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Research Article

NUTRIENT EVALUATION AND DEGRADATION CHARACTERISTICS OF SOME BROWSE PLANTS IN TARABA STATE - NIGERIA

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ABSTRACT

The experiment was conducted at the livestock teaching and research farm of Taraba State University Jalingo, using twenty (20) browse plants commonly found in Ardo-Kola, Jalingo and Lau local government of Taraba State, Nigeria. The browse plants were subjected to chemical composition and rumen degradability study at 6, 12, 24, 48 and 72 hours. Three grams (3g) of each sample in triplicate was transferred into nylon bags and incubated in the rumen of a fistulated bull weighing about 357kg. The highest and the least crude protein CP in the browse plants were obtained in *Newbouldia laevis* (28.13%) and *Boswellia dalzelia* (6.57%) respectively. The mean NDF, Lignin content of the browse species were 49.59%, 6.04% respectively while the mean values for DM, ASH, ADF and EE were 87.10%, 8.54%, 23.93% and 5.80% respectively. The mean tannin, saponin and alkaloid values were 0.18%, 2.00% and 0.04% respectively. The proximate composition of the browse species revealed that browse plants are rich in protein and moderate in lignin and NDF. *Ficus platyphylla* had highest (71.30%) percentage dry matter degradability at 48hours with 16%CP. All the browse plants revealed more than 50% degradation at 48 hours and have acceptable CP, NDF and Lignin values with tolerable tannins, saponins and alkaloid contents and as such are recommended for utilization in ruminant feeding.

INTRODUCTION

The prices of animal products have increased in the last two decades as a result of increase in the price of protein feedstuff used in livestock feed formulation in Nigeria (Mohammed *et al*., 2014). In the tropics the natural pasture which supply the bulk of ruminants feed becomes dry and of low nutritive value during the dry season leading to a marked decrease in voluntary intake and digestibility. In the Savanna Zone of Nigeria, the basal diets of most ruminants in the dry season is based on crop residues and dry standing grasses and most of the diets are imbalanced in nutritional value and vary from year to year (Nyako, 2015).

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The low nitrogen and mineral contents of the crop residues as well as their high lignin and silica contents are considered the major reason for their low digestibility and consequently low utilization by ruminant animals (Malgwi and Mohammed, 2015). Browse has been defined as leaves shoots and sprouts including tender twigs and stems of woody plants, which are cropped to a varying extent by domestic animals (Gidado *et al*., 2013). It could however, be extended to include fruits, pods, and seeds which provide valuable feeds, especially the seeds of deciduous plants. The incorporation of browse species into diets is one of the ways of making affordable improvement to quantity and quality of feed available to ruminants. Browse can improve the total supply of bulk feed given to the ruminant. It can improve the quality of the feed and can also compensate for seasonal fluctuations. This is the reason why fodder trees and shrubs have been the focus of ruminant nutrition research in

recent times, more so because these feed resources are locally available, perennial sources of feed (Fadiyimu *et al.,* 2015). In Nigeria, ruminant animal production is faced with problem of inadequate nutrition due to shortage of feed and all year round availability of quality forage. Long period of dry season, which limit availability of feed adversely affects development of the ruminant industry (Mbahi *et al*., 2006; Moemeka *et al.,* 2013). Fabian *et al*., (2015) highlighted that the effect on ruminants of imbalanced nutrient supply, in particular fermentable nitrogen and protein, include low calving, low birth weight, high calf mortality; low weaning weight and reduced milk production.

