was reared in a shelter. Each farmer participant had 2 to 4 adjacent pens with a possible internal communication designed for a future reproduction trial. The pens were 3 m x 2 m = 6 m² and built in prevision of future use by a lactating doe suckling two to three kids. Half of the pen was roofed and the other half was open to sun and air and allowed a minimal exercise.

Feeding the Grower Goats

$$GR \left(\frac{g}{day} \right) = 1000 \times \frac{\text{Weight (kg) at day Y} - \text{weight at day X}}{Y - X}$$

The refuse of palm frond, cottonseed and mucuna seed were collected every day and weighed in the morning at 08.00 hour before a new ration was served. A bundle of 2 kg of fresh palm frond was hung from the roof of the shelter in a position that allows the animals to eat easily. Special boxes are designed measuring 240 g of cottonseed and 200 g of *mucuna* seed, which help save time in the supplement distribution. Clean water was offered permanently in the pens and the salt block hung permanently.

Management of the Trials

The first growth trial was for four months from August 1995 to November 1995. The second lasts 9 months from August 1996 to April 1997 (3 to 12 months of age) and the third was also for 9 months from February 1997 to October 1997 (3 to 12 months of age). Each animal was identified by a numbered tablet kept by neck yoke. A number of an animal included treatment and animal numbers. Thus, a tablet numbered 31 was for the animal of treatment 3 (T3). Data on feed intake, growth, mortality and causes of mortality as well as observations were collected in collaboration with the farmers. Special forms were elaborated for data collection and filled daily, weekly, and monthly. Weighing offer and refuse were executed every day, while the growers were weighed monthly and the mean growth rate was calculated as:

Mean growth rate per treatment was estimated from individual growth rates of the animals.

Mortality rate in each treatment was estimated for the period of the trial as:

$$MR(\%) = 1000 \times \frac{\text{Initial size} - \text{Final size} \times 100}{\text{Initial size}}$$

Results

Farmers' Involvement

The treatments were distributed among 12 farmers, each of them managing 2 to 4 different treatments. The general principles of distribution of treatments among farmers were:

- a) Allow a farmer who manages a treatment with seed to compare both seeds.
- b) Allow a farmer managing a diet to compare the same diet + salt lick.
- c) A farmer managing the control (diet 1) should not manage a seed. This, in order to avoid the general observation that farmers with the control have tendency to apply the experimental treatment to the control (RAMR, 1990).

Thus, the distribution was (T1, T2) managed by 4 farmers and T3, T4, T5, T6) managed by 8 farmers. Each farmer managing (T1, T2) had two pens, each pen receiving one animal, whereas the farmers managing (T3, T4, T5, T6) had 4 pens each pen received one animal.

The pens were built at the farmer's home and the roles of the farmers were:

Collect the palm frond from the palm grove.

Sweep the shelter and clean the watering place.

Help the research technician weigh the animals.

Make observations on the trial.

Statistical Analysis

The size of data recorded per treatment varied in relation with the final size of the animals in each treatment. Therefore, analysis of variance of samples of unequal sizes method (Snedecor and Cochran, 1989) was used to analyse all the data of the trials.

Dry Matter Intake (DMI)

DMI in the First Growth Trial

In the first trial, mean dry matter intake by growers during the period of 8 to 12 months of age ranged between 43.2 g in the control (T1) and 57.4 g/kg^{0.75}/day in T5 (Table 30). Treatment effect on dry matter intake by growers was significant (P<0.05). The growers fed the seeds consumed significantly more dry matter (P<0.05) than those fed sole palm frond (T1) (Table 2). There was no significant difference in dry matter intake (P>0.05) by growers fed mucuna seed (T5, T6) (57.4 g, 56.8 g) and the mean recorded with the cottonseed plus salt lick in T4 (55.4 g) (Table 2). The mean dry matter intake by growers fed cottonseed (T3) was not different (P>0.05) from the mean recorded with the palm frond plus mineral lick (T2: 47.9 g) (Table 2). A non-significant increase was observed with the T2 and T4. On the contrary a slight decrease was noticed with the salt lick in T6 compared to T5 (Table 2).

