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Nutrients Digestibility, Nitrogen Balance and Blood Profile of West African Dwarf (Wad) Goats Fed Cassava Peels with Urea-molasses Multi-nutrient Block (UMMB) Supplements

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Authors' contributions

This work was carried out in collaboration between all authors. Author OSG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ANF and DEO managed the analyses of the study. Author DEO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The nutrients digestibility, nitrogen utilization and blood profile of West African Dwarf (WAD) goat fed cassava peels with urea-molasses multi-nutrients block (UMMB) supplements was investigated in a twelve weeks experiment. Twenty WAD goats that weighed 8.33±0.35 kg on average were assigned to each of the five experimental diets that contained cassava peels without UMMB supplement (treatment 1) and with UMMB containing 0% urea (treatment 2), 5% urea (treatment 3), 10% urea (treatment 4) and 15% urea (treatment 5), in a completely randomized design (CRD). Results of the study revealed that nutrients digestibility were significantly (P<0.05) influenced by UMMB supplementation. Goats fed diet T_4 also had the highest values of digestibility coefficients of dry matter (DM), crude protein (CP), crude fibre (CF) and nitrogen free extract (83.05%, 71.97%, 67.64% and 71.34%) respectively. Nitrogen retention was significantly (P<0.05) influenced by

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dietary treatments, the values ranged from 0.75 g/day (diet T_1) to 6.07 g/day (diet T_5). Haematological indices and serum biochemistry were within normal range for WAD goats.

Conclusively it can be said that urea-molasses multi-nutrient blocks is offers a reliable source of protein for improved nutrients digestibility and nitrogen utilization by WAD goats fed cassava peels without detrimental effects on the wellbeing of the goats.

Keywords: Digestibility; nitrogen balance; goat; urea molasses multi-nutrient block supplements.

1. INTRODUCTION

The extensive grasslands in the savanna zones of Nigeria constitute a most valuable feed resource for development of ruminant production systems. However, their use and outputs are constrained by quality, seasonality and management. Thus, ruminants suffer from scarcity in feed supply and pasture quality especially during the dry season when the natural vegetation is of poor nutritive value [1,2]. There has been a search for and interest in the use of unconventional and less expensive feed ingredients to mitigate this scarcity [3]. These unconventional feed resources are known to be particularly deficient in protein, minerals and vitamins; they are highly lignified and their digestibility is low. Protein supplementation is known to enhance utilisation of poor-quality feeds like crop residues as it maximises roughage degradation and optimises rumen microbial protein synthesis [4]. However, most of the supplements used such as soya beans, cotton seed cake and groundnut cake are expensive and not readily available. Urea offers a cheap and good alternative source of protein [5], thus enhancing their digestibility, intake and nutrient availability through optimization of rumen fermentation. Also, the use of urea-molasses blocks or multinutrients blocks (UMMB) supplements, has been used improve digestibility and utilization of fibrous feed by salvaging the deficiency of energy, nitrogen, vitamins and minerals lacking in fibrous feeds [6].

Haematological components are valuable in monitoring feed toxicity [7]. In this study, an attempt was made to assess the nutrients digestibility, nitrogen balance and blood profile of West African Dwarf (WAD) goats fed cassava peels with urea-molasses multi-nutrient block (UMMB) supplements.

2. MATERIALS AND METHODS

2.1 Experimental Sites

This experiment was conducted at the Teaching and Research Farm of the Federal University of Technology, Akure, Nigeria. Samples collected where analyzed in the nutrition laboratory of Department of Animal Production and Health of The Federal University of Technology, Akure.

2.2 Experimental Animals and their Management

Twenty West African Dwarf bucks weighing 8.33±0.55 Kg on average were used for the study. The study lasted for 70 days (excluding one month adjustment period). At the end of the adaptation period, the animals were distributed on the basis of their body weights. Four (4) animals were randomly assigned to each of the five experimental diets that contained cassava peels without urea-molasses multinutrients block (UMMB) supplement (treatment 1) and with UMMB supplements containing varying levels of urea (0%, 5% 10% and 15% for treatments 2, 3, 4 and 5 respectively) in a completely randomized design (CRD). The goats were managed on intensive system of livestock production where routine medication as recommended by the Teaching and Research Farm was adopted. Cassava peels were sundried and fed to all of the animals. Daily records of feed intake as well as weekly weight change of each animal were obtained and during the last two weeks of the experiment, the animals were transferred to metabolic cages for digestibility trial where faeces and urine were collected separately for seven (7) days after seven days acclimatization.

