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Nutritive Value Assessment of *Ficus polita* and *Panicum maximum* at Varying Proportions Using an *in vitro* Gas Production Method in the Dry and Wet Seasons

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Abstract: *In vitro* fermentation technique was used to evaluate the replacement effects of *Panicum maximum* (PM) with *Ficus polita* (FP) and Cassava Peels (CPL) at four levels {Treatments 1 (T1), 2 (T2), 3 (T3) and 4 (T4)} in dry and wet seasons. (T1) 0% FP+ 90% PM + 10% CPL; (T2) 30% FP+60% PM + 10% CPL; (T3) 60% FP+30% PM + 10% CPL and (T4) 90% FP+0% PM + 10% CPL. Chemical composition and qualitative analysis of saponin and tannins were determined. *In vitro* Gas Production (IVGP) of diets were carried out over 24 h. Metabolizable Energy (ME), Organic Matter Digestibility (OMD) and Short Chain Fatty Acids (SCFA) were predicted. Methane (CH_4) production was also measured. Results indicated that FP contained high levels of protein in the dry (15.7 g/100 g DM) and wet (19.9 g/100 g DM) seasons. Crude Fibre (CF), Ether Extract (EE), ash and Neutral Detergent Fibre (NDF) values in the dry and wet seasons were 22.0 and 19.0 g/100 g DM, 20.5 and 17.8 g/100 g DM, 7.8 and 10.0 g/100 g DM, 67.0 and 88.0 g/100 g DM, respectively. Qualitative analysis of secondary metabolites in FP indicated the presence of saponin in the dry season while tannin was absent in both seasons. IVGP, ME, OMD, SCFA and methanogenesis were not significantly ($p<0.05$) affected by levels of inclusion of FP. Results revealed that based on the availability of FP, it can be fed to goats at any level of inclusion up to 60% with PM without any detrimental effects.

Key words: *Ficus polita*, *Panicum maximum*, *in vitro* gas production, season

INTRODUCTION

Annual growth of ruminants in dry tropics is often restricted by low nitrogen and high fibre content of native grasses and crop residues. Supplementation of tropical roughages with leguminous fodder trees and shrubs otherwise known as Multipurpose Trees (MPT's) is a way of alleviating nitrogen deficiencies (McSweeny *et al*., 1999). These multipurpose trees are high in crude protein contents (12-30%) compared with mature tropical grasses (3-7%) and are available during the dry season when grasses are scarce. Hence, they are important feed resources that could be harnessed by 'cut and carry' to bridge the seasonal deficits (Topps, 1992). However, some of these MPT's contain Antinutritional Factors (ANFs) which seriously limit their value as animal feeds (Kumar, 1992). *Gliricidia sepium* and *Leucaena leucocephala* are age-long browse plants but their extensive use is hampered by coumarin in the former and mimosin in the latter (Babayemi *et al*., 2006a).

Ficus trees are common homestead plants in Nigeria and are established mainly for provision of shade and beautification of surroundings (Bamikole *et al*., 2004a,b). Ficus is characterized by production of white, milky and gummy latex, portraying the presence of toxic substance. Nevertheless, they possess the attributes of being evergreen, available and accessible (Bamikole *et al*., 2004b). Bamikole *et al*. (2004a) assessed the forage acceptability as well as the nutritive and the antinutritive quality of some Ficus species and observed *Ficus religiosa* and *Ficus thonningii* to be acceptable to goats, contain high protein and some antinutritional factors, particularly saponin and tannins. Bamikole *et al*. (2003) further established that feed intake, feed digestibility and live weight gain of goats can be improved significantly by feeding *Ficus religiosa* up to 75% with *Panicum maximum* (PM) grass. However, *F. polita* has received little attention, as its real potentials are still hidden as feed for ruminants.

The gas production technique (Menke and Steingass, 1988) has proved to be a good test to evaluate tropical feeds. The objective of this study was to evaluate the nutritive value of *Ficus polita* based diets at four different levels of inclusion with *Panicum maximum* in the dry and wet seasons.