Farmers nowadays pay much attention in just feeding their livestock with any locally or costly available feed materials without knowing the digestibility and nutritive values of such materials. It is observed that during the long dry season periods, standing hay, bush forage are poor in nutritive value, quality and other crop residues are not enough in terms of quantity, therefore there is the need to compliment and bridge the gap. This study is designed to evaluate the potentials and nutritive values of some browse plants that are locally readily available and fed commonly to ruminants, to identify the commonly available browse plants in Ardo-Kola, Jalingo and Lau local government areas, determine the proximate composition and anti-nutritive profile of the selected browse plants in the study areas, evaluate the degradation characteristics of the selected browse plant and to rank the selected browse plants based on their nutritive value and degradation as feeds for ruminants and to recommend the appropriate browse plants to farmers to augment feed supplies.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Taraba State University, livestock and research farm Jalingo, Taraba State capital is located between latitude $8^0 3'$ and longitude $11^0 5'$ East of Guinea Savannah Zone of Northern Nigeria. There are two main seasons, dry season and rainy season. Dry season starts early in November and end in March. The wet season runs from April to October. The area has a mean average annual rainfall of about 1000 – 1500mm, with a temperature that ranges from 30^0C to 38^0C depending on the season. It has an undulating topography which complex groups of mountains and hills. The soil type range from sandy to sandy loamy with makes the rural inhabitants mostly farmersf (arable and livestock), Taraba State Diary (2008).

Sample Collection

Twenty (20) common browse plants species were collected in Ardo-Kola, Jalingo and Lau local government areas of Taraba State. Kitchen knife was used to harvest the leaves and twigs, with assistance of a botanist. The samples were ground through a 2mm sieve and stored in sealed containers after drying for 48 hours in an oven at 65^0C and labeled for easy identification. The samples were weighed and packaged in polythene bag weighing 1kg per sample using the weighing balance. Approximately 3 grams of feed samples were weighed in replicates and put into the bags.

Management of Experimental Animal

The experiment was carried out using a fistulated bull which was dewormed and properly treated for external parasites. The animal was fed with grasses and concentrates, water, salt lick provided *ad-libitum* throughout the experiment. The bull was surgically fitted with rumen cannula of 43mm internal diameter and was allowed five weeks recovery period. 3g of each sample was incubated in the rumen of the bull for 6,12,24,48 and 72 hours respectively. Throughout the experimental period, the cannulated site was dressed twice a day with antiseptic (savlon) to prevent infection on the canulated site.

Chemical Analysis

The twenty (20) browse plants were analyzed for dry matter (DM) Ash, crude protein (CP), crude fibre (CF), ether extract (EE), lignin and nitrogen free extract according to AOAC, (2000) method.

Statistical Analysis

The results were analyzed using fit curve macro (Chen, X .B. 1995) for Microsoft Excel (NEEWAY Excel). Degradation constant was estimated from the exponential equation $P = a + b (1-e^{-ct})$ by McDonald and Orskov, (1979)

RESULTS AND DISCUSSION

The mean dry matter (DM) for all the browse plants species values recorded was 87.10%. The least %DM was 83.65% recorded for *Gmelina aborea* while highest 89.75% DM was recorded in *Parkia clappertoniana*. This corroborate to the mean dry matter values of 86.97% reported by Gidado *et al.* (2013) for browse plants in the derived Savanna area of Nigeria. Nyako *et al.* (2014) reported a mean dry matter values of 91.25% which is higher than the values obtained in this research. The observed difference might be due to variation in vegetation zones and the period at which the samples were collected and processed.

The mean crude protein of the browse plants was 13.75%CP. *Boswellia daizelia* recorded the least with 6.57% while the highest 28.13% was recorded in *Newbouldia laevis* followed by *khaya senegalensis* and *Adansonia digitata* with 17.77%CP and 19.87%CP respectively. The %CP of the browse plant species are different from the range 8.98% - 36.50% reported by Nyako *et al.,* (2014). The result from this study confirms that browse leaves contain appreciable amount of nutrients that could be harnessed for ruminant feeding as observed by Abdu *et al.,* (2011). The slight variation in crude protein may be attributed to different growth stage of browse plants. Browse plants with CP level below 7% are considered deficient and therefore may not sustain live weight of animals; such plants may only be supplemented by protein feed sources. The mean ether extract of the browse analyzed was 5.80% with a range of 3.89% and 8.87%. The highest values 8.87% was recorded in *Grewia mollis* and the lowest value 3.89% was recorded in *Annona senegalensis*. This is higher than 1.53% reported by Nyako *et al*. (2014). The mean ash content was 8.54%. It ranged from 3.71% in *Prosopis africana* to 17.05% in *Ficus sycomorus*.