2.3 Preparation of Urea-molasses Multinutrient Block (UMMB)

2.3.1 Ingredients

Formulation of UMMB was done using locally available ingredients namely sugarcane molasses, urea, common salt, vitamin/mineral premix, brewer's dried grain and cement (see Table 1). Molasses was the source of fermentable substrate and various minerals and trace elements. Urea will provide fermentable nitrogen. Cement was used as the binding agent. Brewer's dried grain acts as an absorbent for the moisture contained in molasses and gives structure to the block.

2.3.2 Manufacturing process

The various raw materials were weighed accurately before mixing. Mixing was done manually in a bucket. Mixing the molasses with the urea was the first step. The cement powder was introduced next. The bran was added to this mixture and finally, water (with the salt and mineral premix dissolved in it) was added in sufficient quantity to ensure homogenous mixture. Plastic containers with dimension of about 14 cm x 14 cm x 8cm were used as moulds. Once the mixture was placed in the mould, it was left in a well-ventilated room to set. The mixture took about 6-8 days to set, after which the blocks were ready for feeding.

2.4 Chemical Analysis

The multi-nutrients blocks, feed, faeces and urine were analysed for crude protein/nitrogen, crude fibre, ether extract, and ash were analyzed according to AOAC [8]. Neutral detergent fibre (NDF), acid detergent fibre (NDF) and acid detergent lignin (ADL) were determined as described by Van Soest et al. [9]. Hemicellulose was calculated as the difference between ADF and ADL. Blood samples from individual goats were collected from their jugular vein for haematological and serum analyses. Minerals were determined after wet digestion of the samples with a mixture of perichloric acid and concentrated nitric acid (1:4 v/v) and composition of some minerals (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Iron, Copper and Zinc) in the digest were determined by Atomic Absorption Spectrophotometer (AAS). Anti-nutrients (cyanide, oxalate, tannin, alkaloids and phytate) was also analyzed.

2.5 Digestibility Trial and Nitrogen Retention

Samples of faeces and urine were collected in the morning before feeding and watering during the period of the experiment. Faeces were weighed and oven dried at 105°C for about 3 hours for dry matter (DM) determination. The faecal samples for each experimental animal were thoroughly mixed, milled to pass a 0.2 mm sieve and sealed in polythene bags. These were stored in a cupboard at room temperature until required for chemical analysis.Total urine excreted by each animal was collected in a plaque bucket under each cage and to which few drops of 25% H_2SO_4 was added daily to prevent volatilization of ammonia from the urine. The total volume of urine output per animal was measured and aliquots (10%) of daily output per animal was saved in stopper plastics bottles, labeled and stored in a deep freezer.

Nutrient intake, digestibility coefficient, and nitrogen retention of the goats were recorded and calculated at the end of the experiment.

Apparent digestibility =

$$\frac{\text{Nutrients intake} - \text{nutrients in faeces}}{\text{Nutrient intake}} \times \frac{100}{1}$$

Nitrogen retention = Nitrogen intake – (faecal nitrogen + Urinary nitrogen)

2.6 Blood Collection and Analysis

At the end of the experiment, blood was collected through the jugular vein of the experimental animals into a labeled bijour bottle containing ethyldiamine tetraacetic acid (EDTA) as anti-coagulant and to another without EDTA. The blood in the bottle with EDTA was used in the determination of haematological parameters such as red blood count (RBC), white blood count (WBC), packed cell volume (PCV), haemoglobin (Hb) using the method by Dacie and Lewis [10], while that without EDTA was be used in determining blood serum biochemical indices such as blood albumin, globulin, alkaline phosphatase (ALP), alkaline aminotransferast (ALT), aspartate aminotransferase (AST), and Creatinine using the method by Reitman and Frankel [11].

2.7 Data Collection and Statistical Analysis

Data generated were subjected to the one-way analysis of variance (ANOVA) using the general linear model procedure of SAS (2008). Where significant differences are observed, Duncan's Multiple Range Test was employed to separate the means.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of Cassava Peels and Urea-molasses Multinutrients Blocks (UMMBs)

The proximate composition of the cassava peels and multi-nutrient blocks are presented in

Table 2. The dry matter (DM) contents in the UMMBs ranged between 82.53% and 90.62%, these values were comparable to 83.13 – 88.21% reported by Onwuka [12] for molasses-urea multi-nutrients blocks, but higher than 71.18 – 78.55% reported by Aye et al. [13] for *Gliricidia* molasses-urea multi-nutrients blocks.. The high DM recorded in UMMB-A may be due to the high percentage of rice bran (55%DM content) and absence of molasses in the diet (Table 2).