MATERIALS AND METHODS

Sample collection: Approximately 5 kg of leaf samples of *Ficus polita* was collected in the dry (December-February) and wet (April-September) seasons within and outside the Campus of University of Ibadan, Ibadan, Nigeria. The location is 7°27'N and 3°45'E at altitude

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200-300 m above sea level; mean temperature of 25-29°C and the average annual rainfall of about 1250 mm. Samples were collected from at least four individual trees and from different parts of the trees and pooled for further analysis. *Panicum maximum* was obtained from the pasture land of the teaching and research farm of the University at the same time that the Ficus samples were collected. Cassava peel was obtained from fresh peeled tubers from a garri processing industry in Ibadan, Nigeria.

Sample preparation: Dried *Ficus polita* leaves, *Panicum maximum* and cassava peels were ground in a hammer mill to pass through 1 mm sieve. 200 mg of samples were prepared, comprising of 3 different ingredients; *Ficus polita*, *Panicum maximum* and cassava peels in different proportions (%) to reflect different treatments.

***In vitro* gas production:** The *in vitro* gas production was determined according to Menke and Steingass (1988). The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24 h. After 24 h of incubation, 4 ml of 10 M NaOH was introduced to estimate the amount of methane produced.

Chemical analysis: *Ficus polita* leaves, *Panicum maximum* and cassava peels were oven dried at 105°C to a constant weight for dry matter determination. Crude protein, crude fibre, ether extract and ash were analyzed according to AOAC (1995). Neutral detergent fibre, acid detergent fibre and acid detergent lignin were determined as described by Van Soest *et al.* (1991). Saponin and tannins were determined as reported (Babayemi *et al.*, 2004). Metabolizable energy ME, (MJ/Kg DM) and organic matter digestibility (OMD %) were estimated as established (Menke and Steingass, 1988) and Short Chain Fatty Acids (SCFA) were calculated as reported (Getachew *et al.*, 1999).

Statistical analysis: Parameters were analyzed as a 4 x 2 factorial experiment (4 treatment levels x 2 seasons) and subjected to Analysis of Variance procedure (ANOVA) of SAS (1999). Significant means were separated using the Duncan multiple range test of the same package.

RESULTS AND DISCUSSION

Chemical composition: Table 1 presents the chemical composition and neural detergent fibre of FP and PM in the dry and wet seasons. Crude protein contents of *Ficus polita* in both the dry and wet seasons (15.7 and 19.9 g/100 g DM respectively) were higher than the critical level of 7% required for ruminal function (ARC, 1980). The value of protein for *F. polita* and *P.maximum* in both dry and wet seasons were within the values reported by other workers (Bamikole and Babayemi, 2004; Babayemi, 2007; Arigbede *et al.*, 2006). The high amount of CP in FP in both the dry and wet seasons presents FP as an adequate supplement of PM particularly in the dry season when PM has a CP value of 6.3 g/100 g DM compared to 15.7 g/100 g DM for FP. Values of DM, CF, EE and NDF ranged from 30.4, 22.0, 20.5 and 67.0 g/100 g DM respectively for FP in the dry season to 29.5, 19.0, 17.8, 10.0 and 67.0 g/100 g DM respectively in the wet season. The value of DM observed for FP is lower than the DM value reported for guava leaf (Ngamsaeng *et al.*, 2006) and higher than those reported previously for *Ficus abutilifolia* (Abegunde and Akinsoyinu, 2007). These differences might have been as a result of differences in cell wall lignification and the ratio of leaf to twig in the forage samples used for chemical analysis.

Contents of saponin and phenols: Qualitative contents of saponin and phenols in FP during the dry and wet seasons are shown in Table 2. In the dry season, using the foam height as an indicator, low levels of saponin was present in FP, while tannin was absent. In the wet season however, both saponin and tannin were absent in FP. The presence of saponin in *F. polita* enhances its property as a quality feed for ruminant production particularly in the dry season. Feedstuffs containing

Table 1: Proximate composition and neutral detergent fibre (g/100 g DM) of *Ficus polita* and *Panicum maximum* in the dry and wet seasons

		DM	CP	CF	EE	Ash	NDF
	DS	30.4	15.7	22.0	20.5	7.8	67.0
F. polita	WS	29.5	19.9	19.0	17.8	10.0	88.0
	DS	31.0	6.3	31.3	18.5	9.0	79.5
P. maximum	WS	29.4	8.0	29.8	16.3	13.8	80.5

DS = Dry Season, WS = Wet Season, DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, NDF = Neutral Detergent Fibre, F = Ficus, P = Panicum

Table 2: Qualitative contents of saponin and tannins in *Ficus polita* in the dry and wet seasons

