NUTRIENT INTAKE AND DIGESTIBILITY IN WEST AFRICAN DWARF GOATS FED DIETS CONTAINING *VERNONIA AMYGDALINA* (BITTER LEAF) AS PHYTOGENIC ADDITIVE

Adebayo, K.O., Olatomiwa, O.A. Olaleye T.O., Akinbode, R.M. and Onwuka, C. F.I.
Department of Animal Nutrition, Federal University of Agriculture, Abeokuta
adebayoko@funaab.edu.ng/ +2348035366932

ABSTRACT
Twenty-four West African dwarf (WAD) goats were subjected to four dietary treatments containing Vernonia amygdalina (VA) at varying inclusion levels (0, 5, 10 and 15g/ kg DM) to assess its effect on nutrient intake and digestibility. Panicum maximum was fed as a basal diet and concentrate diet as supplement in a ratio of 60:40.The experiment was laid out in a completely randomized design and it lasted for 112 days. Results showed that VA inclusion increased (p<0.05) total dry matter (DM), crude protein (CP), crude fibre (CF) and acid detergent fibre (ADF) intakes. Goats on diets containing VA also had the highest (p<0.05) CF, ADF and acid detergent lignin (ADL) digestibility. It was therefore concluded that for increased nutrient intake and fibre fibre digestibility, VA can be included in the diet of WAD goats up to 15g/kg DM.

INTRODUCTION
Phytogenic feed additives are substances derived from plants; they are also referred to as phytobiotics or botanicals. They include herbs and spices and their extracts which can be added to animal feed to promote growth and improve the health status of the animals. Their usefulness lies in some chemical substances that produce definite physiological actions in the body of the animals (Oko and Agiang 2009). Some of the useful herbs and spices are indigenous to Africa and include ginger (*Zingiber officinale*), garlic (*Allium sativium*), scent leaf (*Ocimum gratissimum*) and bitter leaf (*Vernomnia amygdalina)* (Muhammad et al. 2009). *Vernonia amygdalina* is a valuable medicinal plant that is widespread in West Africa, it is known as bitter leaf due to its characteristic bitter taste and flavor, and can be used as an active anticancer, antibacterial, anti malarial and anti parasitic agent (Udochukwu *et al*., 2015). The bitter leaf plant contains *vernonine, vernodalin* and *venomygdin*. It is known to be endowed with valuable biochemical properties, fixed oil, alkaloids, saponins, tannins and other glycosides (Bonsi *et al*., 1995).It is a unique plant, so unique that every part of it has an economic importance. Its leaves are macerated and used in cooking soup, while the extracts are used as tonic for prevention of certain illness. *Vernonia amygdalina* have been shown to be valuable nutritionally. It contains significant quantities of lipids (Ejoh *et al.* 2007), proteins with essential amino acids (Igile *et al.* 1994). It also contains carbohydrates (Eleyinmi *et al.* 2008) and carotenoids, though not in large quantities (Udensi *et al.* 2002). Also contained in this plant are essential elements such as calcium, iron, protein, potassium, phosphorus, manganese, copper and cobalt (Bonsi *et al.* 1995). The study therefore aims at determining the effect of diets containing bitter leaf on nutrient intake and digestibity in West African dwarf goats.

MATERIALS AND METHODS
The study was carried out at the Animal Nutrition laboratory of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. Ogun State is in the rainforest zone of South West Nigeria. The area has an annual mean temperature of 34.7°C, a relative humidity of 82% and an annual mean rainfall of 1,037 mm. It is about 70 m above sea level and lies on latitude 7°5'-7°8'N and longitude 3°11.2'E.

PROCESSING OF TEST MATERIALS AND FORMULATION OF DIETS

The leaves of bitter leaf were harvested, air-dried and ground to pass through 1mm sieve. This was used to formulate four concentrate diets which contain bitter leaf at 0, 5, 10 and 15g/kg DM (Table 1).

The diets; basal and concentrate supplement were offered to the animals at 5% of their body weight in a ratio of 60:40 respectively.

Table 1: Ingredient composition of experimental concentrate diet (%)

Ingredients	T1	T2	T3	T4
Cassava peel	40	40	40	40
Maize cob	20	20	20	20
Dried brewer's grain	20	20	20	20
Wheat offal	17	17	17	17
Bone meal	2	2	2	2
Salt	1	1	1	1
Bitter leaf	-	+	++	+++
Total	100	100	100	100
Determined analysis (%)				
Crude protein	11.88	11.88	11.88	11.88
Crude fibre	13.84	13.84	13.84	13.84

-, +, ++, +++ means 0g, 5g, 10g, and 15g of bitter leaf/kg of concentrate feed..

