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Effect of combined levels of *Panicum maximum* and *Gliricidia sepium* on the anti-Nutrients factors' digestibility in West African Dwarf Does

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ABSTRACT: Thirty (30) West African Dwarf does of weaning weight of 5.86 ± 1.20kg, balanced for weight, and age were used to investigate the effect of combinations of *Panicum maximum* (Pm) and *Gliricidia sepium* (Gs) with cassava offal basal diets on antinutrients' digestibility. The five (5) treatments were I (Go) 100% Pm + 0% Gs, II (G_{25}): 75% Pm + 25%Gs, III (G_{50}): 50% Pm + 50% Gs, IV (G_{75}): 25% Pm +75% Gs, V (G_{100}): 0% Pm + 100% Gs, Highest ($P< 0.05$) (75.00%) and lowest (55.80%) digestible oxalate were recorded in G_{100} and G_{75} respectively. Highest digestible phytate (76.44 %), Tannin (77.17%) Saponin (75.00%) and lowest ($P < 0.05$) Phytate (57.35%), Tannin (60.70%),and Saponin (58.33%) were observed in Go, $G_{100,}$ Go with G_{100} and G_{75} respectively while the cyanide content was completely digested in all the treatments. The results were not easily attributable to various combinations but it could be seen that goats can tolerate ANF in both sole grass and legume as well as basal diet effectively.

Keywords: Antinutritional factor, digesitibilty, *Panicum, Gliricidia,* West African Dwarf Does

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INTRODUCTION

The importance of animal protein in human diet cannot be overemphasized, also other products (wool, skin, horns, fat, hormones/biologics, bone, milk, etc.) play important role in the sustainability of mankind (Wilson, 1995). Goats have survived, produced and reproduced due to selective intake of wide varieties of trees, forbs, grasses, herbs and non-convention feed stuff due to the fact that they are browse-preferring intermediate feeders which exhibit high dietary plasticity there by enabling them to switch feed groups when preferred ones are in limited supply (Strangel, 1993). Traditionally, the off-take (extraction) rate of males (bucks) are more than the females (does) because of reasons like zero-prolificacy, sex ratio (1 male to 25 females) ritual purposes, festivity, and unprecedented sales to meet petty contingent expenditure (Devendra and Burns, 1985). Guinea grass (*Panicum maximum*) is a widely distributed tussock, lump-forming grass that grows best on warm frost-free areas. It is considered the best grass for ruminant production; it is highly relished by goats, readily available and stimulates ruminal microbial growth (Anugwa *et al.,* 2000). The existence of multipurpose tree legume like Gliricidia (*Gliricidia sepium*) which is perennial in nature, has high crude protein and also has been identified as one of the fodder legumes that promotes rumen ammonia

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production and live weight gain (Ajayi *et al.,* 2005). The search for alternative feed resources has focused attention on cassava and its by-products such as cassava seviate, offal and peelings. These by-products are available all year round especially now that the economy is being redirected towards non-oil products. The evolution of these by-products which are not directly useful to man can be channeled towards the production of animals and their products thereby reducing over dependence on cassava root tubers. Also, the adverse environmental pollution caused by these by-products can be reduced. The afore-mentioned feeds contain some inherent antinutritional factors as catalogued by Norton (1994) which include oxalate, tannin, cyanogenic glucosides, flavonoids, coumarin, just to mention a few. Researchers (Onwuka, 1990, Oduguwa *et al.,* 1998, and Ogungbesan *et al.,* 2005, Ogungbesan *et al., 2*006) have shown that some of these could be tolerated by ruminants because ruminal microbes secrete enzymes that can degrade these deleterious principles. In addition to this, some plants have inherent "antinutritional factors that hydrolyse these substances (Eeckhoat and Depaepe, 1994) Works have also been done on Gliricidia and Guinea grass on goats (Smith *et al.,* 1995, Ajayi *et al.,* 2005,) while this combinations had been fed with cassava and Brewers dried grain BDG. (Ifut, 1992). More recently Eniolorunda *et al.,* (2008) researched into the nutrients digestibility and utilization of the aforementioned feed stuff but there is no information on the anti nutrient digestibility in animals fed these combinations. This study therefore investigated the effect of combined levels of *Panicum maximum* and *Gliricidia sepium* on the antinutrients factors' digestibility in W.A.D goats.

MATERIALS AND METHODS

The study was conducted at the goat unit of Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria. Ayetoro is located on latitude $7^0$15'N and longitude $3^0$3'E in a deciduous derived savannah zone of Ogun State. The climate is sub-humid tropic with an annual rainfall of 963.3mm in 74 days. Temperature varies between 29 and 34^0C.

