

Mineral and proximate composition of selected forages fed to West African dwarf bucks in Obio Akpa

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Abstract

The nutritive value of leaves from six forages was carried out. The forages were *Andropogon tectorum*, *Panicum maximum*, *Aspilia africana*, *Gmelina aborea*, *Alchornea cordifolia* and *Bambusa vulgaris*, and were collected from Obio-Akpa in Akwa Ibom State. The forages were analysed for proximate composition, mineral/vitamin concentrations and anti-nutritive components. Results showed no significant ($p > 0.05$) differences in the dry matter content which ranged from 86.52 to 98.36%. *A. africana* and *G. arborea* recorded protein contents which was higher than the crude protein (CP) of other forages analysed. A range of 1.94 to 5.24% and 1.28 to 5.84% were recorded for ether extract (EE) and crude fibre (CF) values for the six forages. The values reported for minerals showed that *B. vulgaris* had the lowest value of calcium (0.45%) while *A. tectorum* was low in magnesium (Mg) and potassium (0.57 and 0.22%). Highest content of vitamin A and B₁₂ was recorded in *A. tectorum* (1.17 and 2.11 µg/100g), respectively. The values reported for anti-nutritive factors ranged from 0.98 to 2.23 for tannins, 1.94 to 3.76 for Saponins, 0.01 to 1.23 for oxalates, 0.22 to 0.71 for hydrogen cyanide (HCN) and 1.05 to 1.55 mg/g for phytates. The results showed that the forages studied have good nutrient contents and safe levels of anti-nutritional factors, thus they may be used as feed resources to enhance the production of ruminants.

Keywords: Forages, anti-nutritional factors, WAD bucks, minerals

Introduction

Ruminants depend on essential mineral elements from pastures for their health and performance. Minerals are the most variable amongst all the nutritional contents supplied by pastures. Underwood and Scuttle (1999) reported that pastures often fail to supply all the mineral elements needed by grazing animals in adequate quantity. Animals depend on forages to satisfy all of their requirements nutritionally under pasture system, but unfortunately forages do not supply all these needed minerals throughout the year. Mineral inadequacies in forages have been reported (Vegas and McDowell, 1997) which cause low production rates and reproductive failures. This is likely to affect the production rates of grazing animals (Judson and McFarlane, 1998). Livestock improvement demands the efficient use of

available forages and other feed resources and their potentials in meeting the animal needs and maintaining their health status. Phytochemicals otherwise called anti-nutritional factors can be defined as toxic substances in diets of humans and animals which negatively influence their health by disturbing normal physiological functions. The significant characteristics of anti-nutrients can be predicted by the animal's performance, behavioural pattern and adaptation to feed. D'Mello (2000) noted that the major damages of anti-nutrients include negative impact on growth and reproduction, reduced immune-competence which leads to morbidity and mortality. These chemicals can limit the digestibility of essential nutrients by impairing normal metabolism, causing various disorders, decrease palatability and reduced growth

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rate (Soetan, 2008). However, some ruminants have ability to adapt and neutralize the possible damages (Habtamu and Negussie, 2014).

Therefore, this study was designed to investigate the mineral status and proximate composition of selected forages used by grazing animals.

Materials and methods

The leaves of six indigenous forages commonly consumed by ruminant animals were used in this study. The species were *A. tectorum*, *P. maximum*, *A. africana*, *G. arborea*, *A. cordifolia* and *B. vulgaris*. All the plants were harvested from Obio-Akpa in OrukAnam Local Government Area (LGA) of AkwaIbom State, Nigeria. The area is located between latitude 5° 17'N and 5° 27'N between longitude 7° 27'E and 7° 58'E with an annual rainfall ranging from 3500mm – 5000mm and average monthly temperature of 25°C. The study location lies between latitude 4° 28'N and 5° 3'N and between longitude 7° 27'E and 8° 20'E with a relative humidity between 60 – 90% (SLUS-AK,1989). The forage samples were analysed for dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and ash according to the procedures of AOAC (2002). The mineral composition (calcium and magnesium) of the forages were analysed using atomic absorption spectrophotometry. The hydrogen cyanide (HCN) was determined by the Knowels and Watkins distillation method.), phytates was estimated as phytic acid by Maga method (1982). Tannin and Saponins were determined according to (Polshettiwaret *al.*, 2007). Potassium and sodium was determined by flame photometry (Junsomboon and Jakmunce, 2011).

The means and standard error of means were calculated. Means were separated using Duncan's Multiple Range Test

(Duncan, 1955).

