CORRELATION COEFFICIENT (*r*) AND DRY MATTER DEGRADABILITY OF SOME *FICUS* SPECIES USING *IN SACCO* TECHNIQUE

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ABSTRACT

Dry matter (DM) degradation of Five *Ficus* species forages was determined using the *in sacco* degradability technique. Samples were incubated *in situ* for 3, 6, 12, 24, 48, 72 and 96 h. *In sacco* DM degradation kinetics were described using the equation $y = a + b (1 - e^{-ct})$. The result showed that all ficus species leaves studied have high dry matter (DM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) acid detergent lignin (ADL) and low total condensed tannin and phenolics. The soluble but degradable fraction (a), rate of degradation (c) of insoluble fraction b, lag t and effective degradability (ED) were generally low for all the *Ficus* species forage. DM disappearance was high at 72 h (above 50%) for all the browse species. Correlation coefficient (r) shows both positive and negative relationships. Negative but significant relationship was observed between CP and DM disappearance at 3, 6, 12, 24 and 48 h incubation period. NDF, ADF, ADL, TCT and PHE show weak relationship with incubation time and fementation characteristics. In conclusion,the browse species forages can used as dry season feed because of the high level of CP content and low level of anti-nutritive substances.

INTRODUCTION

The de facto reference method to determine rumen degradability of feed components is the *in situ* nylon bag technique (NBT). However, the NBT is very labourious, time-consuming, and incubation and analyses of the feed residues often last several weeks. Other disadvantages are the need for ruminally cannulated animals, the limited number of practically possible incubation times, particle losses from bags and microbial contamination of incubation residues (De Boever, 2002). Nowadays, the nylon bag technique (Meherez and Orskov, 1977) is the standard technique in feed evaluation systems (Thomas, 2004). Nevertheless, some drawbacks have been pointed out (Cone *et al.*, 1999) and a particular importance has been given to the excessive loss of particulate material that might lead to the disappearance of undegraded material from the nylon bags. In this way, the technique might be inappropriate for feedstuffs with high proportions of soluble materials (starch, sugars) and/or high proportions of small particles (Cone *et al.*, 1999). The objective of this research is to investigate the relationship between chemical composition and *in vitro* gas production and fermentation characteristic.

MATERIALS AND METHODS

Samples collection: Five indigenous fodder plants samples (leaves) were used in this study. The specie were: *Ficus damarensis, Ficus platyphylla, Ficus polita, Ficus sycomorus* and *Ficus thonningii.* The harvested samples were then pooled for each individual tree species and then oven dried at 105^{0}C per 24h to constant weight and ground to pass through a 1.0 mm sieve.

In sacco procedure

Management and feeding of Animals

Three ruminally cannulated bulls were used for this experiment. They were housed in individual pens with concrete floors bedded with wood shavings. The beddings were changed weekly. In these pens they were offered corn bran, cowpea husk and salt lick as supplements daily. The animals also had free access to fresh clean water daily. The diet provided the animals were to allow the rumen microbial population meet their requirement for essential as well as provide optimum rumen environment for degradability. The area around the opening of the cannulae was cleaned regularly with warm water and detergent to prevent infection by pathogens.

In sacco DM degradability study

The rate of nutrient disappearance in the browse species was determined by the use of nylon bag technique. Milled (<1.0mm) samples were oven-dried overnight (24 hrs) at 70°C prior to weighing into the bags measuring 140x20mm when laid flat. Ten bags containing the sample were incubated at the same time in each animal. A bag was removed from each of the three

animals at 3, 6, 12, 24, 48, 72 and 96 hours for observation of nutrient disappearance. After incubation, all the bags were withdrawn from the rumen at the same time and immediately placed under running cold tap water until the rinse water became clear. This was done to wash off ingested feed particles adhering to the bags as well as stop further fermentative processes. The bags with the sample residues were then oven dried at 65^{0}C for 48hours and the weight of the bags plus residues measured and recorded. The zero-hour washing losses that is, losses due to non-incubation, were determined by soaking 5g of each of the samples in triplicates in warm water (37^{0}C) for 1 hour which was followed by washing and drying of the bags as done with the incubated sample residues. Dry matter losses was computed as the difference between the determined dry matter content of the pre-incubated samples and the determined dry matter content of the incubated residues. Dry matter losses was computed as the difference between the determined dry matter content of the pre- incubated samples and the determined dry matter content of the incubated residues. The rumen degradation parameter of DM was calculated using the equations of Ørskov and McDonald (1979):

