



Nutritive Qualities and Minerals Composition of *Megathyrsus maximus* Pellets as Influenced by Proportions of Two Tree Seeds

¹Emiola, C.B.; ²Ojo, V.O.A.; ²Arigbede, O.M.; ²Adelusi, O.O.; ¹Oloko, A.B.; ¹Adams, T.O. and ¹Oladebo, O.

¹Department of Animal Production, Oyo State College of Agriculture and Technology, Igboora, Oyo State;

²Federal University of Agriculture, Abeokuta, Ogun State.

Corresponding author: emiolabukunmi@gmail.com; Tel: +2348075542266

Abstract

The nutrient composition of *Megathyrsus maximus* is reduced during dry season, this necessitates the need to enhance the nutritional quality of the grass in order to meet up with nutrient requirements of ruminant animal. This study investigated the nutritive value of *Megathyrsus maximus* pellets as influenced by proportions of browse tree seeds (*Albizia saman* and *Enterolobium cyclocarpum*). The experiment was arranged in a completely randomized design, consisting of seven pelleted grass/ enriched with browse tree seeds. The group A had 100% of *Megathyrsus maximus* group B had 50% *Megathyrsus maximus*, 50% *Albizia saman*, group C had 60% *Megathyrsus maximus*, 40% *Albizia saman*, group D had 40% *Megathyrsus maximus*, 60% *Albizia saman*, group E had 50% *Megathyrsus maximus*, 50% *Enterolobium cyclocarpum*, group F had 60% *Megathyrsus maximus*, 40% *Enterolobium cyclocarpum*, group G had 40% *Megathyrsus maximus*, 60% *Enterolobium cyclocarpum*. The minerals compositions and proximate analysis were determined. Data collected were analysed using SAS (2002). Result reveal that proximate, fiber and minerals composition of the enriched grass pellets were significantly influenced ($p < 0.05$) by proportions of browse seed. Highest crude protein (20.12%), Ash (9.85%) was recorded for 40% *M. maximus* pellets enriched with 60% *A. saman*. Neutral detergent fibre (NDF), Acid Detergent Fibre (ADF), hemi-cellulose and cellulose contents were higher ($p < 0.05$) in pellets the unenriched *M. maximus* grass to grass containing browse tree seed. The highest Ca/P value were recorded for 40% *M. maximus* pellets enriched with 60% *A. saman*. The study concluded that grass pellet enriched with browse seeds can improve the quality of animal feed during the dry season.

Keywords: Nutritive value, Pellets, *Megathyrsus maximus*, *Albizia saman*, *Enterolobium cyclocarpum*.

Introduction

Panicum maximum (now call *Megathyrsus maximus*) is a dormant and widely distributed grass in the tropical and subtropical areas of the world (Ajayi and Babayemi, 2008). It is a good forage with high quality of nutrient during rainy season (Aganga and Tshwenyane, 2004) and outstanding characteristics which include acceptability, high capacity to produce leaves and tillers, rapid in regrowth after cutting because of possession of high number of basal buds (Olanite *et al.* 2014), high production potential, suitability to grazing and cutting (Cook *et al.*, 2020). However, during the dry season, the grass rapidly witness decline in its outstanding qualities such as acceptability, digestibility, crude protein and high NDF contents, which could hinder its utilization in livestock production systems (Teka *et al.*, 2005). The inclusion of multipurpose legumes is one of the ways of improving the utilization of low quality roughages. (Babayemi *et al.*, 2009). Tree

legumes seeds and pods have been reported to have high crude protein that can supplement low quality or deficiencies of tropical grass during the dry season (Olorunisomo and Fayomi, 2012). According to Arigbede *et al.* (2008) indigenous multipurpose tree species, especially *Enterolobium cyclocarpum* and *Albizia saman* are evergreen and produce seeds that have a very high protein content. According to Babayemi (2009), all parts of *E. cyclocarpum* are relatively high in protein and crude fibre with the crude protein contents ranging from 10.04% in the pod to 21.70% in the seed while the crude fibre ranges from 39.80% to 63.50%. *Albizia saman* (rain tree) is a fast growing tropical tree. The leaves of *A. saman* are fairly rich in protein (Staples and Elevitch, 2006). *Albizia saman* seeds reportedly contain 86.25% DM, 23-25% CP, 2% Ash, 8.0% CF, 25.95% NDF and 8.85% ADL. (Sackey, 2010). Study by Sakita *et al.* (2020) reported that *M. maximus* integrated with *Stylosanthes guianensis* and



