SECONDARY PLANT METABOLITES UTILIZATION IN WEST AFRICAN DWARF DOES FED COMBINED LEVELS OF *ANDROPOGON GAYANUS* (KUNTH) AND *GLIRICIDIA SEPIUM* (JACQ) WITH CASSAVA OFFAL BASED CONCENTRATE

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ABSTRACT

Twenty West African Dwarf Does of average weight of 5±0.58 kg aged between 3 and 6 months were used to determine the effect of level of Andropogon gayanus and Gliricidia sepium with cassava offal based diets on secondary plant metabolites digestibility. The five (5) treatments were I (Gs0); 100% Ag + 0% Gs; II (Gs25) 75% Ag +25%Gs; III (Gs50); 50%Ag +50% Gs; IV (Gs 75); 25% Ag+ 75% Gs; V (Gs100);)0% Ag + Gs100. lowest (P<0.05) and highest (P<0.05) Saponin, Tannin, Phytate, Oxalate and hydrocyanide (HCN) digestibilities (%) were observed in Gs100 (99.61) and Gs0 (99.79), Gs100 (98.63) and Gs25 (99.39), Gs75 (98.26) and Gs50 (99.51), Gs100 (97.32) and Gs0 (99.20) as well as Gs100 with Gs75 (99.94) and Gs0 (100) respectively. No definite pattern of digestibility was established in relation to levels of supplementation but it was evident Goats (does) can accommodate, through degradation of all the allelo chemicals.

Key Words: Grass-legume mixture, cassava offal, West African Dwarf, metabolites, utilization

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INTRODUCTION

Plant (herbages/forages) have coevolved with predator populations of bacteria, fungi insects and grazing animals and have developed defense mechanism which assist their survival;. Many plants also produce chemicals which are not directly involve in process of plant growth but act as deterrents to insect fungal attack are called secondary metabolites (steriods, alkaloids terpenoids, coumarins, flavonoids lignins, tannins and toxic amino acids) and also primary metabolites (lipid, proteins,

polysaccharides, and sugar) that have specific and general metabolites functions within plant cells (Howe and Westley, 1988) The secondary metabolites act as deterrents to insects with fungi, affects animal and man, as well as the nutritive value of forages. Their deleterous effects vary with animal species in that while monogasters are more susceptible, polygasters especially ruminants have potential to denature them in their rumen. (Norton 1994) *Andropogon gayanus*, depending on habitat is a perennial species which grows naturally in African with vertical root that grows up to 80cm down to give drought tolerance ability. It is highly palatable to ruminants especially cattle when young (Skerman and Rivers (1990) while Gliricidia forage has been identified as one of the fodder legumes that promotes rumen ammonia production and live weight gain of animal. (Ajayi et al. (2005). There is dearth of information on their utilization of secondary metabolites in these herbages by goats, it is against this backdrop that this experiment is set out to look at effect of levels of *Andropogon gayanus* and *Gliricidia sepium* on the secondary metabolites utilization in West African Dwarf does fed cassava offal based diets.

MATERIALS AND METHODS

The investigation took place at the Goat multiplication and research unit of the teaching and research farm of the directorate of farms of college of Agricultural sciences, Yewa Campus Ayetoro (7^0 15^N 3^0 3 E, 90-120 masl, T^0 28. 9^0 c, Rainfall, 1945mm, R.H.I. 72.81 Evaporation 1806.9m, soil type oxic paleustalf, soil texture: sandy loam and vegetation: forest mosaic type) (Twenty (20) West African Dwarf goat of ages weight of 5 to 58kg were used for the experiment)

Pen Management: The pens and metabolism cages (1.5mxe l 1mx 1.2m) were swept and dusted. They were later fumigated Dettol® (chloroxylenol, strong antiseptic disinfectant. Reckit Benkister , Ogun State at 27ml /1 litre of water) and Diazintol® (Diazinon a strong and broad spectrum acaricides and larvicide: Alfasan international B.V. Holland at 2ml /1 litre of water). A mixture of used automobile engine oil (1 litre) and sieved wooden ash (250grm) was basally applied on the floor of pens (adaptation, spare and experimental) to repel soldier ants (*Dorylus spp)* while wood shaven were later spread on the floor pens and the oil-ash mixture with shaven as well as disinfectant were henceforth , fortnightly applied till the end of t he trial. Each pen was equipped with feed (Grass/Legume and concentrate) and water containers seperately.

