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DRY MATTER YIELD, MINERAL CONTENTS, ANTINUTRIENTS AND PROXIMATE COMPOSITION OF *Pennisetum purpureum* And *Calopogonium mucunoides* IN THE HUMID TROPICS

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ABSTRACT

The aim of this study was to evaluate the dry matter yield, mineral contents, antinutrients and proximate composition of cultivated Pennisetum purpureum and *Calopogonium mucunoides* in the humid tropics. A total of 6000 cm^2 land area was ploughed and demarcated into eighteen plots with 3 treatments and 6 replicates, each 300 x 270 cm^2 in a Randomized Complete Block Design (RBCD). Pennisetum purpureum and *Calopogonium mucunoides* were obtained from the University of Uyo Teaching and Experimental Farm, Use Offot. The plants were treated against ants, termites, stem borers and other insects and planted manually at a spacing of 50 × 40cm and 30×20cm using cuttings with four nodes and each plot had eighty (80) stands respectively. Samples were harvested at intervals of two weeks (week 8, 10 and 12) after sprouting for chemical analysis. Data collected were subjected to analysis of variance using the General linear model procedure of SAS (2001). The study revealed that time of harvest after sprouting significantly influence (P<0.05) calcium, potassium magnesium, iron and nitrogen composition of Pennisetum purpureum. Calcium, potassium and iron were significantly higher (P<0.05) in Pennisetum purpureum harvested at 12 weeks after sprouting than other treatment groups. *Calogoponium mucunoides* harvested at 8 weeks after sprouting had higher composition of tannin (31.27%), followed by C_2 (28.18%) and C_1 (26.50%). Alkaloid was lower (p<0.05) in C_1 (1.80%) and higher in C_3 (2.94%). In conclusion, the age of these plants at harvest, influences the proximate composition, mineral composition and anti-nutritional factors.

Keywords: Calopogonium, pasture crops elephant grass**,** cultivated pasture crops

INTRODUCTION

From the tropical Americas and the West Indies, *Calopogonium mucunoides* (calopo) spread widely and is currently present in the majority of humid tropical regions, including Africa, Asia, and Australia (US Forest Service, 2011). Calopo is a warm-growing legume that prefers hot and humid tropical areas (Ecocrop, 2011). Daily temperatures between 24°C and 36°C are ideal for its growth (Cook *et al.* 2005), and it endures well with yearly rainfall of 1000 mm or more up to 1500 mm (Kretschmer *et al.,* 2001). In recently cleared, rich terrain, calopo grows easily after seeding and can blanket the soil in within 3-6 months, or even sooner (Kretschmer *et al.* 2001). Calopo can be grazed or harvested in a single cut when the pods are already fully developed, and then fed fresh to livestock as feed, producing up to 14 t DM/ha. Dry matter yields are about 4-6 t/ha when cut every 9–12 weeks. The yield of dry matter, mineral content, antinutrients, and near composition of *Calopogoniummucunoides* grown in the humid tropics were all evaluated in this study.

Perennial grass, *Pennisetum purpureum*, has a rapid rate of growth. From July to February, *P. purpureum* blooms in Florida (Langeland *et al.* 2008), flowering year-round throughout Mexico and Central America, peaking from December to May (Vibrans, 2009). This species blooms in Nigeria between January and June (Tropical Forages, 2013). *Pennisetum purpureum*, like many other C4 grasses, can survive in situations with high daytime temperatures, intense sunshine, dryness, and/or CO_2 limits (Gibson, 2009).

Pennisetum purpureum grew to a height of 4 meters in just three months on an agricultural study plot in Puerto Rico (Tropical Forages, 2013). In addition to being cut for hay and fermented for silage, it is a significant fodder and pasture grass, particularly for cattle (FAO, 2013).

The main objectives of this study is evaluate the dry matter yield, mineral contents, antinutrients and proximate composition of *pennisetum purpureum* and *calopogonium mucunoides* in the humid tropics.

