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INTAKE AND DIGESTIBILITY OF ENSILED CASSAVA WASTES AND *ALBIZIA SAMAN* PODSS MIXTURE BY WEST AFRICAN DWARF SHEEP

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This study was conducted to determine the effect of ensiling on silage quality, feed intake and digestibility by WAD sheep. The nutritive value of cassava wastes (CSW) and *Albizia saman* podss (ASP) silage as indicated by chemical constituents were determined. Metabolizable energy was calculated, while Saponin and Tannin were determined qualitatively. Fifteen yearling ewes with an average live weight of 17.10 kg were randomly assigned to five treatments with three(3) replicates each comprising; 100% CSW(T1), 75% CSW + 25% ASP(T2), 50% CSW + 50% ASP(T3), 25% CSW + 75% ASP(T4), 100% ASP(T5). Results showed that Silages were of good quality. Saponin was detected to be low in the T3 and medium in the T5 silages while tannin was available in the T5 silage alone. The result of the feeding trial showed that there were significant difference ($p<0.05$) in feed DM intake (range 284.25 – 469.14 g/day), weight gain (range -0.62 – 4.80 g/d), apparent digestibility of crude protein (CP) (range 35.48 – 75.21 %), crude fibre (CF) digestibility (range 17.96 – 51.25 %), dry matter digestibility (range 36.15 – 68.47 %), nitrogen balance (range –1.04 – 16.71 g/d) and nitrogen retention (range -11.59 – 71.01 g/d). Ewes fed with T4 had highest feed intake and the least for those on sole CSW (T1). Weight gain (4.80 g/d) of ewes fed T4 silage increased significantly while those fed T1 lost weight and T5 maintained theirs. Apparent dry matter digestibility was highest significantly ($p<0.05$) in ewes fed T5 but least for those on T1. Nitrogen balance was apparently highest in ewes consuming T5 and the least for T1. The Nitrogen retention of the ewes on T5 diet was significantly higher ($p<0.05$) than that for T1 diet. It can thus be concluded that ensiling cassava wastes or *Albizia saman* pods solely as a dry season feed for sheep may be unsuitable, but when in combination will give a good feed resource.

Keywords: Cassava wastes; *Albizia saman* pods; intake; weight gain; ewes.

One of the major problems of feeding ruminants in Nigeria is the seasonal variation in the availability and nutritional value of native pasture or natural grassland (Obua, 2005). Hence the negative effect of the period is obvious in the lost weight, reduced milk production and high mortality of the animals (Babayemi, 2007). This problem can be solved through preservation of feedstuffs (McDonald *et al.*, 1991) which may include foliage podss from browse trees, shrubs, and by-products from food processing.

Many studies have been carried out to obtain the most suitable preservation or conservation techniques (Cooper and McGechan, 1996). Ensiling was found to be better than drying (Obua, 2005). Moreover, silage prepared in the rainy season for use in the dry period is a valid one (Medina *et al.*, 2003).

Cassava wastes constitute 20 - 35% of the total weight of the tuber and these wastes generated at present pose a disposal problem and would even be more problematic in the future with increased industrial production of cassava products due to the renewed interest in its production by the Federal Government of Nigeria (Otukoya and Babayemi, 2008). They constitute an important potential resource if properly harnessed biotechnologically (Obadina *et al.*, 2006) though mainly carbohydrate (fermentable) and low in protein content (Llano *et al.* 2008). Tree species, legumes and non legumes alike, day after day become more important as a feed resource for ruminants, and because of this, several studies have been carried out on the possibility of their inclusion in silage preparation in the tropics (Ojeda, 1999), because their foliage (Medina *et al.*, 2003) and pods could be used as an additional protein source. *Albizia saman* is considered a multipurpose tree (Ayodele *et al.*, 2003) with its leaves and podss forming a natural part of the diet of many ruminant and non-ruminants in the tropics. However, the pods contains hard seeds that are not easily broken down by ruminants after ingestion (Jolaosho *et al.*, 2006). Hence there is the need for proper utilization of the pods for ruminant production. Fermentation is one of the treatments employed to break down fibre.