Table 1. Browse Plants identified (with local and traditionally identified names)

S/N	Scientific name	Common name	Hausa	Fulfulde
1.	*Adansonia digitata*	Baobab tree	Kuka	Bokkal, Hokwaboko
2.	*Annona senegalensis*	Coastal apple	Gwandar daji	Dukuje ladde
3.	*Balanites aegyptica*	Soap berry tree	Aduwa	Tanne
4.	*Boswellia dalzelia*	Frankincense tree	Ararrabi	Biskehi
5.	*Daniela oliveri*	Capaiba balsam	Maje	Karailahi
6.	*Ficus platyphylla*	Gutter-percha tree	Gamji	Dundahi
7.	*Ficus thoningii*	Fig tree	Cediya	Biskehi
8.	*Ficus sycomorus*	Fig tree	Baure	Ibbe
9.	*Grewia mollis*	Sweetberry tree	Dargaza	Korungwol, Killi
10.	*Gmelina aborea*	Gmelina, beech wood	Melina	Debba-lobbo, dolinji
11.	*Gardenia aquella*	Leopard tree	Gaude	Digalihi
12.	*Khaya senegalensis*	Dry zone Mahogany	Madaci	Deleje, Kahi
13.	*Newbouldia laevis*	Africa border tree	Adukuru	Endamyel
14.	*Pakia clappertoniana*	Africa locust tree	Doruwa	Naraje
15.	*Poliostigma thoningii*	Camel tree	Kargo	Barkeje
16.	*Prosopis africana*	Iron tree, Somb tree	Kirya Kohi	Kohi
17.	*Securinega virosa*	White berry-bush, bush weed	Tsa	Gaagahi
18.	*Tamarindus indica*	Tamarind tree	Tsamiya	Jabbe
19.	*Vitex doniana*	Black plum	Dinya	Ngalbije
20.	*Vitex simplicifolia*	Egle Pea tree	Dinyar biri	Ngalbije wadu

Table 2. Proximate Composition of Some Browse Plants

S/N	Sample description	DM	ASH	CP	EE	ADF	NDF	LIGNIN
1.	*Adansonia digitata*	85.73	4.97	19.87	6.15	21.75	51.35	6.35
2.	*Annona senegalensis*	87.47	6.50	12.49	3.89	20.65	40.23	5.97
3.	*Balanites aegyptica*	85.97	10.17	14.45	7.65	23.05	49.21	5.17
4.	*Boswellia dalzelia*	88.73	4.85	6.57	5.75	22.75	57.30	5.84
5.	*Daniela oliveri*	86.87	4.26	11.17	6.31	23.63	57.81	4.99
6.	*Ficus platyphylla*	86.25	11.81	16.43	5.83	25.39	53.67	5.75
7.	*Ficus thoningii*	88.10	9.65	16.41	7.25	24.70	48.30	6.31
8.	*Ficus sycomorus*	88.12	17.05	11.37	5.69	28.98	40.25	4.30
9.	*Grewia mollis*	87.73	12.45	7.32	8.87	25.73	50.23	6.25
10.	*Gmelina aborea*	83.65	7.07	13.03	5.95	21.85	56.73	5.19
11.	*Gardenia aquella*	86.72	8.17	12.47	4.55	19.25	39.25	5.85
12.	*Khaya senegalensis*	89.07	10.70	17.77	6.77	19.65	39.65	5.65
13.	*Newbouldia laevis*	85.89	4.83	28.13	4.57	26.35	46.35	4.83
14.	*Pakia clappertoniana*	89.75	5.19	7.23	5.91	23.62	58.43	5.12
15.	*Poliostigma thoningii*	85.30	11.50	14.45	4.31	25.71	53.24	6.12
16.	*Prosopis Africana*	83.99	3.71	15.17	5.11	26.33	51.73	4.75
17.	*Securinega virosa*	87.87	7.23	11.85	3.90	27.33	48.73	13.24
18.	*Tamarindus indica*	88.73	7.75	16.43	5.65	23.23	43.17	5.57
19.	*Vitex doniana*	87.15	13.63	13.78	5.25	23.15	49.31	5.53
20.	*Vitex simplicifolia*	89.03	9.25	8.57	6.65	25.43	57.23	6.43
	Means	87.10	8.54	13.75	5.80	23.93	49.59	6.04

