PHYTOCHEMICAL AND MINERAL COMPOSITION OF AFRICAN BLACK PLUM (*VITEX DONIANA*) FEED BLOCK

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ABSTRACT
Mineral deficiencies can have negative effects on animal health whereas anti-nutritional composition can limit feed utilization by animals. Thus, a study was conducted to assess the mineral and phytochemical composition of African black plum feed blocks. Drying, crushing and milling of African black plum leaves and fruits were carried out separately and used to formulate feed blocks. The formulations consisted of F1 [0% African black plum (ABP)], F2 (ABP leaf meal) and F3 (ABP fruit meal) feed blocks. Ingredients used for the formulation were thoroughly mixed in a 200L drum and the mixture placed in wooden moulds lined with polythene sheets and pressed manually. The mixtures in moulds were left for 24 hours prior to removal and drying in well ventilated shade for two weeks. The tannin, oxalate, phytate and saponin contents as well as the mineral composition (Ca, Mg, K, P, Na, Zn and Mn) of the feed blocks were determined. The phytochemical composition of the feed blocks did not differ ($p<0.05$) across the treatments and were 0.02%, 0.12%, 0.21-0.23% and 0.13-0.15 for tannin, oxalate, phytate and saponin respectively. The mineral contents of the feed blocks differed significantly ($p<0.05$) across the treatments, with higher values (2.41% Ca, 0.89% Mg, 1.62% K, 3.28% P, 0.75% Na, 50.55% Zn and 113.25% Mn) of all the minerals (except iron) recorded in African black plum fruit meal (F3) feed block. Conclusively, the feed blocks produced contained sufficient quantities of minerals and the composition of the phytochemicals in the feed blocks was low. The use of African black plum feed as a strategy to augment mineral deficiencies in ruminant livestock was recommended.
Keywords: Feed block, Mineral composition, Anti-nutritional factors, African black plum, *Vitex doniana*

INTRODUCTION

A suitable and cheap method of ensuring a range of nutrients is available to animals is through the use of feed blocks, which is a blend of energy, protein and minerals that can act as a vital feed supplement. Feed blocks formulated with non-conventional feed resources are as effective as those prepared from conventional supplements (FAO, 2011). Minerals are significant elements that play key roles in various functions in animals and their deficiencies can have negative effects on animal health, immune system and fertility (Suttle, 2010; Godara *et al*., 2015). Tropical browse trees contain varying quantities of anti-nutritional components that limit their utilization by animals (Njidda and Ngoshe, 2008). Multipurpose trees are among the cheapest sources of feed for ruminants especially where animal production is constrained by limited protein/energy deficiencies (Okukpe and Adeloye, 2011), one of such trees is African black plum (*Vitex doniana*). It is a perennial shrub widely distributed in tropical West Africa (Amah and Okogeri, 2019), the fruit is green when mature and changes to dark brown when fully ripe and are sweet and edible (Aiwonegbe *et al.,* 2018). The fruits are good sources of phytochemicals and nutritional compounds (Amah and Okogeri, 2019). Despite its status as a multi-use plant, there is little or no information on the mineral and phytochemical composition of feed blocks produced from African black plum leaf and fruit meal.

MATERIALS AND METHODS

Experimental Location

The experiment was conducted at the Livestock Teaching and Research Farm, Federal University Dutse, Jigawa State. Dutse lies on latitude $11^{0}46'$N and longitude $9^{0}20'$E with an elevation of 435m above sea level (Ahmad *et al.,* 2015). Rainy season lasts from May to September with an average rainfall of between 600 to 1000 mm whereas high temperatures are recorded between the months of April and September (JARDA, 2012).

Collection and Preparation of Experimental Materials

Fresh leaves of African black plum (ABP) were collected from trees within and around Faculty of Agriculture Farm, Federal University Dutse and shade dried. The fruits were purchased from Danbaji village in Karaye Local Government of Kano state, spread on tarpaulin under shade until completely dried. The dried leaves and fruits were crushed, milled and stored in jute sacks prior to usage.

Formulation of feed block

Feed blocks were produced following the procedure of Yami (2007). Three formulations (F_1, F_2 and F_3) were formulated using locally available materials with the different parts of African black plum included in formulations F_2 (leaf meal) and F_3 (fruit meal) while F_1 had none and served as the control (Table 1). Manual mixing of the ingredients was applied in which approximately 10kg of ingredients was mixed per batch. Molasses was first poured into a 200L drum followed by urea and mixed thoroughly for about 20 minutes; other ingredients were added in order as listed in Table 1 and mixed thoroughly after each addition to get a homogenous mixture. Cement, salt and water were mixed together for form a paste prior to its addition to the already mixed ingredients. The mixture obtained was poured into wooden moulds (Garcia and Restrepo, 1995) lined with polythene sheets and allowed to stay for 24 hours prior to removal from the moulds.

