

NUTRIENT INTAKE AND DIGESTIBILITY OF WEST AFRICA DWARF RAMS FED BASAL DIET SUPPLEMENTED WITH MULTI-NUTRIENT BLOCK

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Summary

Thirty-five (35) West African Dwarf rams (WAD) with an average weight of 13.60 ± 0.2 kg were used to evaluate nutrient intake and digestibility of WAD rams fed basal diet supplemented with multi-nutrient block in a Completely Randomized Design. Multi-nutrient blocks were compounded containing varying levels of Corn Bran (CB) substituting Molasses (M) with CB 0:M 0 %, CB 10 %; M 20 %, CB 20 %; M 10 %, CB 30 %; M 0 % and CB 0 %: M 30 % as treatments 1,2,3,4 and 5 respectively. The trial lasted for fourteen (14) weeks. After the feeding study, the animals were allotted into metabolic cages for separate feeding, faecal and urine sample collection for digestibility trial of WAD rams. The basal diet fed was (*Megathyrus maximus*). Data collected data were analyzed using a one-way analysis of variance (ANOVA). The results obtained showed that multi-nutrient feed block did not significantly affect nutrient intake ($p > 0.05$). The dry matter intake of the basal diet (*Megathyrus maximus*) ranged from 278.81–326.66 g/day and varied significantly across dietary treatments ($p < 0.05$). Multi-nutrient supplementation had a positive significant ($p < 0.05$) effect on all nutrient digestibility parameters. The digestibility of dry matter ranged from 88.94 to 90.44 %, crude protein from 79.92 to 86.26 %, and neutral detergent fiber from 64.42 to 78.57 %. Based on this recent finding, a multi-nutrient feed block supplemented to a basal diet (*Megathyrus maximus*) has no signif-

ificant influence on nutrient intake but has the potential to be utilized to feed ruminants during the dry season for higher feed utilization of WAD rams.

Keywords: ruminants, nutrient intake, digestibility, multi-nutrient block, corn bran (CB), molasses, basal diet (M).

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1. Introduction

The dry season in Nigeria poses a challenge for sheep and goat production due to the limited availability of high-quality nutritive feed resources. This often results in negative impacts such as weight loss, low birth weight, weakened immunity, and high mortality rates [1]. Ruminants in the tropics are generally raised predominantly on grass which are inherently poor in digestibility, nutritive value and unavailability in off-season [2] making it necessary to find alternative feed resources. Moreover, in the dry season, the tropical forage available for grazing in Nigeria is typically high in insoluble fiber and lignin but low in nitrogenous compounds [3]. As a result, these forage resources may not provide a completely adequate diet for livestock production due to multiple deficiencies in minerals, energy, and protein [4]. To evaluate the nutritional value of feed or diet, it is necessary to determine feed intake, digestibility, and efficiency of nutrient utilization. Feed intake is a crucial factor as it determines the total amount of ingested nutrients the animal receives for maintenance, growth, reproduction, and production. The amount of nutrients absorbed depends on the interaction between intake and digestibility [5]. The low crude protein (CP) contents in the forage limit microbial activity in the rumen, reducing intake, digestibility, and animal performance [6]. This pattern highlights the need for supplementary resources such as multi-block to bridge these gaps in livestock nutrition.

Feeding livestock with nutrient blocks is a convenient and cost-effective method of providing a variety of nutrients required by both the rumen microbes and animals, which may be deficient in the normal diet [7]. The objective of this study is to evaluate the nutrient intake and nutrient digestibility of West Africa Dwarf Ram fed a basal diet supplemented with a multi-nutrient block.

2. Materials and methods

The experiment was carried out at the southern farm of the Institute of Agricultural Research and Training (IAR&T), Moor Plantation and lasted for sixteen (16) weeks. The study was conducted at the small ruminant unit of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The unit is located in the south western part of Nigeria. The area lies within the rain forest ecological zone and fall within longitude and latitude 7°–27°N and 3°–25°E respectively and altitude of 220–300 m above sea level^o with the average rainfall of about 1250 mm. The temperature and relative humidity ranges from 30–35 °C and 76–84 % respectively.