MATERIALS AND METHODS

Experimental Site

The research was conducted at the Pasture Land of the Teaching and Research Farms, University of Uyo Annex, Uyo, Akwa Ibom State. Uyo is located on latitude 4^0 59^1 and 5^0 04^1N and longitude 7^0 53^1 and 8^0 00^1E, with an elevation of about 60.9 m above sea level. Uyo has a bi-modal rainfall pattern with mean annual rainfall of 2190 mm and mean relative humidity of 81%. The average maximum and minimum temperatures are 31^oC and 18^oC, respectively (Tadross *et al.* 2005).

Land Preparation and Planting of Pasture

The study was conducted from June to August. The total land area cultivated was 6000 cm^2. The study site was ploughed manually then demarcated into eighteen plots with 3 treatments and 6 replicated with each measuring 300 x 270 cm^2 in a Randomized Complete Block Design (RBCD). The plots were irrigated to field capacity after the land was prepared. *Pennisetum purpureum* and *Calopogonium mucunoides* were obtained from the University of Uyo Teaching and Experimental Farm, Use Offot. The plants were treated with Chlorofos, 125mls per 10 litres of water against ants, termites, stem borers and other insects. *Pennisetum purpureum* and *Calopogonium mucunoides* were planted manually at a spacing of 50 × 40cm and 30×20cm respectively using cuttings with four nodes and each plot had eighty (80) stands. Two nodes/vines were placed into the ground and above the ground at an angle of 30 – 45°. Organic poultry manure of 1kg/plot was applied to the forages. Weeding was done manually immediately after the weeds starts to grow. Throughout the 12 weeks of the experiment, water pipes were used to manually irrigate every plotto supplement rainfall. One kilogram of organic poultry manure per plot was spread on the forages. As soon as the weeds began to grow, they were physically removed.

Harvesting of plants

After sprouting, samples of calopo (*Calopogonium mucunoides*) and elephant grass (*Pennisetum purpureum*) were harvested at intervals of two weeks, namely: weeks 8, 10, and 12. Samples of calopo and elephant grass were taken to the laboratory for chemical analysis.

Data Collection

From the second week until the last cut of the sample grass on the twelfth week, the number of tillers and leaves was counted, and the height of the grass and the largest leaf length (cm) were measured once every two weeks. To avoid edge effects, five samples were chosen at random from each plot and labeled for data collection. After collecting the samples for twelve weeks, dry biomass was measured. Using pruning scissors, 1000g of whole elephant grass and calopo leaves samples were manually cut at random from the nodes and taken by hand from each plot. For the sampling procedure, fodder leaves were cut into lengths of 1-3cm using pruning shears, and their DM content was calculated after been oven dried at 60°C for 48 hours (AOAC, 2005). A 2-mm screen was used to filter the samples after milling.

Chemical Analysis

Samples were analysed in the Animal Science Laboratory, University of Uyo, Uyo. Ash content was determined by combusting at 750 °C overnight (AOAC, 2005). The nitrogen (N) content was determined using the Kjeldahl technique (AOAC, 2005), and the results were converted to crude protein (CP) using N x 6.25. To determine the fat content, the AOAC (2005)-described soxhlet fat extraction method was applied. Minerals such as nitrogen, phosphorus, potassium, (K), calcium (Ca), magnesium (Mg), manganese (Mn), and iron (Fe) were identified using inductively coupled plasma optical emission spectrometry (ICP-OES) (SOP, 2005). The AOAC (1984) and Evans (2003) techniques were employed in this study for phytochemical screening. The plants were tested for alkaloids, flavonoids, saponins, and tannins.

Statistical Analysis

Data collected were subjected to analysis of variance using the General linear model (GLM) procedure of SAS (2001).Significant differences observed among replicates means were separated using the Duncan's multiple range test of same software.

