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Growth Performance and Carcass Evaluation of Weaner Grasscutters Fed *Vernonia amygdalina* Leaf Meal

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ABSTRACT

Grasscutters (*Thyromomys swinderianus*) reared intensively for meat production is often exposed to stress and inadequate feeding as a result of their wasteful feeding habits. *Vernonia amygdalina* leaves have been used in the mediation of stress and as nutraceutical in animal and human health. This study investigated the growth performance and carcass evaluation of weaner grasscutters fed *Vernonia amygdalina* leaf meal supplemented diets. A total of thirty-six weaner grasscutters of mixed sexes weighing between 281.33 and 304.21g were allotted to six treatments in a completely randomized design (CRD). The animals were randomly assigned to six treatments made up of six grasscutters each. The treatment A (control) given feed without *Vernonia amygdalina* (VA) leaf meal, B had 1g VA/kg feed, C had 2g VA/kg feed, D had 3g VA/kg feed, E had 4g VA/kg feed and F had 5g VA/kg feed. Feeding was done for a period of seven (7) weeks. Data collected were subjected to analysis using statistical analysis system (SAS), 2008 model and mean differences separated with Tukey studentized range test. The result showed significant ($p < 0.05$) differences in total feed intake, weight gain and feed conversion ratio (FCR) of 1.01. The carcass evaluation showed an improvement in carcass weight, foreleg, fore muscle, shoulder bone, rib, chest muscle, loin bone and loin muscle with VA treated diets with a significantly ($p < 0.05$) better performance in those given 3g VA/kg feed. There was also a significant ($p < 0.05$) improvement in the haematology and hepatic parameters except platelets, AST and ALT. In conclusion, grasscutters can be fed 3gVA/kg feed in a pellet form for enhanced growth performance and carcass characteristics, an indication that VA had growth promoting ability that enhance carcass yield.

Keywords: Bitter-leaf, Grasscutter, Growth performance, haematology, hepatic-indices

Introduction

The need for cheaper sources of animal protein has brought attention to the rearing of wild animals. One of the successfully reared wild animals today is the grasscutter (Akinloye, 2005; FAO, 2016). Proper grasscutter feeding has been the major factor that determines the health of the animal apart from the environmental component in which the animal exists

(Essawi and Srour, 2000; Asibey, 2014). Grasscutter meat is a well relished protein source and it accounts for the greater proportion of bush meat sold in most parts of the continent of Africa, particularly West Africa (Wallace, 2013). Studies carried out demonstrated that the animals could be kept in captivity (Baptist and Mensah, 2006; Ntiamo-Baidu,

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2008; Wallace, 2013). The problem of adequate nutrition in captive grasscutter could be solved by providing browse plants that could supply essential nutrients and have medicinal value (Okukpe *et al.*, 2017). Leaf meals do not only provide protein source but also some essential vitamin such as vitamin A and C, minerals and oxycarotenoids. The constraints to enhance utilization of leaf meals reside chiefly on factors such as fibre content, the presence of anti-nutritive compounds and deficiency of certain amino acids (Fereidoon, 2014).

Vernonia amygdalina (VA) is a shrub or small tree that grows throughout tropical Africa. It is popularly called bitter leaf because of its abundant bitter principles (Ekpo *et al.*, 2007). The bitter taste of the leaf has been attributed to the presence of anti-nutritive principles like saponins, alkaloids, tannins and glycosides (Buttler and Bailey, 2003). There have been several reports on its antimicrobial, antiplasmodial, antitumor, antioxidant and antihelminthic properties (Ehiagbonare, 2007; Jisaka *et al.*, 2013; Izevbigie, 2013; Farombi, 2013). Aqueous leaf extracts of *Vernonia amygdalina* have been previously reported to have prebiotic properties (Surubally, 2008). The findings by Akwaowo, (2010) reported that the young leaves often preferred for human consumption, contain high cyanide (60.1mg 100-1g DM) and tannin content (40.6mg 100-1g DM) than older ones. Proximate composition of *Vernonia amygdalina* leaf meal (VALM) in South-Western Nigeria showed a chemical composition of 527.83 ME kcal/ kg, 86.40% DM, 21.50% CP, 13.10% CF, 6.80% EE, 11.05% Ash, and the result on mineral composition indicated that *V. amygdalina* has 3.85% Calcium, 0.40% Magnesium, 0.03% Phosphorus, 0.006% Iron, 0.33% Potassium and 0.05% Sodium (Owen, 2011). Furthermore, *Vernonia amygdalina* has also been fed to broilers, where it was able to replace 300g kg⁻¹ of maize-based diet without negative effect on feed intake, body weight gain and feed efficiency (Bonsi *et al.*, 2015). The use of supplements along with the feeding of roughages has been found to improve performance in grasscutters (Agboola, 2010). The objectives of the study were to determine the effect of *Vernonia amygdalina* leaf