Urochloa humidicola improved CP, decreased NDF and ADF thus increase productivity in livestock systems. Since problems associated with livestock productivity is usually on feed supply, it is also pertinent that conservation strategies that best fit into the realities of the Nigerian ruminant livestock production systems must be sought for, as the success of conservation strategies tends to differ between regions and production goals, implying that – no one good for all conservation strategy exists. For instance, while conserving forages as hay could serve as a plausible approach, the hay curing process is weather dependent, which sometimes leads to wasted grass resources during the drying process (Borreani *et al.*, 2007). This is asides the dry matter and nutritive value losses often associated with hay production (Arinze *et al.*, 2003). Silage, on the other hand, maybe too sophisticated as the fermentation process must be carefully mediated to ensure that high levels of proteolysis by plant or bacterial proteases, does not occur during the ensiling process (Scherer *et al.*, 2019). In contrast to conserving forages as hay or silage, studies in the literature (O'Doherty *et al.*, 2000; Abdollahi *et al.*, 2013; Oyaniran *et al.*, 2018; Du *et al.*, 2019) have reported improved feed quality through the use of pellet technology. While the short term cost of the equipment purchase is the major limitation towards forages pellet production, its long term economic benefit, as well as improved forage quality through reduced forage fibre constituents and increased digestibility (Oyaniran *et al.*, 2018), have been reported. Also, processing forages into pellets has been reported as one of the practical ways towards improving feed intake and utilization (Beigh *et al.*, 2017). Despite benefits of browse plant parts, there is little or no research on how *A. saman* and *E. cyclocarpum* seeds could influence the nutritional value of *M. maximus*. A study revealed that *M. maximus* integrated with *Stylosanthes guianensis* and *Urochloa humidicola* has improved CP, and decreased NDF, and ADF thus increase productivity in livestock systems (Sakita *et al.*, 2020). Thus the need to enhance the nutritional quality of the grass so as to meet up with nutrient requirements of animals with addition of browse plant is topical now. Therefore, the research on the nutritive of *M. maximus* pellets as influenced

by proportion of browse tree seeds and storage durations was investigated.

Materials and Methods

The field experiment and the chemical analysis were carried out at the Pasture and Range Management unit of the Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Nigeria which lies within latitude 7°10'N and longitude 3°2'E. The location in the derived savanna zone of Nigeria having humid climate with mean annual rainfall of about 1037mm and temperature of about 34.7°C (Google Earth, 2020). The local variety of *Megathyrus maximus* was sourced from already established plots in 2018 on a land area measuring 589m² (31m x 19m) and split into 3m x 4m plots. Grasses on the plots were cutback to 10cm above ground level. After cutback, the grasses were fertilized at 150kg/ha with poultry manure and were allowed for 6 weeks period of re-growth during wet season before harvesting, according to Jimoh *et al.* (2015). After harvesting, the grasses were chopped, sun dried for three days on the farm before used to make pellets. The cluster of ripened pods from two (2) leguminous trees: *A. saman* and *E. cyclocarpum* were harvested by handpicking from the multipurpose trees arboretum located within the premises of FUNAAB, planted in 2004. The seeds were manually separated from the pod, cleaned, and sun dried for five days using a black trampoline sheet, toasted in the oven for about 15 minutes at 170°C until the testa starts breaking. Then they were dried in a thermostat regulated oven at 65°C for 24 hours until constant weight was attained, the seeds were milled and pelleted. The milled grasses were mixed with the milled seeds of *E. cyclocarpum* and *A. saman* separately at different proportions. The composite samples were homogenised using a mixer. Cassava flour was used as a binder (proportion of 1kg of cassava flour to 100kg of the milled sample), and water was added to moisten, the emerging composite mixture. The composite mixture was pelletized using a pelletizing machine that was fitted with 6mm die size. The pelletizer produced pellets with an average size of 40mm. The pellets were placed based on the treatment structure of *E. cyclocarpum* and *A. saman*. The resulting moist warm pellets were spread out on a trampoline and air-dried for 2 days. Following drying, the