MD = Dry Matter, CP = Crude Protein, EE = Ether Extract, ADF = Acid Detergent Fibre, NDF = Neutral Detergent Fibre

Table 3. Anti Nutritional Factors in the Browse Plants Identified (%)

S/N	Sample description	Tannins	Saponnins	Alkaloids
1.	*Adansonia digitata*	0.18	1.83	ND
2.	*Annona senegalensis*	0.12	2.07	0.02
3.	*Balanites aegyptica*	0.11	4.78	0.21
4.	*Boswellia dalzelia*	0.21	6.31	0.01
5.	*Daniela oliveri*	0.21	1.81	0.01
6.	*Ficus platyphylla*	0.19	0.96	0.01
7.	*Ficus thoningii*	0.17	0.15	ND
8.	*Ficus sycomorus*	0.14	0.40	0.01
9.	*Grewia mollis*	0.21	2.16	0.01
10.	*Gmelina aborea*	0.23	2.16	0.01
11.	*Gardenia aquella*	0.16	0.21	0.02
12.	*Khaya senegalensis*	0.13	2.29	0.42
13.	*Newbouldia laevis*	0.19	2.53	0.02
14.	*Pakia clappertoniana*	0.19	2.22	0.01
15.	*Poliostigma thoningii*	0.16	0.21	0.02
16.	*Prosopis Africana*	0.22	3.15	ND
17.	*Securinega virosa*	0.12	2.02	0.02
18.	*Tamarindus indica*	0.17	2.02	0.02
19.	*Vitex doniana*	0.21	0.40	0.01
20.	*Vitex simplicifolia*	0.18	2.53	0.02
	Mean	0.18	2.00	0.04

Table 4. Percentage Dry matter Degradation of Browse Plants (%)

S/N	Name of browse plant	Washing loss	6hrs	12hrs	24hrs	48hrs	72hrs
1.	*Adansonia digitata*	16.20	38.90	42.20	47.60	55.30	63.20
2.	*Annona senegalensis*	48.60	54.10	60.70	64.40	71.30	72.60
3.	*Balanites aegyptica*	41.10	46.70	50.20	54.10	61.10	64.40
4.	*Boswellia dalzelia*	28.60	34.50	38.40	48.90	54.80	63.50
5.	*Daniela oliveri*	20.40	28.60	33.60	43.50	52.00	57.40
6.	*Ficus platyphylla*	48.60	54.10	60.70	64.40	71.30	72.60
7.	*Ficus thoningii*	19.40	29.70	36.60	47.50	62.90	73.00
8.	*Ficus sycomorus*	18.40	26.50	31.10	59.20	64.20	67.20
9.	*Grewia mollis*	27.60	28.80	36.00	40.70	45.90	46.20
10.	*Gmelina aborea*	18.50	21.80	30.30	38.10	53.50	55.90
11.	*Gardenia aquella*	37.10	43.10	51.50	55.40	61.20	62.60
12.	*Khaya senegalensis*	45.20	52.10	55.70	58.50	64.20	66.20
13.	*Newbouldia laevis*	39.00	41.10	45.90	50.00	55.60	57.10
14.	*Pakia clappertoniana*	25.50	33.60	36.40	41.50	60.20	65.00
15.	*Poliostigma thoningii*	27.60	34.50	38.60	44.80	52.80	56.40
16.	*Prosopis Africana*	26.90	31.40	38.40	48.50	62.80	64.50
17.	*Securinega virosa*	18.10	25.20	31.70	38.50	48.70	62.30
18.	*Tamarindus indica*	27.80	33.40	38.50	48.70	62.30	65.10
19.	*Vitex doniana*	22.30	28.70	33.20	42.80	57.80	63.60
20.	*Vitex simplicifolia*	37.80	42.20	45.90	49.30	56.00	59.10
	Means	29.74	36.45	41.78	49.31	58.77	62.62