meal on the growth performance and carcass characteristics of grasscutter.

Materials and Methods

Experimental site: The experiment was carried out at the grasscutter unit of the biotechnology laboratory, Department of Animal Production, University of Ilorin, Nigeria.

Experimental diets: Fresh *Vernonia amygdalina* leaves were harvested from the university garden, rinsed, air dried for four days retaining the greenish coloration. It was ground into powder using a food blender and later incorporated into a formulated commercial grower mash at graded levels. It was then mixed evenly after which a liquid binder (local hot water starch) was added, mixed and forced through an extruder to form pellets, it was then sun dried for two days.

Vernonia amygdalina (VA) leaf powder was added at different levels per kilogram commercial feed (Grower Topfeed[®]) manufactured in May, 2017 and used within a month of production i.e. treatment A – Control (VA not added), B – 1g of VA per kg of feed, C – 2g of VA per kg of feed, D – 3g of VA per kg of feed, E – 4g of VA per kg of feed and F – 5g of VA per kg of feed.

Experimental animals and management: A total of thirty-six (36) weaner grasscutters of mixed sexes (eighteen males and eighteen females) were procured from the Institute of Agricultural Research and Training (IAR&T), Ibadan, Nigeria at 12 weeks of age. They were randomly allotted to six treatments of two replicate with three grasscutters per replicate. The grasscutters were weighed to determine their initial body weight. The grasscutters were housed in wire-net cages with a floor space of 8.3m × 5.5m, L × B per replicate. They were offered experimental diets and water *ad libitum* for a period of seven weeks. They were given *Pennisetum purpureum*, *Panicum maximum* and *Citrullus lanatum* in the acclimatization period during which the test ingredient was gradually administered to the animals before the start of the experiment. Records of daily feed intake and weekly weight gain were taken.

At the end of the experiment, four animals were selected per treatment after starving for about 10 hours before slaughtering by severing the carotid artery and the jugular vein. Blood was collected into plain and Ethylene diamine tetracetic acid (EDTA) coated bottles for haematology and biochemical tests. The haematological parameters were determined as previously described by Swenson (1970) and Aderolu *et al.* (2007). The Mean Cell Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) and Mean Corpuscular Haemoglobin (MCH) were estimated by calculation using a standard formula (Iwalokun *et al.*, 2006). The animals were later skinned before evisceration after which they were cut into primal parts. Internal and external organs were weighed using electric weight balance (George Home product, Leed, U.K.).

Table 1: Composition of the commercial grower feed (Top feed^R)

Ingredients	Composition (kg)
Maize	50.00
Soybean meal	12.50
Fish meal	1.00
Wheat offal	11.45
Palm kernel cake	7.00
Corn bran	6.00
Groundnut cake	8.00
Bone meal	2.50
Oyster shell	1.00
Salt	0.30
Vitamin premix	0.25
Total	100
Calculated CP	18.44%
Calculated ME (Kcal/kg)	2810.67

The liver was also collected and kept in an EDTA free bottle. The liver was homogenized and then centrifuged at 3000g for about 10 minutes to separate plasma from residue. The hepatic indices parameters tested for include; Alkaline phosphatase (ALP), Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), Total Protein, and Albumin. The biochemical parameters were determined as previously described by Aderolu *et al.* (2007). The study was conducted following the guidelines of the

Research Policy of the University of Ilorin on Animal Welfare and Ethics.

