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ORIGINAL RESEARCH ARTICLE

Gmelina arborea leaves with cassava peel silage as feed resource for West African Dwarf goats in South West Nigeria

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ABSTRACT

Inadequate forage in quality and quantity during the dry season is the major constraint in ruminant production in Nigeria, and this negatively influences the performance of these animals. In an effort to surmount this limitation, Gmelina arborea leaves (GML) and cassava peel (CsP) were ensiled at different proportions to evaluate the physio-chemical quality, intake and growth response by West African dwarf (WAD) goats fed the diets. The varying proportions of GML and CsP were mixed as follows; 100GML, 90GML+10CsP, 70GML+30CsP and 50GML+50CsP. The mixtures were ensiled for 21 days. Sixteen West African dwarf (WAD) goats aged 7-8 months weighing between 8.45- 8.48kg housed in individual pens were used to determine feed intake, growth rate and feed conversion ratio for 90 days. Completely randomized design was adopted for the study. Silages with CsP had pleasant smell and pH range of 3.7-4.7 while the silage without CsP had non-pleasant smell with pH of 9.5. The pH and temperature reduced with increasing level of cassava peel while the smell, texture and appearance improved with increasing level of cassava peel. Dry matter, crude protein, neutral detergent fibre and non- structural carbohydrate ranged from 26.25-30.75, 12.11-13.93, 27.45-41.39 and 34.47-50.22% respectively. Dry matter intake and daily weight gain, varied significantly (P < 0.05) with increasing proportion of cassava peel and highest at equal proportions of Gmelina arborea and cassava peel with values ranging from 246.91-486.79g/day, 13.22-35.11g/day respectively. Feed conversion ratio was significantly different (P<0.05) and values ranged from 13.87- 18.68 with animals on diet 50%GML+50%CsP having the least value while those on 100%GML had the highest value. Conclusively, the inclusion of cassava peel to Gmelina arborea leaves enhanced silage quality and its nutrient compositions, as well as improved feed intake and weight gain by WAD goats at 50%GML inclusion.

Key words: Cassava peel, *Gmelina arborea* leaves, goats, silage,

INTRODUCTION

In Nigeria, ruminant animals form a vital part in the livestock economy production system. The attainment of sustainable livestock production largely depends on the availability, quality and quantity of feed (Ibhaze *et al.,* 2015). Scarcity and poor quality of forage is usually experienced during the dry season, this renders these animals undernourished for a significant part of the year (Jayasuriya, 2002). Efforts are continually being made by animal nutritionists and livestock farmers to circumvent this problem. Cassava peel is a cheap source of dietary energy (3810Kcal/KgME) as reported by Obioha (1992). *Gmelina arborea* is a readily available cheap non-conventional feed resource for ruminants in Nigeria. It is a fast growing deciduous browse plant of high nutritive value reaching up to 40 m tall and 1.4m in diameter and grows in climates with mean annual temperatures of 21-28^0 C (Jensen, 1995). The leaves contain as much as 14.6% and 6.7% DM crude protein and crude fibre respectively (Amata and Lebari, 2011) and a suitable energy source for livestock diets (Amata, 2014). Silage is a veritable means of preserving feed materials for future use and can be preserved for months or years. The study aimed at evaluating the nutritive qualities of GML and CsP silage and growth response by West African dwarf goats fed this silage during the dry periods of the year.

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MATERIALS AND METHODS

The study was conducted at the Ruminant Unit of the Teaching and Research Farm, Federal University of Technology Akure, Nigeria (Latitude 7° 18'N and Longitude 5^0 10'E) with mean annual rainfall of about 1,500 mm, mean annual relative humidity of about 76% and temperature of 27^0C.

