PERFORMANCE CHARACTERISTICS OF ***TEPHROSIA BRACTEOLATA* *(GULL ET PERR)*** BASED DIETS IN CELL WALL FRACTIONS DIGESTIBILITY AND NITROGEN RETENTION IN WEST AFRICAN DWARF GOATS

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ABSTRACT

Sixteen west African Dwarf Goats (8 bucks and 8 does) were balanced for age, sex and weight (average of 5.79±0.60kg), to test for performance characteristics, cell wall digestibility and Nitrogen Retention. The animals were fed Tephrosia bracteolata based diets. They were allotted randomly to the following dietary treatments (T. bracteolata, P. maximum, Concentrate) namely, I as control, II, III and IV for one hundred and twelve days; 14 day pre-growth adaptation, 84 days growth and 14 days digestibility (7 days adaptation and 7 days monitoring). Highest DM was observed in IV and lowest in I. Treatment IV also had highest and daily weight gain and lowest occurred in I. Concerning NDF, ADF and NDL digestibility (%), highest occurred in IV and and lowest recorded in I. Similarly trend of highest in IV and lowest in I repeated itself with respect to nitrogen balance. This study confirmed that with concentrate waste, Tephrosia bracteolata can be sole feed to goats with A.I.B. (Agro industrial byproducts) for optimal performance with or without grass supplement despite it inherent anti nutrient factors.

Keywords: *Cell wall digestibility, Performance Characteristics, Nitrogen Retention, Tephrosia bracteolata, West African Dwarf Goats*

INTRODUCTION

Tephrosia (family: *Leguminosae,* sub family: *Papillionoidea,* Tribe: *Tephrosiea* and Genus: *Tephrosia*) (Traman, Paul and James, 1956) is a French language which means staying green in English (Phillips, 1986). *Tephrosia bracteolata* agronomically

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indicates that majority of its species survive and persist in all types of weather conditions either "clement" or "inclement" to maintain and sustain their above-ground phyto-mass. According to Brewbaker (1986) who also catalogues that *Tephrosia bracteolata* is native to Africa and is also among the list of Nitrogen fixing multi purpose trees and shrubs (MPTs) for fodder in Africa. *Tephrosia* species {*Tephrosia-candida* (Roxb), *Tephrosia - linearis* (Wild), *Tephrosia - purpureum* (Linn), *Tephrosia - pedicellata* (Bak), *Tephrosia* - Vogelli (Hook) etc. in general are dispersed throughout the tropics occurring also in South Africa, Sub-tropical Australia, and North America (Daniel, 1871). Although some species of *Tephrosia* are said to be relished by herbivores and ruminants (IBPGR, 1984, Le-Hourou, 1986) irrespective of the fact, they contain some secondary plants metabolites, *Tephrosin*, a polyphenol which is an isomer of tannin (Phillips, 1986). This must have occasioned the manufacturing of pesticides and insecticides from these plants especially from vogelli species.

In Western part of Nigeria, it is called "Roro" and also being "praised-song" as that which enables Does (female goats) to give birth to quadruplet and Ewes (female sheep) to give birth to triplet because these phenomena are not common in that area which must have been due to inherent leguminous hormones-like and phyto-oestrogenic properties (Hufstedler and Greene, 1975). As a result of competition between livestock and humans for available proteinous feedstuff, also, increasing land pressure and resultant restriction of livestock to marginal lands have resulted in the need to supplement animals on those lands as well as the rampant deforestation that informs the diversion of land to food crop production (Fomunyam and Mbomi, 1989). This bottleneck in ruminant/animal production can be overcome by supplementary diets with locally produced cheap protein source (Fomunyam and Mbomi, 1989). *Tephrosia spp* is one of the cheapest forage sources of protein to satisfy ruminant livestock nutritional requirements because their nitrogen content is a satisfactory substitute for more expensive protein supplement. They also have additional advantage of availability, accessibility on farm, laxative influence on alimentary system and reduction in feed cost (Devendra, 1988).