The crude protein (CP) of the UMMB supplements increased with increased urea content and the values ranged from 8.05% to 29.79%. The CP values of UMMBs B, C and D were higher than the values of 11-15% reported by Mata and Cambellas [14] and Onwuka [12] when these authors fed crop residue with UMMB supplement to sheep. However, the observed CP values in this study compared favourably to the reported value of 17-33% by Aye et al. [13] when cassava peels with *gliricidia* based molasses-urea multi-nutrients block supplements were fed to sheep. Thus, UMMB supplements containing 5-15% urea could be a good source of alternative protein in goats' nutrition.

The crude fibre (CF) content was higher in UMMB-A than the others, this observation might be due to very high rice bran content (55%). The CF content fell within the range values (7 – 13%) reported by Onwuka [12] when UMMB was used as a supplemental feed resource for ruminants. The high nitrogen free extracts (NFE) of the UMMB supplements might be due to the molasses contents of the supplements. The energy content of the supplements increased with increased molasses content and the highest molasses (45%) in UMMB-B resulted in highest gross energy content. The observed poor energy in UMMB-A might be due to the absence of molasses (Table 2) in the supplement. The NFE and energy contents of the multi-nutrients blocks showed its potential as an excellent source of fermentable carbohydrates and energy for optimum ruminal activity.

Table 1. Components of urea-molasses block for each of the treatments

Ingredients	BlockA (%)	Block B (%)	Block C (%)	Block D (%)
Urea	0.0	5	10	15
Molasses	0.0	45	40	35
Common salt	5	5	5	5
Cement	15	15	15	15
Brewer's dried grain (BDG)	29.0	29.0	29.0	29.0
Rice bran	55	0.0	0.0	0.0
Premix	0.5	0.5	0.5	0.5
Sulphur	0.5	0.5	0.5	0.5
TOTAL	100	100	100	100

Table 2. Proximate composition (%) and gross energy ($MJKg^{-1}$) of cassava peels and urea-molasses multi-nutrient blocks (UMMBs)

Parameters	Cassava peels	Urea-molasses multinutrients blocks (UMMB)				CV (%)
		A	B	C	D	
Dry matter	86.57	90.62	82.53	84.88	85.16	3.10
Crude protein	5.35	8.05	17.94	22.93	29.79	14.32
Crude fibre	11.83	15.29	9.95	7.47	7.30	50.45
Ether extract	3.72	6.84	4.53	3.02	4.07	29.28
Ash	15.5	8.12	9.51	7.21	7.91	31.28
Nitrogen free extract	63.6	61.7	61.07	59.00	50.93	5.57
Neutral detergent fibre	52.12	57.04	44.20	43.93	43.74	71.76
Acid detergent fibre	46.06	44.65	36.35	35.89	36.18	57.84
Acid detergent lignin	28.14	34.98	32.62	33.75	33.81	62.32
Hemicellulose	6.06	12.39	7.85	8.04	7.56	26.46
Cellulose	17.92	9.67	4.03	2.14	2.37	77.81
Gross energy (MJ Kg^{-1} DM)	7.96	8.05	14.85	13.08	11.94	24.61

**UMMB A (0% urea, 0% molasses); UMMB B (5% urea, 45% molasses); UMMB C (10% urea, 40% molasses); UMMB D (15% urea, 35% molasses)*

The DM of the cassava peels was high (86.57%) and the observed value agrees with reports [15]. The CP of the cassava peels was 5.35%, this value was lower than 6.5% reported by Adegbola et al. [16], but comparable to 5.48 reported by Akpabio et al. [17]. The crude fibre (CF) content of the cassava peels was 11.83%, this value was higher than 10.0% reported by Adegbola et al. [16]. The fats, NFE and energy of the cassava peels were also in agreement with those given by Adegbola et al. [16].