Collection and preparation of feed materials

Gmelina arborea leaves were harvested from Federal University of Technology premises. Composite cassava peels were obtained from a cassava processing centre in Akure. The harvested GML leaves and CsP were chopped into smaller sizes (3cm) using sharp cutlasses and mixed in the following proportions; 100%GML, 90%GML +10%CsP, 70%GML + 30%CsP and 50%GML+ 50%CsP in order to meet the protein and energy requirements of the goats. The diets were packed inside 120litres drums and 4litres mini plastic silos, compressed, weighted with sand bags to prevent entering of air and then covered with plastic lid. After 21 days of fermentation, samples of silage were taken from each mini-silo for silage quality (colour, smell, pH, and temperature) and chemical composition. Fibre fractions, proximate and macro (Ca, Na, P, K, Mg) and micro (Zn, Fe) minerals composition of silages were determined using the methods of Van Soest and Robertson, (1985) and AOAC (1997) respectively. Dry Matter of silages was determined by drying 500 g of samples in a forced-air oven Model DHG-9109A, Shanghai Meditry Instrument Co. Ltd) at 65^0C for 24hrs and values obtained were corrected for loss of volatile compounds by multiplying with the correction factor of 1.056 (Fox and Fenderson, 1978). After drying, samples were weighed, milled and stored in air-tight containers until they were required for analyses. Metabolisable energy of the diets was calculated by the equation (%ME= 36x%CP+ 81.8x% EE+ 35.5x % NFE) (Pauzenga, 1985).

Feeding Trial Study

Sixteen (16) West African dwarf (WAD) goats weighing 8.45 -8.48kg were purchased at the local market in Owo, Ondo state, Nigeria. The animals were placed on prophylactic treatment through the administration of a long-acting antibiotic (Oxytocin) at 1ml/ 10kg. Animals were also treated against ectoparasites and endoparasites using 10% levamisol and diasuntol respectively and allowed to acclimatize with the new environment and fed for two weeks before data collection commenced. The animals were randomly allotted to the four experimental diets making a total of four animals per diet and were housed in individual pens with concrete floor and wood shavings to act as beddings to absorb urine and faeces. Animals were offered the experimental diets *ad-libitum* for a period of 90days alongside with salt lick. Feed intake was calculated by weighing the daily remnants and subtracting it from the quantity fed. The animals were weighed weekly to evaluate their weight gain. The completely randomized design was adopted. All data obtained were subjected to one way analysis of variance (ANOVA) of (SAS, 2012) and significant means were separated using the Duncan's multiple range test of the same package.

RESULTS AND DISCUSSION

The silage quality of GML and CsP mixture is shown in Table 1. All silages with CsP had a light green colour, firm texture, and pleasant smell while silage without CsP had a non - pleasant smell. The pH of the silages ranged from 3.7 -9.5. Silages with CsP had pH values within the range (3.5-5.5) classified as good silage (Meneses, *et al.,* 2007), 3.75-4.70 reported as acceptable range for good silage in the tropics (Bilal, 2009). Temperature ranged from 25-29^0C. High temperature during ensiling reduces lactic acid concentration and aerobic stability, and increase pH (Weinberg, *et al.,* 2001) and temperature above 30^oC will result in dark silage due to caramelization of sugars in the forage (McDonald *et al.,* 1995) The higher pH recorded in silage without CsP may be due to inadequate soluble carbohydrate concentration in GML resulting in production of less lactic acid.

Chemical composition of the silages is presented in Table 2. Significant ($P<0.05$) differences were observed in the dry matter, ash, and fibre fractions. There was a reduction in the crude protein, fibre contents and increase in the non-structural carbohydrate of the silages with increasing proportion of CsP in the mixture. This implies that higher values of crude protein (13.46-13.93%) obtained for silages with higher proportions of GML could be due to the contribution of GML that has a higher crude protein content of GML than CsP. Although, all silages had crude protein content higher than the

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normal range of 7.7% and 10- 12% recommended for small ruminants by (NRC, 1981) and ARC (1985) respectively and 8% necessary to provide the minimum ammonia concentration required by rumen micro-organism to support optimum rumen activity (Norton, 2003). The quantity and chemical composition of the fibre fractions of a feed has the greatest influence on its digestibility (McDonald *et al*., 1995). The crude fibre contents of the diets ranged from 29.31-34.79%. The lower fibre fractions observed in diets with increasing proportions of CsP could be that CsP had a diluting effect on the fibre components. However, the NDF fraction (27.4-41.39%) in the diets were lower than the range of 60-65% suggested as the critical limit, which might impair the efficiency in utilization of tropical forages by ruminants (Van Soest, 1982; Muia, 2000). This suggests that the digestibility and utilization of the diets would not be impaired. The presence of minerals in the diets of animals is vital for the animal's metabolic processes (Onwuka and Akinsoyinu, 1998). The mineral constituents of the diets is presented in Table 3. Diet 50%GML +50%CsP had the highest Calcium concentration (0.44%) and 100%GML had the highest Iron (0.009%) and Phosphorus (0.07%) contents.