DM = Dry Matter, hrs = Hours, Washing loss = Control

Table 5. Degradability Parameters as Subjected to the Exponential Equation

S/N	Name of sample	A	B	C	A+B
1.	*Adansonia digitata*	16.20	77.60	0.01	93.80
2.	*Annona senegalensis*	48.60	24.90	0.05	73.50
3.	*Balanites aegyptica*	41.10	28.40	0.02	69.50
4.	*Boswellia dalzelia*	28.60	41.60	0.02	70.20
5.	*Daniela oliveri*	20.40	40.60	0.32	61.00
6.	*Ficus platyphylla*	48.60	24.90	0.05	73.50
7.	*Ficus thoningii*	19.40	70.10	0.02	89.500
8.	*Ficus sycomorus*	18.40	50.10	0.06	68.50
9.	*Grewia mollis*	27.60	18.90	0.07	46.40
10.	*Gmelina aborea*	18.50	42.30	0.03	60.80
11.	*Gardenia aquella*	37.10	25.40	0.07	62.50
12.	*Khaya senegalensis*	45.20	23.40	0.03	68.60
13.	*Newbouldia laevis*	39.00	19.00	0.05	58.00
14.	*Pakia clappertoniana*	25.50	67.70	0.01	93.20
15.	*Poliostigma thoningii*	27.60	32.80	0.03	60.40
16.	*Prosopis Africana*	26.90	41.70	0.04	68.60
17.	*Securinega virosa*	18.10	48.20	0.02	66.30
18.	*Tamarindus indica*	27.80	42.60	0.03	70.40
19.	*Vitex doniana*	22.30	52.80	0.02	75.10
20.	*Vitex simplicifolia*	37.80	25.80	0.02	63.60

A = Washing loss (water soluble fraction), B = Rumen degradation Fraction (water soluble), C = Degradable rate Constant (Fraction/hr), A + B = Potential Degradability.

The mean value of ash is in concord with 7.16% reported by Akinfemi and Muktar, (2012). The Ash content of *Parkia clappertonniana* with 5.19% was similar to 5.20% reported by Nyako *et al.*, (2015). The ADF content of the entire browse species studied revealed a mean value of 23.93% and ranged from 19.25% for *Gardenia aquella* to 28.98% in *Ficus sycomorus* and this agrees with the 23.30% maen ADF reported by Gidado *et al*., (2013) but slightly higher than the 21.42% reported by Yashim *et al*., (2014) while the mean Neutral Detergents Fibre (NDF) value for browse plants was 49.59% and ranged from 40.23% for *Annona senagalensis* to 58.34% for *Parkia clappertoniana*. This value is slightly higher than the range reported by Gidado *et al*., (2013) and Yashim *et al*., (2014) as 39.23% to 58.63% and 34.61 to 38.88%, respectively. The mean values for lignin in all the browse plants analyzed as 6.04% and the range of 4.30% for *Ficus sycomorus* to 13.24% in *Securinga virosa* and this is slightly than (5.75%) reported by Gidado *et al*., (2013). Lignin is the indigestible fraction of the plant cell wall and stems usually have higher lignin content than leaves and hence high NDF which reduces digestibility Gidado *et al*., (2013). One of the constraints to the use of browse species as a livestock feed is the presence of toxic and anti-nutritional constituent as presented on table 3. These constitutions have different but adverse effects on animal performance including loss of appetite and reduction in dry matter intake and protein digestibility. Thus, the tanin, saponin and alkaloid content of the browse plants in the study area ranged from 0.11% to 0.23%, 0.15% to 6.78% and 0.01 to 0.42% respectively. Mean tannin content of all the browse plants was 0.196%. The level of tannin which adversely affect digestibility in ruminants is between 2% and 5% Gidado *et al*., (2013). Goats are known to have threshold capacity of about 9% dietary tannin. Tannin levels also increased from 0.85 to 1.35mg/100g as the levels of *F. sycomorus* increased from 0 to 15% in the concentrate supplements (Yashim *et al.,* 2014). Therefore, *Gmeline Aborea* which recorded the highest 0.23% tannin level and all the other

browse plants contain tannin content that is within the tanin tolerance level of ruminants.