Initial works done on *Tephrosia* species includes *Tephrosia vogelli* and cotton seed cake fed to sheep and goats in dry season by Fomunyam and Mbomi, (1989). Anugwa, Okworo and Ekwuno (2000) fed *Tephrosia bracteolata* along side other browses to determine intake and digestibility in kid. Analytically, Ologhobo (1989) and Oduguwa O., Oduguwa B., Onwuka and Olajobi (1998) studied some forage legumes (T*ephrosia bracteolata* inclusive) secondary plant metabolites/anti quality-factors. Also, Adeloye (1994) fed *T. bracteolata* with *Parkia fililiodea* (Keay) for intake determination in West Africa Dwarf Goat and Ayoade, Ogebe, Okwori and Ogbeide (1998) sole fed *T. bracteolata* to goats to evaluate its intake and digestibility. In Australia, Strickland, Lambourne and Ratcliff (1989) undertook a rat bioassay of *Tephrosia bracteolata* and found out that it was similar in palatability and feed value to *Lucerne Medicago sativum.* There is little information on *Tephrosia bracteolata* supplemented with *Panicum maximum* (Jacq), which is common and available in

Southwestern Nigeria. This experiment on this premise was set out to investigate the growth rate, cell wall fractions, digestibility and nitrogen retention of West African Dwarf Goats fed various combinations of *T. bracteolata* and *P. maximum* with concentrate.

MATERIALS AND METHODS

Experimental site: The experiment took place at the goat research section of the Rocky-feller teaching and research farm, University of Ibadan (Forest- savannah transition zone in south-western Nigeria, at 7° 27'N and 3°45'E at an altitude of between 200 and 300 meters above sea level and the climate is modified sub-humid type).

Pen Management: The pens and metabolism cages were swept and dusted and were later fumigated with Dettol (Chloroxylenol®, a strong antiseptic/disinfectant) manufactured by Reckilt Benckiser Ogun state, Nigeria at the rate of 27ml to 1 liter of water and also with Diazintol {Diazinon Dimpylate® a strong and broad-spectrum insecticide (acaricides and larvicides) manufactured by Alfasan International B.V. Holland, at the rate of 2ml to 1litre of water}. A mixture of used automobile engine oil (1 liter) and sieved wooden ash (250 grams) was basally applied on the floor (to repel soldier ants, dorylus spp). Wood shaven were later spread on the floor of pens (adaptation, spare and experimental pens). These (oil-ash mixture and wood shaven) were henceforth fortnightly applied and changed respectively until the end of the trial.

Feed Materials: *Tephrosia bracteolata* shoots were cut 50cm above the ground from Pasture and Range section of the farm and sorted into leaves (leaves plus fine stem up to 6mm in diameter, Tarawali S., Tarawali G., Larbi and Harrison (1995) and Leaves were allowed to wilt over night before feeding.

Animals and Management: 10 Bucks and 10 Does of West African Dwarf Goats breed and aged between 4 and 7 months with an average initial live weight of 5.79±0.60kg were used in this intake, digestibility, growth and Nitrogen-balance experiment. The goats which were sourced from home steads and local markets within and outside the station's environs were on arrival lairaged in the adaptation pen where they were, prior to the commencement of the experiment, dewormed with Levaject (Levamisole® by SKM PHARMA PVT LTD, Bangolere India) Intramuscularly at the rate of 1ml/20kg bw, Ivomec (Ivermectin® by SKM PHARMA PVT LTD.India) subcutaneously at 1ml/40kg bw around the shoulder blade.

Terroxy L.A®. (Oxytetracyclin long Acting by SKM PVT Ltd, India) at the rate of 1ml/10kg was applied intramuscularly; they were also dipped in diazintol solution and finally vaccinated against Pest-de-Petite Ruminante using tissue culture Rinderpest vaccine (TCRV) at the rate of 1ml/animal subcutaneously (P.P.R) (Reynold, Attah-Krah and Francis, 1988) after which Tanvit (Multivitamin and anti stress by SKM Pharma Pvt Ltd India) was administered intramuscularly at the rate of 3ml/

animal. During the 84 daylong growth trials, animals were housed in individual pens and they were adjusted for 14 days before the commencement of feed offered and leftovers recordings. During the last 2 weeks of the experiment, the animals were transferred to modified metabolism cages (Onwuka and Akinsoyinu, 1989) in preparedness for digestibility and the balance aspect of the experiment.

Experimental Design and Treatments: Sixteen (16) of the twenty (20) animals were divided into 4 groups of animals each based on their sex, age and were also balanced for their weight. Each group was randomly assigned to me of the four (4) treatments and individual animals were completely randomized within the experimental pens in the unit. Each animal was fed twice daily at 0800hours (GMT) and 1400 hours (GMT) with forage allowance (*T. bacteolata and P. maximum*) at 4% of their body weight and concentrate allowance at 1% of their body weight. The feed allowance (forage and concentrate) was adjusted as the animals changed weight. Fresh drinking water was available *ad libitum* and each component was served in separate containers.