Statistical Analysis - All data were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) 2008 Model. Means of the treatment were separated using Tukey studentized range test.

Results and Discussion

The results showed that there was significant ($p < 0.05$) differences in the total feed intake, weight gain and feed conversion ratio of the grasscutters fed the *Vernonia amygdalina* supplemented feed. Those fed treatment D containing 3g of VA per kg feed had similar feed intake to the control and had higher weight gain with an average feed conversion ratio of 1.01 (Table 2).

This is in agreement with Agboola (2010) that the use of supplements along with the feeding of roughages have been found to improve performance in grasscutters. However, the use of pelleted concentrate feed as supplements in diets was reported to be of no significant effect on the performance of growing grasscutters (Adeniji, 2009) which was contrary to the present findings. These findings might be as a result of the different feeding habit of grasscutter which are habitually nocturnal and wasteful feeders. They have been reported to perform well when fed green or dry forages accompanied with concentrates with a dietary energy level of 2800 kcalME/kg than on a low dietary energy level (van Zyl and Delpont, 2010; Okukpe *et al.*, 2017). It has been reported that an increase in dietary components of crude fibre (CF), acid detergent fibre (ADF) and neutral detergent fibre (NDF) decreased digestibility and daily weight gain in grasscutter (Karikari and Nyameasem, 2009). van Zyl *et al.* (2009) reported that high dietary fibre reduced the digestibility of dry matter (DM), protein and fat component of feed with a reduction in growth rates of grasscutters. The improved feed conversion ratio might be as result of increased consumption of the treated feed and the

presence of some phytochemical principles in *Vernonia amygdalina* that enhance taste as well as absorption of feed in the gastrointestinal tract (Okukpe *et al.*, 2016). This study correspond with Durunna *et al.* (2011) who observed an increased weight gain with low feed conversion ratio in broilers given 75ml/litre of bitter leaf extract. It also supports the findings of Tangka (2003) that reported improved growth performance of animals fed bitter leaf. The increase in the weight correlates with the lower FCR observed in the treated group. The lower the FCR the higher it is for the animals to convert feed consumed to meat. The result pertaining to FCR of this study is in line with the findings of Olobatoke and Oloniruha (2009) who reported that inclusion of VA leaf powder in cockerels feed significantly improved FCR. This could be associated with its effect on enhancing the gastro intestinal enzyme thereby improving digestion and assimilation of nutrients (Adaramoye *et al.*, 2008). The findings by Windisch *et al.* (2007) also reported improved growth performance of animals fed VA. Furthermore, the report of Mohammed and Zakariya'u (2012) supported the observations made by Abubakar *et al.*, (2010) that phytogenic feed additives are often associated with the improvement of flavor and palatability of feed, thus bitter leaf extract enhances production performance of birds. The reported activity of

Vernonia amygdalina is attributable to the complex active secondary plant compounds that are pharmacologically active (Clement *et al.*, 2014). However, the observations made by Mohammed and Zakariya'u (2012) pertaining to improvement of weight gain and FCR in broilers are contrary to the present findings and this may be attributed to the levels of inclusion of VA in diet.

The carcass evaluation showed an improvement in carcass weight, fore-leg, fore-muscle, shoulder bone, rib, chest muscle, loin bone and loin muscle in animals with the VA treated diets with a significantly ($p < 0.05$) better performance in treatment D (Table 3).

The results of the present study are in accordance with report of Abubakar *et al.* (2010) who observed variation in carcass characteristics of broiler birds fed varying levels of garlic. Graham *et al.* (1986) reported that diets with low dietary fibre contain more soluble carbohydrates which would be digested before reaching the caecum in rabbits resulting in less effect on the caecal mucosa.

On the haematology parameters (Table 4), the *Vernonia amygdalina* supplement significantly ($p < 0.05$) affected all the parameters studied except platelets (PLT).