Table 1. Quality of *Gmelina arborea* leaves and cassava peel silage at 21 days of ensiling

Quality	100 GML	90GML+10CsP	70GML+30CsP	50GML+50CsP
Appearance	Green	Light green	Light green	Light green
Smell	Non- pleasant	Slightly pleasant	Pleasant	Very pleasant
Texture	Firm but wet	Firm	Firm	Very firm
Temperature ^{0}C	29.0	26.0	26.0	25.0
pH	9.5	4.7	4.5	3.7

GML = *Gmelina arborea* leaves, CsP= Cassava peel

Table 2. Chemical composition of *Gmelina arborea* leaves and cassava peel silages at 21 days ensiling

Parameter	Diets				SEM
	100GML	90GML+ 10 CSP	70GML+ 30 CSP	50GML+ 50 CSP	
Dry matter	26.43^c	26.25^c	28.54^b	30.75^a	3.24
Crude protein	13.93	13.46	13.14	12.11	1.87ns
Crude fibre	34.79^a	32.56^b	29.62^c	29.31^c	3.68
Ether extract	4.34	4.09	4.12	4.23	0.12ns
Ash	5.87^b	6.34^{ab}	7.21^a	5.99^b	0.25
Neutral detergent fibre	41.39^a	38.67^b	31.51^c	27.45^d	5.34
Non- structural carbohydrate	34.47^d	37.44^c	44.02^b	50.22^a	5.75
Nitrogen free extract	41.07	43.55	45.91	48.36	5.23
Acid detergent fibre	35.38^a	24.67^b	22.85^c	20.98^d	4.81
Acid detergent lignin	40.63^a	35.45^b	31.52^c	26.87^d	5.24
Calculated ME (Kcal/g)	2314.47	2365.15	2439.86	2498.75	

a,b,c: Means along the same row with identical superscripts are not significantly ($p > 0.05$) different.
GML = *Gmelina arborea* leaves, CsP= Cassava peel

Calcium (Ca), Zinc (Zn) and Iron (Fe) concentrations in the diets were adequate to meet the requirements of the goats and the values compared favourably with the

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recommended values of 0.2-0.8% (Ca), 0.002 - 0.0033% (Zn) and 0.003 - 0.005% (Fe) respectively (McDowell, 1992). It was observed that the values of Fe increased with increasing proportion of GML indicating that Fe is most abundant in green leafy materials. Other minerals (Na, P) that are inadequate in the diets could be supplied to the animals as salt licks and bone meals which are relatively cheap.

Table 3: Mineral composition of *Gmelina arborea* leaves and cassava peel silages at 21 days ensiling (%)

Diets	Na	K	Ca	Mg	Zn	Fe	P
100GML	0.05	0.07	0.24	0.04	0.003	0.009	0.07
90GML+10CsP	0.04	0.05	0.22	0.04	0.003	0.008	0.06
70GML+ 30CsP	0.03	0.06	0.30	0.04	0.002	0.006	0.02
50GML+50CsP	0.06	0.07	0.44	0.05	0.002	0.005	0.04

GML = *Gmelina arborea* leaves, CsP = Cassava peel

Na (Sodium), K (Potassium), Ca (Calcium), Mg (Magnesium), Zn (Zinc), Fe (Iron), P (Phosphorus)

Table 4: Performance indices of West African dwarf goats fed *Gmelina arborea* leaves and cassava peel silages