$P=a + b (1-e^{-ct})$; Where: P =Potential degradability after time't'; a =Water Soluble Fraction (zero hour); b =Insoluble but degradable fraction after time 't'; c =Rate of degradation of slowly degradable fraction b; t =Incubation length i.e. 3, 6, 12, 24, 36, 48, 72, 84 and 96 hours; e =exponential; The effective ruminal degradability of DM (EDDM) was calculated according to Ørskov and McDonald (1979): $EDDM = a+b \times (c/(c + k))$ where $k = 0.12h^{-1}$

Chemical analysis

The samples were analyzed in triplicate for dry matter (DM) and crude protein (CP), according to AOAC (2002) procedures. Neutral detergent fibre (NDF), acid detergent fibre (ADF) and lignin were determined as described in Van Soest *et al.* (1991). Total condensed tannin were determined as reported by (Polshettiwar *et al.*, 2007). Finally, phenolics were determined using Folin Ciocalteu metho as described by Makkar (2000).

Statistical analysis

Data obtained were subjected to analyzed as a randomized complete block design using GLM procedure of SAS (Statistical Analysis System Institute Inc., 2003). Standard errors of means were calculated from the residual mean square in the analysis of variance.

RESULTS AND DISCUSSION

Chemical composition

The result of the chemical composition is presented in Table 1. The CP of the browse leaves in this study were within the range of 56-213 g kg^{-1} DM, 96.30 – 166.60 g kg^{-1} DM and 139.60 – 214.20 g kg^{-1} DM reported by Abegunde *et al.* (2009). The CP contents of all the browse forage species is high enogh and can be used to supplement poor quality roughages/pastures during the dry season to increase productivity in ruminant livestock in tropical regions. Though, optimum utilization of CP in browse is dependent on soluble phenolic compounds, such as tannins and insoluble proanthocyanidins, of the browse species (Woodward and Reed, 1989). Although these secondary plant compounds were very low in the present study. The ash content compare favourably with the findings of Abegunde *et al.* (2009) who reported ash of *Ficus* species ranging from 77.50 - 205.00 g kg^{-1} DM in tropical environment. The NDF, ADF and ADL contents of the browse forage leaves obtained in the present study is in the range of 535.60 – 568.10 g kg^{-1} DM, 215.00 – 246.50 g kg^{-1} DM and 81.0 – 134.10 g kg^{-1} DM, respectively, are within the range reported by Abegunde *et al.* (2009) and, Njidda and Ikhimioya (2010) for tropical browse species. The moderate to higher NDF, ADF and ADL in the present study is a positive attribute of the browse species since the voluntary DM intake and digestibility are dependent on the cell wall constituent (fibre), especially the NDF and lignin (Bakshi and Wadhwa, 2004). *In sacco* DM disappearance after 48 and 72 h was significant and positively correlated with NDF. *In sacco* DM disappearance at all incubation times was negatively correlated with TCT except at 48 h incubation. The ADF and ADL concentrations of the ficus species leaves did not show any significant correlation with DM disappearance and estimated parameters. This is similar to the findings of Kamalak *et al.* (2004). CP and NDF

concentration was negatively correlated with the *a*, and *b* fractions and potential degradability (*pd*) and negatively correlated to fractional degradation rate *c*. these findings showed that the soluble fraction *a* wwas linked to cell wall content (complementatry to the NDF fraction) while the *b* was mainly linked to the fibre components and lignin. Hence, the variability of the *a* and *b* fractions was linked to the variability of the fibre fraction. This result is similar to the findings of Haj-Ayed *et al.* (2000). The relationship between chemical composition and ED was generally weak which is similar to the findings of Haj-Ayed *et al.* (2000) who reported that higher levels of both NDF or ADL content reduces ED.

CONCLUSION

It was concluded that, because of the relatively high CP concentrations of the foliage of the five *Ficus* species and the low level of tannin, the foliage of these species would be effective protein supplements for ruminants grazing poor quality grass. There were significant relationship between parameters obtained using the *in sacco* technique.

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Table 1. Chemical composition of the ficus leaves (g kg^{-1} DM).