	------------------- Saponins -------------------		---------------------- Phenols ---------------------	
Seasons	Foam (mm)	Comment	Colour change	Comment
Dry season	6	Low	-	Negative
Wet season	5	Negative	-	Negative

saponin had been shown to be defaunating agents (Teferedgne, 2000) and capable of reducing methane production (Babayemi *et al*., 2004). Methane produced during anaerobic fermentation in the rumen represents 2-12% gross energy loss to the host animal and contributes to emissions of greenhouse gases into the environment (Moss *et al*., 1995). There have been many efforts to inhibit methane production because methane production has a negative correlation with energy utilization in ruminants (Hillman *et al*., 1993). Methane production was higher in the dry season (Fig. 1), feedstuffs that show high capacity for gas production are also observed to produce high amounts of methane. This scenario was observed in this study. Methane production reduces the amount of energy available to the animal. The suppressed methanogenesis expected in the wet season was not observed, perhaps the absolute level of saponin was not enough to express observable inhibitory effects on methane production.

***In vitro* gas production parameters:** Results (Fig. 2, 3) showed steady increases in gas production as incubation period progressed from 0-24 h. The gas production, particularly in the dry season showed a consistent increase with time which undermines the degradability of the forage diets in this season. Variations observed in the IVGP, ME, OMD, SCFA values among treatments in both the dry and wet seasons were not significant (p>0.05), implying that any of these treatments could be used to feed goats though higher absolute values for ME and OMD were observed in the 60% FP based diet. In the dry season, gas production patterns were similar and higher in the mixed forage diets but low in the sole ficus diet. Values of ME, SCFA, and OMD reported for FP in the dry season were higher than values reported for both tealeaf and spent tealeaf (Babayemi *et al*., 2006b), but consistent with values reported for *F. abutilifolia* (Abegunde and Akinsoyinu, 2007) and for some multipurpose tree species in Abeokuta, Nigeria (Arigbede *et al*., 2006). Higher values of 45.0-52.6 ml/200 mg DM were reported for tree species in the semi-arid region of North Mexico (Cerillo and Juarez, 2004).

***In vitro* gas production characteristics:** The gas production characteristics in terms of soluble fraction (a), Potential gas production (b), potentially degradable fraction (a+b) and the rate of fermentation (c) of the *F. polita* diets are presented in Table 4. The a, a+b, b and c values ranged between 8.00 and 10.30, 51.47 and 39.84, 41.51 and 31.51 and 0.028 and 0.040 respectively in the dry season, while same parameters in the wet season ranged between 1.33 and 4.67, 11.99 and 18.00, 10.33 and 13.33 and 0.01 and 0.082 respectively. In both seasons, soluble fraction was higher in the mixed forage diets, this may be attributable to the higher protein content of these diets as contributed by the ficus species in the diet. The values of 0.028 and 0.040 (Dry season) and 0.051 and 0.071 (Wet season) for the rate of gas production of the diets of *F. polita* show that they are highly digestible since the rate at which a feed or its chemical constituents are digested in the rumen is as important as the extent of digestion. Values observed in this study in the dry season are similar to values of

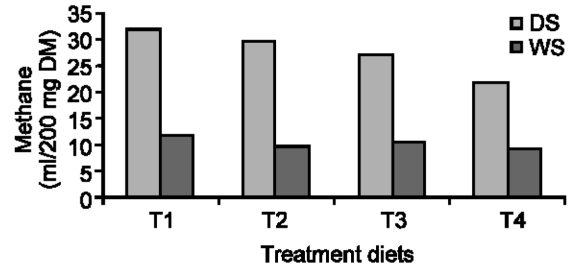

Fig. 1: Methane (ml/200 mg DM) production for diets of PM and FP at different proportions in the dry and wet seasons

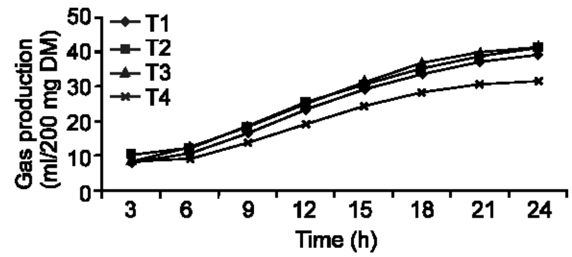

Fig. 2: Cumulative gas production profile for mixtures of *F. polita* and *P. maximum* in the dry season. (T1): 0% *F. polita* + 90% *P. maximum* + 10% Cassava peel, (T2): 30% *F. polita* + 60% *P. maximum* + 10% Cassava peel, (T3): 60% *F. polita* + 30% *P. maximum* + 10% Cassava peel, (T4): 90% *F. polita* + 0% *P. maximum* + 10% Cassava peel