RESULTS

Growth Parameters and Biomass of *Pennisetum purpureum* and *Calopogonium mucunoides*

Table 1 displays the results on growth parameters and biomass of *Pennisetum purpureum* and *Calopogonium mucunoides*. At 2, 4, 6, 8, 10, and 12 weeks after sprouting (WAP), the leaf area of the two-plant species was substantially different ($P<0.05$). *Calopogonium mucunoides* had considerably higher leaf area in all weeks studied. *Calopogonium mucunoides* exhibited leaf areas of 3.40, 4.42, 9.64, 11.16, 12.17, and 13.93 cm^2 at 2, 4, 6, 8, 10, and 12 WAP, while *Pennisetum purpureum* had leaf areas of 1.20, 2.50, 3.64, 4.48, 4.60, and 8.00 cm^2 for the periods of 2, 4, 6, 8, 10, and 12 WAP.

The leaf count results revealed that there was no significant difference (P>0.05) at 2 and 4 WAP, but at 6, 8, 10, and 12 WAP, *Calopogonium mucunoides* was considerably (P<0.05) higher than *Pennisetum purpureum*. At 4, 6, 8, 10, and 12 WAP, the stem girth of *Pennisetum purpureum* was substantially (P<0.05) greater than that of *Calopogonium mucunoides*. At 4, 6, 8, 10, and 12 WAP, the height and vine length of *Pennisetum purpureum* were substantially (P<0.05) higher than *Calopogonium mucunoides*. *Calopogonium mucunoides* had better (P<0.05) root tillers at 4, 6, 8, 10, and 12 WAP than *Pennisetum purpureum*. Results at 2, 4, 6, 8, 10, and 12 weeks revealed that, *Pennisetum purpureum* had considerably longer (P<0.05) leaf length than *Calopogonium mucunoides*. Fresh and dry biomass indicated that *Pennisetum purpureum* were significantly (P<0.05) higher than *Calopogonium mucunoides* at 8, 10 and 12 weeks of harvesting.

Proximate Composition (% DM) of *Pennisetum purpureum*

The nutritional value of *Pennisetum purpureum* as obtained from the laboratory analysis is shown in Table 2. The result obtained revealed significant differences (p<0.05) on dry matter, crude protein, ash, crude fibre, ether extract, nitrogen free extract and metabolizable energy. Dry matter content was higher (p<0.05) in *Pennisetum purpureum* harvested at 8 weeks and 10 weeks than those harvested at 12 weeks. Crude fibre, crude fat and ash were significantly higher (p<0.05) in *Pennisetum purpureum* harvested at 12 weeks than those harvested at 8 weeks and 10 weeks after sprouting

Table 1Growth Parameters and Biomass of *Pennisetum purpureum* and *Calopogoniummucunoides*

WAP	2		4		6		8		10		12		SEM
Treatment	Pp	Cm	Pp	Cm	Pp	Cm	Pp	Cm	Pp	Cm	Pp	Cm	
LA	1.20^{i}	3.40^{g}	2.53^{h}	4.57^{f}	3.64^{g}	9.64^{d}	4.47^{f}	11.14^{c}	4.60^{f}	12.28^{b}	8.00^{e}	13.93^{a}	0.68
LC	4.03^{i}	3.52^{i}	9.73^{g}	7.27^{h}	14.91^{f}	21.96^{e}	15.02^{f}	31.29^{c}	15.57^{f}	44.53^{b}	25.00^{d}	64.47^{a}	2.92
SG	1.67^{f}	0.97^{hi}	3.63^{e}	0.89^{i}	4.69^{d}	1.20^{g}	5.77^{c}	1.34^{fg}	6.24^{b}	1.50^{fg}	7.20^{a}	1.48^{fg}	0.38
H/VL	16.43^{h}	12.18^{h}	87.12^{g}	78.62^{g}	103.68^{f}	102.41^{f}	176.02^{c}	130.67^{e}	216.17^{b}	149.00^{d}	279.20^{a}	151.20^{d}	12.47
RT	2.00^{i}	1.97^{i}	2.82^{h}	4.92^{e}	3.29^{g}	5.20^{e}	3.84^{f}	8.41^{c}	5.63^{d}	9.47^{b}	5.90^{d}	13.40^{a}	0.55
LL	12.59^{e}	5.30^{g}	55.34^{d}	8.07^{f}	64.76^{c}	11.16^{e}	75.49^{b}	12.36^{e}	104.87^{a}	12.61^{e}	105.93^{a}	13.33^{e}	6.31
FB	-	-	-	-	-	-	14.63^{c}	6.30^{f}	17.70^{b}	8.07^{e}	21.60^{a}	9.87^{d}	13.03
DM	-	-	-	-	-	-	11.40^{c}	3.13^{f}	14.17^{b}	5.13^{e}	15.13^{a}	6.83^{d}	9.33