Table 2: Effect of dietary supplementation with *Vernonia amygdalina* on growth performance of *Thryonmys swinderianu*

Parameters	A(0g/kg)	B(1g/kg)	C(2g/kg)	D(3g/kg)	E(4g/kg)	F(5g/kg)	±SEM
FI (g)	6366.70 ^{ab}	5733.30 ^{cd}	5766.70 ^{cd}	6566.70 ^a	6100.00 ^{bc}	5400.00 ^d	89.92
WG (g)	4866.70 ^c	6566.70 ^a	6066.70 ^{ab}	6500.00 ^a	6255.60 ^{ab}	5400.00 ^{bc}	192.50
FCR	1.30 ^a	0.87 ^c	0.94 ^{bc}	1.01 ^b	0.97 ^{bc}	1.00 ^{bc}	0.027

NB: a,b,c,d,e,f - different superscript across the row differ significantly ($p < 0.05$), where FI - Feed Intake; WG - Weight Gain, FCR - Feed Conversion Ratio, VA - *Vernonia amygdalina*, SEM - Standard Error of Mean.

Table 3: Carcass Evaluation of *Thryonomys swinderianus* fed graded levels of *Vernonia amygdalina* supplemented diets

Parameter (g)	A (0g VA/kg feed)	B (1gVA/kg feed)	C (2gVA/kg feed)	D (3gVA/kg feed)	E (4gVA/kg feed)	F (5gVA/kg feed)	± SEM
Carcass wt	676.00 ^b	479.00 ^f	592.00 ^d	595.00 ^d	747.00 ^a	665.00 ^c	0.58
Head	129.90 ^a	104.90 ^c	103.80 ^c	102.30 ^c	122.90 ^b	104.90 ^c	0.64
Forefeet	2.20	2.50	2.50	2.40	2.50	2.60	0.24
Hind feet	8.00 ^{ab}	7.50 ^b	5.30 ^c	6.80 ^{bc}	8.00 ^{ab}	9.30 ^a	0.32
Foreleg	17.00 ^b	6.30 ^c	8.50 ^d	22.70 ^a	12.40 ^c	10.20 ^d	0.41
Hind leg	40.8 ^a	20.3 ^d	19.5 ^d	25.7 ^b	25.0 ^{bc}	22.90 ^c	0.44
Fore muscle	4.70 ^c	4.80 ^c	15.50 ^b	21.10 ^a	10.40 ^c	8.00 ^d	0.29
Hind muscle	36.20 ^a	11.30 ^c	14.10 ^d	21.40 ^b	20.50 ^c	18.40 ^c	0.46
Fore bone	2.10 ^b	1.30 ^d	3.00 ^a	1.60 ^{cd}	1.90 ^{bc}	1.90 ^{bc}	0.07
Hind bone	4.30 ^{ab}	3.20 ^b	4.90 ^a	4.30 ^{ab}	4.00 ^{ab}	4.20 ^{ab}	0.27
Loin bone	5.60 ^{ab}	4.70 ^b	3.00 ^c	6.30 ^a	6.00 ^{ab}	5.50 ^{ab}	0.34
Shoulder	34.10 ^a	24.90 ^c	27.00 ^d	29.10 ^c	31.10 ^{bc}	33.10 ^{ab}	0.42
Shoulder muscle	28.00 ^a	20.60 ^b	23.00 ^b	22.50 ^b	26.00 ^a	28.50 ^a	0.58
Shoulder bone	5.10 ^b	4.40 ^c	3.00 ^c	5.90 ^a	4.00 ^d	4.00 ^d	0.07
Loin muscle	16.40 ^c	27.70 ^d	34.20 ^c	42.00 ^a	35.50 ^c	38.20 ^b	0.35
Loin	22.00 ^f	32.80 ^c	38.00 ^d	48.30 ^a	42.00 ^c	43.80 ^b	0.35
Rib	43.90 ^b	39.10 ^{bc}	37.00 ^{cd}	52.40 ^a	42.80 ^{bc}	30.70 ^d	1.33

Table 4: Effect of dietary supplementation with *Vernonia amygdalina* on haematology of *Thryonomys swinderianus*