Parameters	100GML	90GML+10CsP	70GML+30CsP	50GML+50CsP	SEM
Initial weight (kg)	8.48	8.48	8. 45	8. 47	
Final weight (kg)	9.67^{c}	10.45^{b}	10.87^{b}	11.63^{a}	0.01
Body weight gain (kg)	1.19^{c}	1.97^{c}	2.42^{b}	3.16^{a}	1.20
Weight gain ($kgBW^{0.75}$)	1.14^{b}	1.67^{b}	1.94^{b}	2.37^{a}	1.14
Dry matter intake (g/day)	246.91^{d}	382.32^{c}	432.67^{b}	486.79^{a}	1.55
Average daily weight gain(g/day)	13.22^{d}	18.56^{c}	26.89^{b}	35.11^{a}	0.17
Feed conversion ratio	18.68^{a}	17.46^{b}	16.09^{c}	13.87^{d}	0.08

abcd: Means with same superscripts along the same row are not significantly different ($p > 0.05$)
GML = *Gmelina arborea* leaves, CsP = Cassava peel

Significant ($P<0.05$) differences were observed in the performance traits as shown in Table 4. Animals fed silage with equal proportions of GML and CsP recorded the highest feed intake (486.79g/day), average daily weight gain (35.11g/day) and the least feed conversion ratio (13.87) while the animals on 100GML had the least values for feed intake (246.91g/day), weight gain (13.22g/day) and the highest feed conversion ratio (18.68). The feed intake trend could be an indication of the better acceptability by goats of the diets with higher proportions of cassava peel as reported by Ibhaze *et al.,* 2015 in a previous study. Also, the higher intake values observed in animals on silages with higher proportions of CsP could be due to the better silage quality. This result conforms with the findings of (Olorunnisomo, 2011) that the addition of cassava peel greatly enhanced intake of other feedstuffs among goats. The significantly higher growth response of animals fed 50% inclusion level of GML is in tandem with the report of Okafor *et al.* (2012) that 50% inclusion of *Gmelina arborea* can be used as replacement forage to groundnut haulms in the diet of fattening red sokoto bucks. Osakwe *et al. (*2007) reported that *Gmelina arborea* at 25% and *Panicum purpureum* at 75% fed to West African dwarf goats gave the optimum performance in dry matter intake, growth rate and nutrient digestibility of weaner goats. Rapid digestibility had been reported of GML and CsP ((Lowry, 1995, Smith, 1988 respectively). Diet 50%GML+50% CsP could have been rapidly and better digested, thereby resulting in highest consumption by animals fed the diet. This could be related to the fibre content of the diet which enhanced intake. McDonald *et al.* (1995) opined that intake is related to the concentration of cell walls in ruminant feed and that there is a

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negative relationship between the neutral detergent fibre content of feeds and the rate of digestion This corroborates with the report of Muinga *et al*. (1992) who reported lower dry matter intake with increased proportion of crude fibre. The trend in weight gain showed significant difference ($p<0.05$) as goats on 50% GML +50% CsP had the highest weight gain (35.11g/day) while those on 100% GML had the least (13.22%). The results obtained compares favourably with the values (5.54-28.57g/day) reported by Adebisi *et al*.(2015) who fed *Panicum maximum* supplemented with *Gmelina arborea* leaves mixture to WAD goats but were slightly lower than the values (29-38.44g/day) obtained by Ibhaze and Fajemisin (2015) who fed naturally fermented maizecob based diets to West African dwarf goats. Findings in this study proved that weight gain is basically a reflection of dry matter intake and efficient utilization of the nutrients. The significantly ($P<0.05$) higher values of FCR of 18.68 and 17.46 recorded for animals with higher proportions of *Gmelina arborea* implied that the animals utilized those feed with lesser efficiency as compared to 13.87 for those on diet with 50%GML inclusion.

CONCLUSION

The study revealed that the adverse effects of dry season on ruminants (goat) and the economic loss to the livestock farmer can be overcomed by feeding the animals with *Gmelina arborea* leaves and cassava peel silage, and better results can be achieved at equal proportions of *Gmelina arborea* leaves (50%) and cassava peel (50%). • *Gmelina arborea* leaves should not be ensiled solely but with readily source of carbohydrate such as cassava peel which will enhance the silage quality, encourage feed intake and consequent weight gain of goats. *Gmelina arborea* leaves with cassava peel silage has potential as protein and energy supplement for West African dwarf goats. it is a farmer friendly means of mitigating the adverse effects of dry season on both the animals and the livestock farmers in South West Nigeria

CONFLICT OF INTEREST

There is no conflict of interest with regards to the publication of this study

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