The present study was thus designed to investigate the qualitative characteristics, nutritive value, intake and digestibility of cassava wastes ensiled with *Albizia saman* pods as a valid alternative for feeding ruminants in the tropics.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the small ruminant unit of the Teaching and Research Farm, University of Ibadan, Nigeria between March and August 2008. The location is $7^0 27$'N and $3^0 45$'E at an altitude of 200 – 300 m above sea level. The average annual rainfall is about 1250 mm with a mean temperature of 25 ^{0}C – 29 ^{0}C. The study coincided with the commencement of dry season period in Nigeria.

Collection and preparation of silage materials

Cassava wastes (CSW), (consisting of peel and skin of tuber) were collected from Mokola in Ibadan and the podss were hand picked from the *Albizia saman* (ASP) trees within the campus of the University of Ibadan, between January and March. The CSW and *Albizia saman* podss were mixed for silage in a 30 kg plastic capacity silo. Each silo was lined with polythene sheets. Each silo was then filled with Cassava wastes and *Albizia saman* podss either singly or in mixtures as the case may be. The materials in the silo were compressed to eliminate trapped air, and rapidly sealed with the initially lined polythene sheets in order to prevent re-entry of air. Sand bags were placed on each of the silos. The ensiling lasted for six months.

Experimental animals and diets

Fifteen ewes, aged between 10-12months with mean weight 17.20 ± 0.08kg were used for the growth trials. The animals were bought from Bodija and Oranyan market within Ibadan metropolis, Ibadan, Nigeria. They were fed with their usual feed before acclimatization periods. The animals were prophylactically treated with Oxytetracyline long acting antibiotics (Oxytetracure LA. 20%) and dewormed with levamisole (1mg/10kg) body weight, respectively. They were dipped against ectoparasites with Amitraz solution and were allowed to adapt for 2 weeks.

The ewes were divided into 5 groups of three animals per treatment based on body weight and were randomly allocated to the experimental diets in a completely randomized design. The five treatments were: 100 % CSW (T1), 75%CSW+25%ASP(T2), 50 % CSW + 50 % ASP(T3), 25 % CSW + 75 % ASP(T4) and 100 % ASP(T5). The silages were offered at 08.00 h at 2kg per animals and at 10.00 h Guinea grass were offered to each of the animal. The feeds offered and refused by the animals were carefully weighed using a top loading scale. This is done so as to determine the actual voluntary feed intake by difference. The animals were weighed weekly before morning feed to ascertain weight change throughout the period of 56 days.

Digestibility and nitrogen utilization trials

The ewes were kept in separate metabolic cages, which allowed for separate urine and faecal collection. The animals were allowed 7 days to adapt to the metabolic cages and another 7 days for collection of faeces and urine. Ten percent of each day's collection of faeces was sampled and then bulked. The faeces collected were stored in the freezer until ready for analysis. The urine was collected in bottles wetted with 2ml of 10 % tetraoxosulphate VI acid to prevent nitrogen loss and stored in a freezer pending analysis.

Chemical analysis

Dried and ground samples of the silage and faeces were used for chemical analysis. Nitrogen in the silage, faeces and urine was analyzed, using micro-kjedahl method and value was multiplied by 6.25 to determine the crude protein content. Crude fibre, ether extract and ash in silage and faeces were determined according to A.O.A.C. (1990). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined in the silage and faeces using the procedures of Van Soest *et al.* (1991). Metabolizable energy was also calculated according to the methods of Alderman (1985) and MAFF (1984) and the mean values calculated.

Statistical Analysis

All data collected were subjected to a one way analysis of variance (ANOVA) using SAS (1999) computer software package significant treatment means were compared using the Duncan Multiple Range T-test of the same software. The statistical design was completely randomized design.

RESULTS AND DISCUSSION

Table 1 shows the quality of ensiled feedstuffs made from cassava and *Albizia saman* pods combinations.