Table 6. Effective dry matter degradability parameter a,b,c and fractional out flow rate k = 0.002 and k = 0.005 and k = 0.008 of browse plants

S/N	Sample description	a	b	c	RSD	K=0.02	K=0.05	K=0.008
1.	Adansonia digitata	36.30	57.50	0.00	0.62	53.70	44.80	41.90
2.	Annona senegalensis	48.60	24.90	0.05	1.34	66.10	60.70	57.80
3.	Balanites aegyptica	43.50	26.00	0.02	0.48	57.40	51.70	49.30
4.	Boswellia dalzelia	29.20	41.00	0.02	2.25	51.30	42.30	38.50
5.	Daniela oliveri	21.50	39.60	0.03	0.81	45.90	37.00	32.80
6.	Ficus platyphylla	48.60	24.90	0.05	1.34	66.10	60.70	57.80
7.	Ficus thoningii	22.50	67.00	0.02	0.23	55.50	41.20	35.60
8.	Ficus sycomorus	3.20	65.30	0.06	6.34	53.40	41.00	34.10
9.	Grewia mollis	20.20	26.30	0.07	0.95	40.90	36.30	33.60
10.	Gmelina aborea	13.10	47.70	0.03	2.09	43.40	33.00	28.10
11.	Gardenia aquella	35.00	27.40	0.07	1.57	56.00	50.60	47.40
12.	Khaya senegalensis	49.30	19.30	0.03	0.72	60.80	56.50	54.50
13.	Newbouldia laevis	36.20	21.80	0.05	0.62	51.40	46.70	44.30
14.	Pakia clappertoniana	27.70	65.50	0.01	3.36	52.70	40.60	36.40
15.	Poliostigma thoningii	29.60	30.80	0.03	0.17	47.70	40.80	37.70
16.	Prosopis Africana	21.40	47.20	0.04	1.72	52.40	42.10	37.20
17.	Securinega virosa	20.10	46.30	0.02	0.91	44.20	34.10	30.00
18.	Tamarindus indica	24.60	45.80	0.03	1.56	53.00	42.80	38.10
19.	Vitex doniana	21.30	53.80	0.02	1.30	49.60	37.90	33.10
20.	Vitex simplicifolia	39.30	24.30	0.02	0.59	52.40	47.10	44.80

a = Fitted Soluble Fraction
b = Fitted Insoluble but degradable at 50, 20 and 12 hours mean retention time
c = Degradation rate constants time respectively
k = Fractional outflow rate from the rumen
RSD= Residual Standard Deviation

The Saponin content of the browse plant studied varied from 0.150% in Ficus thoningii to 6.31% in *Boswellia dalzielia*. This is differ slightly from what was reported by Yashim *et al.,* (2014) who reported saponin content for *Boswellia dalzielia, Balanite aegyptice, khaya senegalensis, Newboullia leavis* and *Vitex simplicifolia* at 6.31%, 4.78%, 2.29%, 2.53% and 2.53% respectively and such level will affect the nutritional potentials of livestock this is contrary to Gidado *et al.* (2013) who suggested tolerated level of Saponins in ruminant diet a range of 1.50 to 2.00%. Alkaloids contents varied from 0.04 in *Grewia mollis* and 0.42% in *Khaya senegalensis*. This value is lower than the values obtained by Omoniyi *et al.* (2013) who reported alkaloid range of 0.36 to 1.58% for indigenous tree legumes of South-Western Nigeria. This observed difference could be attributed to some environmental factors like climate, differences in soil type and variation in soil nutrient as well as maturity of plant at harvest.

The percentage dry matter degradability of all the browse plants is presented on table 4. High percentage dry matter degradability at 6 and 12 hours was recorded in *Ficus platyphylla* 54.10% while least was recorded in *Gmelina aborea* 21.80%. *Annona senegalensis* and *Ficus platyphylla* recorded highest dry matter degradability of 60.70% each at 12 hours of incubation while least was recorded in *Ficus sycomorus* 30.10%. The degradability percentage of all the browse plants was above 40% at 48 hours of incubation and this implies that all the browse plants can be comfortably utilized in feeding ruminant based on the recommendations of F.A.O, (1986) which suggested a minimum of 40 to 50% degradation at 48 hours in the rumen cited in Malgwi and Mohammed, (2015). Feeds were ranked according to degradability values at 48 hours Nyako *et al*. (2014). It was observed that roughages were bulky, containing more than 18% Crude Fibre, and with low digestibility, the high crude fibre in the basal feeds confirmed the fact that degradability decreased with increasing fibre content. However, Smith, (1988) recommended 60% degradation at 48 hours, and based on this recommendation *Adansonia digitata* (55.30%), *Bosewellia dalzelia* (54.80%), *Danelia olieveri* (52.00%), *Grewia mollis* (45.90%), *Gmellia aborea* (53.50%), *Newbouldia laevis* (55.60%), *Poliostigma thoningii* (52.80%), *Securinega virosa* (48.70%), *Vitex doniana* (57.80%), and *Vitex simplicifolia* (56.0%) may not be suitable for feeding ruminant livestock. At 72 hours, percentage dry matter degradability ranged from 72.60% – 55.90%. This range is slightly below the range of 78.84% – 83.67% reported by Malgwi and Mohammed, (2015) who used crop residues to formulate rations for ruminants. Thus, browse plants have good potential degradability and as such can be used formulating rations for ruminants.

