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Effect of *Spondias mombin* on Intake and Digestibility in West African Dwarf Sheep Fed Graded Level of Whole Cassava Root Meal Based Diet

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Abstract

The supplementing of *Spondias mombin* instead of concentrate mixture diets and its effect on feed intake body weight change and digestibility was investigated using sixteen West African Dwarf Sheep in a completely randomized design experiment. The diets used were 100% concentrate (Diet 1; control), 75% concentrate plus 25% *Spondias mombin* (Diet 2), 50% concentrate plus 50% *Spondias mombin* (Diet 3) and 25% concentrate plus 75% *Spondias mombin* (Diet 4). Dry matter intake was significantly (P < 0.05) higher in sheep fed concentrate diet plus *Spondias mombin* (Diets 2, 3 and 4) than those fed concentrate alone (Diet 1, control). The highest dry matter intake was exhibited by sheep fed 50% concentrate plus 50% *Spondias mombin*. Sheep fed concentrates plus *Spondias mombin* exhibited a superior daily weight gain to those fed concentrates only. Live weight gain was not significantly (P > 0.05) different between diets 3 and 4. However, a significant (P < 0.05) difference existed among diets 3 and 4, and the other two dietary treatments. Feed conversion (feed/gain ratio) was significantly higher (P > 0.05) in animals fed diets 3 and 4 than those diets 1 and 2. Nutrient digestibility was not significantly (P > 0.05) influenced by dietary treatments. In conclusion, the intake and digestibility of nutrients by West African Dwarf were best when up to 50% and above of *Spondias mombin* was included in the diet. Therefore an indication that *Spondias mombin* could provide the needed nutrients for sheep especially during the dry season when feed resources are scarce.

Keywords: *WAD sheep, digestibility, Spondias mombin, Cassava Root Meal.*

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Introduction

Adequate nutrition is one of the ways to enhance livestock productivity. In Nigeria, the main feed resources for livestock are natural pastures (Aye, 2002). This is aggravated by lack of alternative feed sources or supplementation during critical periods (Mpairwe *et al.,* 1998). The demand for cheaper and quality alternative sources of livestock feedstuff to replace the expensive conventional feedstuffs particularly those of energy and protein origin is gathering momentum. Cassava is a crop that is dominant in the tropics. It is one of the most drought tolerant crops and can be successfully grown is marginal soils giving reasonable yields where many other crops cannot do well. Therefore cassava offers tremendous potentials as source of food energy for animals, provided it is well balanced with other nutrients. There is a great deal of current interest in supplementing feeds of animals with cassava in Africa.

Spondias mombin (iyeye), is a browse plant that is common in many parts of West Africa and it is available throughout the year. In, Nigeria, it is a popular animal feedstuff in the dry season when the quality of grasses available is poor and low in nutrients. One important attribute of forage legume is their positive effect on intake and digestibility (Ash, 1990; Aregheore and Yahaya, 2001). *Spondias mombin* is highly nutritive, with high levels of dry matter and crude protein. It can be fed as fresh forage, hay or silage (Carew *et al.*, 1980; Eniolorunda and Oduyemi, 2003). However, browse plants cannot constitute a complete feed when fed alone. This should be borne in mind in the feeding management of sheep (Carew, 1981). The present study was undertaken to evaluate the effect of replacement *Spondias mombin* on intake and digestibility of nutrients by West African Dwarf sheep fed graded levels of Cassava Root Meal based diets.

Materials and Methods

This study was carried out at the sheep and goat unit of the Department of Animal Production, Teaching and Research Farm, College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ogun State, Nigeria. Sixteen sheep (8 rams and 8 ewes) ranging between 10 and 12 months of age, with an average live body weight of 18.15±kg were used for this experiment. Prior to the commencement of the experiment, animals were dewormed using Levamisole and dipped into Diasuntol solution to control ectoparasites. Sheep were housed in disinfected and well ventilated pens. They were given 2.0kg (Dry Matter) of feed with free access to water for fourteen (14) days prior to the beginning of experiments in order to ensure uniform pre-experimental management. Animals were divided into four equal groups, according to their weight each group contained two rams and two ewes.