Browse Forages	DM	CP	NDF	ADF	ADL	TCT	PHE
Ficus damarensis	927.30^{c}	148.80^{c}	545.50^{b}	236.40^{b}	134.10^{a}	0.23^{a}	0.62^{b}
Ficus platyphylla	942.30^{d}	130.70^{c}	535.60^{c}	246.50^{a}	81.40^{c}	0.18^{c}	0.48^{c}
Ficus polita	952.00^{a}	165.30^{a}	536.20^{c}	237.20^{b}	92.30^{d}	0.20^{b}	0.24^{d}
Ficus sycomorus	965.60^{a}	144.60^{a}	536.00^{c}	246.40^{a}	112.40^{c}	0.17^{c}	0.81^{a}
Ficus thonningii	955.00^{a}	162.80^{b}	568.10^{a}	215.00^{c}	121.10^{b}	0.24^{a}	0.65^{b}
SEM	**1.43**	**1.25**	**1.27**	**1.35**	**0.21**	**0.02**	**0.02**

a, b, c, means in the same column with different superscript differ significantly, DM=Dry matter; CP=Crude Protein; OM=Organic Matter; NDF=Neutral detergent fibre; ADF=Acid detergent fibre; Acid detergent lignin (P<0.05);TCT=Total condenced tannin; PHE=Phenolics; SEM=Standard error of means.

Table 2. Degradation characteristics and Effective degradability of DM of Five *Ficus* species incubated in the rumen of bulls

Browse Forages	a	B	a+b	c	Lag T	ED
Ficus damarensis	13.19^{a}	69.31^{a}	82.48^{a}	0.016	0.30	21.10^{a}
Ficus platyphylla	8.33^{b}	68.01^{a}	76.34^{b}	0.023	0.20	19.80^{c}
Ficus polita	5.49^{c}	67.82^{ab}	73.31^{c}	0.026	0.50	18.40^{d}
Ficus sycomorus	6.44^{c}	64.71^{c}	71.15^{d}	0.027	1.10	20.20^{b}
Ficus thonningii	5.82^{c}	65.26^{c}	71.08^{d}	0.029	0.30	18.20^{d}
SEM	**1.21**	**1.21**	**1.22**	**0.019**	**0.38**	**1.56**

a, b, c, means in the same column with different superscript differ significantly (P<0.05); SEM=Standard error means; NS=Not Significant

Table 3. *In sacco* Dry Matter Disappearance of the Five *Ficus* species (% DM)

Browse forages	3	6	12	24	48	72	96
Ficus damarensis	14.28^{b}	18.59^{b}	26.49^{c}	38.40^{a}	48.02^{c}	58.79^{a}	69.47
Ficus platyphylla	18.63^{a}	26.45^{a}	35.99^{a}	37.45^{a}	47.81^{c}	59.87^{a}	70.81
Ficus polita	6.85^{a}	20.94^{d}	27.89^{d}	35.02^{b}	54.62^{a}	59.95^{a}	70.38
Ficus sycomorus	7.52^{a}	22.66^{c}	32.76^{b}	38.18^{a}	49.54^{c}	59.49^{a}	71.11
Ficus thonningii	6.98^{c}	17.45^{e}	28.41^{c}	36.53^{b}	55.75^{b}	60.04^{a}	69.38
SEM	**0.47**	**1.64**	**0.70**	**0.93**	**2.04**	**0.62**	**1.77**

a, b, c, means in the same column with different superscript differ significantly (P<0.05); SEM=Standard error means.

Table 4: *In sacco* correlation coefficients (*r*) of the relationship between the chemical composition and dry matter disappearance or estimated parameters from different browse leaves

In Sacco	CP	NDF	ADF	ADL	TCT	PHE
3	-0.817***	-0.321	0.454	-0.263	-0.165	-0.069
6	-0.785**	-0.746*	0.807***	-0.810***	-0.870***	-0.153
12	-0.804***	-0.454	0.594*	-0.673*	-0.784**	0.158
24	-0.682*	-0.093	0.350	0.462	-0.140	0.791**
48	0.886***	0.571*	-0.752**	0.018	0.447	-0.316
72	0.251	0.183*	-0.284	-0.652*	-0.150	-0.387
96	-0.535*	-0.798**	0.822***	-0.673*	-0.996***	0.005
a	-0.390	-0.086	0.198	0.482	0.288	0.185
b	-0.178	-0.321	0.251	-0.073	0.200	-0.558*
pd	-0.333	-0.190	0.235	0.290	0.273	-0.106
c	0.373	0.272	-0.328	-0.132	-0.184	0.036
LagT	0.013	-0.364	0.388	0.090	-0.578*	0.463
EDMD	-0.648*	-0.416	0.586*	0.353	-0.212	0.459

CP=Crude Protein; NDF=Neutral detergent fibre; ADF=Acid detergent fibre; Acid detergent lignin (P<0.05);TCT=Total condenced tannin; PHE=Phenolics; ***P<0.001; **P<0.01; *P<0.05