3.2 Minerals and Anti-nutrients Composition of Urea-molasses Multi-nutrients Blocks and Cassava Peels

Minerals and anti-nutrients composition of urea-molasses multi-nutrients blocks and cassava peels are presented in Table 3. The Ca level in the multi-nutrients blocks ranged from 2.46 - 3.18%. These values were higher than the range of 0.76 - 0.89% reported by Aye et al. [13] for *Gliricidia* base molasses-urea multi-nutrients blocks, but compared favourably to 0.90 – 4.00% reported by Liu et al. [18] when UMMB was fed to cattle and goats. The phosphorus level (0.68-1.92%) in UMMBs B, C and D was high compared to previous reports on UMMB; 0.5% [18]; 0.54% [19]. Magnesium content of the multi-nutrients blocks supplements ranged from 0.33 to 0.88% and these values were more than the values (0.14 - 0.19%) reported by Aye et al. [13] for *gliricidia* based UMMB. The high mineral content in UMMB makes it a very good source of essential minerals to goats on supplemental feeding.

The Cyanide content (16.02 mg/kg) of the cassava peels was higher than the content of the multinutrient blocks (1.33-5.43 mg/kg). The values obtained were below toxic level (50 mg/Kg) as reported by Nwokoro et al. [20]. The tannin content of the cassava peels observed compared favourably to the value of 0.19 - 0.14% in cassava peels from bitter and sweet cassava [17].

The concentration of these ANFs in the cassava peels and multi-nutrients blocks are below the toxic levels that could exert toxic effects on ruminants, since the goats are capable of hydrolyzing these secondary metabolites to produce other beneficial chemical compound through rumen microbial activities [21].

3.3 Nutrients Digestibility of WAD Goats Fed Cassava Peels with UMMB Supplements

The result of nutrients digestibility in Table 4 indicated a relatively high nutrients digestibility by goats fed diets T_3, T_4, and T_5. This reveals that the diets were palatable and digestible. Dry matter (DM) digestibility was significantly ($P<0.05$) improved by dietary treatments. The value of DM digestibility ranged from 60.98 to 83.05%. This finding was in agreement with the reports of Ali [22], Aye et al. [13]; for sheep fed crop residues with UMMB supplements, but higher than the values reported by Sansoucy et al. [23] for lambs consuming 100 $gday^{-1}$ UMMB.

Crude protein (CP) digestibility ranged between 50.28% (diet T_1) and 71.97% (diet T_4), these values were lower than 64.54 to 80.74% reported by Aye et al. [13] but higher than the reported value of 32.53 to 61.34% by Ali [22] for lamb fed crop residue with UMMB supplements. The digestibility coefficient of crude fibre (CF), ether extract (EE) and energy were significantly ($P<0.05$) improved by UMMB

Table 3. Mineral and anti-nutrients composition of cassava peels and urea-molasses multinutrient blocks

Parameters	Cassava peels	Urea-molasses multinutrients blocks			
Minerals (%)		**A**	**B**	**C**	**D**
Calcium	0.21	2.46	3.18	3.02	2.61
Phosphorus	0.18	0.25	1.92	0.94	0.68
Sodium	0.03	0.41	1.01	0.31	0.62
Potassium	0.33	0.82	2.09	1.94	0.85
Magnesium	0.18	0.31	0.76	0.88	0.62
Anti-nutrients					
Cyanide (ppm)	16.02	5.42	1.33	1.94	2.13
Tannins (%)	0.19	1.21	0.10	0.08	0.12
Oxalates (mg/g)	247.62	115.42	43.05	56.22	64.21
Phytate-P (mg/g)	10.93	6.83	2.12	3.14	4.86
Alkaloids (mg/g)	7.02	3.21	0.94	1.27	1.15

**UMMB A (0% urea, 0% molasses); UMMB B (5% urea, 45% molasses); UMMB C (10% urea, 40% molasses); UMMB D (15% urea, 35% molasses)*

Table 4. Nutrients digestibility (%) of WAD goats fed cassava peels supplemented with urea-molasses multi-nutrients blocks