DMI in the Second Growth Trial

In the second growth trial the mean dry matter intake by s in the period of 3 to 12 months of age ranged between 41.7 in the control (T1) and 54.3 g/kg^{0.75}/day in T6 (Table 2). Treatment effect on dry matter intake by growers trial was not significant (P>0.05). However the values recorded with the seeds were greater than s obtained in the control (T1) and T2 (42.8 g) (Table 2). The means with mucuna seed varied from 46.6 g (T5) to 54.3 whereas 46.9 g to 50.4 g was recorded with the cottonseed (T3, T4). There was a slight increase in all the treatments with salt lick T2, T4, T6 (Table 2).

Table 2: Dry intake (DMI) at grower stage (g/kg^{0.75} / day).

	T1	T2	T3	T4	T5	T6
DMI (1)	43.2 ^a	47.9 ^{ab}	52.9 ^{bc}	55.4 ^c	57.4 ^c	56.8 ^c
Mean SD	5.9	4.5	10.3	7.4	7.8	8.4
	SE=3.08		LSD=8.7		P<0.05	
DMI (2)	41.7	42.8	46.9	50.4	46.6	54.3
Mean SD	4.4	4.3	7.2	7.4	5.0	6.8
	SE=3.18				p>0.05	
DMI (3)	40.4	42.7	47.7	50.6	51.3	53.0
Mean SD	6.0	4.6	10.4	6.9	8.7	8.4
	Se=3.47				p>0.05	

Means bearing different letters along a horizontal row differ significantly (p<0.05).

DMI in the Third Growth Trial

In the second growth trial the mean dry matter intake by growth in the period of 3 to 12 months of age range between 41.7g in the control (T1) and 54.3g/kg^{0.75}/day in T6 (table 2). Treatment effect on dry matter intake by growers in this trial was not significant (P>0.05). However the values recorded with the seeds were greater than the means obtained in the control (T1) and T2 (42.8 g) (Table 2). The means with mucuna seed varied from 46.6 g (T5) to 54.3g (T6) whereas 46.9 g to 50.4 g was recorded with the cottonseed (T3, T4). There was a slight increase in all the with salt lick T2, T4, T6 (Table 2).

DMI in the third growth trial

In this trial the mean dry matter intake by the experimental grower goats for the period of 3 to 12 months of age varied 40.4 g in the control T1 to 53.0 g/kg^{0.75}/day in T6 (table 2) Treatment effect on dry matter intake was not significant (P>0.05) (Appendix a), although the values recorded with the seeds (T3 to T6) were higher (47.7 g to 53 g) than the in the control (T1) and T2 (40.4 and 42.7) (Table 2). The greater values were recorded with

the mucuna seed (T5, T6) (51.3 g, 53.0 g) and a little increase was observed in the dry matter intake with the salt lick in T2, T4 and T6.

Digestible Dry Matter Intake (DDMI) at Grower Stage

DDMI in the First Growth Trial (8 to 12 Months)

The mean digestible dry matter intake by growers in the period of 8 to 12 months ranged between 25.8 g in the control (T1) and 39.1 g/kg^{0.75}/day in T5 (Table 3). Treatment effect on digestible dry matter intake was highly significant (P<0.01). The growers fed the seeds (T3 to T5) consumed more digestible dry matter (33.8 to 39.1g) (P<0.01) than those in the control (Table 3). The differences between the values recorded the mucuna seed and the cottonseed were not significant (P>0.05). A non-significant increase in digestible dry matter intake was observed with the salt lick in T2 and T4. On the contrary a little decrease was noticed in T6 (Table 3).

Table 3: Digestible dry matter intake (DDMI) at grower stage (g/kg^{0.75} /day).