WAP: week after sprouting, LA: leaf area, LC: leaf count, SG: stem girth, H/VL: height/vine length, RT: root tillers, LL: leaf length, FB: fresh biomass, DB: dry biomass, Pp: *Pennisetum purpureum,* Cm: *Calopogoniummucunoides,* SEM: standard error of mean

$^{a\text{-}i}$ means with same superscript on the same row are not significantly different ($P < 0.05$)

Table 2: Proximate Composition of *Pennisetum purpureum*

Parameters (%)	P1	P2	P3	SEM
Dry matter	99.99[a]	99.04[a]	99.68[b]	0.02
Crude Protein	10.84[b]	12.95[a]	10.04[c]	0.67
Ash	5.33[c]	5.58[b]	6.76[a]	0.02
Crude fibre	10.08[c]	17.78[b]	18.32[a]	0.01
Crude fat	1.57[ab]	1.38[b]	2.14[a]	0.17
Nitrogen Free extract	72.17[a]	61.35[c]	62.50[b]	0.26
Metabolisable energy(Kcal/g)	340.51[c]	364.27[a]	349.59[b]	0.13

[abc] mean with the same superscripts in the same row are not significantly different (P<0.05) SEM = standard error of mean; P_1 = *Pennisetum* harvested at 8 weeks, P_2= *Pennisetum purpureum* harvested at 10 weeks. P_3 = *Pennisetum purpureum* harvested at 12 weeks.

Table 3: Proximate Composition of *Calopogoniummucunoides*

Parameters (%)	C1	C2	C3	SEM
Dry matter	99.42[c]	99.51[b]	99.65[a]	0.00
Crude Protein	13.73[b]	16.05[a]	16.35[a]	0.19
Ash	5.19[c]	6.37[b]	8.85[a]	0.01
Crude fibre	7.73[c]	13.25[b]	14.22[a]	0.02
Crude fat	3.46[a]	2.57[b]	1.80[c]	0.02
Nitrogen Free extract	69.89[a]	61.76[b]	58.78[c]	0.1 9
Metabolisable energy(Kcal/g)	365.9 1[a]	324.4 4[c]	346.0 4[b]	0.20

[abc] mean with different superscripts in the same row were significantly different (P<0.05), SEM = standard error of mean; C_1 = *Calogoponiummucunoides* harvested at 8 weeks, C_2=*Calogoponiummucunoides*harvested at 10 weeks. C_3 = *Calogoponiummucunoides* harvested at 12 weeks.

Proximate Composition of *Calopogoniummucunoides*

The proximate composition of *Calopogonium mucunoides* is shown in Table 3. Dry matter contents were significantly different (p<0.05) in the study and were 99.42, 99.51 and 99.65% for *Calogoponium mucunoides* harvested at 8, 10 and 12 weeks after sprouting respectively. Metabolizable energy, nitrogen free extract and crude fat content were higher (p<0.05) in C_1 than other treatment groups. Result obtained on crude fibre, ash, crude protein and dry matter were statistically higher (p<0.05) in C_3 than other treatment groups. Higher (p<0.05) crude protein was recorded in C_3 (16.35%) while C_1 had the least value of 13.73%. Ash was statistically influenced (p<0.05) by week of harvest after sprouting and was observed to increase progressively from 5.19% to 8.85% for C_1, C_2 and C_3 respectively with time of harvest. Crude fibre composition was 14.22%, 13.25% and 7.73% for C_3, C_2 and C_1 respectively. Higher (p<0.05) metabolizable energy (365.91 Kcal/g) was recorded for C_1 while C_2 had the lower value of 324.44 Kcal/Kg.