Results and discussion

The proximate composition of the leaves from *Andropogon tectorum*, *Panicum maximum*, *Aspilia africana*, *Gmelina arborea*, *Alchornea cordifolia* and *Bambusa vulgaris* is presented in Table 1. Values obtained from proximate analysis showed significant ($p < 0.05$) differences among the treatment groups. However, these values did not show any consistent trend in the study. The crude protein of *Gmelina arborea* (GA) and *Aspilia africana* (AA) were higher than those of the other forages. The crude protein of the forages ranged from 2.75 to 13.24% which will provide ammonia required for rumen microorganisms to support optimum microbial activity. The use of different types of forages in small quantities can supplement poor quality pastures and crop residues (Norton, 2003). Le Houerou (1980) had a mean of 12.5% in West African browse specie with 17% for leguminous species. However, the variations in the different species can be explained by inherent characteristics of each species from soil and fix atmosphere nitrogen as in legumes (Rittner and Reed, 1992). Other factors causing variation in the chemical composition of forages include soil type and location, age of the plant used for consumption by the animals.

Highest value (5.84%) of crude fibre was recorded in *Bambusa vulgaris* while the other species had moderate contents. This is in line with the reports of Njidda et al (2010) that voluntary dry matter intake and digestibility are dependent on the fibre content of the forage. Fibre is known to promote softer stools with increased frequency and regularity of elimination. (Amata and Lebari, 2011). Among all the forages used in the experiment, *B. vulgaris*

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recorded the highest percentage of crude fibre (41.85%) while the least (12.80%) was recorded in *A. africana*. This may have been due to the dry season in which the experiment was conducted. Fibre is important in the diet of farm animals, it acts as diluents. Its absence in diets leads to incidence of a wide range of diseases which include colon biventricular, obesity and diabetis mellitus (Oke *et al.* 2007). Fibre is also necessary for proper bowel movement (Odoemelam and Ahamefule, 2006). Ash

content of the forages followed the same trend as crude fibre.

The ash content which is an indication of the presence of minerals is within the ranges reported by Amata and Lebari (2011), and Kubmarawa *et al.* (2008). The highest values (16.38%) in *Andropogon tectorum* may also have been due to the high concentration of minerals. The proximate values so obtained, were contrary to those reported by Ikhimoya *et al.* (2007), Obua *et al.* (2012) and Philip and Owen (2014).

Table 1: Proximate composition of selected fodder crops used for the experiment

Parameter	<i>Andropogon tectorum</i>	<i>Panicum Maximum</i>	<i>Aspilia Africana</i>	<i>Gmelina Arborea</i>	<i>Alchornea Cordifolia</i>	<i>Bambusa Vulgaris</i>	SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	
DM (%)	86.52	98.23	98.36	96.75	97.54	96.86	10.17
Crude protein (%)	2.75 ^c	2.42 ^c	12.51 ^a	13.24 ^a	7.95 ^b	8.29 ^b	2.80
Ether extract (%)	5.24 ^a	2.86 ^b	1.94 ^c	2.12 ^c	3.45 ^b	2.02 ^c	0.52
Crude Fibre (%)	3.93 ^b	2.17 ^c	1.28 ^c	1.46 ^c	1.75 ^c	5.84 ^a	4.86
Ash Content (%)	16.38 ^a	2.89 ^b	1.79 ^c	2.32 ^b	2.25 ^b	2.35 ^b	0.48
Energy (Kcal/kg)	1735.20	802.60	1826.20	1778.60	1116.10	1045.00	182.47

^{a, b, c} Means on the same row with different superscripts are significantly ($p < 0.05$) different.

SEM = Standard error of the means

Results of the phytochemical analysis of six selected forages are shown in Table 2. There were no significant ($p > 0.05$) differences observed among the different parameters studied except for saponin. The tannin levels reported in this study, though not significantly ($p > 0.05$) different ranged from 0.98 mg/g to 2.23 mg/g DM which is lower than 60 to 100g DM considered to be detrimental to animals (Barry and Duncan, 1984). Similarly, Waghorn (2008) further reported that dietary condensed tannins of 2 to 3% have been shown to have beneficial effects since they reduce protein degradation in the rumen by the formation of protein tannin complex. The saponin content of the forages ranged from 1.94 mg/g DM in *Adropogon tectorum* to 3.76 mg/g DM in *Gmelina arborea*. Feedstuff containing saponin had been shown to be

defaunating agents (Teferedegne, 2000) and capable of reducing methane production (Babayemi *et al.*, 1999). Saponin is also found to have effect on reduction of blood and liver cholesterol, depression of growth rate, bloat in ruminant, absorption (Cheeke and Shull, 1985). The oxalate contents of the forages investigated were equally low. The oxalate ranged from 0.17 – 1.45 g/kg which is likely not harmful to the animals. Akinsoyinu and Onwuka (1988) noted that oxalate has been shown to deplete calcium reserves. Reasonable amounts of calcium and phosphorous intakes will be lost via faeces and urine to the soil. Calcium oxalate adversely affects the absorption and utilization of calcium in the animal's body (Smith *et al.*, 2013).

The hydrogen cyanide contents ranged

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from 0.22 – 0.71mg/g DM. this range is negligible to pose problems to the animals. This level obtained in the study is in agreement with the observations of Kumar, (2003) that the quantity of HCN produced by most forages is too low to pose major animal health challenges. The lethal dose of HCN for cattle and sheep is 2.0 to 4.0 mg per kg body weight.