Feed Materials: *Gliricidia sepium* leaves (leaves plus fine sterm up to 6mm in diameter) (Tarawali *et al.* 1995). Were harvested from pasture and Range section of the farm and spread under a shade to allow for wilting overnight before feeding the next morning. Likewise Andropogon leaves were harvested 15cm from the ground (Tarawali *et al*., 1995). Cassava peels used, were collected from cassava processing centers in Ayetoro, sundried to above 12% MC and stored while cassava offal were sourced from centers also in Ayetoro sundried, store and bagged for onward concentrate compounding as shown in table 1.

Animals Management: Twenty (20) West African Dwarf does were sourced from goat units, homestead, and local markets 15km radius of the campus were on arrival lairaged in the adaptation pen, prior to the commencement of the experiment, they were wormed with levaject® (levamisole, SKM pharma vet Ltd, Bangolere India, 1ml/20kg i/m) injected with Ivomec® (Ivermectin, SKM pharma vet; 1ml/40kg sc,) Terroxy L/A (Oxytetracylin, Long – acting : SKM PVT. L.T.D., India:

1m/10kg, they were also dipped in Diazinon solution and finally vaccinated against *Peste-des-petite-ruminante* (P.P.R) (Reynolds *et al*., 1988) after which Tanvit® (Multivitamin and anti-stress: SKM pharma) was administered intra muscularly at 3ml/head. During an initial fourteen (14) days, they were adapted in the adaptation pen with ad libitum supply of the test material and well nourished concentrate. After which they transferred into their respective experimental pens.

Experimental Design and treatments

The animals were divided into 5 groups (4 each) after balancing for age and weight .Each group was randomly assigned to one of the five treatments and individual animals were completely randemised within the pens. Each animal was fed twice daily at 0800hrsGMT with both forages (4 % body weight of forage allowance) and at 1600 hours with concentrate (1% body weight of concentrate allowance). Both allowances constitute the feed allowance which was 5% body weight of the animal as shown in table 2. This feed allowance was constantly adjusted as animal weight changes. Each component was served in separate containers and fresh drinking was available daily *ad libitum*.

The live weight of goats were measured at the beginning of the trial and subsequently at weekly interval earth in the morning before feed was offered. Records of performance and criteria for this include feed intake weight change and mortality. To calculate daily feed intake, amount of a gayanus, G. sepium and concentrated offered to, and refused by each animal were recorded daily and samples of feed offered collected three times per week. Samples for storing were even dry at 65^0C for 48 hours while that for DM determination was oven dried at between 100-105^0c for 48hours in forced draught oven at the beginning of the trial and subsequently at weekly interval early in the morning before feed was offered interval. Record of performance and criteria for this include feed intake, weight change and mortality; To calculate daily feed intake, amount of A.gaynus , G. sepium and concentrate offered to, refused by, each animal here recorded daily and samples of feed offered were collected three times per week. After the growth trial (1^{st} 72days) the goats were transferred to metabolism cages in the last 12days. This was made of welded wire mesh fitted with removable feeders and arranged for quantitative collection of faeces and urine separately but feeding and management remained the same as during the growth trial. The animals were left to adjust" in the cages for 5 days after which total faces and urine produced by individual animals were collected for 7days after. The amount of fed offered and refused were recorded daily and samples bulked separately for each animal for the entire collection 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 days collection for each animal were taken and prepared for storage and DM determination as mentioned earlier. Feeds and faceal samples were separately and thoroughly mixed and milled to pass through a 0.60mm sieve and stored in hermetically sealed containers prior laboratory analysis. The urine was collected in a plastic tray placed under each cage, 10ml of 10% concentrated H_2S0_4 was added to the tray daily to prevent microbial colonisation and prevent NH_4 volatilisation from the urine. The total output of urine for animal was measured (Chen and Gomez, 1992) And 10% aliquots were saved in stoppered numbered plastic bottles and stored at -5^0c until needed for chemical analysis.