Mineral Composition of *Pennisetum purpureum*

The result on mineral composition analysis is shown in Table 4. The study revealed that time of harvest after sprouting significantly influence (p<0.05) calcium, potassium, magnesium, iron and nitrogen composition of *Pennisetum purpureum*. Calcium, potassium and iron were significantly higher (P<0.05) in *Pennisetum purpureum* harvested at 12 weeks after sprouting (P_3)than other treatment groups and significantly lower (p<0.05) in nitrogen and magnesium. Calcium was higher in P_3 (22.16 mg/g), then in *Pennisetum purpureum* harvested at 8 weeks after sprouting (P_1) (22.16 mg/g) and the least value (17.31 mg/g) was in those harvested at 12 weeks after sprouting (P_2). The potassium compositions were 10.15 mg/g, 9.16 mg/g and 7.84 mg/g for P_3, P_2 and P_1 respectively. Phosphorus composition though not statistically significant (p>0.05), was numerically higher in P_3 (4.46 mg/g) and lower in P_2 (3.57 mg/g). Whereas magnesium decreased (p<0.05) with time of harvest after sprouting, manganese on the other hand increased (p<0.05) progressively. A range of 47.20% to 70.19 mg/g was observed for magnesium while 0.93 mg/g - 1.81 mg/g was observed for Manganese. Another important mineral, iron was similar (p>0.05) in *Pennisetum purpureum* harvested at 10 and 12 weeks after sprouting respectively, lower in *Pennisetum purpureum* harvested at 8 weeks after sprouting. Nitrogen content was higher in *Pennisetum purpureum* harvested at 10 weeks after sprouting than those harvested 8 and 12 weeks after sprouting respectively.

Mineral Composition of *Calopogonium mucunoides*

The results on mineral composition analysis is shown in Table 5. The study revealed that time of harvest after sprouting significantly influenced (P<0.05) calcium, phosphorus, magnesium, iron and nitrogen with the exception of potassium and manganese in *Calopogonium mucunoides*. Calcium, phosphorus, magnesium, iron and nitrogen were significantly higher (p<0.05) in C_2 and C_3 than in C_1 group. Calcium was 22.35mg/g in C_3 and 19.73 mg/g) in C_2 and the least value was in C_1 (11.68 mg/g). Phosphorus composition was higher (p<0.05) in C_3 (8.10 mg/g) and lower in C_1 (4.46 mg/g). The values, 53.84, 51.38 and 47.20 mg/g, were recorded for magnesium composition for C_3, C_2 and C_1 respectively. A range of 8.26 - 9.16 mg/g was observed for potassium; 0.97 - 1.21 mg/g for manganese, 0.03 - 0.35 mg/g for iron and 2.19 - 2.62 mg/g for nitrogen in this study.

Anti- nutritional factors of *Pennisetum purpureum* (% DM)

Results from laboratory analysis for anti-nutritional parameters investigated showed that time of harvest after sprouting as presented in table 6, had statistical influence (p<0.05) on tannin, alkaloid, flavonoid and saponin across all treatments. Tannin, alkaloid, flavonoid and saponin content were higher (p<0.05) in P_3 than in P_1 group. *Pennisetum purpureum* harvested at 10 and 12 weeks after sprouting had similar (p>0.05) composition of Tannin (13.43 and 13.75%) respectively, higher than that *Pennisetum purpureum* harvested at 8 weeks after sprouting (10.60%).