Thirty growing Wet African Dwarf does aged 5-7 months and with an average live weight of 5.86kg were used for this experiment. They were obtained from donor farms located some 15km northwest of the experimental site. Two weeks before the commencement of the experiment, animals were dewormed with Levamisole (Kepro, B.V Holland, 1mL/per 20kg body weight) to control endoparasites and dipped in Diazintol solution (Alfasan International, B.V Holland) at the rate of 1mL per liter of water against ectoparasites. Long acting Oxytetraciclina 200 La (Invesa, Spain) at 1 mL per 10kg body weight was also administered. The animals were randomly allocated on live weight basis to 5 groups of 6 does each. The 5 groups were then moved into previously sanitized individual pens and offered the experimental diets daily for 98 days (including the first 14days for adaptation and subsequent 84days for measurement).

The dietary treatments were:

- 100% *Panicum maximum* and 0% *Gliricidia sepium* (G 0).
- 75% *Panicum maximum* and 25% *Gliricidia sepium* (G 25).
- 50% *Panicum maximum* and 50% *Gliricidia sepium* (G 50).
- 25% *Panicum maximum* and 75% *Gliricidia sepium* (G 75).
- 0% *Panicum maximum* and 100% *Gliricidia sepium* (G 100).

Combined levels of *P. maximum* and *G. sepium* were supplemented with a cassava offal-based concentrate. The *G. sepium* foliage were allowed to wilt overnight prior to feeding. *P. maximum* leaves were harvested daily, manually chopped to 5cm and fed to the animals fresh. All animals were fed twice daily (forages at 3% body weight by 08.00h and concentrate by 16.00h at 2% BW) and fresh water was available at all times. Cassava offal used for the study was collected from four Fufu processing centers in Ayetoro, Ogun State and dried to a moisture content level of about 12% before being used to compound a concentrate ration containing 16% CP and 2600Kcal kg^{-1} Me. The concentrate included 40% cassava offal, 15% cassava peels, 15% GNC, 25% PKC, 4% bone meal, 0.5% mineral premix and 0.5% salt. The animals were weighed once weekly and the level of feeding adjusted depending on liveweight changes. Daily voluntary intake was estimated by difference of the feed offered and residue collected. Digestion and nitrogen balance trial was conducted after 72 days of feeding. During the metabolism trial, the goats were housed in individual metabolism cages (90cm x 75cm x 90cm) made of welded wire mesh fitted with removable feeders and arranged for quantitative collection of faeces and urine separately. The trial lasted for 12 days with a five-day adaptation period to accustom the goats to cages prior to a 7 days collection and measurement period. Total faecal output and urine were collected in the morning before feeding and watering. The faeces were weighed fresh and 10% aliquots of each day's collection for each animal were taken, dried at 60^0C for 48h in a forced draught air oven and bulked. A sub sample from each animal was dried in a similar oven at 100-105^0C for 48h for dry matter (DM) determination. Another sub-sample was thoroughly mixed and milled to pass through a 0.60mm sieve and stored in sealed polythene bags until analysed. The urine was collected in a plastic tray placed under each cage. 10mL of 10% concentrated H_2SO_4 was added to the tray daily to prevent volatilization of NH_3 from the urine. The total output of urine per animal was measured and 10% aliquots were kept in stoppered numbered plastic bottles and stored at -5^0C. Methods employed for feed and faecal samples were as follows: Phytate (Maga, 1983), Oxalate (Beutler, et al., 1980) Saponin (Strong, 1976), Tannin (Hagerman and Butler, 1983) and cyanide (Poonam and Hahn, 1984).

Statistical Analysis

Data obtained from these chemo-assays were used to calculate the metabolites' digestibility and were further subjected to analyses using one-way ANOVA/completely randomized design using individual goat as replicates. Model sums of square were partitioned to test linear and quadratic trends of supplementation using the General Linear models (GLM) procedures SAS (2002) and significantly different means were separated using least significant difference at 0.5 level of probability.

The general linear model is defined thus

X_{ij} = □+ □$_i$+ e_{ij}

□ is Grand population mean

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

□$_i$ is the fixed treatments (diets I to V) effects

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

RESULTS AND DISCUSSION

Table 1 shows the chemo-metric of the anti-nutritional factors analysed for in respective feed components. These from nutritional stand point could be undesirable to some extent but ensure the coevolution of these herbs with herbivores (Rosenthal and Janzen, 1979), They (i.e. tannin and saponin) at times in small quantity are desirable and advantageous to the animals consuming them. Oxalate was not detected in *P. maximum*. This is contrary to the findings of

Table 1: Chemo-metrics of deleterious principles in the feed components (mg/100g)

Composition	*P. maximum*	*G. sepium*	*Concentrate*
Oxalate	ND	1.25	1.16
Phytate	98.45	101.22	113.51
Cyanide	ND	0.15	0.34
Tannin	ND	2.65	3.06
Saponin	ND	0.10	0.11

ND: Not Detected

Skerman and Riveros (1990) and Esminger and Olentine (1980) who established that tropical grasses contain Oxalate even more than any other herbage but the findings of Ogungbesan *et al.,* (2006) is in consonance with the works of the above two authors who recorded 8.16% DM oxalate in Guinea grass.