pellets were stored in transparent polythene bags and kept in cool dry containers under room temperature. The experiment was laid out in a completely randomized design, consisting of the grass and browse plants seeds mixed at different proportions. These constituted seven (7) treatments replicated three times. The different proportions of the grass and browse tree seeds were combined as follows:

Megathyrus maximus 100 %: Seed 0 % – T1
M. maximus 60 %: *A. saman* seeds 40 % – T2
M. maximus 50 %: *A. saman* seeds 50 % – T3
M. maximus 40 %: *A. saman* seeds 60 % – T4
M. maximus 60 %: *E. cyclocarpum* seeds 40 % – T5
M. maximus 50 %: *E. cyclocarpum* seeds 50 % – T6
M. maximus 40 %: *E. cyclocarpum* seeds 60 % – T7

Pellet samples weighing about 300g from each treatments were dried at 65°C until a constant weight was attained. Following this, the samples were hammer milled, then allowed to pass through a 1 mm sieve screen, after which it was subjected to chemical analysis. The Contents of dry matter, crude protein, ether extract and ash were determined according to A.O.A.C. (2000). Non-fibre carbohydrate (g/kgDM) were calculated as $NFC = 1000 - CP - Ash - EE - NDF$. Neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) were analysed according to Van Soest *et al.* (1991) while cellulose was taken as the difference between ADF and ADL and hemicellulose were calculated as the difference between NDF and ADF. For minerals, the samples were dried in a forced draught oven for 24 hours, followed by wet ash using nitric acid and hydrochloric acid in ratio 3:1. After wet digesting on the samples in nitric and hydrochloric acids, the contents of Calcium, Potassium and Magnesium were determined with atomic absorption spectrophotometry following procedures described by Fritz and Schenk, (1979), while Phosphorus (P) were determined using a flame photometer. The units of the measured elements were in g/kg. All data obtained were analyzed using one-way analysis of variance with SAS (2002). Significant means were separated using Duncan's multiple range test (Duncan, 1955). A significance level of 5% was used to express statistical difference between means.

The model for the experiment is expressed as:

$$Y_{ij} = \mu + T_i + \sum_{ij}$$

Where:

Y_{ij} = Observed value of the dependent variable

μ = Population mean

T_i = Effect due to the pelleted grass/browse seeds proportions ($i = 1, 2, \dots, 7$)

$\sum_{ij}$ = Random residual error

Results

The value of Proximate and fibre composition of fresh pellets mixed at different proportions were presented in Table 1 and 2 which indicated that all values were significantly different ($p < 0.05$) in dry matter content. The highest dry matter (DM) value (95.02%) was recorded for proportion of *Megathyrus maximus* 50%: *Albizia saman* seed 50%, followed by proportion of *M. maximus* 60%: *A. saman* 40% while the lowest value (94.02%) was recorded in the proportion of 60% *Entrolobium cyclocarpum*. There were significant differences ($p < 0.05$) in crude protein content of browse seeds proportions. The highest crude protein value (20.12%) was recorded in the proportion of 60% *A. saman*, followed by 50% inclusion of *A. saman*, while the lowest value (7.98%) was recorded in sole *M. maximus*. The crude protein content was increasing with increase in browse tree seeds. There were significant differences ($p < 0.05$) in ash content across the treatment, the highest value (9.85%) was recorded in inclusion of 60% *A. saman*, while the lowest value (6.80%) was recorded for pure grass.