2.1. Preparation of experimental multi-nutrient block

Megathyrsus maximus used as basal diet was harvested 10 cm above the ground from established pasture with the use of a knife. Harvested forage was chopped into smaller pieces with the use of a cutlass and wilted for 1–2 days before feeding to animals. The multi-nutrient blocks were fed as supplements in the morning and evening.

The ingredients used for the production of multi-nutrient block were sourced from a reputable market which included corn bran, molasses, cassava peel, groundnut cake, urea, corn cob, cassava starch, palm kernel cake, salt, limestone, bone meal and premix. The ingredients were milled and mixed according to their nutrient sources, energy sources, protein sources, and mineral sources as shown in **Table 1**. Cassava starch was used as binder for the multi-nutrient blocks. 5 kg of mixed multi-nutrient feed was poured into nylon lined in plastic (mould) and solidify 48 hours then removed from a bucket and air-dried (not exposed to direct sunlight) for 2 weeks.

Table 1

Gross (%) composition of multi-nutrient feed blocks supplemented to basal diet

Feed ingredients (g)	T1	T2	T3	T4	T5
Corn bran	0.00	20.00	10.00	0.00	30.00
Molasses	0.00	10.00	20.00	30.00	0.00
Cassava peel	30.00	0.00	0.00	0.00	0.00
Groundnut cake	8.00	8.00	8.00	8.00	8.00
Urea	2.00	2.00	2.00	2.00	2.00
Corn cob	15.00	15.00	15.00	15.00	15.00
Cassava starch	15.00	15.00	15.00	15.00	15.00
Palm kernel cake	20.00	20.00	20.00	20.00	20.00
Salt	1.00	1.00	1.00	1.00	1.00
Lime stone	4.00	4.00	4.00	4.00	4.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Premix	1.00	1.00	1.00	1.00	1.00
Total	100	100	100	100	100
Calculated analysis	—	—	—	—	—
Energy (MJ)	10.50	10.52	10.54	10.52	10.53
Protein (%)	14.65	15.59	14.89	13.69	16.69
Fiber (%)	11.90	11.89	11.49	11.66	11.79

2. 2. Experimental animals and their management

Thirty five (35) West African Dwarf rams weighing between 13.0 ± 0.02 kg were used for the experiment. Animals on arrival at the farm were given necessary prophylactic treatment. The animals were treated against endo-parasite and ecto-parasites using Ivermectin at the rate of 1 ml/50 kg body weight. After the acclimatization period, ram was allotted into five treatments of three replicates each balanced for body weight. Animals were housed individually in a well-ventilated pen. The experimental design used was Completely Randomize Design (CRD). At the onset of the experiment, the initial body weight of the animals was measured and recorded weekly. The animals were fed 5 % based on their body weight.

Multi-nutrient feed blocks and basal diet were offered daily in the morning and evening with water provided *ad libitum* during the experimental period. The rams were allowed two weeks for adjustment to the feed before actual data collection commenced. The feed offered and refusals for each ram were weighed and recorded daily.

2. 3. Nutrient digestibility trial

At the end of the feeding trials, the animals were allotted to individual metabolic cages designed for separate collection of faeces and urine. Nutrient intake and digestibility trials were carried out in the last 7-day feeding trial, with 14 days adjustment period. The quantity of feed offered and leftover for each ram was weighed daily. The weight difference between them was the feed intake. Daily faecal sub-samples were weighed, oven dried and bulked together. A representative sample (10 %) aliquot was obtained from the orts and stored in an air-tight container until it was needed for chemical analysis. Daily urine samples (20 ml) for each ram was collected in a sample bottle containing sulphuric acid and frozen until it needed chemical analysis.

Multi-nutrient feed block, *Megathyrus maximus* and faecal samples were analyzed for proximate compositions according to [8] and fiber fractions were determined according to [9].

3. Result and discussion

Table 2 shows the proximate composition and fiber fractions of the experimental diet. The results revealed that the diets had relatively high dry matter (DM) content, with values ranging from 81.00 % to 81.45 %, indicating that the diet can be stored for a longer period without spoilage. The crude protein ranges from 79.92 % to 86.24 %, which is higher than the 7 % critical crude protein required for ruminal function [10].