Table 1: Quality of ensiled cassava wastes with *Albizia saman* pods

Parameters	Treatments				
	100%CSW	75%CSW+ 25%ASP	50%CSW+ 50%ASP	25%CSW+ 75%ASP	100%ASP
Colour	Dark Brown	Dark Brown	Dark Brown	Reddish Brown	Reddish Brown
Odour	Alcoholic (Strong)	Alcohol	Alcohol	Alcohol	Alcohol
Texture	Wet and Firm	Wet and Firm	Semi-dry, very firm	Dry and firm	Dry, very firm
Temperature (°C)	25.13	25.83	25.83	25.67	27.00
pH	3.38	3.46	3.63	4.61	4.12
Structure	Visible	Visible	Visible	Visible	Visible

CSW- Cassava wastes; ASP- Albizia saman pods

The colour of the silages was observed to change with increasing inclusion of the pods and ranged from dark brown in T1 to reddish brown in T5. The various silage colours obtained in the present study were close to the original colour of both feedstuffs and this is in agreement with the findings of Oduguwa *et al.*, (2007). In the present study, the reddish brown colour was probably as a result of increased inclusion of *Albizia saman* podss. Albizia pods is naturally red in colour and on hydrolysis with a high water containing cassava wastes might produce an intermediate the reddish brown colour. The odour was generally alcoholic with the T1 silage being very strong than the others. The odour observed in this study was comparable with that of Menenses *et al.*, (2007) who reported that the end product (silage) had a pleasant smell. Therefore, implying a well made silage and possible proliferation of lactic acid bacteria.

The pH value ranged from 3.38 to 4.61. The values showed a trend increasing with increased inclusion of *Albizia* podss. The lowest pH was recorded for T1 (3.38) while highest was observed in T4 (4.61).The pH values observed here were higher than that obtained by Oduguwa *et al.* (2007) but lower than the range classified to be good for silage (4.5 – 5.5) in some treatments (Menenses *et al.*, 2007). Loc *et al.* (1997) reported 3.7 for cassava peels at 90, 120, 150 and180 days of ensiling. The result obtained for temperature in the present study was below the range of 30 – 60 ° C (t'Mannetje, 1999) presumed to tamper with the colour of silage and tending to spoilage by caramelization. The current temperature (25–27° C) of the silage therefore indicates a well made silage.

Table 2 shows the secondary metabolites of the ensiled Cassava peels together with *Albizia saman* podss.

Table 2: Secondary metabolites of ensiled cassava wastes with *Albizia saman* pods

	100%CSW	75%CSW+ 25%ASP	50%CSW+ 50%ASP	25%CSW+ 75%ASP	100%ASP
Saponin	-ve	-ve	Low	-ve	Medium
0.2ml $FeCl_3$	-ve	-ve	-ve	-ve	+ve
1ml $FeCl_3$	-ve	-ve	-ve	-ve	+ve

-ve- Negative, +ve- Positive; CSW- Cassava wastes; ASP- Albizia saman pods

Table 3: Chemical Composition and estimated energy (MJ/Kg DM) of the Silage mixture (g/100g)

	100% CSW	75%CSW + 25%ASP	50%CSW+ 50%ASP	25%CSW+ 75%ASP	100% ASP	SEM
Dry Matter(DM)	31.78^{b}	28.44^{c}	46.36^{b}	53.44^{ab}	60.53^{a}	1.65
Crude Protein(CP)	4.81^{d}	10.06^{c}	16.19^{b}	16.63^{b}	24.50^{a}	0.10
Crude Fibre(CF)	10.00^{c}	12.00^{a}	8.00^{d}	10.00^{c}	11.00^{b}	0.13
ASH	6.00^{ab}	7.00^{a}	5.00^{b}	5.00^{b}	5.00^{b}	0.30
Ether Extract(EE)	14.00^{b}	14.00^{b}	12.00^{d}	13.00^{c}	15.00^{a}	0.16
Neutral Detergent Fibre(NDF)	40.00^{d}	38.00^{d}	46.00^{d}	49.00^{b}	53.00^{a}	0.50
Acid Detergent Fibre(ADF)	27.00^{c}	30.00^{b}	24.00^{d}	27.00^{c}	42.00^{a}	0.34
Acid Detergent Lignin(ADL)	11.00^{c}	11.00^{c}	8.00^{d}	14.00^{b}	20.00^{a}	0.26
Cellulose	16.00^{c}	19.00^{b}	16.00^{c}	13.00^{d}	22.00^{a}	0.40
Hemicellulose	13.00^{b}	8.00^{c}	22.00^{b}	22.00^{b}	11.00^{bc}	0.62
ME^{1}	7.94	8.20	8.49	6.65	5.35	nd
ME^{2}	11.16	11.07	11.43	11.29	11.20	nd
Mean ME	9.55	9.64	9.96	8.97	8.28	nd

ME^{1}-Metabolizable energy (MAFF, 1984); ME^{2} – Metabolizable energy (Alderman, 1985); nd- Not determined. a,b,c, = means on the same row bearing different superscripts differ ($p<0.05$) significantly.