However, all the previous workers failed to mention whether their oxalate was in soluble or insoluble form (Tangendjaja and Wina, 1995) , Oxalate recorded in *Gliricidia sepium* was more than those documented by Ologhobo (1989) in browses (0.52- 0.82mg/100gm) and less than that catalogued by Aletor and Omodara (1994) of *Gliricidia sepium* (222.41mg/100gm) and *Leucaena leucocephala* (88.16mg/100gm). Phytate (mg/100g) content unusually observed in *P. maximum* was 94.45 while that in G. sepium (101.22) was higher than that of *G. sepium* (16.18mg/100gm) recorded by Aletor and Omodara (1994) as well as higher or lower than those browses recorded by these authors. The cyanide content (mg/100gm) of *G. sepium* is 0.15, although its presence may seem erratic or unusual, it could be Holocalin, p=Glucosyl-oxyman deloritrile, pro-acacipetalin, prunasin, sambunigrin, or vicianin which are cyanides present in leguminous plants (Conn. 1981). The tannin (mg/100gm) of the legume (2.65) was at variance with the findings of Budi and Wina (1995) who did not detect any property of tannin activity in *G. sepium*. Its saponin (mg/100gm) was 0.10 and did not also conform with that reported by Onwuka (1992) who obtained 0.33% DM saponin in *G. sepium.* All the antinutrients factors detected in the concentrate might have been from various ingredients of the ration. Various factors are however, responsible for variabilities in chemical composition of herbages. These include plant parts, age, season, soil fertility, species, cultivar, post harvest treatments, growing conditions (water stress, drought stress, photo-periodicity) (Rosenthal and Janzen, 1979).

In Table 2, the apparent digestibility of the deleterious principles is shown. The term apparent was added because the digestibility did not anticipate their subsequent absorption in the gastro intestinal tract, but their degradation or destruction enzymatically in the rumen. The intake of all these secondary plant metabolites might have been occasioned by those present in the various combinations of feed consumed. The highest and lowest (P<005) oxalate digestibility was observed in G100 and G25 which implies that the levels have little or no effect on the degradation pattern though there was degradation of at least more than half of those ingested by the rumen microbes (Preston and Leng, 1987). Oxalate complexes calcium, phosphorus and decreases protein availability but does not chelate zinc. Although Phytate is often used interchangeably in literature with Phytic acid and Phytin, Phytic acid, phytate and phytin refer respectively to the free acid, the salt, and the calcium and magnesium salt (Evers, *et*

Table 2: Antinutritional factors' Intake and digestibility in West African Dwarf Does fed various combinations of Grass/Legume with cassava offal based diet

	Treatments					SEM	Probability^{b}	
Parameters	**G (control)**	**G25**	**G50**	**G75**	**G100**		**L**	**Q**
Feed Oxalate (g/d)	0.93^{e}	1.75^{d}	2.45^{c}	2.90^{b}	3.78^{a}	0.15	XX	**X**
Faecal oxalate (g/d)	0.25	0.63	0.76	1.28	0.98			
Digestible oxalate (%)	73.16^{a}	59.24^{b}	60.09^{b}	55.80^{c}	75.00^{a}	12.61	NS	XX
Feed phytate	115.73^{a}	107.79^{b}	102.76^{c}	91.76^{d}	93.04^{d}	20.41	XX	NS
Faecal phytate	27.17	32.95	43.67	39.14	24.90			
Digestible phytate (%)	76.42^{a}	69.43^{c}	57.50^{c}	57.35^{c}	73.52^{b}	10.00	X	XX
Feed cyanide (g/d)	0.32^{e}	0.37^{d}	0.47^{c}	0.61^{b}	0.74^{a}	0.09	Xxx	NS
Faecal cyanide (g/d)	0.00	0.00	0.00	0.00	0.00			
Digestible cyanide (%)	100	100	100	100	100	0.00	NS	NS
Feed Tannin (g/d)	1.93^{d}	2.87^{c}	4.30^{b}	4.97^{b}	6.34^{a}	0.69	XXX	NS
Faecal Tannin (g/d)	0.54	0.93	1.39	1.95	1.44			
Digestible Tannin (%)	72.20^{b}	67.11^{c}	67.67^{c}	60.70^{d}	77.17^{a}	8.52	XX	NS
Feed Saponin (g/d)	0.25^{e}	0.40^{d}	0.46^{c}	0.56^{b}	0.65^{a}	0.11	XX	NS
Faecal Saponin (g/d)	0.06	0.17	0.19	0.25	0.16			
Digestible Saponin (%)	75.00^{a}	58.58^{b}	58.88^{b}	58.33^{b}	75.00^{a}	9.84	NS	X