Growth Trial: To calculate daily feed intake, amount of *T. bracteolata, P. maximum* and concentrate offered to and refused by each animal were recorded daily, and samples of feed offered were collected three times per week for DM determination (oven drying at 65°c for 48 hours). Sub samples of feed offered were ground to pass through a 1mm sieve and stored for laboratory analysis. The goats were weighed once, early in the morning before morning feed were offered per week throughout the experimental period.

Digestibility Trial: During the last 14 days, goats were transferred to metabolism cages but feeding and management remained the same as during the growth trial. The animals were left to "adjust" in the cages for 6 days after which, total faeces and urine produced by individual animals were collected for 8 days. The amounts of feed offered and refused were recorded daily and samples bulked separately for each animal for the entire collection period. Individual urine was collected in solution of 10% concentrated sulphuric acid (H_2SO_4) v/v (volume for volume) and kept in refrigerator for Nitrogen determination. Samples of feed offered, feed refused and faeces were collected daily from animal and their DM determined by oven drying at 65°C for 48 hours. At the end of the entire collection period, feed refused, representative feed samples and pooled faecal samples were oven-dried for DM determination and ground through a 1-mm sieve and stored until needed for chemical/ laboratory analysis.

Laboratory/Chemical Analysis: Proximate analysis was carried out according to A.O.A.C. (1990) method and Nitrogen in feed; faeces and urine were assayed using the Kjeldahl technique of the same method. NDF, ADF, and ADL in feed and faeces were determined according to Vansoest and Robertson (1985). Concerning the ANF in *T. bracteolata,* Saponin assaying method according to Strong (1976) was used, the Precipitation method by Hagerman and Butler (1983) was employed for Tannin, while Phytate determination method by Maga (1983) was used for Phytate and Oxalate was analyzed using the rapid method as catalogued by Beutler, Becker, Michael and Walter (1980).

Statistical Analysis: One-way analysis of variance was used for all data that were generated and to be compared, and where there are significant differences among compared data; least significance difference was used at 5% level of probability. As packaged in the general linear model of SAS (2000.) The general linear model is as defined thus:

$$X_{ij} = \mu + \alpha_i + e_{ij}$$

Where:

μ is the Grand population mean

X_{ij} is the individual data generated from the fixed treatments effects

α_i is the fixed treatments (diets I to IV) effects

e_{ij} is the error (replicate) term within each treatment.

RESULTS AND DISCUSSION

Table 1: Concentrate Composition Fed to Animals on *Tephrosia bracteolata* Based diet.

Ingredients	Percentage
Sorghum brewer's waste (DUSA)	40.00
Corn Offal	40.00
Palm Kernel Cake	14.00
Bone Meal	2.00
Oyster shell	2.00
Salt	2.00

Table 2: Proximate Composition of the *Tephrosia bracteolata, Panicum maximum* and concentrate fed W. A. D goats (% D. M)

Nutrients	Tephrosia bracteolata	Panicum maximum	Concentrate
Dry matter	37.01	35.21	96.53
Crude protein	23.36	8.44	16.82
Ether Extract	2.18	2.92	5.35
CF	22.15	33.61	25.22
NDF	66.14	74.30	21.46
Ash	5.31	6.92	8.70
NFE	47.0	48.11	43.91
P	0.29	0.35	0.79
Ca	1.42	0.72	1.84
Mg	0.68	0.49	0.77
K	1.25	1.36	0.62
Na	0.10	0.39	0.73
Oxalate	0.30	nd	nd
Phytate(mg/g)	2.75	nd	nd
Tannin	0.37	nd	nd
Saponin	0.25	nd	nd

Nd: not determined.

Table 3: Feed Components of each Treatment

Feed	Treatments I (Control) %	II %	III %	IV %
Tephrosia bracteolata	20	40	60	80
Panicum maximum	60	40	20	-
Concentrate	20	20	20	20

Table 4: Performance characteristics of WAD Goats fed Combinations of *Tephrosia bracteolata* based diets.