Table 2

Chemical composition of multi-nutrient feed blocks

Parameters (%)	T1	T2	T3	T4	T5
Dry matter	81.20	81.00	81.10	80.90	81.45
Crude protein	79.92	80.95	82.73	82.72	86.24
Ether extract	8.200	8.10	8.25	8.15	8.45
Ash	11.20	10.85	10.75	10.53	11.00
Crude fiber	15.69	15.44	15.71	15.45	15.75
Nitrogen free extract	49.34	50.45	48.94	50.10	49.97
Neutral acid detergent	49.34	50.45	48.94	50.10	49.97
Acid detergent fiber	32.79	34.32	33.49	32.99	33.41
Acid detergent lignin	9.62	10.43	11.20	12.40	12.78
Hemicellulose	16.55	16.13	15.45	18.11	16.56
Cellulose	23.17	23.90	22.29	20.59	20.63

Note: T1 – 0 % CB 0 % M; T2 – 10 % CB 20 % M; T3 – 20 % CB 10 % M; T4 – 30 % CB 0 % M; T5 – 0 % CB 30 % M; CB – Corn bran; M – Molasses.

The nutrient intake of West African Dwarf rams fed basal diet (*Megathyrus maximus*) supplemented with a multi-nutrient feed block is shown in **Table 3**. This study found no significant ($p < 0.05$) correlation between feed block intake and the parameters examined. This finding contradicts [11] observation that a multi-nutrient feed block improved basal feed intake. The maximum dry matter intake seen in the basal diet (*Megathyrus maximus*) in the diet containing suggested that the feed had a higher protein quality and a significant degree of fiber content, which improved the meal's palatability, tolerance, and acceptance. This corroborated with the report of (1) [1] who observed that the nature of feeds with acceptability plays an important role in regulating feed intake in small ruminant livestock. The DM intake reflects the better palatability and/or acceptability of the basal diet (*Megathyrus maximus*) of treatment1 in **Table 3** could be attributed to the fact that small ruminants have affinity to *Megathyrus maximus* as it is offered as sole feed, animals have no choice than to fed on what was served [12]. Dry matter intake of the basal diet in this study is higher than 212.05–236.59 g/day reported by [13] when *Megathyrus maximus* was supplemented with *Moringa oleifera* fed to WAD sheep and 90.86 to 105.66 g/day) reported by [14] when goats were fed with different tropical browse plants with *Pennisetum purpureum* as basal diet. This could be attributed to the palatability and digestibility of *Megathyrus maximus* of which supplementation does not significantly ($p < 0.005$) influence. Moreover, dry matter intake of the feed block recorded in this study which even though was not significantly ($p < 0.005$) influenced is slightly lower to 220–230 g/day reported by [15] in sheep grazing on natural pasture supplemented with multi-nutrient feed block. However, the total dry matter intake obtained for both *Megathyrus maximus* and feed block in this study 523.70–563.85 g/day is lower than 711.36–1099.64 g/day reported by [16] for nutrient intake and digestibility of West African Dwarf rams fed Toasted *Enterolobium cyclocarpum* base multi-nutrient feed block. This could be attributed to high crude protein content in the feed block which stimulates the rumen microbial activities that improve feed intake.

Presented in the **Table 3** is the nutrient intake of West African dwarf rams fed basal diet supplemented multi-nutrient feed block. The total dry mater intake recorded ranged from 529.07 to 563.85 g/head/day. The crude protein ranged between 59.19–68 %, ether extract 39.95–43.03 %, Ash 124.41–129.23 %, and nitrogen free extract 183.02–191.89 g/day/head.

Table 4 shows the nutrient digestibility of West African Dwarf rams fed basal diets containing varying levels of TTFM. The dry matter digestibility ranged from 88.94 to 90.44 %. the crude protein varied from 79.92 % to 86.24 %, ether extract ranged from 84.33 to 89.00 %.