The qualitatively determined secondary metabolites were Saponin and tannins. The T3 and T5 silages recorded low and medium saponin levels respectively. The presence of saponin in the T3 and T5 silages further enhances the property of the silages as quality feed, being beneficial for ruminant nutrition. Teferedegne (2000) had reported that feedstuffs containing saponin had been shown to be defaunating agents and Babayemi *et al.*, (2004) reported that they are capable of reducing methane production. The T5 silage is shown in Table 2 to contain Tannin. This is contrary to the report of Otukoya (2007) that the *Albizia saman* pods does not contain tannin, but it is in line with the report of Hosamani *et al.*, (2005) that there is the presence of tannin in *Albizia saman* pods.

Table 3 presents the chemical composition of the ensiled cassava wastes with *Albizia saman* pods. The crude protein content ranged from 4.81g/100g for T1 to 24.50g/100g in T5 silage. There was a significant ($p < 0.05$) difference in CP content as the ASP inclusion increased except for the T3 and T4. The increase in CP value is in agreement with Oboh and Akindahunsi (2003), that increase in protein content of fermented cassava wastes could be as a result of secretion of some extracellular enzymes (proteins) such as amylases, linamarase and cellulase into the mash by the fermenting organisms in an attempt to make use of the cassava starch as a source of carbon (Raimbault, 1998). Values obtained for CP in the silages were higher than the critical value of 70g/kg recommended for small ruminants (NRC, 1981), except for T1. The addition of ASP also enhanced the CP of the cassava wastes. The crude fibre content recorded the highest (12.00%) in T2 silage while the lowest (8.00 %) was obtained in T3. There was significant ($p < 0.05$) difference in the values obtained except for T1 silage and T4 which were similar. The neutral detergent fibre (NDF) and acid detergent fibre (ADF) values of the silages in Table 3 ranged from 38% to 53% and 24% to 42% respectively. There was significant ($p < 0.05$) difference in the NDF and ADF values as seen in Table 3. There was an increase in NDF as ASP inclusion increased except for the T2. Cellulose content ranged from 13 % to 22%. For hemi-cellulose, T2 silage recorded the lowest (8.0 %) while the highest (22%) was recorded by T3 and T4 silages. The crude fibre (CF) content in this study ranged from 8% to 12 %. Otukoya (2007) reported 33.36% CF value for stored ASP in polyethylene bags while Oboh and Akindahunsi (2003) reported 6.5% as CF for CSW naturally fermented and later Oboh (2006) reported 11.7% for naturally fermented CSW. The neutral detergent fibre (NDF) and acid detergent fibre (ADF) values of the silages in the current study were higher than 20.79% and 4.87% reported for CSW (Aderemi and Nworgu, 2007) fermented for 10 days. Otukoya (2007) reported NDF of 47.46 % for ASP stored in polyethylene bag and was lower than that obtained for T5 in the present study. A trend was observed in NDF values except for T2. There was an increase in NDF content as ASP percentage inclusion increased. The result obtained in this study was lower than that reported by Oluwadamilare (1997) for 58.7% NDF and 51.0% ADF in cassava leaf silage. After 10 days of fermentation, Aderemi and Nworgu (2007) recorded an ADL value of 6.08% which was lower than that obtained for T1 in the present study. A high NDF connotes low intake due to slow degradability while high ADF is low digestibility (Wood and Badve, 2001). The mean metabolizable energy values obtained for the different silages ranges between 8.28 and 9.96 (MJ/kg). The T3 silage had the highest mean metabolizable energy. The least mean metabolizable energy was obtained in the T5 (8.28MJ/kg). The values obtained in this study were close to the values obtained by Igbekoyi (2008) when he ensiled *Albizia saman* pods with guinea grass (10.39,10.58,10.74,and 10.76) MJ/kg and for corn silage as reported by Nishida *et al.*, (2007) (11.39,11.78 and 11.84). This thus, suggested that *Albizia saman*-cassava waste based silage can supply the metabolizable energy similar to that of corn silage.