Parameters	Treatments			
	I	II	III	IV
Initial weight (kg)	5.85±0.20	5.90±0.43	5.55±0.76	5.85±0.14
Final weight (kg)	9.26±0.87	9.53±0.85	9.77±0.91	10.41±0.73
Weight gain (kg)	3.41b±0.82	3.63b±0.51	4.22a±0.43	4.56a±0.22
Daily Weight gain (g)	40.59d±4.93	43.21c±3.75	50.24b±3.84	54.29a±3.66
DM Intake (g/day)	-	-	-	-
T. Bracteolate	79.71	114.85	157.38	284.61
Guinea grass	115.27	80.11	69.13	-
Concentrate	60.70	67.16	61.18	54.27
Total DM intake (G/day)	256d±35.48	262.c±40.37	288b±36.93	339a±31.72
DM intake g/bw 0.75	48.24±3.89	48.36±4.02	52.02±3.70	58.88±3.15
Nutrient Intake(g/day)	-	-	-	-
C.P	38.00d±18.46	44.89d±16.71	52.87c±16.39	75.66a±11.25
NDF	151.71c±16.93	149.89±18.51	168.58b±14.72	198.89a±12.06
Feed conversion ratio	6.30	6.07	5.75	6.24

abcd Means in the same row for each parameter with different superscript are significantly different (P<0.05)

Table 5: Cell Wall Fraction Digestibility of W.A.D. Goats Fed Combinations of *Tephrosia bracteolate* based diets.

Parameters	Treatments			
	I	II	III	IV
DM Intake (g)	256d±33.42	262c±30.83	288b±32.75	339a±32.65
NDF in feed (g)	151.71	149.89	168.58	198.89
NDF in faeces (g)	54.42	52.97	44.98	36.92
NDF Digestibility (%)	62.15d±25.48	64.66c±26.12	73.32b±24.71	81.53a±25.37
ADF in feed (g)	103.78	104.51	113.87	132.55
ADF in faeces (g)	45.79	45.69	36.85	32.49
ADF digestibility (%)	55.88c±8.20	56.28c±8.50	67.64b±9.30	75.49a±9.23
ADL in feed (g)	17.25	19.56	24.33	29.68
ADL in faeces (g)	15.75	17.56	21.50	24.98
ADL digestibility (%)	8.67d±1.50	10.23c±2.34	11.64b±3.02	15.84a±2.36

abcd Means in the same row for each parameter with different superscripts are significantly different (P<0.05).

Table 6: Nitrogen Balance of W.A.D Goats fed Combinations of *Tephrosia bracteolata* based diets

Parameters	Treatments			
	I	II	III	IV
Nitrogen Intake (g/day)	6.08d±2.50	7.18c±2.41	8.46b±2.18	12.11a±2.46
Faecal Nitrogen (g/day)	3.34	3.42	3.90	5.68
Urinary Nitrogen (g/day)	1.77	2.22	2.78	3.76
Nitrogen Balance (g/day)	0.97c±0.60	1.54b±0.56	1.78b±0.67	2.67a±0.62

abc Means in the same row for each parameter with different superscript are significantly different (P<0.05)

Table 1 shows the Ingredients used in formulating the concentrate used as supplement in the experiment, while table 2 shows the chemical composition of *Tephrosia bracteolata*, *Panicum maximum* and Concentrate. Table 3 shows the feed components in each treatment. Although there were dilution technique (Lowry, 1989) effects of other feed components on the secondary plant metabolites measured in *T. bracteolata* (Table 2) only. Ruminants have rumen microbes that secrete enzymes with oxalate degrading properties and phytase (Oduguwa et al, 1998). Despite the fact that small amount of tannin (predominantly condensed) is desirable in feed to enhance its undegradable intake protein or rumen by pass value, the amount present (0.37% DM) was still insignificanly low in that goats have a threshold of 9% DM of tannin (Ologhobo, 1989).

In the same vein, Saponin content can still be degraded to a tolerable level by the ruminal microbes. Though too much Saponin can cause bloat, its possibility of being used in treating "artherio-sclerosis" due to its ability to form stable complexes with cholesterol have been studied by Mikhailova, Nikolova and Stoyanov (1965). As reflected on table 4, highest total DM intake in g/day in animals was on diet IV, followed by treatment III, while treatment I had the lowest behind treatment II. In the same vein, the CP and NDF intake in g/day progressively decreased from treatments IV to I. On table 5, the digestibility of NDF and ADL assumed the same pattern of decreasing linearly from treatments IV down to treatment I. With respect to the ADF digestibility, as usual treatment IV recorded the highest, treatment III was descendingly next while treatments I was higher than treatment II.