The experimental diets used were made up of *Spondias mombin* plus concentrate supplements. The concentrate consisted of Whole Dried Cassava Root Meal (WDCRM) and Dried Cassava Leaf Meal (DCLM) [which were derived from the bitter variety of *Manihot esculenta* (Crantz) at 36.5% and 12% respectively. Soil particles were washed off from unpeeled tubers, sliced into thin chips and sun dried to a constant weight on concrete platform. The dried chips were later milled to obtain Whole Dried Cassava Root Meal (WDCRM). Fresh cassava leaves harvested without petioles were chopped into smaller sizes immediately, wilted under shade for 24 hours and sun dried until practical dryness was achieved. Other ingredients include maize bran (20%), palm kernel cake (30%), mineral and vitamin premix (0.5%) and salt (1%). The determined crude protein of the concentrate supplement was 14% while that of dry *Spondias mombin* was 11.97% (AOAC, 2002).

The *Spondias mombin* leaves and branches were cut and sun dried for two and half to three hours to reduce moisture content. They were chopped daily before being supplied to experimental animals. Each of the group was fed for 42 days. Animals were given 1.65kg (1.50kg Dry Matter) per head daily. The residues of *Spondias mombin* and concentrate diets were weighed using sensitive top loading scale. In order to estimate feed intake. Animals were supplied with water *ad libitum.* There were four dietary treatments: 100% concentrate (Diet 1, control); 25% *Spondias mombin* plus 75% concentrate (Diet 2); 50% Spondias mombin plus 50% concentrate (Diet 3) and 75% *Spondias mombin* plus 25% concentrate (Diet 4). These diets were randomly allocated to the four groups.

Animals were weighed before and after each experimental period which lasted for 21-day preliminary period and 7-day collection period. The total daily faecal output was weighed for each animal and 25% of the sample was taken and stored in a freezer (-4^{0}C). These were bulked for each animal and dried in an oven at 105^{0}C for 24 hours to determine the dry matter (DM) contents. The grounded sun dried sample of *Spondias mombin* leaves, basal diets and faeces were analysed for their proximate composition (AOAC, 2002). The ground sample of dried whole cassava root and dried cassava leaves were also analysed. The nutrient intake, growth rate, nutrient digestibility, feed conversion (feed/gain ratio) and differences among treatment means were separated using Duncan Multiple Range Test (SAS, 2002).

Result and Discussion

Table 1 shows the chemical composition of the experimental diets. The *Spondias mombin* leaf meal has crude protein of such value (11.97%) was lower than that (13.97 – 17.84%) which was reported by Aina (1996). This difference in the percentage of crude protein may be as a result of several factors such as time of harvesting, nutrient composition of the soil in which it was planted as well as season of the year (Toledo and Formoso 1993; Lazo *et al.,* 1996; and Bamikole *et al.,* 2004). It has been reported that protein contents of browse has a range of 10.0% to 37.0% (Mecha and Adegbola, 1980); 9.2% to 34.0% (Ifut, 1981) and 25-50% (Mokoboki et. al., 2005). Though there are slight variation in the chemical composition of the experimental diets, but the differences are not significant (P > 0.05) as shown in Table (1).