Table 4 presents the performance characteristics of WAD sheep fed ensiled *Albizia saman* pods with cassava waste silage. Dry matter intake increased with increasing inclusion of *Albizia saman* pods but reduces again in the T5 silage. The least intake (284.25g) by the sheep was on silage with T1. There was significant ($p<0.05$) difference in the dry matter intake of the silages combinations. The highest weight gain (4.8 kg) was recorded in the T4 silage also the intake and feed conversion was also highest (469.14g and 6.38) in this treatment. This could be traced to the level of CP in the diet (Otukoya and Babayemi, 2008) and total intake of DM, and was similar to the report of Ngwa *et al.*, (2002) that an increase in the DM and OM intakes improved weight gain as the levels of ensiled *Acacia* podss increased in the diet of sheep. Otukoya

(2007) made a similar observation when the DM and OM intake of goats fed *Albizia saman* podss increased with enhanced inclusion of the podss in the diets. The feed conversion efficiency for the sheep on the T1 was negative (-1.38), this might be attributed to the characteristically low level of CP (Otukoya and Babayemi, 2008) because the sheep in this treatment significantly losses weight. The sheep feed the T5 silage neither gains nor loses weight, hence the feed may be said to be a good maintenance ration. The sheep fed T2, T3 and T4 silages show a significant ($p<0.05$) weight change in line with their feed conversion efficiency which is not significantly ($p>0.05$) different from one another.

Table 4: Performance characteristics of WAD Sheep fed ensiled cassava waste with *A. saman* pods

Parameter	100%CSW	75%CSW+ 25%ASP	50%CSW+ 50%ASP	25%CSW+ 75%ASP	100%ASP	SEM
Initial Wt.(Kg)	17.30^a	17.20^a	17.20^a	17.00^a	17.00^a	0.083
Final Wt.(Kg)	16.50^c	20.83^b	21.01^b	22.00^a	17.00^c	0.127
Weight gain(kg)	- 0.62^e	3.83^b	3.81^b	4.80^a	0.00^c	0.089
Weight gain(g/d)	-15.38^e	73.65^b	73.08^c	92.31^a	0.00^d	0.152
Weight(g/day/kgW$^{0.75}$)	33.51^c	48.45^b	48.35^b	55.55^a	48.52^b	0.174
Silage DMI	284.25^d	405.65^c	408.32^b	469.14^a	406.25^c	0.164
P. max DMI	294.81^a	292.36^{ab}	289.55^b	282.85^c	219.35^d	0.816
Total DM Intake	579.06^d	698.01^b	697.87^b	751.99^a	625.60^c	0.877
FCR	-1.38	5.49	5.45	6.38	0	nd

a,b,c= means on the same row bearing different superscripts differ ($p<0.05$) significantly.

Table 5: Apparent digestibility (%) by WAD Sheep fed the ensiled cassava waste- *A. saman* pods

Parameter	100%CSW	75%CSW+ 25%ASP	50%CSW+ 50%ASP	25%CSW+ 75%ASP	100%ASP	SEM
Dry matter	36.15^e	56.25^c	48.44^d	61.57^b	68.47^a	0.11
Ash	79.98^a	6.50^e	44.35^b	23.13^d	36.92^c	0.07
Crude Protein	55.92^c	35.48^e	50.98^d	70.68^b	75.21^a	0.16
Crude Fibre	17.96^e	27.29^b	22.43^d	23.13^c	51.25^a	0.93
Ether extract	45.59^e	68.83^b	57.04^d	67.48^b	76.87^a	0.10
NDF	49.22^c	49.48^c	34.99^d	51.37^b	68.46^a	0.12
ADF	27.10^d	47.65^b	24.82^e	43.06^c	66.95^a	0.07
ADL	15.41^c	7.10^e	41.76^a	9.41^d	30.60^b	0.11
Cellulose	64.26^d	79.34^c	90.33^a	79.30^c	87.10^b	0.11
Hemicellulose	22.12^d	1.83^e	46.10^c	61.56^b	74.19^a	0.06

a,b,c= means on the same row bearing different superscripts differ ($p<0.05$) significantly.