Laboratory Analysis

Feed and faecal samples were analysed for their deleterious or anti nutritional factors or secondary metabolites (Howe and Westthly 1988), which were assayed thus: Saponin was done by method of strong (1979) Tannin was determined by protein precipitation method according to Hagerman and

Butter, (1983) Method of Maga (1983) was used for Phytate while Oxalate was analysed with the Rapid method of Beutler *et al*., (1980) Lastly, Cyanide content of sample was determined using an automated enzyme assay by Poonan and Hahn (1984)

Statistical Analysis

Data obtained from these samples chemo-metric were used to calculate the metabolites digestibility. They were fed their subjected to analyses using one way ANOVA / completely randomized design using individual goats as replicates. Model sums of square were partitioned to test the linear and quadratic trend of inclusion/supplementation using the general linear models (GLM) procedures as package due S.A.S (2002) and significantly different means were separated using least significance difference at 0.5 level of probability in the same package; The general linear model is us defined thus

$Xy= \mu+\alpha i+ eij$

Xy= individual data generated from the fixed treatment (GS0-GS100) effects

μ= Grand population mean

αi = the fixed treatments effects

eij= the error (replicate) term within each treatment.

RESULT AND DISCUSSION

Table 1 and 2 shows respectively, the components in concentrate and dietary treatment allocation. The chemo-metric (table3) of secondary plant metabolites or antinutrients for antinutritional factors or toxic factors or phytoalexins or allelochemicals, or deleterious principle and undesirable factors from animal nutrition stand point they undesirable but their presence is beneficial to the plant synthesing them in that as they are important component of plant coevolutionary and survival mechanism from predatory organisms and harsh weather (lingo-cellosic component) (Howe and Westley (1980) In addition to this, they could also be of pharmacentical importance (defaunative) (Mackie *et al.,* 1798) antihelminthic (Rozenthal and Janson. 1979) and antihypercholesteroleamic agent (Ernest (1996)). Of the metabolites ($Mg100gm^{-1}$) saponin ranged from 0.96 (A.gayanus) to 17.13 (concentrate). These values were different (in quantity and unit of measurement) from works observed in literatures (Ogungbesan, 2004, 2006, and 2010) though his corroborates the findings of Rosenthal and Janzen (1979).who reported that Saponin is present in all almost all the higher plants, Tannin observed in G. sepium (2.10) was lower than that reported by Ogungbesan (2010) and that in A .gayanus (1.06) seems uncommon but skermen and Riveros reported *brachiara radicans* as being called "Tanner Grass" which implies possible presence of properties of tannin activity in this family *Graminae.* The phytate in *G. sepium* (116.73) was higher than that recorded by Ogungbesan (2010) in *G.sepium* (101.22) but lower that obtained by Aletor and Omodara (1994) in G.sepium (16.18)

The unusual presence phytate in *A. gayanus* which has not been reported could arise from the fact that phytate have been recorded from seeds and agro-industrial by products of *Graminae* (Eeck-hout and De paepe 1994) Oxalate found both in *A. gayanus* (1.04) and *G.sepium* (1.29) were lower than reported by Ologhbo (1989) lastly, Cyanide (HCN) content was low in *G.sepium* (0.18) was in consonance with the findings of Ologhobo (1989) while non was detected in *A.gayanus* which was contrary to the submission of conn (1981) who reported that cyanogens are present *Graminae*; Those antiquality factors present in the concentrate must have be from individual ingredients with those factors(Conn, 1981).In as much as they are phytochemical, their concentrations are bound to be influenced by factors such as plant parts assayed, age of plants, session of harvests, soil fertility,

