PHYSICOCHEMICAL PROPERTIES OF AFRICAN BLACK PLUM MULTI-NUTRIENT BLOCK

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ABSTRACT
Considering the inherent qualities of African black plum (Vitex doniana) plant, its exploitation in the formulation of multi-nutrient blocks may enhance the performance of ruminants on low quality roughages when offered as supplements. The study was thus conducted to determine the chemical composition and physical properties of multi-nutrient block licks produced from African black plum leaf and fruit meals. The leaves and fruits of African black plum were dried, crushed and milled. Three formulations of blocks were designated as F1 [control; 0% African black plum (ABP)], F2 (ABP leaf meal) and F3 (ABP fruit meal) nutrient blocks. The ingredients were mixed thoroughly in a 200L and the mixture placed in wooden moulds lined with polythene sheets. The mixture in the moulds were pressed manually and allowed to stay for 24 hours and afterwards, dried in well ventilated shade for two weeks. Chemical composition of the blocks was significantly ($p<0.05$) different in the blocks formulated except for dry matter, with higher values (with the exception of nitrogen free extract) recorded in the F2 formulation. Physical assessment of the blocks revealed the blocks had good and comparable hardness and compactness while the colours were black, dark green and dark brown for F1, F2 and F3 respectively. All the formulations had fine texture and sweet aroma. It was concluded that African black plum nutrient blocks had appreciable level of nutrients that can supplement the nutrient needs of ruminant livestock.
Keywords: African black plum, multi-nutrient block, chemical composition, physical properties

INTRODUCTION

A strategy to augment the efficiency of feed resources utilization is to provide the deficient nutrients through supplementation as this will supply the deficient nutrients in the basal diet as well as the nutrients essential for production. The high cost of conventional concentrate supplements is a limitation to its usage in improving the nutritive value of poor-quality roughages (Singh *et al.,* 2015), thus to alleviate this hindrance, supplementation using multi-nutrient block licks will improve the utilization of these poor-quality roughages by supplying fermentable nitrogen and minerals which could by-pass the rumen (Dzidiya *et al*., 2015). Formulation of multi-nutrient blocks based on low cost and locally available feed resources that do not compete with human food has been advocated (Makkar, 2007). African black plum (*Vitex doniana*) is a tree crop found in northern, eastern and western Nigeria. It grows in open woodland and savannah regions of tropical Africa (Adejumo *et al.*, 2013). The fruits are referred to as 'Black plum' or 'African olive' and are plum-like, sweet and edible (Audu *et al.,* 2022). The young leaves are rich in nutrients and are often eaten as vegetables (Adejumo *et al.,* 2013) while the fruits are used as sweeteners (Abu, 2002). The seeds contain high fat (36.52 %), protein (27.57 %) and minerals (5.18 %) (Amah and Okogeri, 2019). The tree has the potential of inclusion in animal diets due to its high nutrient profile. Thus, the aim of this study is to ascertain the nutritional quality of nutrient blocks produced from African black plum as a potential supplement for ruminants through evaluating the chemical composition and physical assessment of the blocks.

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 and has an elevation of 435 meters above sea level (Ahmad *et al.,* 2015). Rainy season lasts from May to September with an

average rainfall of between 600 to 1000 mm while high temperatures are normally recorded between the months of April and September (JARDA, 2012).

Collection and Preparation of Experimental Materials

The fresh leaves of the African black plum (ABP) were collected from trees within and around Faculty of Agriculture Farm, Federal University Dutse and were shade-dried for four (4) weeks. The fruits were purchased from Danbaji village in Karaye Local Government of Kano state. The fruits were spread on tarpaulin until completely dried under shade. The dried leaves and fruits were crushed, milled and stored in jute sacks prior to usage.

Multi-nutrient block formulation

Multi-nutrient blocks without African black plum (F_1; control) were produced following the procedure of Yami (2007). Two other formulations (F_2 and F_3) were prepared using locally available materials along with the different parts of the African black plum tree (Table 1). Mixing of the ingredients was done manually according to procedure described by Yami (2007) and approximately 10 kg of ingredients was mixed per batch. Molasses was first poured into a 200L drum and urea was added while continuously mixing. The urea-molasses mixture was thoroughly stirred for about 20 minutes. The other ingredients were added in the order listed in Table 1 and mixed thoroughly after addition of each ingredient to obtain a homogenous mixture. The cement was made into a paste with water and salt prior to adding to the rest of the mixed ingredients. The homogenous mixture obtained was transferred into wooden moulds (Garcia and Restrepo, 1995) lined with polythene bags and allowed to stay for 24 hours prior to removal from the moulds.