Table 5 shows the apparent digestibility of WAD sheep fed ensiled cassava wastes and *Albizia saman* pods. The DM digestibility of T5 silage was higher ($p<0.05$) than all other treatments/diets. There was significant ($P < 0.05$) variation for the parameters among the treatment means for DM, OM and NDF. Digestibility in crude protein increased tremendously as *Albizia saman* pods inclusion level increases. The highest digestibility was observed in the T5 silage for all parameters except for ADL and cellulose. So also, the least nutrient digestibility was observed for the parameters (DM, OM, CF, EE and NDF) in the T1 silage. Batista *et al.*, (2002) reported that mesquite podss contained 11.4% - 12.7% CP, NDF of 29%, ADL of 21-22% and ADF of 17.2%. Ngwa *et al.*, (2002) observed that, the digestibility of all components (DM, OM, N, NDF, ADF, and ADL) decreased as the proportion of silage increased in the diet except when the silage was fed as sole feed. The apparent hemicellulose digestibility result obtained in this study is in line with the results of Ngwa *et al.*, (2002) but contrasted with the result of Igbekoyi (2008), as it increases with increase in the inclusion of podss in the silages (1.83 in 25% pods to 61.56 in the 75% inclusion of podss). Bruno- Soares and Abreu (2003) observed a significant difference in dry matter digestibility from 56.3% to 60.2% and organic matter digestibility from 60.5% to 63.3% when *Gleditsia triacanthos* podss levels were increased in the diet fed to the sheep.

Table 6: Nitrogen utilization by WAD sheep fed ensiled cassava waste with *Albizia saman*

Parameter	100% CSW	75%CSW+25% ASP	50%CSW+50% ASP	25%CSW + 75%ASP	100%ASP	SEM
Nitrogen intake (g /d)	1.12^{e}	7.46d	12.01^{c}	14.22^{b}	23.53^{a}	0.06
Faecal nitrogen (g/d)	1.75^{d}	4.81^{b}	5.85^{a}	4.17^{c}	5.83^{a}	0.05
Urinary Nitrogen (g/d)	0.41^{b}	0.43^{b}	0.49^{b}	0.63^{b}	0.99^{a}	0.04
Nitrogen balance (g/d)	-1.04^{e}	2.22^{d}	5.67^{c}	9.42^{b}	16.71^{a}	0.08
Nitrogen retention (%)	-11.59	29.77	47.20	62.95	71.01	17.75

a,b,c,= means on the same row bearing different superscripts differ ($p<0.05$) significantly. CSW- Cassava wastes; ASP- Albizia saman pods

Nitrogen utilization of WAD sheep fed ensiled cassava wastes and *Albizia saman* pods is shown in Table 6. The nitrogen intake (g/d) ranged from 1.12 in T1 to 23.53 in T5 silages. The nitrogen intake was significantly ($p < 0.05$) different among treatment combinations and a similar trend was found in nitrogen balance. The values for nitrogen retention increased significantly ($p < 0.05$) as the level of pods inclusion increases, ranging from – 11.59 % in the T1 silage to 71.01 % in the T5 silage. Igbekoyi (2008) reported that nitrogen retention increases with increasing inclusion of podss in *Albizia saman* pods-Guinea grass silage fed sheep ranging from 57.6% in 10% to 64.6% in 40% pods inclusions. The positive trend in nitrogen retention as *Albizia saman* pods increased in this study compared favourably with the work of Ngwa *et al.*, (2002) who reported nitrogen retention values of 3.05, 2.50 and 5.12 as the level of *Acacia sieberiana* podss in the diet of sheep increased. The increased retained nitrogen in the body was not only by an increase in the digested protein but also by the improved utilization of the absorbed proteins. This means that more protein for anabolism and less for oxidation (Osakwe, 2006). The low and high intakes of nitrogen can be attributed to the function of plant nitrogen content of non-digestible fibre-bound nitrogen and the extent of nitrogen precipitation by tannins as noted by Nantoume *et al.*, (2001) and observed in this study.

CONCLUSION

The chemical composition, apparent digestibility, nitrogen utilization and other parameters showed that *Albizia saman* pods/cassava waste mixture silage has the potential of meeting the nutritional needs of sheep in terms of protein and energy needs. The positive response in terms of improved weight gain and digestibility of nutrients by the ewes indicated that *Albizia saman* pods included silage can serve as a sustainable feedstuff for ruminants during the off-season.

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