Experimental animals and management

Twenty- four (24) West African dwarf goats with an average live weight of 6.5 - 9kg were used for the experiment. Pens were cleaned and disinfected with Izal solution prior to the arrival of the animals. The goats were kept in the quarantine section for two weeks for proper prophylactic treatment which consisted of intramuscular application of oxytetracycline LA and vitamin B complex at the dosage of 1 mL/10 kg body weight of the animal. The animals were maintained on *Panicum maximum* grass and concentrate and clean water was supplied *ad libitum.* They were thereafter divided into four treatment groups of five animals each on weight equalization basis and housed in individual pens. The study comprises 14 days of adaptation followed by 12 weeks feeding trial and 2 weeks' nutrient digestibility study. The diets were offered at 8:00am in the morning and 12.00pm in the afternoon. The concentrate diets were offered first and then the basal diet in separate feeding trough. Left over of the feed offered was weighed and recorded every morning to compute feed intake on dry matter basis. Initial weights of the animals were taken on the first day of the experiment and thereafter fortnightly throughout the experiment. The nutrients intake was calculated as follows:

Dry matter intake =% dry matter of feed x daily feed intake

Crude protein intake =% crude protein of feed x daily feed intake etc.

NUTRIENT DIGESTIBILITY STUDY

After 12 weeks feeding trial, four goats from each treatments were transferred into clean metabolic cages for separate collection of faeces and urine. There was a 7-day acclimatization followed by 7 days' collection of faeces. Aliquots of collected faeces were dried in the oven at 65^0 C till constant weight.

CHEMICAL ANALYSES

Oven dried feed and faecal samples were analyzed for their proximate compositions: crude protein, crude fibre, ether extract and ash according to AOAC (2000). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined by the methods of Van Soest *et al.* (1991).

STATISTICAL ANALYSIS

All data collected were subjected to one-way analysis of variance in a completely randomized design using version 9.1 of SAS software (SAS, 2001)

RESULTS AND DISCUSSION

Vernonia amygdalina (VA) is rich in crude protein, ether extract and ash (Table 2). The CP and ash content obtained in this study are however lower than the range (17 to 33g/100g DW and 10 to13g/100g DW respectively) reported by Alabi (2005). However, ether extract content falls within the range of 2 to 15g/100gDW reported by same author. Presented in table 3 is the nutrient intake of goats fed experimental diets. *Vernonia amygdalina* inclusion increased ($p<0.05$) total dry matter, CP, CF ADF intakes. This is indicative of better degradability and hence increased intake. According to Olafadehan *et al*. (2017) feed intake is a function of availability, palatability, fibre digestion and digesta flow rate. Fajemisin *et al*. (2010) also reported increased nutrient intake when graded levels of VA leaf meal was included in the diets of West African dwarf ewes. The diets have significant ($p<0.05$) effect on CF, ADF and ADL digestibility (Table 4). Crude fibre, ADF and ADL digestibility were highest in diets containing VA while the least values were obtained in the control diet. This implies that the secondary metabolites in VA did not interfere with the digestion process in the rumen.

Table 2: Chemical composition (%) of Bitter leaf *(Vernonia amygdalina)*

Parameters	Percentage
Dry matter	84.00
Crude protein	14.46
Ether extract	8.31
Ash	4.33
Tannin	1.89
Saponin	2.08
Oxalate	3.91

Table 3: Nutrient intakes of West African dwarf goats fed experimental Diets (g/day)

Parameters	T1 0g	T2 5g	T3 10g	T4 15g	SEM
Dry matter (grass)	107.9^{b}	138.93^{a}	123.39^{ab}	143.65^{a}	5.16
Dry matter(conc.)	94.11	94.18	95.19	96.26	0.52
Total dry matter	202.01^{b}	238.18^{a}	218.58^{ab}	239.91^{a}	5.31
Crude protein (grass)	23.22^{b}	30.11^{a}	26.75^{ab}	31.19^{a}	1.12
Crude protein (Conc.)	13.39	13.41	13.54	13.67	0.07
Total crude protein	36.60^{b}	43.52^{a}	40.28^{ab}	44.83^{a}	1.14
Crude fibre (grass)	17.19^{b}	24.45^{a}	21.26^{ab}	21.60^{ab}	1.04
Crude fibre (conc.)	14.25	14.23	14.41	14.57	0.08
Total crude fibre	31.39^{b}	38.71^{a}	35.66^{ab}	36.17^{ab}	1.05
Ether extract (grass)	11.42	13.78	13.13	13.16	0.46
Ether extract (conc.)	8.31	8.32	8.40	8.50	0.46
Total ether extract	19.73	22.11	21.53	21.85	0.47
Ash (grass)	2.45^{b}	3.18^{a}	3.03^{ab}	3.08^{ab}	0.12
Ash (conc.)	5.95	5.97	6.55	6.62	0.19
Total Ash	8.40	8.97	9.58	9.82	0.27