	T1	T2	T3	T4	T5	T6
DMI (1)	25.8 ^a	27.1 ^a	33.8 ^b	36.8 ^b	39.1 ^b	38.7 ^b
Mean SD	3.5	2.5	6.6	4.9	5.3	5.8
	SE=2.02		LSD=5.7		P<0.01	
DMI (2)	24.9 ^a	24.2 ^a	30.0 ^{ab}	33.5 ^{bc}	31.7 ^{bc}	37.5 ^c
Mean SD	2.7	2.4	4.6	4.9	3.4	4.7
	SE=2.29		LSD=6.51		P<0.01	
DMI (3)	24.1 ^a	24.1 ^a	30.5 ^b	33.6 ^b	35.0 ^b	33.6 ^b

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Mean SD	3.6	2.6	6.6	4.6	5.9	5.8
	SE=2.10		LSD=5.9		P<0.01	

Means bearing different letters along o horizontal row differ significantly (p<0.01).

DDMI in the Second Growth Trial (3 to 12 Months)

The mean digestible dry matter intake by growers born at the kidding of the experimental female goats used in the growth trial varied from 24.2 g in T2 to 37.5 g/kg^{0.75}/day (Table 3), whereas a value of 24.9 g was recorded in the control (T1) (Table 3). Treatment effect was highly significant (P<0.01).

The value in T3 was not statistically different (P>0.05) from the means recorded in T1 and T2 (Table 3). There was no significant difference between the digestible dry matter intake with the mucuna seed (T5, T6) (31.7 g, 37.5 g) and the value recorded with the cottonseed plus mineral lick (T4) (33.5 g) (Table 3). The value recorded with the mucuna seed plus salt 6) was higher (P<0.01) than the mean obtained with the cottonseed without salt lick T3 (30.0 g) (Table 3)

A non-significant increase in digestible dry matter intake was observed with the salt lick in T4 and T6. On the contrary a non-significant decrease was noticed in T2 so that the latter treatment showed the lowest value of digestible dry matter intake the second trial.

DMI in the Third Growth Trial (3 to 12 Months)

The digestible dry matter intake by the experimental growers at the second kidding of the female goats ranged between g in the control (T1) and 36.6 g/kg^{0.75}/day in T6 (Table 3).

Treatment effect on digestible dry matter intake was highly significant (P<0.01).

The seeds improvement on digestible dry matter intake by growers was highly significant (P<0.01). The values recorded with the mucuna seed in T5 (35.0 g) and T6 (36.6 g) were not statistically different (P>0.01) from the means obtained with the cottonseed in T3 (30.5 g) and T4 (33.6 g) (Table 3). A non-significant increase in digestible dry matter intake was served with the salt lick in T4 and T6, but the value in T2 4.1 g) was similar to the mean recorded in T1.

Digestible Crude Protein Intake (DCPI) at Grower Stage

DCPI in the First Growth Trial (8 to 12 Months)

The mean digestible crude protein intake by growers in the period of (8 to 12 months) ranged between 3.3 g in the control and 6.4 g/kg^{0.75}/day in T5 (Table 4). Treatment effect on digestible crude protein intake by growers was highly significant (P<0.01).

The seeds improvement on digestible crude protein intake by growers was highly significant (P<0.01). The values recorded with the mucuna seed (T5, T6) were significantly higher (p<0.01) than the mean obtained and T4 (5.3 g). There was a non-significant increase (P>0.05) of digestible crude protein intake with the salt lick in T2 and T4.

DCPI in the Second Growth Trial (3 to 12 Months)

The digestible crude protein intake by growers born at the first kidding of the experimental female goats ranged between 3.1 g in the control (T1) and 5.9 g/kg^{0.75}/day in T6 (Table 4). Treatment effect on digestible crude protein intake by growers was highly significant (P<0.01). The seeds improvement on digestible crude protein intake (T3 T6) was highly significant (P<0.01). The values recorded with the mucuna seed (T5, T6) were not different (P>0.05) from - e value of 5.3 g obtained with the cottonseed plus salt lick 4) (Table 4). However the mean recorded with the mucuna seed us salt lick (T6) was higher (p<0.01) than the value obtained growers fed cottonseed without salt lick (T3). There was a non-significant increase (P>0.05) in digestible rude protein intake with the salt lick in T2, T4 and T6.