Nutrient digestibility in **Table 4** result reveals a significant difference ($p < 0.05$) in all parameters evaluated. T5 supplement significantly has higher digestibility in terms of CP 86.64 %, ash 90.18 %, NFE 88.35 %, ADF 78.07 %, NDF 78.57 %, ADL 70.62 %, hemicellulose 89.96 % and cellulose 77.00 % when compared to others, likewise T4 was superior in term of DM 90.44 %

and EE 89.00 %. Digestibility of feed is classified as high (>60 %), medium (40–60 %) and low (<40) [17]. According to this report, the digestibility of all the nutrients obtained in this present study was high according to [18]. The high digestibility values obtained for most nutrients suggest that the diets were highly degraded in the rumen.

Table 3

Nutrient intake of West African Dwarf Sheep fed basal diet supplemented with multi-nutrient feed blocks

Parameters (g/day/head)	T1	T2	T3	T4	T5	SEM
Dry matter (DM)	DM	DM	DM	DM	DM	DM
<i>Megathyrus maximus</i>	326.66 ^a	309.21 ^{ab}	310.17 ^{ab}	288.12 ^{bc}	278.81 ^c	9.24
Feed block	202.41	214.48	253.68	240.56	246.24	9.42
Total	529.07	523.70	563.85	528.68	525.05	10.32
Crude protein (CP)	CP	CP	CP	CP	CP	CP
<i>Megathyrus maximus</i>	25.12	28.02	26.45	25.43	24.11	1.41
Feed block	34.07	37.01	41.32	36.14	40.77	0.30
Total	59.19	68.79	68.27	61.57	61.12	1.33
Ether Extract (EE)	EE	EE	EE	EE	EE	EE
<i>Megathyrus maximus</i>	21.68	20.88	29.59	19.76	18.97	0.52
Feed block	20.19	21.68	21.44	20.19	22.16	0.85
Total	41.87	42.56	43.03	39.95	41.13	0.98
Ash	Ash	Ash	Ash	Ash	Ash	Ash
<i>Megathyrus maximum</i>	74.15 ^{ab}	75.46 ^{ab}	79.62 ^a	72.16 ^b	71.32 ^b	1.92
Feed block	54.34	53.61	58.16	56.16	55.62	1.74
Total	128.49	129.07	137.78	128.32	126.94	8.45
Crude fibre (CF)	CF	CF	CF	CF	CF	–
<i>Megathyrus maximus</i>	94.62	94.64	94.62	93.63	94.16	3.68
Feed block	34.61	32.16	31.96	30.78	32.14	1.63
Total	129.23	126.80	125.58	124.41	126.30	8.87
Nitrogen Free Extract	NFE	NFE	NFE	NFE	NFE	NFE
<i>Megathyrus maximus</i>	107.78	116.76	106.38	111.32	109.74	3.68
Feed block	76.32	75.14	77.42	74.82	73.28	1.68
Total	184.10	191.89	184.10	186.14	183.02	11.32
Neutral Acid Detergent	NCD	NCD	NCD	NCD	NCD	NCD
<i>Megathyrus maximus</i>	104.71 ^{ab}	101.68 ^{ab}	98.61 ^b	106.84 ^a	102.82 ^{ab}	3.33
Feed block	63.82	60.14	62.14	61.44	61.65	3.64
Total	168.53	161.82	160.75	168.28	164.47	12.41
Acid Detergent Fibre	ADF	ADF	ADF	ADF	ADF	ADF
<i>Megathyrus maximus</i>	76.41 ^{ab}	85.16 ^a	74.16 ^{ab}	82.12 ^a	75.13 ^{ab}	1.86
Feed block	52.16	53.16	54.62	55.66	51.36	2.43
Total	128.57	138.32	128.78	137.73	126.49	6.55
Acid Detergent Lignin	ADL	ADL	ADL	ADL	ADL	ADL
<i>Megathyrus maximus</i>	58.45	57.16	56.48	58.16	59.10	4.24
Feed block	32.16	33.08	31.62	32.16	33.10	4.10
Total	90.60	90.24	88.10	90.32	92.20	12.84
Hemicellulose (HM)	HM	HM	HM	HM	HM	HM
<i>Megathyrus maximus</i>	28.30	16.52	24.45	24.72	27.20	1.47
Feed block	11.66	6.98	7.52	5.83	10.29	1.26
Total	39.966	23.50	31.97	30.55	37.90	2.33
Cellulose (CEL)	CEL	CEL	CEL	CEL	CEL	CEL
<i>Megathyrus maximus</i>	17.41	28.00	17.68	23.96 ^{able}	16.03	2.38
Feed block	20.00	20.08	23.00	23.45	18.26	1.67
Total	37.41	48.08	40.68	47.41	34.29	2.12