The Ether extract ranged from 6.80% in pure grass to 10.56% in proportion of 60% *E. cyclocarpum*. The content of NFC, NDF and ADF declined in value as the proportion of the seed increased. The ADL values ranged from 3.80% - 4.72%. Highest ($p < 0.05$) was recorded for *M. maximus* 40%: *A. saman* 60% while the lowest was recorded in *M. maximus* 60%: *E. cyclocarpum* 40% proportion. The cellulose content declined with increased in the proportion of browse tree seeds. Highest value (31.73%) was recorded for sole *M. maximus* while the least value (21.79%) was recorded in proportion of 60% *A. saman*.

The values of macro (Phosphorus, Potassium, Sodium, Calcium and Magnesium) and micro mineral (Iron, Manganese, Zinc, and Copper) composition of proportions or grass/ browse seeds were presented in table 2 and 3 respectively. There were significant ($p < 0.05$)



differences in the mineral contents of fresh pellets. It was observed that the highest value for Calcium, Phosphorus and Sodium content was recorded for *M. maximus* 40%: *A. saman* 60%. The Ca and Na content was increasing with increase in the proportions of browse seed while Potassium content declined with increase in the browse seed. Iron content was relatively higher in the proportions of 60% seed (*A. saman* 60% and *ME. cyclocarpum* 60%) with value of (48.58mg/kg DM). The micro mineral contents were relatively lower in pure grass. (*M. maximus*). The Zn content increased with increase in the content of browse seed. The highest Copper value (12.87mg/kg DM) was recorded for *M. maximus* 60%: *E. cyclocarpum* 40%. While least value (9.17mg/kgDM) was recorded for sole *M. maximus*.

Discussion

The mixture of grasses and legumes enhances nutritional qualities of feed given to animals in any given environment thus enhances nutrients requirements of animals and improving the utilization of low quality roughages. In this study, the higher crude protein recorded for mixture of grasses with legume seeds pellets suggested that, the mixture of grasses with legumes seed can improve the nutritional status of pellets made from forages, thus maintain and sustain the nutritional needs of ruminant during the dry season. The finding agreed with the reports of Feyissa *et al.* (2014) that reported increase in inclusion of protein content from legumes brought a product of higher protein contents. The author opined that probably because tropical grasses are composed chiefly of soluble carbohydrate with low protein. The CP content in proportion with browse tree seeds in this study ranges from (13.28% - 20.12%) above 10.60 -12.24% reported by Ojo *et al.* (2018) for herbaceous legume pellets, the differences could be due to higher CP contents in the browse seeds than herbaceous legume. Increase in CP contents of the grass and browse tree seeds mixtures showed that seeds have an enhancing ability for the grass. The beneficial effect of mixing legume seeds with the grasses was also observed in the dry matter content of the pellets. In this study, dry matter content was higher than 89.92 % reported by Oyaniran *et al.* (2018) in nutritive quality of forage leave legume pellet. This could be as a result of