Table 4: Digestible crude intake at grower stage (g/kg^{0.75}/ day).

	T1	T2	T3	T4	T5	T6
DCPI (1)	3.3 ^a	3.7 ^a	4.9 ^b	5.3 ^b	6.4 ^c	6.3 ^c
Mean SD	0.4	0.4	1.0	0.8	1.0	1.0
	SE=0.33		LSD=0.95		P<0.01	
DCPI (2)	3.1 ^a	3.3 ^a	4.4 ^b	5.3 ^{bc}	5.0 ^{bc}	5.9 ^c
Mean SD	0.3	0.3	0.6	1.0	0.8	1.1
	SE=0.42		LSD=1.1		P<0.01	
DCPI (3)	3.0 ^a	3.3 ^a	4.7 ^b	5.2 ^b	6.1 ^{bc}	6.5 ^c
Mean SD	0.5	0.4	1.1	0.8	1.0	1.0
	SE=0.38		LSD=1.1		P<0.01	

Means bearing different letters along a horizontal row differ significantly (p<0.01).

DCPI in the Third Growth Trial (3 to 12 Months)

The digestible crude protein intake by growers weaned at the second kidding of experimental female goats varied from 3.0 g in control to 6.5 g/kg^{0.75}/day in T6 (Table 4). Treatment effect on digestible crude protein intake was highly significant (P<0.01). The seeds improvement on digestible crude protein intake by growers was highly significant (P<0.01). The values recorded with the cottonseed (T3, T4) were not different (P>0.05) from obtained with the mucuna seed without salt lick (T5) (6.1g) (Table 4), whereas the value recorded with the mucuna seed plus salt lick (T6) was higher (P<0.01) than the mean obtained in growers fed cottonseed without salt lick (T3) (4.7 g) (Table 4). A non-significant increase was observed with the salt lick in T2, T4, and T6. (Table 4).

Daily Weight Gain of Growers

First Growth Trial

The growth rate of growers of 8 to 12 months ranged between 18.4 g in the control (T1) and 29.6 g/day in T6 (Table 5). Treatment effect was highly significant (P<0.01). The growers fed diets supplemented with the seeds (T3 to T6) showed higher growth rate (P<0.01) than those in the control (T1). The animals fed mucuna seed plus salt lick (T6) grew faster (29.6 g) (P<0.01) than those fed the cottonseed without salt lick (T3) (Table 5). There was no significant difference (P>0.05) between the values recorded in T4, T5, and T6. A non-significant increase (P>0.05) of growth

rate was observed with the salt lick in T2, T4 and T6.

Second Growth Trial

The daily weight gain of growers of 3 to 12 months varied from 20.3g in T1 to 33.1 g/day in T6 (Table 5). Treatment effect was highly significant (P<0.01). The growers fed the seed (T3 to T6) showed higher growth rate (P<0.01). There was no significant difference (P>0.05) in growth rate of animals fed mucuna seed (T5, T6) and those fed cottonseed plus mineral lick (T4) (Table 5) whilst the value in T6 was higher (P<0.01) than the mean in T3. The salt lick improvement on growth rate was not significant in T2, T4 and T6 (P>0.05). The values were 23.2, 30.3 and 33.1 respectively (Table 5).

Third Growth Trial

The mean growth rate of growers of 3 to 12 months varied from 23.4 g in the control to 35.8 g/day in T6 (Table 5). Treatment effect was highly significant (P<0.01). The animals fed the seeds grew faster (P<0.05) than those fed sole palm frond (T1) or palm frond + mineral lick (T2). No significant difference was found between the two seeds. However, the value recorded in T6 was higher (P<0.01) than the mean obtained in T3. The mineral lick improvement on daily ht gain of growers was significant in T6 (P<0.01) than the mean obtained in T3. The mineral lick improvement on daily weight gain of growers was significant in T6 (P<0.01) (table 5).

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Table 5: growth (GR) at grower stage (g/day).