As shown on table 6, trend of nitrogen intake (g/day) was the usual treatment IV > III >II > I trend. Treatment IV was also topping. Unusually, treatments III and II were not different with treatment III. Treatment I was distinctively lowest in the row of Nitrogen balance. Following the same pattern, the total DMI, nutrients intake (crude protein and Neutral detergent fiber), daily weight gain significantly increased from treatment I to treatment IV. This finding was in consonance with reports of Smith, Larbi, Jabbar and Akinlade (1995) and Bonsi, Osuji, Tuah and Umunna (1995) that as legume increases the dry matter intake also advances. Since animals were still at their actively growing stage and are being furnished with complete and balance nutrients (an inherent attribute of legumes in that protein, energy, minerals and vitamins that are essential for growth and reproduction of ruminal microbes are "Synchronically" made available at the right time, amount and place in the rumen) this will enhance their performance. It could also be vividly appraised that there was a sort of substitution effect of Guinea grass and concentration fraction for legume with increase inclusion of *Tephrosia bracteolata*. This was also corroborated by the work of Larbi, Thomas and Hanson (1993) which could be due to the dynamism in the microbial population in the rumen of these animals by the gradual displacement of grass/concentrate microbes by "leguminophilous microbes". Contrarily, the feed conversion ratio was highest in treatment I. This could be ascribed to judicious and efficient utilization of available nutrients to animals compared with those with relatively more available nutrients. Moreso, the utilization of various ingredients in the lower gastro-intestinal tract and metabolism in the various organs and tissues would also influence the feed conversion ratio (MacDonald, Edwards and Greenhalgh, 1995). The digestibility of cell wall fraction (table 5) namely NDF, ADF and ADL were decreasing with increasing inclusion of Guinea grass. This could be due to different proportions of hemicellulose, cellulose and lignin as well as whether majority of lignin is either in core lignin (as in majority of grasses) or non-core lignin (as commonly present in legumes (Galyean and Goetsch, 1993). Furthermore, the restriction of legume lignification to a ring of xylem, phloem cap, and interbundular cells, minimizes the physical restriction of cell digestion in legumes. Relative to digestion of grasses, legumes are characterized by a quantity of readily fermentable substrate (as stated earlier) available for microbial use after mastication, legumes are high in soluble substrates and stored starch that might increase numbers of both holotrichs and entodiniormorphs (Jones and Wilson 1987).

Also, dietary characteristics that promote relatively high numbers of protozoa may indirectly yield high ruminal fibrolytic activity by causing opposite bacterial shift (Mackie et al., 1978) through a process called "defaunation", consequently high and fast digestibility leads to higher feed intake. Table 6 shows the nitrogen intake of animals on various treatments with treatment IV having usually the highest ($P<0.005$) which might not be unconnected with the fact that this treatment had the highest Nitrogen content which is even in excess of the recommended 6-8% C.P/ DM requirement for ruminants (NRC, 1981). Accordingly, the highest faecal and urinary Nitrogen was also observed in treatment IV where we had highest intake, this was supported by the works of Osuji and Devers (1979) and Bonsi et al., (1995).

The apparent Nitrogen balance (this is so because in real balance trial endogenous faecal and urinary alterations, gaseous excretion of nitrogen from both rumen and respiratory tracts which were supposed to be monitored were not taken into consideration) was positive across all the treatments with treatment IV having the highest. This phenomenon apparently indicates that more that enough protein needed was released to the body by the diets thereby precluding the possibility of endogenous addition. Furthermore, inefficient ruminal utilization of ammonia would also be reflected in the urinary nitrogen excretion a fraction of excess ammonia absorbed through the rumen wall is converted into urea, and excreted in the urine and would not be efficiently utilized by the rumen microbes (Bonsi et al., 1995).

In addition to how ruminal retention time/fill and hence high dry matter intake, with concomitant proteinous/nitrogenous nature of legumes attributable to their better performance enhancer, could also not be connected with phyto-oestrogenic- hormone like substances present in majority of legumes (Hufstedler and Greene, 1995) which would have caused accelerated uptake and utilization of nutrients by various cells, tissues and organs of the body. In terms of utilization of protein also, the tannin present would ensure high Rumen-by-pass value of the nutrients, which are better utilized than those from the microbial origin.

CONCLUDING REMARKS

This experiment was set out to investigate the growth rate, cell wall digestibility and nitrogen retention of West African Dwarf Goats fed various combinations of *Tephrosia bracteolata*, *Panicum maximum* with Concentrate. In terms of utilization of protein also, the tannin present would ensure high Rumen-by-pass value of the nutrients, which are better utilized than those from the microbial origin. Tephrosia bracteolata and other multi-purpose legume should be incorporated into our local/indigenous farming system because of it's nitrogen fixing ability and stability of soil aggregate as a legume, it's valuable fed/forage resources to animals especially ruminants from varying essential products of animal origin to human beings like meat, milk, egg, miscellaneous products can be obtained. Finally, it environmental impact in terms of reducing methanogenesis in ruminants which cause global warming by depleting the valuable Ozone layer must be researched into and explored.

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