Parameters/ Treatment	A(0g/kg)	B(1g/kg)	C(2g/kg)	D(3g/kg)	E(4g/kg)	F(5g/kg)	± SEM
WBC (x10 ³ µL)	11.06 ^c	21.56 ^a	1.98 ^d	18.04 ^{ab}	13.7 ^c	14.67 ^{bc}	0.89
LYM(x10 ³ µL)	6.33 ^b	12.66 ^a	0.96 ^c	11.09 ^a	4.87 ^b	5.78 ^b	0.45
MID(x10 ³ µL)	1.05 ^c	3.29 ^a	0.32 ^c	2.12 ^b	0.42 ^c	1.01 ^c	0.21
GRA(x10 ³ µL)	3.67 ^c	5.60 ^b	0.70 ^d	2.12 ^{cd}	8.46 ^a	7.87 ^a	0.39
RBC(x10 ³ µL)	1.21 ^c	2.99 ^b	0.88 ^c	6.89 ^a	4.45 ^b	3.90 ^b	0.35
HGB(g/dl)	6.30 ^b	11.30 ^a	5.80 ^b	13.70 ^a	12.10 ^a	11.30 ^a	0.56
MCH(pg)	52.20 ^b	37.70 ^c	66.30 ^a	19.90 ^d	27.10 ^{cd}	28.90 ^{cd}	2.65
HCT (%)	18.69 ^b	33.90 ^a	17.40 ^b	41.10 ^a	36.30 ^a	33.90 ^a	2.24
MCHC(g/dl)	58.50 ^b	34.30 ^c	32.00 ^c	49.20 ^b	71.00 ^a	76.20 ^a	2.62
PLT(µl)	999.90	999.90	999.90	999.90	999.90	999.90	33.73
MPV(fl)	14.50 ^b	14.70 ^b	15.00 ^b	21.10 ^a	15.10 ^b	15.20 ^b	1.05
PDW	39.10 ^{ab}	39.63 ^{ab}	32.80 ^b	23.70 ^c	42.30 ^a	41.50 ^a	1.57
P-LCC	8010.0 ^b	9999.9 ^a	7380.0 ^b	9730.0 ^d	9999.0 ^a	9999.0 ^a	273.06
PLCR (%)	65.33 ^b	66.13 ^b	71.21 ^{ab}	92.99 ^a	66.37 ^b	67.99 ^b	4.87

NB: a, b, c, d - different superscripts along the same row which indicates that they are significantly different. (p<0.05). WBC = white blood cell, LYM= lymphocyte, MID = minimum inhibitory GRA= granulocyte, RBC= red blood cell, HGB = haemoglobin, MCH= mean corpuscular haemoglobin, HCT= haematocrit, MCHC = mean corpuscular haemoglobin concentration, PLT =platelet, MPV =mean platelet volume, PDW =platelet distribution width, P-LCC =, P-LCR =platelet large cell ratio, SEM= standard error of mean

Table 5: Effect of dietary supplementation with *Vernonia amygdalina* on hepatic indices of *Thryonomys swinderianus*

Parameters/ Treatment	A(0g/kg)	B(1g/kg)	C(2g/kg)	D(3g/kg)	E(4g/kg)	F(5g/kg)	± SEM
TP (mg/dl)	15.55 ^a	9.99 ^b	9.77 ^b	10.27 ^b	13.87 ^{ab}	13.09 ^{ab}	0.87
ALP (U/I)	75.62 ^b	9.88 ^d	2.28 ^d	7.98 ^d	137.56 ^a	57.00 ^c	1.60
AST (U/I)	134.74	116.32	137.37	124.21	131.58	128.42	5.77
ALB (U/I)	5.28 ^{ab}	6.65 ^a	6.59 ^a	7.07 ^a	2.98 ^{ab}	5.98 ^a	0.51
ALT(U/I)	41.98	35.63	44.48	39.86	42.55	40.05	2.51

NB: a,b,c, d - different superscripts along the same row indicates that they are significantly different ($p < 0.05$). TP= total protein, ALP= alkaline phosphatase, AST= aspartate aminotransaminase, ALB= albumin, ALT= alanine aminotransaminase, SEM= standard error of mean.