	T1	T2	T3	T4	T5	T6
GR (1)	18.4 ^a	19.2 ^a	24.6 ^b	26.4 ^{bc}	28.3 ^{bc}	29.6 ^c
Mean SD	2.9	3.0	5.1	5.7	5.2	3.6
	SE=1.76		LSD=5.0		P<0.01	
GR (2)	20.3 ^a	23.2 ^a	27.1 ^b	30.3 ^{bc}	30.4 ^{bc}	33.1 ^c
Mean SD	2.5	2.5	4.6	4.5	2.9	4.4
	SE=1.96		LSD=5.5		P<0.01	
GR (3)	23.4 ^a	25.9 ^a	29.9 ^b	33.5 ^{bc}	30.3 ^b	35.8 ^c
Mean SD	1.9	5.1	2.7	4.9	3.8	4.7
	SE=1.80		LSD=5.1		P<0.01	

Means bearing different letters along a horizontal row differ significantly (p<0.01).

Weight at One Year

Second Growth Trial

The weight of growers at one year ranged between 9.2 kg in the control (T1) and 14.6 kg in T6 (Table 6). Treatment effect on at on year was highly significant (P<0.01). The growers fed diets supplemented with the seeds showed higher weight at one year (P<0.01) compared to the control (T1) and T2. The mean weight at one year varied from 12.0 kg in T3 to 14.6 kg in T6 (Table 6). There was no significant difference (P>0.05)

between the values in T3, T4, and T5, whereas the value in T6 was higher (P<0.01) than the mean recorded in T3. About 3 to 5 kg more were gained by animals fed the seeds. No significant difference was found between the two seeds, though greater weights at one year were recorded with the mucuna seed in T5 (13.4 kg) and T6 (Table 6). An increase of about 1 kg was observed in all the treatments with the salt lick, so that higher values were recorded in treatments with mineral lick (T2, T4, and T6).

Table 6: Weight at one year in the second and the third trial (kg).

	T1	T2	T3	T4	T5	T6
2 nd growth	9.2 ^a	10.2 ^a	12.0 ^b	13.2 ^{bc}	13.4 ^{bc}	14.6 ^c
Trial	0.7	0.7	1.2	1.2	0.8	1.2
Mean SD	SE=0.53	3.0	LSD=1.5		P<0.01	
3 rd growth	10.1 ^a	11.1 ^a	12.8 ^b	13.9 ^{bc}	13.2 ^b	15.1 ^c
Trial	0.5	1.4	0.7	1.3	1.0	1.3
Mean SD	SE=0.49		LSD=1.4		P<0.01	

Means bearing different letters along a horizontal row differ significantly (p<0.01).

Third growth trial

The weight of grower goats at one year in the third growth trial varied from 10.1 kg in the control (T1) to 15.1 kg in T6. Treatment effect on weight at one year was highly significant (P<0.01). The growers fed the seeds showed higher weights at one year (P<0.01). The values varied from 12.8 kg in T3 to 15.1 kg in T6. There was no significant difference between the two seeds. However, the value in T6 was higher (P<0.01) than the mean record in T3. An increase of 2 to 5 kg was observed with the seeds. About 1 to 2 kg of increase was noticed in treatments with

the salt lick (T2, T4, and T6) (Table 6). The salt lick effect was significant in T6.

Mortality Rate of Growers

Mortality Rate at First Growth Trial

Initial size was 8 animals per treatment (Table 7). None of animals fed the seeds died (except that in T5 an animal died from diarrhoea). Two animals in the control (T1) and one in T2 died during this trial. Therefore, mortality rate calculated for the period of the trial (4 months) was 25% in the control and 12.5% in

T2 and T5 (Table 7). The mortality rate decreased in treatments with mineral lick (T2,

T4, T6) (Table 7).

Table 7: Mortality rate at grower stage (3 to 12 months).