browse seeds used in this study compared with herbaceous leaves that the aforementioned authors used. Ash content in fresh pellet falls within the range (6.38-8.75%) reported by Ojo *et al.* (2018) on the quality of herbaceous leaves pellets reported. The proportion of ash content present is a reflection of mineral contents present in the feed material (Verma, 2006). This suggested that the pellets could be a better source of essential valuable and useful mineral needed by ruminants for good body development. Content of dietary fibre levels in this study implies that the intake and digestibility of the pellets will not be impaired since the range of NDF contents in this study were lower than 65% suggested as the critical limit above which efficiency of utilization of tropical forages by ruminant would be impaired except that of *Megathrus maximus* at 60 and 90 days of storage duration. Higher NDF values suggest a possible repression in the digestibility and intake since excessive fibre has been reported to affect intake levels (Unigwe *et al.*, 2016). NDF content is reducing as *M.egathyrus maximus* increased as this might be due to lower proportion of the browse seeds. Minerals are considered to be one of essential feed ingredients responsible for maintenance and reproductive of animals and proper functioning of microorganism in the rumen of the animals for digestion of feeds (NRC 2001). The values recorded for Ca content in this study were above the critical level of 3g/kg DM recommended for ruminant needs in warm wet climate (McDowell *et al.*, 1995). Concentration of Ca recorded in this study was higher than the range of 1.2-2.6g/kg suggested by Reuter and Robinson (1997) for maintenance of growing and lactating sheep and was also within the range of 2-6g/kg DM reported by Khan *et al.* (2006) for lactating cattle and sheep. Dietary phosphorus levels recorded in this study was higher than the level of 1.7 g/kgDM considered by Underwood (1981) to be marginal for grazing animals, implying that there is no need for phosphorus supplementation. Higher level of K than the 8g/kg recommended for grazing animals (Underwood, 1981) was recorded in this study, confirming the report of Minson, (1990) that K concentration in grasses is generally high. However, it has been suggested that high producing ruminants, may require K levels above 10g/kg, under stress particularly heat



stress (Khan *et al.*, (2005). The mineral contents in this study is increasing as the browse seeds increasing in the proportions. The improvement in the mineral contents of mixed seeds pellets with grass at different proportions might be as a result of synergy both forages exhibited, in which browse seeds improved the quality of the grass.

Conclusion

It could be concluded that pellets made of 40% *Megathyrus maximus* and 60% *Albizia saman* had the highest CP content, calcium, phosphorus and lower fiber content than 100% *Megathrus maximus*

Table 1: Effects of proportions of grass/ browse seed mixture on proximate

Treatment	DM	Ash	EE	CP
	% DM			
<i>Megathyrus maximus</i> 100%	94.77 ^b	6.11 ^f	6.80 ^{fg}	7.98 ^g
<i>M. maximus</i> 60: <i>A saman</i> 40	94.78 ^b	8.48 ^c	6.96 ^{ef}	15.51 ^{bc}
<i>M. maximus</i> 50: <i>A saman</i> 50	95.02 ^a	9.31 ^b	7.34 ^e	16.57 ^b
<i>M. maximus</i> 40: <i>A saman</i> 60	94.53 ^c	9.85 ^a	9.28 ^b	20.12 ^a
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	94.71 ^b	6.98 ^e	7.87 ^{cd}	13.28 ^{ef}
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	94.32 ^d	7.35 ^d	8.14 ^c	14.31 ^{de}
<i>M. maximus</i> 40: <i>E. cyclocarpum</i> 60	94.02 ^e	7.50 ^d	10.56 ^a	14.67 ^{cd}
SEM	0.12	0.47	0.45	1.28

abcdefg Means in the same row with different superscripts differ significantly (p< 0.05)

DM=Dry matter, CP= crude protein, EE= Ether extract, SEM = Standard error of means

Table 2: Effects of proportions of grass/ browse seed mixture on fibre

Treatment	NFC	NDF	ADF	ADL	Hemicellulose	Cellulose
	% DM					
<i>Megathyrus maximus</i> 100%	20.13 ^a	62.68 ^a	36.29 ^a	4.56 ^{ab}	26.39 ^a	31.73 ^a
<i>M. maximus</i> 60: <i>A saman</i> 40	17.21 ^b	51.98 ^{de}	28.93 ^d	4.25 ^{de}	22.90 ^{de}	24.70 ^d
<i>M. maximus</i> 50: <i>A saman</i> 50	14.80 ^e	51.83 ^{ef}	28.91 ^{de}	4.21 ^{ef}	23.07 ^{cd}	24.68 ^{de}
<i>M. maximus</i> 40: <i>A saman</i> 60	14.13 ^{ef}	46.62 ^g	26.50 ^g	4.72 ^a	20.11 ^g	21.79 ^g
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	16.32 ^c	56.66 ^b	32.68 ^b	3.08 ^g	23.98 ^b	28.88 ^b
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	15.40 ^d	54.90 ^c	32.36 ^{bc}	4.45 ^{bc}	22.54 ^{ef}	27.91 ^{bc}
<i>M. maximus</i> 40: <i>E. cyclocarpum</i> 60	13.81 ^{fg}	52.24 ^d	28.67 ^{ef}	4.27 ^d	23.57 ^{bc}	24.40 ^{ef}
SEM	0.77	1.45	1.16	0.10	0.64	1.18