Table 1. Chemical (Proximate) Composition of the experimental diets

Component	Diet 1	Diet 2	Diet 3	Diet 4	*Spondias mombin*
Dry matter %	92.13	91.50	90.82	90.16	89.50
Crude Protein %	14.00	13.50	12.98	12.48	11.97
Crude Fibre %	12.05	11.70	11.34	10.98	10.62
Ash %	10.80	10.53	10.28	10.01	9.75
Ether Extracts	4.40	4.50	4.59	4.69	4.78
Nitrogen Free Extracts %	58.75	59.83	60.92	62.00	63.08
Acid Detergent Fibre %	1.628	1.501	1.374	1.247	1.120
Neutral Detergent Fibre %	1.828	1.681	1.533	1.386	1.238
Acid Detergent Lignin%	1.038	0.968	0.898	0.828	0.758

Diet 1 (control) = 100% concentration
Diet 2 = 25% *Spondias mombin* plus 75% concentrate
Diet 3 = 50% *Spondias mombin* plus 50% concentrate
Diet 4 = 75% *Spondias mombin* plus 25% concentrate

Table 2. Intake of Nutrients by WAD sheep fed graded levels of Spondias mombin and Cassava Root Meal based diet.

Measurement	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Dry Matter Intake (g/day)	1202.29^{c}	1205.05^{c}	1498.53^{a}	1469.61^{b}	26.08
Feed conversion (g feed/g gain)	21.37^{b}	21.16^{b}	25.39^{a}	25.07^{a}	1.25
Crude Protein Intake (g/day)	182.70^{c}	177.80^{c}	214.17^{a}	203.42^{b}	8.05
Protein efficiency ratio (g protein/g sem)	3.25^{b}	3.13^{b}	3.63^{a}	3.47^{a}	0.19
Crude Fibre Intake (g/day)	150.72^{b}	147.50^{b}	178.75^{a}	170.72^{a}	6.85
Ether Extract Intake (g/day)	50.89^{b}	52.68^{b}	67.44^{a}	68.26^{a}	1.31
Nitrogen Free Extracts Intake (g/day)	727.54^{b}	748.45^{b}	955.10^{a}	961.11^{a}	20.51
Initial body weight (kg)	18.25	18.00	18.13	18.25	
Final body weight (kg)	22.30	22.10	22.38	22.47	
Body weight gain (kg)	4.05	4.10	4.25	4.22	
Live weight gain (g/day)	56.25^{b}	56.94^{b}	59.02^{a}	58.61^{a}	0.67

Means in the same row with different superscripts show significant difference ($p>0.05$).
Diet 1 (control) = 100% concentration
Diet 2 = 25% *Spondias mombin* plus 75% concentrate
Diet 3 = 50% *Spondias mombin* plus 50% concentrate
Diet 4 = 75% *Spondias mombin* plus 25% concentrate

Table 2 shows the intake of nutrients by West African Dwarf Sheep. Supplementation with *Spondias mombin* has a significant ($P < 0.05$) effect on daily dry matter intake. Dry matter intake increased as the percentage of Spondias in the diet increased except in diet four where there was a slight drop in dry matter consumption. Sheep fed 50% Spondias plus 50% concentrate, and also sheep feed 75% Spondias plus 25% concentrate exhibited a significantly ($P < 0.05$) higher dry matter intake (1498.53 and 1469.61g/day respectively) than the sheep on the other diets. Among animals fed Spondias plus concentrate, intake was significantly ($P < 0.05$) highest for those receiving 50% Spondias plus 50% concentrate. This result differs from that observed by Aina (1996) for West African Dwarf goats fed Spondias mombin plus concentrate. He observed the highest feed intake in goats fed 75% Spondias plus 25% concentrate diet.

Sheep offered diet 3 and diet 4, exhibited a significantly (P < 0.05) higher daily live weight gain (59.02 and 58.61 g/day respectively) than the sheep on diets containing 25% *Spondias* plus 75% concentrates. Average daily gain of (56.25, 56.94, 59.02 and 58.61g/day) obtained from the present study were within the range between (53 and 148g/day) reported by Abil *et al.* (1992) when they replaced cotton seed cake and maize with wheat bran in the diets of Yankassa sheep. Njire and Kana (1994) reported that ADG values were between 9 and 78g/day when they fed elephant grass supplemented with stylus and concentrate to West African Dwarf sheep.