^{b}Probability for linear (L) and quadratic (Q) trends.$p<0.05$; **$p<0.01$; ***$p<0.001$.*
abcde: Means on same row with different superscripts differ = P<0.05)
G0 = 0% Gliricidia sepium +100% Panicum maximum + Concentrate
G25 = 25% Gliricidia sepium +75% Panicum maximum + Concentrate
G50 = 50% Gliricidia sepium +50% Panicum maximum + Concentrate
G75 = 75% Gliricidia sepium +25% Panicum maximum + Concentrate
G100 = 100% Gliricidia sepium +0% Panicum maximum + Concentrate

al., 1999). The phytate digestibility (%) was highest (P<0.05) in G0 (74.42) and lowest in G75 (57.35). showing a quadratic trend which also shows that there is little effect of level of inclusion in the degradability of the antinutritional factor but that the animals can degrade appreciable amount of this deleterious principle, This is in consonance with the findings of Aletor and Omodara (1994) and Oduguwa, *et al*., (1998). There was complete degradation of the cyanide content in the feed, as supported by the findings of Rosenthal and Janzen (1979) who reported that the enzymes secreted by microbes in the rumen and large intestine have hydrolytic activity on cyanogenic glycoside to such an extent that there was little or none left in the resultant feaces. There was also a linear trend in the tannin digestibility (%) where highest (77.17) and lowest (60.70) was observed in G100 and G75 respectively. Ruminants have rumen microbes that secrete enzymes tannase which degrade tannin especially if it is made of more hydrolysable than condensed. Apart from this mechanism, ruminants' saliva also possesses mucin that binds with tannin and release protein from the tannin-protein complex (Hoffman, 1987). Although there was a linear increase of intake of saponin with increase in legume level, the trend in digestibility was different and its linear trend not significant. There was appreciable but irregular trend in the degradability of saponin from the inclusion point of view. Saponin degradability had been confirmed by Rosenthal and Janzen (1979) who also attributed this to the inability of saponin to cause hypo-cholestereamia in ruminants. Apart from the abovementioned mechanisms for the attenuation of these antinutritional factors, herbivores have some biochemical defence mechanisms against phyto-allelo chemicals and they include mixed function oxidase, epoxide hydrases, reductases, hydrolytic enzymes and group transfer enzymes. All these are intra-hepatic mechanism (Rosenthal and Janzen (1979). The various degradation by animals in the different diets without recourse or reference to the combinations or inclusion level has been reported by Devendra (1990) who observed that there are specific, breed and even individual differences in tolerance and utilization of plant allelo-chemicals or undesirable factors by ruminants. Other measures that can be embarked upon to attenuate or control or reduce these metabolites could be from two entities involved viz Plant and animal (ruminants). Plant selection and breeding of plants (spp, variety and accessions) with inherently low anti-nutrients factors can be employed (Devendra, 1990). In the same vein, molecular manipulation of the gene controlling these factors can be tried but the fear of tampering adversely with genes that are responsible for desirable attributes can not be ruled out. Furthermore, adoption of strategies like dilution techniques, a simple approach to reduce toxicity is to feed the toxic plant in mixture with other plant, thus diluting the effective level of each compound can be used. Also, wilting technique can be employed; enzymes capable of degrading specific secondary compounds often occur with the compound in different structures in the same plant cells and reaction occurs when cell membrane are disrupted. Cutting management that will ensure feeding between flushies when the allelo-chemicals are at their peak in concentration and lastly, fertilizer management that will alleviate situation of nutritional stress in plant which stimulate the biosynthesis and secretion of these phyto alexins (Lowry, 1989). On the parts of the animals (ruminants): intrafusion / inoculation of bacterial species that can degrade anti nutrient from host rumen into rumen of other ruminants where multiplication and subsequent detoxification will continue (Allison, *et al.*, 1992) or even the genetic manipulation of otherwise rumen microbes with less degrading potential into those that can secrete enzymes that can detoxify the undesirable factors in herbages have been tried successfully (Keith, 1995)

CONCLUSION

Since ruminants (goats) can effectively utilize forages despite the inherent antinutritional factors they contain, research effort must be directed towards harnessing these animals and forages potentials.

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