NDF (grass)	107.18	110.25	182.53	134.78	8.89
NDF (Conc.)	72.09	72.20	72.93	73.74	0.39
Total NDF	179.23	182.42	205.43	208.50	8.85
ADF (grass)	77.79[b]	100.94[a]	96.18[ab]	97.81[ab]	3.75
ADF (conc.)	36.05	36.10	38.06	36.87	0.43
Total ADF	113.78[b]	137.00[a]	134.20[ab]	134.63[ab]	3.79
ADL (grass)	32.69[b]	42.42[a]	40.42[ab]	41.18[ab]	1.58
ADL (conc.)	16.90	16.94	18.59	17.28	0.41
Total ADL	49.58	59.36	59.01	58.39	1.73

Means in the same row with different superscripts are significantly different (P<0.05)

Table 4: Nutrient Digestibility of West African dwarf goats fed Experimental diets (%)

Parameters	Treatment				
	T1	T2	T3	T4	SEM
Dry matter	68.16	72.23	70.49	73.24	1.04
Crude protein	69.28	73.04	72.42	69.71	0.91
Crude fibre	73.93b	80.58a	78.26a	78.67a	0.83
Ether extract	52.94	55.89	56.10	55.59	1.36
Ash	65.33	65.93	66.27	71.06	1.10
NDF	51.46	58.55	57.51	59.02	1.34
ADF	31.56[b]	47.41[a]	49.09[a]	47.89[a]	2.61
ADL	24.38[b]	50.13[a]	35.97[ab]	37.77[ab]	3.59

Means in the same row with different superscripts are significantly different (P<0.05)

CONCLUSION AND RECOMMENDATION

Based on the findings of this work, VA improved nutrient intake and fibre digestibility up to 15g/kg DM. It can therefore be included in the concentrate supplement for West African dwarf goats at 15g/kg DM

REFERENCES

Alabi, D.A., Onibudol, M.Z., Amusa, N.A. 2005. Chemical and nutritional composition of four botanicals with fungitoxic properties. World Journal of Agriculture Science. 1:

A.O.A.C., 2000. Official Methods of Analysis, 17th edition, Association of Official Analytical Chemists. Gaithersburg, MD, USA.

Bonsi, M. L. K., P. O. Osuji, A. K. Tuah, and N. N . Umunna, 1995. "Vernonia amygdalina as a supplement to teff staw (Eragrostis tef) fed to Ethiopian Menz sheep". Agro Forestry System 31(3): 229 – 241.

Ejoh, R. A., Nkonga, D. V., Innocent, G. and Moses, M. C. (2007), Nutritional components of some nonconventional leafy vegetables consumed in Cameroun, Pakistan Journal of Nutrition 6, 712-714.

Eleyinmi AF, Sporns P, Bressler DC (2008). Nutritional composition of Gongronema latifolium and Vernonia amygdalina. Nutrition. Food Scirnce., 38: 99-109.

Fajemisin, A.N., A.A. Fadiyimu and G.A. Alokan, 2010. "Protein and antinutrient intakes and digestibility of West African dwarf ewes fed graded levels of Vernonia amygdalina leaf meal diets". Internationa Journal of Current Research, 2: 57-61

Igile, G. O., Oleszek, W. I., Jurysta, M. R., Burda, S. I., Farifunso, M. E. and Fansanmade, A. A. (1994). Flavonoids from Vernonia amygdalina and their antioxidant activities, Journal of Agricultural and Food Chemistry 42, 2445-2448.

Muhammad Javed, Fazil –Raziq Durrani, Abdul Hafeez, Rifatullah khan and Ijaz Ahmad (2009), "Effects of aqeous extract of plant mixture on carcass quality of broiler chicks". Research Publishing Network (ARPN)

Oko, O.O.K. and E.A. Agiang 2009, "Phytochemical evaluation of 3 extractants of Aspilia africana leaves". Proc. of the International conference on Global food crisis, April 19 -24th, Federal University of Technology, Owerri, Nigeria, 87-90.

Olafadehan, O. A. and G.C. Okoye 2017. "Feed intake and blood profile of red sokoto goats fed urea treated ensiled cowpea husk based diets". J. Anim. Prod. Research, 29(1): 48-56.

SAS 2001. Statistical Analysis Systems, SAS/STAT User's guide, SAS Institute Inc., Cary, North Carolina, U.S.A.

Udensi, E., Ijeh, I. and Ogbonna, U. (2002), Effect of traditional processing on the phytochemical and composition of some local Nigerian leafy vegetables, Journal of Science and Technology 8, 37- 40.

Van Soest P. J., J. B. Robertson and B.A. Lewis 1991. "Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition". Journal of Dairy Science. 74: 3583–3597