Feed conversion followed a pattern that deviated from that of feed intake being significantly (P < 0.05) higher in Diets 3 and 4 than that of Diets 1 and 2. However, the best (P < 0.05) feed conversion was obtained in sheep fed 25% *Spondias mombin* plus 75% concentrate (Diet 2). There was no significant (P > 0.05) difference between Diet 1 and Diet 2 in terms of feed conversion.

Protein intake followed the same trend as feed intake. Crude protein intake was the highest (P < 0.05) in animals fed Diet 3 (50% concentrate + 50% Spondias). Animals on Diet 2 equally has a significantly (P < 0.05) higher protein intake than those on Diets 1 and 2 which had comparable values (P > 0.05). Protein efficiency ratio followed the same pattern as feed conversion ratio. Therefore, though high levels of *Spondias mombin* inclusion (Diets 3 & 4) elicited increased feed and protein intake, it did not translate to better efficiency of feed utilization. Invariably there are inhibitions to efficiency of protein utilization with increasing levels of *Spondias mombin*. The best efficiency of feed and protein conversion was in Diet 2 (75% concentrate and 25% Spondian) where the animals had the least protein intake. The possibility of a physiological adaptation of better utilization in the face of limited protein availability cannot be ruled out.

Fifty percent Spondias plus 50% concentrate also induced the highest (178.75 g/day) crude fibre intake. Ether extract intake was significantly (P < 0.05) higher in sheep fed diets 3 and 4 (67.44 and 68.26 respectively) than in sheep fed other diets. Plant palatability also plays a crucial role on feed intake by animals. The ether extract and fibre contents of Spondias mombin may also be the cause for higher feed intake by experimental animals on diets 3 and 4, as it has been said that nutrients such as crude protein, fibre and fat also relate to plant palatability (Malachek and Provenza 1981).

Animals on diets 3 and 4 had higher percentage of digestibility of nutrient (Dry matter, crude protein, crude fibre and ether extract). (Table 3). Similar trend was found for TDN (Table 3). However such differences were not significant. Though not significantly different (P > 0.05) digestibility results did not tally with the results on feed and protein conversion efficiency, which again raises the question of possible limitation at utilization at the systemic level.

Table 3. Nutrient Digestibility in Animal fed graded levels of Spondias mombin and Cassava Root Meal based diet.

Item	Treatment				
	Diet 1	**Diet 2**	**Diet 3**	**Diet 4**	**SEM**
Dry Matter	51.24	46.37	55.89	54.73	5.62
Crude Protein	58.94	60.22	65.31	63.92	4.44
Crude Fibre	51.79	45.94	57.79	55.46	6.80
Ash	55.89	44.51	62.47	59.80	9.18
Ether Extract	52.77	56.29	58.44	56.13	3.89
Nitrogen Free Extract	53.74	47.50	56.73	55.92	4.09
Total Digestible Nutrient (%TDN)	53.02	51.81	58. 48	56.97	3.09

Means on the same row with different superscripts show significant difference. ($P < 0.05$).

Crude protein and ether extract digestibility were significantly ($P > 0.05$) higher in the diet contained 75% Spondias plus 25% concentrate. Crude fibre digestibility was highest in diet containing 50% Spondias plus 50% concentrate. Dry matter digestibility was significantly ($P > 0.05$) higher in diet 1 (0.026) than in all other diets. Diets 3 and 4 had significantly ($P < 0.05$) higher TDN (85.346 and 85.817% respectively) than other diets. Generally, all the animals on all experimental diets were able to retain substantial amount of nutrients considering what was consumed to what was voided which was an indication of good nature of the experimental diets and remarkable management practice.

Conclusion

Results showed that the intake and digestibility of nutrients by West African Dwarf sheep were best when up to 50% and above of *Spondias mombin* was included in their diet. This therefore is an indication that *Spondias mombin* could provide the needed nutrients for sheep especially during the dry season when feed resources are scarce. However, more studies should be conducted to know the optimal inclusion rate for efficient utilization of *Spondias mombin* by ruminants.

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