The white blood cell (WBC) had the highest value in treatment B and the lowest in C. Lymphocyte (LYM), red blood cell (RBC), haemoglobin (HGB), packed cell volume (HCT), mean platelet volume (MPV) and platelet large cell ratio (PLCR) were significantly ($p < 0.05$) high in treatment D than the other treated animals. The increased RBC values obtained in treatment D were comparable with the findings of Ogunsanmi *et al.* (2002) and Opara and Fagbemi (2008). High red cells can increase the delivery of oxygen to the tissues, and the animal experience full calories of energy (Bush, 1991). However, the increased number of cells in blood causes the blood to become thickened and sticky. This may put a huge strain on the heart, and can cause heart attacks and heart failure. Opara and Fagbemi (2008) reported that red blood cell count is an indication of feed quality. Thus haemoglobin (Hb) concentration in this study fell within the normal range of (12 – 18g/dl) normally contained in the blood of grasscutters. Haemoglobin has the unique property of combining reversibly with oxygen and is the medium by which oxygen is transported within the body. It takes up oxygen as blood passes through the lungs and releases it as blood

passes through the tissues. A significant increase in the WBC count was observed in the experiment group as compared to the control except in treatment C. Okukpe *et al.* (2016) reported a decrease in WBC count in captive grasscutters administered plant extracts. The presence of high levels of vitamin A, vitamin C, vitamin E and phytates that are known to have antioxidant properties and useful in maintaining good health, may have been responsible for the increase in WBC values observed in the treated groups. The presence of high levels of vitamin (40.82 mg/100 g), vitamin C (15 mg/100 g), vitamin E (tocopherol) (3.71 mg/100 g), β -carotene (6.80 mg/100 g) and phytate (6.5 mg/100 g) that have been indicated to have antioxidative properties (Boham and Kocipai, 1994; Foo *et al.*, 2014) and useful in maintaining good health, have been suggested as possible causes of increased WBC in the blood. Leukocyte counts have been reported to increase due to any form of stress, exercise, feeding, age, breed and wide variety of other conditions (Jori *et al.*, 2001; Okukpe *et al.*, 2016). The mean corpuscular haemoglobin concentration MCHC, MCH, MPV had significant differences between the control group and the experimental

groups suggesting that the amount and quantity of leaf meals (20%) added to the diets did not have any detrimental effect on the internal physiological milieu of the grasscutters. Thus, the grasscutters on some of the experimental diets were able to perform better in some parameters compared with the control. There was no significant ($p>0.05$) difference in the Platelet values, except in treatment A and C. This therefore shows that the inclusion of *V. amygdalina* up to 5g does not affect the blood clotting ability of the grasscutters. Therefore, cuts would not result into excessive bleeding. With increased levels of *V. amygdalina*, the platelets remain the same. This may be due to the presence of tannins in the *Vernonia*, which have astringent properties which are important anti-oxidant and in wound healing (Fereidoon, 2014). Platelet distribution width and platelet crit which are indication of variation in platelet size were similar across all the treatment.

There was also significant difference ($p<0.05$) in all hepatic parameters (Table 5) except AST and ALT which showed no significant difference ($p>0.05$). It was observed that there were no significant differences in the values for AST and ALT across the treatment. Their uses for clinical purpose are primarily for the diagnosis of liver diseases (Bush, 1991; Jori *et al.*, 2001). The effect of the extract on some biochemical indices of liver function for this research was in line with the findings of Ojiako and Nwanjo (2006) that aqueous extract of *V. amygdalina* leaves had positive effect on some liver function tests in albino Wister rats. This further buttress the fact that *V. amygdalina* has nutritional, clinical and veterinary relevance considering diverse applications of the plant in almost all African countries. In this investigation the level of these marker enzymes (ALT, and AST) were reduced though there was no significant difference, thus improving renal and hepatic functions. This observation is consistent with earlier report on

hepato-protective potentials of leaf extracts of *V. amygdalina* in mice (Iwalokun *et al.*, 2006).

Conclusion

Vernonia amygdalina leaf meal improved the growth performance and carcass characteristics of grasscutter up to the inclusion level of 4g of VA/kg of feed. However, there was depressed feed intake at higher levels of *Vernonia amygdalina* leaf meal inclusion. It can therefore be concluded that *Vernonia amygdalina* leaf meal could be included in a commercial feed up to 4g/kg feed in a pellet form for enhanced growth performance and the carcass characteristics of captive grasscutter due to its growth enhancing potential.

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