The result of the degradability parameters of browse plants studied is presented in Table 5. The degradability parameters of the browse plants were subjected to exponential equation $P = a+b\ (1-e^{-et})$ (Orskov and Mc Donald, 1979). It was revealed that *Annona senegalensis, Balanite eagyptica, Ficus platyphylla and Khaya senegalensis,* have the highest solubility values of 48.60%, 41.10%, 48.60%, and 45.20% respectively. While *Adansonia digitata, Securinega virosa, Ficus sycomorus, Gmelina, aborea*, and *Ficus thoningii* have the lowest solubility of 16.20% 18.10%, 18.50% and 19.40% respectively. The rumen degradable fraction (B) ranged between 77.60% for *Adansonia digitata* and 18.90% for *Grewia mollis*. The rate of degradation constant (C) ranged between 0.01 fraction/ hours in *Adansonia digitata* to *Grewia mollis* 0.07 fraction/ hours. The potential degradability (A+B) of the browses appeared to have an inverse relationship with the rate of degradability (C). All the browse plants studied recorded leg time which indicates that degradation did not occur similarly in the rumen. The effective degradation in the rumen depends on how long the feed remains in the rumen which is also a function of the quality of the feeds fed to the animals (Reddy 2001). The highest effective degradability (ED) value (66.10%) was observed in *Adansonia digitata* and *Ficus platyphylla* while the lowest value (40.90%)

was obtained in *Grewia mollis* at the fractional out flow rate of k = 0.02 (i.e MRT = hours). The effective degradation in the rumen depends on how long the feed remains in the rumen which is also a function of the quality of the feeds fed to the animals (Reddy 2001). The effective degradability (ED) values in Table 6 are the predicated degradability of the browse studied as if fed to the animal and are retained in the rumen for 50, 20 and 12 hours respectively, (k = 0.002, 0.005 and 0.08). The highest effective degradability (ED) value (66.10%) was observed in *Adansonia digitata* and *Ficus platyphylla* while the lowest value (40.90%) was obtained in *Grewia mollis* at the fractional out flow rate of k = 0.02 (i.e MRT = hours).

Conclusion

This study revealed that browse plant species can conveniently be utilized in formulating quality rations for fattening and maintainance of ruminant feeding as most of the browse plants evaluated in this study appear to have high CP and low NDF and lignin contents as well as palatable level of anti-nutritive factors. Most of the browse plants studied are good feed resources which can be blended with two or more crop residues in enhancing ruminant diets.

Recommendations

Based on the findings of this study, *Parkia clappertoniana*, *Annona senegalensis*, *Adonsonia digita, Prosopis africana*, *Ficus thoningii*, *Ficus platyphylla, Balanite aegyptica, Khaya senegalensis, Tamarindus indica* and *Ficus sycomorus* are highly recommended for inclusion in ruminant livestock feeding due to their high CP content with acceptable levels of NDF and lignin contents and are available all years round, which provide either leaves or pods consumed by ruminants in the semi arid environment of North-eastern part of Nigeria. Though browse plants are not planted or cultivated in plantation in Nigeria the seasonal loss of weight of ruminant and their productivity, generally make the establishment of browse plantation a necessity for feeding ruminant animals and further research to be carried out to thoroughly explore the potential of these plants.

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