Note: T1 – 0 % CB 0 % M; T2 – 10 % CB 20 % M; T3 – 20 % CB 10 % M; T4 – 30 % CB 0 % M; T5 – 0 % CB 30 % M; CB – Corn bran; M – Molasses.

Table 4

Digestibility of West African Dwarf Rams fed basal diet supplemented with multi-nutrient feed blocks

Parameters (%)	T1	T2	T3	T4	T5	SEM
Dry matter	89.33 ^b	89.19 ^b	88.94 ^b	90.44 ^a	89.77 ^{ab}	0.17
Crude protein	79.92 ^c	80.95 ^{bc}	82.73 ^b	82.72 ^b	86.24 ^a	0.56
Ether extract	84.33 ^{bc}	85.40 ^b	86.63 ^a	89.00 ^a	86.07 ^b	0.38
Ash	84.92 ^d	85.51 ^d	86.84 ^c	89.05 ^b	90.18 ^a	0.44
Nitrogen free extract	86.33 ^{bc}	85.56 ^c	86.30 ^{bc}	86.87 ^b	88.35 ^a	0.25
Acid detergent fiber	69.00 ^{ab}	73.35 ^{ab}	70.75 ^{ab}	65.08 ^b	78.07 ^a	0.58
Neural acid detergent	64.42 ^c	67.83 ^{bc}	74.94 ^{ab}	76.59 ^a	78.57 ^a	1.50
Acid detergent lignin	69.50 ^{ab}	43.53 ^d	46.59 ^{cd}	58.20 ^{bc}	70.62 ^a	2.81
Hemicellulose	85.49 ^b	86.74 ^{ab}	87.24 ^{ab}	87.88 ^{ab}	89.96 ^a	0.58
Cellulose	64.47 ^b	74.56 ^{ab}	71.85 ^{ab}	64.10 ^b	77.00 ^a	1.73

Note: T1 – 0 % CB 0 % M; T2 – 10 % CB 20 % M; T3 – 20 % CB 10 % M; T4 – 30 % CB 0 % M; T5 – 0 % CB 30 % M; CB – Corn bran; M – Molasses.

The Dry matter (DM) digestibility in this study is slightly higher than 89.01 % reported by [19] on Moringa multi-nutrient feed block with *Brachiaria decumbens* as basal diet and 83.05 % reported by (20) on nutrients digestibility, nitrogen balance and blood profile of West African Dwarf (WAD) goat fed cassava peel with urea molasses multi-nutrient block (UUMMB) supplements. This could be attributed to the type of concentrate and feed ingredient used in the diet. The crude protein (CP) digestibility value in this study indicated that the diet contains adequate amount of CP which was effectively digested to release nutrient. The CP digestibility in this study is higher than 50.28–71.97 % reported by [20] on WAD goats fed cassava peels with urea molasses multi-nutrient feed block and 64.54–85.41 % reported by [21] for sheep fed basal diet supplemented with *Gliricidia* based multi-nutrient feed block.

The result obtained for Neutral acid detergent Acid detergent fiber digestibility of treatment 5 of this study projected the ability of fed animal to digest cell wall fractions and process structural carbohydrate to obtain nutritional quality benefit them [22].

4. Conclusions

Basal diet (*Megathyrus maximus*) supplemented with a multi-nutrient feed block could not influence the feed intake of WAD rams. Digestibility in this study indicated that feed block has potential of being used to feed ruminant during dry season. Though, animals fed with multi-nutrients containing gave the highest digestibility in all the parameters measured in this study.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Data availability

Manuscript has no associated data.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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