	T1	T2	T3	T4	T5	T6
1st growth trial	8	8	8	8	8	8
Initial size	2	1	0	0	1	0
dead	25	12.5	0	0	12.5	0
mortality %						
2 nd growth trial	3	5	5	7	5	7
Initial size	1	1	1	0	0	1
dead	33	20	20	0	0	14
mortality%						
3 rd growth trial	4	6	7	8	7	9
Initial size	1	1	0	0	0	1
dead	25	17	0	0	0	11
mortality%						
Mean of (1, 2, 3)	28	17	7	0	4	8

Mortality Rate at Second Growth Trial

The growers in the second growth trial are the weaned progenies of the animals used in the first growth trial. As some of the growers died at pre-weaning stage the available weaned growers were reduced and initial numbers were smaller than in the first trial. Thus, initial size per treatment varied from 3 to 7 growers (Table 7), and the number of dead animals varied from zero (T4, T5) to one (T1, T2, T3, T5) (Table 7).

Mortality rate calculated for the trial period was (in 9 months) 0% in T4 and T5, 14% in T6, 20% in T2 and T3 and 33% in the control (T1). In this trial the lower mortality rates were recorded in treatments with the seeds (T3 to T6). The mortality rate decreased in treatments with the mineral lick (T2 and T4) except in T6 (Table 7).

Mortality rate at third growth trial

The growers in this trial are the weaned progenies at the second kidding of the females used in the first trial. Some of these progenies died at pre-weaning stage (Table 7) and the number of available weaned growers was reduced in some of the treatments.

However, larger initial sizes of 8 to 9 growers were observed in some of the treatments (Table 7) as result of increased litter size in does at their

second kidding (Table 7). Thus, initial size per treatment in the third growth trial was 4 to 9 (Table 7). Smaller initial sizes were in T1 and T2 as result of lower litter size of their does and higher mortality of the kids at pre-weaning stage. Dead animals in this trial were zero (T3, T4, T5), to one (T1, T2, T6). Thus, calculated mortality rate for the trial period was 0% in T3, T4, and T6, 11% in T6, 17% in T2 and 25% in T1 (Table 7). Thus, the lower mortality rate were recorded in treatment with the seed (T3 to T6) and the higher mortality rate were observed in the control (T1). The mortality rate decreased in treatments with the salt lick (T2, T4) except in T6 (11%). The mean mortality rate of the three trials varied from 0% with the cottonseed supplement + mineral lick (T4) to 28% in the control (T1) (Table 7). The lower mean mortality rates were recorded in treatments with the seeds whereas salt lick effect was positive in T2 and T4.

Discussions

Dry Matter in Take by Growers

The dry matter intake recorded per treatment in the first growth trial with grower goats of 8 to 12 months of age was slightly higher than those observed in growers of 3 to 12 months because

the former were used to browsing before the trials start. The period of 3 to 5 months was a period of training to browsing by the animals in the second and third growth trial, which slightly depressed the means calculated in these trials.

The values recorded for all the growth trials were in the range of 40 to 60 g/kg^{0.75}/day, which was lower than the value reported in young grower goats fed young *Panicum* supplemented with *Leucaena* (101.1 g) (Kakengi, 2001) and also lower than the range of 72.3 to 77 g/kg^{0.75}/day recorded in young growers fed *Gliricidia* as basic ration supplemented with on soybean milk residue, cowpea seed waste and corn starch residue (Odeyinka *et al.*, 2003). The lower level of dry matter intake by growers in this trial may be explained partly by the type of supplement used, the cottonseed and the mucuna seed which are less palatable to goats than the ingredients used by these authors.

Digestible Dry Matter Intake by Growers

The values recorded with the palm frond in these trials (24 to 26 g) were higher than the 19.5 g and 23.5 g reported in goats fed *Panicum* hay and *Panicum* hay + low level of *Gliricidia* (10 g DM/kg^{0.75}) respectively (Adjiboye, 1983). However, the level of digestible dry matter intake by growers in the control T1 is still under the maintenance requirements of 29.6 g DDMI/kg^{0.75}/day assuming ash = 10% (N.R.C, 1981; Bosman *et al.*, 1987).