specific and varietal variations, cultivar differences, post harvest treatments, and growing conditions (water, and drought stress, photo periodicity) (Rosenthal and Janzen 1979) as well as laboratory analytical dissimilarities . Table 4 shows the intake and digestibility of these undesirable factors. although the term digestibility is used, technically speaking it is either ruminal degradation , attenuation or denaturation by microbal enzymes such that post ruminally the negative effect would be precluded and normal bio-utilization could be facilitated. The intake must have been determination by those present in the various combinations of feed consumed. There was virtually complete degradation of saponin among the treatments; also there was no significant effect of level of inclusion on the denuturation. This has been corroborated by Rosenthal and Janzen (1979) , Ologhobo (1989), and Ogungbesan, (2010), that is more reason why its pharmaceutical property of anti-hyper cholesterolaemia can not be manifested ruminant rather in monogastric (Ernest 1996). The same trend observed for Saponin repeated itself in Tannin disgestibility. The Tannin in the feed could have been made up of the soluble hydrolysable tannin that can be completely degraded in rumen but protein its rumen by pass value would be compromised. This phenomenon has been confirmed by Preston and Leng (1987), Onwuka (1992) Ogungbesan 2005, there was no significant effect of the inclusion on the Phytate digestion which was also similar among the treatments. There was a slight linear effect on decomposition of Oxalate i.e. the higher the inclusion of Gliricidia, the lower the oxalate degradation albeit majority of it was degraded. No linear significant was also witnessed in Cyanide denaturation but there was similar and total decomposition among the treatments which mean that the microbes were able to secrete hydrocaynide hydrolytic enzymes this has been confirmed several workers (Rosenthal and Janzen (1979), Preston and Leng (1989),and Ogungbesan (2010)). The various degradation by animals in different levels without irrespective of the inclusion level has been reported by Devendra (1990) Who observed that there are specific, breed and even individuality of different in tolerance and utilization of plant allelochemicals or undesirable factors by ruminants. Apart from intra ruminal degradation. There are other methods of detoxification, ruminants produce mucin in their saliva that binds tannin and release protein for digestion (Hoffinan (1987), herbivores also have detoxification mechanism like mixed function oxidase, epoxide hydrases, reductases, hydrolytic enzymes and group transfer enzymes. Other strategies that could be targeted at plant, involve selection and breeding (species, variety and accession) with inherenthy low allelochemcals; Molecular manipulation of gene (s) controlling these factors can be tried but if traits is polygenic it could affect other characters; Dilution technique (a simple approach to reduce toxicity is by feeding the toxic plant in mixture with other plants, thus diluting the effective level of each compound, wilting technique: enzymes capable of degrading specific secondary compound often occur with the compound in different structures in the same plant cells an reactions occur when cell meinbraneasre disrupted ; cutting management: one that will ensure feeding between flushies when the allechemicals are at their peak in concentration and lastly; fertilizer management; this will alleviate situation of nutritional stress in plant which stimulate the biosynthesis and secretion of these phyto alexins (Lowry 1989) zoological magnipulation include; Intraruminal fusion or 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 a.,l* (1992) or even the genetic manipulation of otherwise rumen microbes with less degrading potential into those that can secrete enzymes that can detoxity the undersirable factors in her bages have been successful (keith,1995)

Table 1 Component of concentration (%)

INGREDIENTS	PERCENTAGE
Cassava offal	40
Cassava peeling	15
Groundnut Cake	15
Palm kernel cake	25
Bone meal	4
Premix	0.5
Salt	0.5

Table 2 Dietary treatment allocation

MATRAL	G50	GS25	G550	G575	GS100
Gliricidia sepium(Gs)	-	25	50	75	100
Andropogon gayanus (Ag)	100	75	50	25	-
Gs +Ag (forage allowance) 4% body weight	4	4	4	4	4
Concentrate (% body weight)	1	1	1	1	1
Forage + concentrate (feed allowance) 5% body weight	5	5	5	5	5