The phytin levels were in the range of 0.97mg/g DM to 1.55mg/g DM as shown in Table 2. The levels are low and may not have adverse effects on ruminants. Phytates are known to increase requirements for minerals, especially phosphorus which forms insoluble complexes with phytic acid because of the special affinity for this metal ion and zinc (Tulean *et al.*, 2008).

The tannin content of the forages used in the study were at tolerable levels and ranged from 0.98% in *Andropogon tectorum* to 2.27% in *Alchornea cordifolia*. In ruminants, condensed tannins have been shown to be beneficial. The protein-tannin complex in the rumen dissociates post-ruminally as a sort of by-pass protein and the effect of its presence may therefore be negligible. The saponin content of the forages ranged from 1.94% in *Andropogon tectorum* to 3.76% in *Gmelina arborea*. Saponins are characterized by a bitter taste and foaming properties. In non-ruminants, retardation of growth rate due primarily to reduction in feed intake is probably the major cause.

Table 2: Phytochemical analysis of selected fodder crops used for the experiment

Parameter	<i>Andropogon tectorum</i>	<i>Panicum maximum</i>	<i>Aspilia africana</i>	<i>Gmelina arborea</i>	<i>Alchornea cordifolia</i>	<i>Bambusa vulgaris</i>	SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	
Tannins	0.98	1.12	1.34	1.44	1.27	2.23	0.18
Saponins	1.94 ^c	2.18 ^b	3.33 ^a	3.76 ^a	1.95 ^c	2.71 ^b	0.31
Oxalates	0.98	1.01	0.74	1.45	0.17	1.23	0.18
Hydrogen cyanide	0.43	0.71	0.43	0.22	0.47	0.23	0.07
Phytates	1.05	1.32	1.25	1.55	1.11	0.97	0.09

a, b, c Means on the same row with different superscript are significantly (p<0.05) different.
SEM = Standard error of means

However, in ruminants, saponins cause bloat but because saponins undergo bacterial degradation in the rumen, growth may not be retarded in ruminant animals (Kumar, 1991). Although the values of the anti-nutritional factors were not significant, their values however fell below the toxic levels recommended for ruminant animals (Kumar, 1991; Philip *et al.*, 2014; Njidda, 2010). Mineral and vitamin composition of selected forage plants used for the study is as summarized in Table 3. The values obtained among the treatment means reveals that there were not significantly (p>0.05) different. Values for minerals though not significant, fell within the

normal range recommended for ruminants except magnesium (Mg), sodium (Na), iron (Fe), copper (Cu) and zinc (Zn). Mineral deficiency could result in depression of animal performance. Sub clinical mineral deficiencies are widespread and responsible for yet unestimated, but probably great economic losses in livestock production. However, mineral status of grazing animals in most African countries has received very little attention. The values recorded for vitamins indicate that there were also no significant (p>0.05) differences among the treatments but were in line with earlier reports (Akinsoyinu, 1986).

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Table 3: Mineral and vitamin compositions of selected fodder crops used in the experiment

Minerals	<i>Andropogon tectorum</i>	<i>Panicum maximum</i>	<i>Aspilia Africana</i>	<i>Gmelina arborea</i>	<i>Alchornea cordifolia</i>	<i>Bambusa vulgaris</i>	SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	
Fe (ppm)	1.95	2.44	1.55	1.22	2.56	1.97	0.10
Zn (ppm)	0.48	2.75	2.17	0.54	0.75	1.42	0.12
Co (ppm)	1.09	1.11	0.49	0.42	0.34	0.29	0.05
Cu (ppm)	0.81	1.07	0.65	0.17	0.81	0.25	0.11
Cr (ppm)	0.35	3.14	2.34	0.12	1.29	0.91	0.08
Na (mg/kg)	0.93	0.49	0.84	1.21	1.19	0.97	0.11
Mg (mg/kg)	0.57	1.29	0.84	0.61	1.15	0.75	0.05
K (mg/kg)	0.35	0.92	0.75	0.22	0.65	0.35	0.04
Ca(mg/kg)	0.46	0.74	0.75	0.54	1.32	0.45	0.03
Vitamins							
Vitamin C (mg/100g)	1.53	2.22	1.03	1.62	0.55	0.85	0.09
Vitamin A (µg/100g)	1.17	0.62	1.23	0.65	0.79	0.87	0.17
Vitamin E (µg/100g)	0.41	0.09	0.32	0.57	0.53	0.44	0.87
Vitamin B1 (mg/100g)	0.71	0.44	1.43	0.55	1.03	0.99	0.04
Vitamin B6 (mg/100g)	1.05	0.76	0.75	0.92	1.16	0.89	0.06
Vitamin B12 (µg/100g)	1.45	0.24	0.90	2.11	1.76	0.43	0.04

Means of treatment in a row are not significantly (p<0.05) different

Conclusion

The study indicated that among the forages used for this study, *Andropogon tectorum* had low mineral content but could be combined with other forages for use by grazing animals for optimum production.

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