Alkaloid was lower in P_1 (2.24%) and P_2 (2.44%) than in P_3 (3.50%). Higher value (p<0.05) of flavonoid (11.86%) was recorded in P_3, followed by P_2 (11.27%) and P_1 (8.48%). Saponin composition was least in P_1 (1.20%) while P_2 and P_3 had a composition of 1.48% and 1.92% respectively.

Anti-nutritional factors of *Calopogonium mucunoides*in (% DM)

Results obtained on anti-nutritional parameters investigation as presented in table 7, revealed that time of harvest after sprouting had significant effect (p<0.05) on tannin, alkaloid, but no effect (p>0.05) on flavonoid and saponin composition in *Calopogonium mucunoides.* Tannin and alkaloid were significantly higher (p<0.05) in C_3 than in C_1 group while flavonoid and saponin were similar in all treatment groups. *Calogoponium mucunoides* harvested at 8 weeks after sprouting had higher composition of tannin (31.27%), followed by C_2 (28.18%) and C_1 (26.50%). Alkaloid was lower in C_1 (1.80%) and higher in C_3 (2.94%). Ranges of 9.36% - 11.60% and 1.11% -1.18% were observed for flavonoid and saponin contents respectively.

Table 4: Mineral Composition of *Pennisetum purpureum*

Parameters (Mg/g)	P1	P2	P3	SEM
Calcium (Ca)	20.24 ^{a}	17.31 ^{b}	22.16 ^{a}	0.76
Potassium (K)	7.84 ^{b}	9.16 ^{a}	10.15 ^{a}	0.76
Phosphorous (P)	4.28	3.57	4.46	0.53
Magnesium (Mg)	70.19 ^{a}	53.02 ^{b}	47.20 ^{c}	3.57
Manganese (Mn)	0.93	1.07	1.81	0.27
Iron (Fe)	0.01 ^{b}	0.10 ^{a}	0.10 ^{a}	0.00
Nitrogen (N)	1.73 ^{b}	2.07 ^{a}	1.61 ^{c}	0.01

^{abc} mean with the same superscripts in the same row are not significantly different (P>0.05). SEM = standard error of mean; P_1 =*Pennisetum purpureum* harvested at 8 weeks, P_2 = *Pennisetum purpureum* harvested at 10 weeks. P_3 = *Pennisetum purpureum* harvested at 12 weeks.

Table 5:Mineral Composition of *Calopogoniummucunoides*

Parameters (Mg/g)	C1	C2	C3	SEM
Calcium (Ca)	11.68^{b}	19.73^{a}	21.35^{a}	1.02
Potassium (K)	8.26	8.30	9.16	0.82
Phosphorous (P)	4.46^{b}	7.35^{a}	8.10^{a}	0.49
Magnesium (Mg)	47.20^{b}	51.38^{a}	53.84^{a}	3.49
Manganese (Mn)	1.07	0.97	1.21	0.07
Iron (Fe)	0.03^{b}	0.35^{a}	0.16^{ab}	0.08
Nitrogen (N)	2.19^{b}	2.57^{a}	2.62^{a}	0.03

^{abc} mean with the same superscripts in the same row are not significantly different (P>0.05). SEM = standard error of mean; C_1 = *Calogoponiummucunoides* harvested at 8 weeks, C_2=*Calopogoniummucunoides* harvested at 10 weeks of harvest. C_3=*Calopogoniummucunoides* harvested at 12 weeks of harvest.

Table 6:Anti- nutritional factors of *Pennisetum purpureum*

Parameters (%)	P1	P2	P3	SEM
Tannin	10.60^{b}	13.43^{a}	13.75^{a}	0.37
Alkaloid	2.24^{b}	2.44^{b}	3.50^{a}	0.21
Flavonoid	8.48^{b}	11.27^{a}	11.86^{a}	0.76
Saponin	1.20^{b}	1.48^{b}	1.92^{a}	0.11

^{abc} mean with the same superscripts in the same row are not significantly different (P>0.05). SEM = standard error of mean; P_1 =*Pennisetum purpureum* harvested at 8 weeks, P_2 = *Pennisetum purpureum* harvested at 10 weeks. P_3 = *Pennisetum purpureum* harvested at 12 weeks.