Table 3 Secondary plant metabolite assay in feed components (mg 100gm^{-1})

Metabolism	Gliricidia sepium	Andropogon gayanus	Concentrate
Saponin	0.96	6.89	17.13
Tannin	2.10	1.06	4.11
Phytate	116.73	76.40	129.31
Hydrocyanide	0.18	0.00	0.66

Table 4 Intake and Digestibility of secondary plant metabolites in West African Dwarf Does fed levels of *Andropogon gayanus* and *Gliricidia sepium* with cassava offal based concentrate

Metabolites	Levels					SEM	Probability	
	G50(control)	Gs25	Gs50	Gs75	Gs100		L	Q
Saponin (g/day)								
Intake	4.84^{a}	6.86^{ab}	5.76^{ab}	5.73^{ab}	7.15^{a}	0.30	xx	x
Faecal	0.005	0.022	0.013	0.021	0.27	0.01		
Digestible (%)	99.79^{a}	99.71^{a}	99.68^{a}	99.63^{a}	99.61^{a}	0.07	Ns	Ns
Tannin (g/day)								
Intake	1.45^{bc}	1.64^{a}	1.43^{C}	1.51^{b}	1.47^{bc}	0.02	Ns	Ns
Faecal	0.006	0.010	0.005	0.011	0.014	00		
Digestible(%)	99.31^{a}	99.39^{a}	99.30^{ab}	98.67^{ab}	98.63	0.11	Ns	Ns
Phytate (g/day)								
Intake	12.03^{b}	15.12^{a}	13.18^{ab}	11.78^{b}	14.07^{a}	0.44	x	x
Faecal	0.148	0.189	0.128	0.195	0.237	0.00		
Digestible (%)	98.75^{a}	98.74^{a}	99.51^{a}	98.26^{a}	98.29^{a}	0.15	Ns	Ns
Oxalate (g/day)								
Intake	12.90^{a}	12.68^{a}	11.82^{ab}	11.46^{ab}	10.49^{b}	0.03	xxx	Ns
Faecal	0.103	0.247	0.191	0.264	0.238	0.01		
Digestible(%)	99.20^{a}	98.88^{a}	98.38^{ab}	97.69^{b}	\97.32^{b}	0.19	x	x
HCN (g/day)								
Intake	27.45^{b}	29.06^{b}	32.78^{ab}	34.57^{a}	35.70^{a}	0.74		xxx
Faecal	0.00	0.01	0.01	0.02	0.02			
Digestible (%)	100^{a}	99.97^{a}	99.96^{a}	99.94^{a}	99.94^{a}	6.28	Ns	Ns

P: Probability for (L) linear and (Q) quadratic trends
^{X}P<0.05, ^{xx}P <0.01, ^{xxx} P< 0.001

abc: Means in same row with same superscripts are similar (P> 0.05)
L: Level of supplementation calculated as percentage of total feed allowance (Forage + concentrate) of 50g DM kg^{-1} live weight
G50=% Gliricidia sepium + 100% Andropogon gayanus + concentrate.
Gs25= 25% Gliricidia sepium + 75% Andropogon gayanus + Concentrate
Gs50=50% Gliricidia sepium + 50% Andropogon gayanus + concentrate
Gs75= 75% Gliricidia sepium+25% Andropogon gayanus + concentrate
Gs100= 100% Gliricidia sepium +0% Andropogon gayanus + concentrate

CONCLUSION

Despite the presence of these allelochemicals in plants, it evident that goats(ruminant) can tolerate them and utilize effectively, these herbages.Attention should be drawn toward exploring the pharmaceutical potentials of these vegetations for ethnobotanical purposes in both men and animal. Management strategies that will rationalise land use and at same time integrate ruminant production should be embarked upon like Alley forming with grasses, Intensive feed garden, Alley grazing; Rotational system, Alley grazing ; permanent system, fodder tree bark, Three strata forage system (Tsfs) and sloping Agricultural land Technology (SALT).

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