abcdefg Means in the same row with different superscripts differ significantly (p< 0.05)

DM= Dry matter, Neutral detergent fibre, ADF = Acid detergent fibre, ADL = Acid detergent fibre, ADL = Acid detergent lignin, SEM = Standard error of means



Table 3: Effect of propositions of grass/browse seeds mixture on macro mineral Composition of fresh pellets

Treatment	Ca g/kg DM	P	K	Mg	Na
<i>Megathyrus maximus</i> 100%	3.18 ^g	2.54 ^g	22.82 ^a	3.45 ^g	3.02 ^g
<i>M. maximus</i> 60: <i>A saman</i> 40	6.31 ^{ef}	4.69 ^{bc}	18.38 ^{bc}	5.27 ^a	3.89 ^e
<i>M. maximus</i> 50: <i>A saman</i> 50	6.86 ^{cd}	4.64 ^{cd}	16.23 ^d	4.40 ^{de}	4.69 ^c
<i>M. maximus</i> 40: <i>A saman</i> 60	9.69 ^a	5.41 ^a	13.69 ^{ef}	4.68 ^c	5.83 ^a
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	6.62 ^{de}	3.86 ^f	19.59 ^b	5.11 ^{ab}	3.67 ^{ef}
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	7.29 ^b	4.48 ^{de}	14.06 ^e	4.18 ^f	4.57 ^{cd}
<i>M. maximus</i> 40: <i>E. cyclocarpum</i> 60	7.99 ^b	4.89 ^b	11.61 ^g	4.53 ^{cd}	5.25 ^b
SEM	0.64	0.32	1.46	0.21	0.35

abcdefg Means in the same row with different superscripts differ significantly (p< 0.05)

Ca=Calcium, P=Phosphorus, K=potassium, Mg=Magnesium, Na= sodium. SEM=Standard errors of mean

Table 4: Effect of propositions of grass/browse seeds mixture on micro mineral Composition of fresh pellets

Treatment	Zn m g/ kg	Mn	Cu	Fe
<i>Megathyrus maximus</i> 100%	19.23 ^g	39.68 ^g	9.17 ^g	27.97 ^{ef}
<i>M. maximus</i> 60: <i>A saman</i> 40	30.34 ^{cd}	50.05 ^{bc}	10.64 ^c	36.93 ^b
<i>M. maximus</i> 50: <i>A saman</i> 50	31.47 ^{bc}	48.67 ^{de}	10.99 ^b	31.27 ^{cd}
<i>M. maximus</i> 40: <i>A saman</i> 60	37.72 ^a	53.19 ^a	10.62 ^{cd}	48.58 ^a
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	28.31 ^{ef}	45.06 ^f	12.87 ^a	29.57 ^{de}
<i>M. maximus</i> 60: <i>E. cyclocarpum</i> 40	29.65 ^{de}	49.90 ^{cd}	10.44 ^{de}	33.17 ^{bc}
<i>M. maximus</i> 40: <i>E. cyclocarpum</i> 60	31.99 ^b	51.46 ^b	10.19 ^{ef}	48.58 ^a
SEM	1.44	1.49	0.34	4.03

abcdefg Means in the same row with different superscripts differ significantly (p< 0.05)

Cu=Copper, Fe=iron and SEM=Standard errors of mean.

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