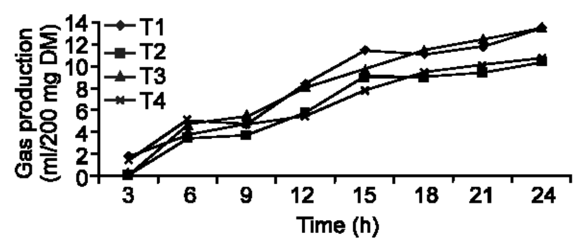

Fig. 3: Cumulative gas production profile for mixtures of *F. polita* and *P. maximum* in the wet season. (T1): 0% *F. polita* + 90% *P. maximum* + 10% Cassava peel, (T2): 30% *F. polita* + 60% *P. maximum* + 10% Cassava peel, (T3): 60% *F. polita* + 30% *P. maximum* + 10% Cassava peel, (T4): 90% *F. polita* + 0% *P. maximum* + 10% Cassava peel

Table 3: Effect of replacement levels of *Panicum maximum* with *Ficus polita* on *in vitro* gas production parameters in the dry and wet seasons

		T1	T2	T3	T4	SEM
	DS	43.3	41.3	42.7	31.7	4.0
IVGP	WS	13.3	10.3	13.3	10.7	2.4
	DS	8.4	8.4	8.6	7.4	0.5
ME	WS	4.5	4.3	4.9	4.8	0.3
	DS	61.1	61.3	62.6	54.8	3.5
OMD	WS	38.9	37.1	40.5	39.0	2.2
	DS	1.0	0.9	0.9	0.7	0.1
SCFA	WS	0.3	0.2	0.3	0.2	0.1

IVGP = *In vitro* Gas Production, ME = Metabolizable Energy, OMD = Organic Matter Digestibility, SCFA = Short Chain Fatty Acids, DS = Dry Season, WS = Wet Season, T1 = 0% FA + 90% PM + 10% Cassava peel, T2 = 30% FA + 60% PM + 10% Cassava peel, T3 = 60% FA + 30% PM + 10%, Cassava peel, T4 = 90% FA + 0% PM + 10% Cassava peel

Table 4: Gas production characteristics of *Ficus polita* diets in the dry and wet seasons

	a (ml)		a+b (ml)		b (ml)		c (ml/h^{-1})	
	DS	WS	DS	WS	DS	WS	DS	WS
T1	8.00^{b}	1.67^{c}	47.00^{a}	15.00^{b}	39.00^{a}	13.33^{a}	0.037^{a}	0.071^{a}
T2	10.30^{a}	3.33^{b}	51.47^{a}	13.66^{c}	41.17^{a}	10.33^{b}	0.032^{ab}	0.051^{b}
T3	8.33^{b}	4.67^{a}	49.84^{a}	18.00^{a}	41.51^{a}	13.33^{a}	0.040^{a}	0.054^{b}
T4	8.33^{b}	1.33^{c}	39.84^{b}	11.99^{c}	31.51^{b}	10.66^{b}	0.028^{bc}	0.062^{a}
SEM	1.23	0.54	1.52	1.29	1.44	0.70	0.02	0.03

^{a,b,c}Means on the same column with different superscripts are significantly different ($p<0.05$). F = Ficus; a = Soluble fraction; b = Potential gas production; a + b = Potentially degradable fraction; c = Rate of fermentation (constant). DS = Dry Season; WS = Wet Season; SEM = Standard Error of Means

0.026-0.059 reported for some MPTs (Makkar and Becker, 1996). Getachew *et al.* (2004) however reported higher rates of 0.056-0.17 for corn grain and canola meal which probably was due to the high nutrient profile in those feeds than in the forages used in this study.

Conclusion: The present study reveals that diets of PM can be supplemented up to 60% with FP based on its availability. In the wet season, diet supplementation with FP may be low. This may be raised to 60% inclusion in the dry season when grasses are scarce.

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