The digestible dry matter intake in T2 ranging between 24 g and 27 g in all the trials were also below the maintenance requirements, whereas the seeds have increased the total digestible dry matter intake from less than 26 g to more than 33 g. Particularly with the mucuna seed digestible dry matter intake was 35 g to 40 g, which was close to the value of 35.0 g reported in growers of 3 to 5 months fed *Panicum* plus *Leucaena* (Egbe, 1984). Similar range of digestible dry matter intake of 37.4 g to 42.3 g was also reported by Ademosun *et al.*, (1985) in young grower goats fed legume browses such *Leucaena* and *Gliricidia*. However, the value in this trial is lower than the mean of

55 g reported in grower goats fed *Panicum* maximum supplemented with concentrate (Egbe, 1984). The concentrate used by Egbe was a mixture of maize, rice bran, brewers dried grains, salt and vitamins + minerals.' Such concentrate, however cannot be purchased by poor resource farmers in the Adja plateau. Therefore, the seeds showed a potential value as supplements to. Low quality diet. In this respect they are comparable to the legume browses such as *Leucaena* and *Gliricidia*.

Digestible Crude Protein Intake

The digestible crude protein in the control was 3.0 to 3.3 g or a mean of 3.1 g/kg^{0.75}/day which can meet the requirements for maintenance taken at 2.5 g/kg^{0.75}/day (Rivière, 1978). However the surplus of digestible crude protein is low and allows only a low growth rate. A grower of about 10 kg live weight (5.6 kg metabolic weight) consumed about 3.1 g x 5.6 = 17.3 g. This level of intake is below the requirements for 30 g growth rate, whereas a grower of 15 kg live weight (7.6 kg metabolic weight) in the control consumed 3.1 g x 7.6 = 23.7 g which is also below the requirements for 30 g growth rate.

Therefore the digestible crude protein intake in the control can only ensure a low growth rate. The digestible crude protein intake with the mucuna seed, ranging between 5.0 g and 6.5 g with a mean of 6.0 g, is more than 100% above the requirements for maintenance. A grower of 10 kg live weight (5.6 kg metabolic weight) consumed 6.0 g x 5.6 = 33.6 g which can meet the requirements for 50 g growth rate. A grower of 15 kg (7.6 kg metabolic weight) consumed 6.0 g x 7.6 = 45.6 g. This allows more than 50 g growth rate. The overall mean digestible crude protein intake was 4.9 g in treatments with the cottonseed and a grower of 10 kg live weight consumed 4.9 g x 5.6 = 27.4 g, which is close to the requirements for 50 g growth rate. A 15 kg grower consumed 4.9 x 7.6 = 37.2 g, which also covered the 34 g requirements for 50 g growth rate. Thus, the digestible crude protein intake recorded with the cottonseed allows for about 50 g growth rate.

Growth Rate

In the control (T1) and (T2) the growth rate of 18 g to 23 g with a mean of 20.7 g recorded for the trials was slightly lower than the mean of 25 g reported earlier in the same area in growers between 3 and 12 months of age (RAMR, 1992). This lower value may be related to the fact that offer of pure palm frond in this trial was rigorous, whereas in RAMR monitoring the feed was sometimes mixed with a small part of other browses or forage species or with kitchen wastes. Also, RAMR monitored animals sometimes escaped from tethering and have the opportunity to graze and improve their diets. The value recorded with the palm frond is similar to the mean of 20 g growth rate (between 3 and 5 months) reported in growers fed only *Gliricidia* legume browse at village level (Boon *et al.*, 1984). From Boon's report it also appeared that the combination of *Leucaena* and *Gliricidia* increased the digestible dry matter intake and allowed a higher growth rate of about 35 g/day (75% increase). He concluded that inclusion of more components in goat's diet tended to increase the digestible dry matter intake and the animal performance. Therefore, diversification of the feed component, appeared as a factor of feed intake and performance improvement in goats. However the low digestible crude protein intake with the palm frond as calculated above is probably the major factor that lowered the growth rate in treatment T1 and T2.