Table 7: Anti- nutritional factors of *Calopogoniummucunoides*

Parameters(%)	C1	C2	C3	SEM
Tannin	26.50^{b}	28.18^{ab}	31.27^{a}	1.12
Alkaloid	1.80^{c}	2.40^{b}	2.94^{a}	0.14
Flavonoid	11.21	9.36	11.60	0.91
Saponin	1.11	1.11	1.18	0.91

^{abc} mean with the same superscripts in the same row are not significantly different (P>0.05). SEM = standard error of mean; C_1 = *Calogoponiummucunoides* harvested at 8 weeks, C_2=*Calogoponiummucunoides* harvested at 10 weeks. C_3=*Calogoponiummucunoides* harvested at

DISCUSSION

Growth Habit and Biomass of *Pennisetum purpureum and Calopogonium mucunoides*

The result on growth habit and biomass of *Pennisetum purpureum and Calopogonium mucunoides* time of harvesting after sprouting resulted in growth and biomass of the plants. The higher vegetative growth and biomass accumulation recorded in *Pennisetum purpureum* compared to *Calopogonium mucunoides* agrees 56with the report of Randall (2012), that *Pennisetum purpureum* is an aggressive grass that grows rapidly tall and thick clumps. The higher biomass observed in *Pennisetum purpureum* could be due to fast growing rank of *Pennisetum purpureum* stems.

Proximate Composition (% DM) of *Pennisetum purpureum*

The dry matter contents were similar to the values of 99.07%, 100% and 100% reported by Okoli *et al.* (2003), Okaraonye and Ikewuchi (2009) and Johnson-Ajinwo and Joy (2018) respectively and disagrees with the reports of Obua *et al.* (2012) and Ukanwoko and Igwe (2012) who reported 90.68% and 65.77% respectively. The difference in the dry matter content of the grasses with the earlier reports could be due to the processing methods adopted, period of establishment (wet or dry seasons) or harvesting of forage plant as suggested by Ajayi (2012). Crude protein was in line with the results of Haryani*et al.* (2018) and Rambau (2016) who reported significant increase as the age of the grass increased. The crude fat (ether extract) content agreed with the results of Oloruntola *et al.*(2015), Obua *et al.* (2012) and Ukanwoko and Igwe (2012) who reported values of 2.35, 2.51, 1.85 and 2.66% respectively. The results on crude fibre is similar to the result of Onyeonagu and Eze (2013) with 14.63%, but however differs with the findings of Johnson-Ajinwo and Joy (2018), Haryani *et al.*2018 and Oloruntola *et al.*(2015). The higher contents reported by these authors may be attributed to the age at which the grasses were harvested from the wild. Ash content was similar to the result of Obua*et al.*(2012). The metabolizable energy were higher than those of Johnson-Ajinwo and Joy (2018), and Okaraonye and Ikewuchi (2009).

Proximate Composition (% DM) of *Calopogonium mucunoides*

The result on dry matter in this study is lower than the result reported by Oyaniran *et al.* (2018), Obua *et al.* (2012), Elisha (2012) and Asongwed-Awa *et al.* (2003) who reported 59.60, 89.84, 86.50 and 92.1% respectively. The difference in the dry matter content of the legume could be due to the processing methods adopted and period of establishment. The crude protein content obtained was in line with the result of Jusohand Nur-Hafifah (2018) and Onyeonagu and Eze (2013) who had values of 15.43 and 15.75% respectively. Crude fat was similar to the reports of Jusoh and Nur-Hafifah (2018), Obua *et al.,*(2012), and Elisha (2012) with values of 1.97, 3.18 and 1.90% respectively. Crudefibre agreed with the result of Onyeonagu and Eze (2013). The nitrogen free extract contents were similar to those of the value of Elisha (2012).