Table 1: Percentage ingredient composition of African black plum multi-nutrient block

	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
ABP leaf meal	-	15.00	0.00
ABP fruit meal	-	0.00	15.00
Total	**100.00**	**100.00**	**100.00**
Water (Litres)	4.00	10.00	12.00

ABP = African black plum, 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

Homogenous mixture of each formulation was placed in wooden moulds measuring 10 cm x 5 cm with a height of 4 cm and was pressed manually with hands (Allen, 1996). The surface of the wooden moulds were covered with polythene sheets to prevent the mixture from sticking to the walls of the moulds. The blocks were left in the moulds to dry out for 24 hours after which they 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).

Assessment of Multi-Nutrient Block

The hardness and compactness of the three types of blocks were measured by three independent scorers (comprising of adult males between the ages of 30 – 45 years) according to the method of Hassoun (1989). Hardness was assessed by pressing with the thumb in the middle of the block. A block was characterized soft (*), medium (**) or good (***) when the thumb penetrated easily, very little or only with greater pressure, respectively. The compactness was assessed by trying to break the block by hand; a block was characterized as null (+), medium (++), fairly good or good (+++) when it is broken easily, with difficulty or with great effort, respectively (Singh *et al.,* 2015).

Statistical analysis
Data generated were subjected to analysis of variance of SAS (1999) Statistical Package. Means were separated using Duncan's Multiple Range Test at 5% probability level ($p<0.05$).

Results and discussion
Chemical composition of the formulated multi-nutrient blocks
The result of the chemical composition of the multi-nutrient blocks formulated is presented in Table 2. The chemical composition of the blocks was significantly ($p<0.05$) different in the three formulations except for dry matter with higher values (with the exception of nitrogen free extract) recorded in the African black plum leaf meal (F_2) formulation. The dry matter and crude protein values obtained conforms with the values reported by Omoniyi *et al.* (2013). Crude protein content was higher than the report of Adli *et al.* (2018) but similar to that of Adegun *et al.* (2011). The variation in the nutritional composition of the multi-nutrient blocks could be due to the fact that the blocks were formulated from various local, easily-available and low-cost feed ingredients (FAO, 2011).

Table 2: Chemical composition (%) of multi-nutrient block formulations

	Multi-nutrient block formulations			
Parameters (%)	F_1	F_2	F_3	SEM
Dry matter	87.72	87.84	87.03	0.36
Crude protein	20.33[b]	23.56[a]	20.73[b]	0.19
Crude fibre	14.41[b]	15.04[a]	13.87[c]	0.03
Ether extract	2.65[b]	2.95[a]	3.05[a]	2.88
Nitrogen free extract	57.05[a]	52.44[b]	56.70[a]	0.35
Ash	5.56[b]	6.01[a]	5.65[b]	0.05
Acid detergent fibre	15.55[b]	16.43[a]	15.30[b]	0.06
Neutral detergent fibre	34.20[c]	40.18[a]	38.40[b]	0.08

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

Physical assessment of the multi-nutrient blocks
Table 3 presents the result of the measurement of the physical properties of the multi-nutrient blocks formulated. Hardness and compactness of the blocks recorded was good in all the formulations. The colour of F_1 was black, F_2 was dark green while F_3 was dark brown. The different formulations had fine texture and sweet aroma. The hardness (***) and compactness (+++) of the blocks (F_1 - F_3) formulated were good and similar. Study by Asaolu (2012) disclosed optimal hardness and compactness of blocks indicate the ingredients were held together reasonably well by the cement binder and thus, will ensure the gradual release of the urea component.

Table 3: Physical assessment of multi-nutrient blocks

	Multi-Nutrient Blocks		
Parameters	F_1	F_2	F_3
Hardness	***	***	***
Compactness	+++	+++	+++
Colour appearance	Black	Dark green	Dark brown
Texture	Fine	Fine	Fine
Aroma	Sweet	Sweet	Sweet

Soft (*), Medium (**), Good (***), Null (+), Medium (++) and Fairly good/Good (+++)

CONCLUSION
The study showed that formulated African black plum multi-nutrient blocks were of good quality and had appreciable level of nutrients adequate to meet the nutrient needs of ruminant livestock.

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