The growth rate of 27 to 30 g/day recorded with the cottonseed match well with the 28.7 g reported in growers fed young *Panicum maximum* supplemented with 40% *Gliricidia Sepium*, whereas the range of 29 to 35 g recorded with the mucuna seed is comparable to the 32 g growth rate reported in young goats fed *Panicum* hay + high. Level of *Leucaena* (30 g/kg^{0.75}).

This shows the potential of the seeds as supplements to the palm frond, particularly that the mucuna seed. However, the values recorded are below the 60 g growth rate reported in growers fed *Panicum* hay supplemented with commercial concentrates (Ademosun *et al.*, 1985).

The mortality rate observed in growers before 12 months ranging between 25 and 33% (mean =

28%) in the control is close to the value of 30% reported earlier on the Adja plateau (RAMR, 1992) and lower than the range of 40 to 60% reported in post-weaned goats on farms in Togo (Hadzi, 1987). Between zero and one year mortality rate of 30% is also reported on farms in Senegal (IEMVI, 1990).

Although morbidity from PPR is low in the area, farmers are very aware of this disease because of its deadly nature. In fact, mortality rate of more than 60% is generally observed when PPR occurs (Koudandé, 1993). Vaccination against PPR is yearly organized in the area and incidence of this disease have been reduced. Nevertheless, other prevalent diseases such as broncho-pneumonia, enteritis diarrhoea and scabbies occur and are not only of high morbidity but also of high case fatality rates. Similar observations are reported in Nigeria at village level by Smith *et al.*, (1987) who classified the various diseases occurring in confined goats flock into three categories:

High morbidity-high mortality diseases such as enteritis broncho-pneumonia and injuries

High morbidity-low mortality diseases such as contagious ecthyma and caseous lymphadenitis

Low morbidity-high mortality diseases such as PPR and coccidiosis.

Against the more prevalent diseases, farmers in the area, are used to endogenous practices such as feeding the animals with grilled maize or introduction of local limestone in drinking water to treat cases of diarrhoea, rubbing mixture of kerosene plus palm oil on the animal's body to treat scabbies. Against the respiratory diseases such as broncho-pneumonia, the farmers use the commercial chloramphenicol capsules. However, efficiency of these practices have not been well established. For the majority (67%) of the goat keepers in the zone these practices are not efficient as the mortality rate is still high {Koudandé, 1993}.

In the current trial, no case of PPR was observed probably as result of the systematic vaccination of the experimental goats. Although the animals were dewormed twice a year with an anthelmintic (Bolumisole RI), cases of enteritis diarrhoea and broncho-pneumonia were observed. All the cases of diarrhoea occurred in treatments without salt lick (T1, T3 and T5)

whereas the broncho-pneumonia was observed particularly in the control. The farmer's endogenous practices have been used in this trial. Thus, the broncho-pneumonia was treated with chloramphenicol with 49% success, whereas 51% of the animals that suffered from the disease died.

About 70% of the animals that succumbed to diarrhoea responded to the limestone in drinking water that was similar to the positive response of a large number of animals to kaolin used against enteritis in Nigeria (Smith *et al.*, 1987). In relation with the fact that no case of diarrhoea have been, observed in treatments with the salt lick, this suggests that the calcium content of the limestone and the kaolin, as well as the calcium of the salt lick played a role of intestinal astringent making the growers resistant to diarrhoea. This partly explains the lower mortality rates in treatments with the salt lick in T2, T4 and T6.

Conclusion

The seeds improvement on dry matter intake was not significant. However the seed improvements on nutrients intake such as digestible dry matter and digestible crude protein were highly significant. The difference between the two seeds was not significant although greater values were recorded with the mucuna seed. The palm frond offered alone did not meet the maintenance requirements of digestible dry matter and crude protein in growers, whereas the seeds were comparable to *Gliricidia* and *Leucaena* legume browses. The salt lick improvements on digestible dry matter and crude protein intake were not significant. The seeds improvements on growth rate of growers and weight at one year were significant ($P < 0.01$). Lower mortality rates were recorded in growers fed the seed, particularly the seed + salt lick. The higher performances were recorded with the mucuna seed. The salt lick improvement on growth rate of growers was not significant.

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