Mineral Composition of *Pennisetum purpureum*

The mineral composition of *Pennisetum purpureum* agrees with the finding of Rambau *et al.* (2016) who observed significant effect on age of harvesting among treatment on calcium and potassium content of *Pennisetum purpureum.* Iron content observed in this study is lower than reports of Johnson-Ajinwo and Joy (2018), Elisha (2017) and Rambau *et al.*(2016) who had values of 0.20, 0.11 and 0.29-0.63 mg/g in their respective studies. Similar nitrogen on tent was reported by Onyeonagu *et al.*(2012) with the mean value of 2.10 mg/g. The variations among treatments groups may be due to the age of the grass, season, harvesting and processing methods. Rambau *et al.* (2016) noted that the older at harvest, the higher the proximate composition, mineral composition and anti-nutritional factors.

Mineral Composition of *Calopogoniummucunoides*

The mineral composition of *Calopogonium mucunoides* showed significant differences in calcium, phosphorus, magnesium, iron and nitrogen except for potassium and manganese. Result on calcium content was similar to the findings of Elisha (2017) and Asongwed-Awa *et al.* (2003), but higher than the result of Ahamefule *et al.* (2006) who recorded value of 1.56 mg/g. Potassium and magnesium were lower than the reports of Elisha (2017), Onyeonagu *et al.* (2012) and Asongwed-Awa *et al.* (2003) while Phosphorus was higher than their results. Iron contents of *Calopogonium mucunoides* agrees with the result of Elisha (2017), but did not agree with report of Asongwed-Awa *et al.* (2003). Nitrogen content is in contrast with the finding of Onyeonagu *et al.*(2012) with the mean value of 3.15 mg/g. The variations among treatments groups may be due to the age of the legume, season, harvesting age and processing methods.

Anti-Nutritional Factors of *Pennisetum purpureum*

Age of harvesting after sprouting *Pennisetum purpureum* affected tannin, alkaloid, flavonoid and saponin content. Tannin content of *Pennisetum purpureum* was higher than results obtained by Elisha (2017), Obua *et al.*(2012) and Onyeonagu *et al.*(2012)who had values of 0.55, 1.07 and 0.21% in their respective studies and lower than result of Okaraonye and Ikewuchi (2009) with the mean value of 28.64%. Alkaloid level was similar to the result of Onyeonagu *et al.*(2012). Saponin content of *Pennisetum purpureum* is in accordance with the finding of Onyeonagu *et al.* (2012) but higher than the results of Obua *et al.,* (2012) and Okaraonye and Ikewuchi (2009). Low levels of anti-nutritional factors show the potentials of this plant for feeding ruminants in the humid tropics.

Anti-Nutritional Factors of *Calopogoniummucunoides*

Age at harvest after sprouting influenced tannin and alkaloid levels of *Calopogonium mucunoides* in this study, but, however did not influence concentration of flavonoid and saponin among the treatments. Tannin concentration in *Calopogonium mucunoides* was higher than results obtained by Oyaniran *et al.*(2018), Elisha (2017), Enechi and Abugu (2016), Obua *et al.*(2012) and Onyeonagu *et al.* (2012) respectively. Result recorded on alkaloid also differed from the results of Enechi and Abugu (2016) and Onyeonagu *et al.* (2012) who had mean values of 0.34 and 3.25% respectively. Saponin also differed from the values reported by these authors. Elisha (2017) reported that, early harvest of fodder is more beneficial than the late harvest.

CONCLUSION

From the results obtained in this study, age of *Pennisetum pupureum at* harvest influences the proximate composition, mineral composition and anti-nutritional factors. The age at which *Calopogonium mucunoides* was harvest had effect on the nutritional and antinutritional properties. Thus, *Pennisetum pupureum and Calopogonium mucunoides* can be harvested at 8 weeks for better nutritional quality.

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