Table 1: Percentage ingredient composition of nutrient block licks

	Multi-Nutrient Blocks		
Ingredients (%)	F_1	F_2	F_3
Molasses	50.00	10.00	10.00
Urea	10.00	8.00	8.00
Wheat bran	20.00	27.00	27.00
Cotton seed cake	-	15.00	15.00
Cement powder	5.00	10.00	10.00
Common salt	5.00	5.00	5.00
Bone meal	5.00	5.00	5.00
Lime stone powder	5.00	5.00	5.00
African black plum leaf meal	-	15.00	0.00
African black plum fruit meal	-	0.00	15.00
Total	**100.00**	**100.00**	**100.00**
Water (Litres)	4.00	10.00	12.00

F_1 = 0% African black plum, F_2 = African black plum leaf meal, F_3 = African black plum fruit meal

Moulding, drying and packaging of multi-nutrient blocks

The mixture obtained for each formulation was placed in wooden moulds (10 cm x 5 cm with a height of 4 cm) and pressed manually with hands (Allen, 1996). The surface of the wooden moulds were covered with polythene sheets to ease the removal of blocks from the moulds. The blocks were left in the moulds to dry out for 24 hours and were taken out and left to air-dry in well-ventilated shed (Asaolu, 2012) for two weeks. The dried blocks were packed in polythene bags and stored under room temperature with adequate ventilation (Singh *et al.*, 2015).

Chemical analysis

Dry matter (DM) and proximate composition (CP, CF, EE, NFE and ash) of the feed blocks were determined according to AOAC (2005), macro (Ca, Mg, K, Na and P) and micro (Zn, Fe and Mn) minerals composition of the feed blocks were determined using atomic absorption spectrometer and according to AOAC (2005) respectively. Tannin was analyzed according to Makkar and Goodchild (1996), phytate according to Maga (1982), oxalate according to AOAC (2005) and, saponin and alkaloid according to Harborne (1973) methods.

Statistical analysis

Analysis of variance of SAS (1999) Statistical Package was used to analyze the data obtained and where significant differences occur, Duncan's Multiple Range Test was used to separate the means at probability level of 5% ($p<0.05$).

RESULTS AND DISCUSSION

Mineral composition of the feed blocks

The result of mineral composition of the feed blocks is as shown in Table 2. The mineral contents of the feed blocks differed significantly ($p<0.05$) across the treatments, with higher values of all the minerals (except iron) recorded in the formulation containing the fruit meal of African black plum (F_3). Calcium content obtained for the feed blocks was higher than 0.16-0.32% (Omotosho *et al.,* 2019), while magnesium, potassium, phosphorus and sodium compared favourably with reported values (0.45-0.95%, 1.21-1.99%, 1.72-3.63% and 0.29-0.60% respectively) by same authors. Calcium deficiency results in broken bones, convulsions and death in animals (Audu *et al.,* 2023). The potassium content was lower than the utmost unbearable limit of 3% (Ghazanfar *et al.,* 2011), thus will not result in potassium toxicosis when administered to ruminants.

Table 2: Mineral composition of the feed blocks

	Treatments			
Minerals	F_1	F_2	F_3	SEM
Calcium (%)	1.08^c	1.31^b	2.41^a	0.01
Magnesium (%)	0.62^c	0.71^b	0.89^a	0.06
Potassium (%)	1.42^b	1.13^c	1.62^a	0.01
Phosphorus (%)	2.33^b	2.10^b	3.28^a	0.05
Sodium (%)	0.42^b	0.35^b	0.75^a	0.04
Zinc (ppm)	20.41^c	32.96^b	50.55^a	0.02
Manganese (ppm)	73.14^b	61.80^c	113.25^a	0.04
Iron (ppm)	167.36^c	260.45^a	232.50^b	0.02

$^{a, b, c}$ means within the same row with different superscripts differ significantly ($p<0.05$), F_1 = 0% African black plum (ABP) feed block, F_2 = ABP leaf meal feed block, F_3 = ABP fruit meal feed block, SEM = Standard error of mean.

Phytochemical composition of the formulated feed blocks

Table 3 indicates the result of the phytochemical composition of the feed blocks produced. The phytochemical contents of the feed blocks did not differ ($p<0.05$) across the treatments and were lower than the report of Omotosho *et al.* (2019). The lower contents of the phytochemicals observed suggest the levels will not have any detrimental effect on ruminant livestock (Amoah *et al.,* 2018).

Table 3: Phytochemical composition of the feed blocks

	Treatments			
Parameters (%)	F_1	F_2	F_3	SEM
Tannin	0.02	0.02	0.02	0.01
Oxalate	0.12	0.12	0.12	0.01
Phytate	0.21	0.22	0.23	0.01
Saponin	0.13	0.15	0.15	0.04

F_1 = 0% African black plum (ABP) feed block, F_2 = ABP leaf meal feed block, F_3 = ABP fruit meal feed block, SEM = Standard error of mean.

CONCLUSION

The feed blocks manufactured had enough minerals and the phytochemical composition of the blocks was low. The use of African black plum feed blocks as a strategy to augment mineral deficiencies in ruminant livestock is recommended.

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