Nutrients	Treatments					±SEM
	1	2	3	4	5	
Dry matter (DM)	60.98^c	70.39^b	75.90^{ab}	83.05^a	80.43^a	2.34
Crude protein	50.28^d	52.08^b	59.25^{ab}	71.97^a	67.58^a	3.81
Crude fibre	52.62^c	54.87^b	59.20^{ab}	67.64^a	63.50^{ab}	2.73
Ether extract	54.22^c	62.36^b	69.31^{ab}	79.13^a	72.84^{ab}	4.57
Nitrogen free extract	59.44^b	66.13^a	68.35^a	71.34^a	69.31^a	1.43
Energy	58.07^{ab}	52.24^b	55.42^{ab}	64.51^a	63.42^a	2.72
Neutral detergent fibre	62.18^b	61.37^b	59.55^b	76.17^a	71.39^a	2.05
Acid detergent fibre	52.67^b	55.90^b	61.29^b	77.06^a	71.98^a	3.42
Acid detergent lignin	53.04^c	58.93^c	62.08^{bc}	76.68^a	65.90^b	2.52
Hemicellulose	54.83^b	56.16^b	63.30^{ab}	73.76^a	70.97^a	1.89
Cellulose	50.31^b	51.15^b	62.39^a	71.51^a	68.50^a	3.02

a, b, c, d=means with different superscripts on the same row are significantly different.
n=4
TREATMENT 1 = Cassava peels only
TREATMENT 2 = Cassava peels + UMMB supplement containing 0% urea; 0% molasses
TREATMENT 3 = Cassava peels + UMMB supplement containing 5% urea; 45% molasses.
TREATMENT 4 = Cassava peels + UMMB supplement containing 10% urea; 40% molasses.
TREATMENT 5 = Cassava peels + UMMB supplement containing 15% urea; 35% molasses.

supplementation. These findings were similar to those reported by Mcdonald et al. [24] that nutrient digestibilities are improved by protein supplementation.

3.4 Nitrogen Utilization of WAD Goats Fed Basal Diet with UMMB Supplementation

Nitrogen utilization of WAD oats fed cassava peels with UMMB supplements is shown in Table 5. Nitrogen intake by the goats fed cassava peels with UMMB supplements increased with increased urea levels in the multi-nutrients blocks. The values ranged from 1.95 g/day (diet T_1) to 7,75 g/day (diet T_5). This observation was in line with the report of Aye et al. [13] who reported increased nitrogen retention in sheep fed cassava peels with *Gliricidi* based molasses-urea multi-nutrients blocks supplement. This observation could be attributed to the increased nitrogen availability in the rumen for optimum microbial activities.

The nitrogen retention by the goats increased with increased level of urea in the multi-nutrients blocks, the value ranged between 0.75 g/day (diet T_1) and 6.07 g/day (diet T_5), these values were lower than 1.97 to 8.05 g/day reported by Olorunnisomo [15] for sheep fed soaked or fermented cassava-urea meal, but comparable to the reports of Aye et al. [13] when sheep was fed cassava peels with *Gliricidia* based molasses-urea multi-nutrients blocks supplement. However, the positive nitrogen retention values observed signified that the diets were adequate in their supply of nitrogen to the rumen.

Table 5. Nitrogen utilization of WAD goats fed cassava peels with UMMB supplements

	Diets					±SEM	%CV
	A	B	C	D	E		
Nitrogen Intake ($gday^{-1}$)	1.95^e	2.67^d	4.93^c	6.89^b	7.75^a	0.61	46.89
Faecal Nitrogen ($gday^{-1}$)	1.10	1.07	1.12	1.01	1.18	0.03	5.11
Urinary Nitrogen ($gday^{-1}$)	0.09	0.22	0.36	0.61	0.48	0.06	52.24
Nitrogen retention ($gday^{-1}$)	0.75^b	1.38^d	3.45^c	5.23^b	6.07^a	0.15	61.54

**a, b, c, d, e =Means with different superscripts on the same row are significantly different (P<0.05). n=4*
TREATMENT 1 = Cassava peels only
TREATMENT 2 = Cassava peels + UMMB supplement containing 0% urea; 0% molasses
TREATMENT 3 = Cassava peels + UMMB supplement containing 5% urea; 45% molasses.
TREATMENT 4 = Cassava peels + UMMB supplement containing 10% urea; 40% molasses.
TREATMENT 5 = Cassava peels + UMMB supplement containing 15% urea; 35% molasses.

3.5 Haematological Parameters of WAD Goats Fed Cassava Peels with UMMB Supplements

Table 6 presents the haematological parameters of WAD goats fed cassava peels with UMMB supplements. Analysis of haematological parameters of animals is very important for the diagnosis of various pathological, metabolic disorders, impact of environmental, nutritional and pathological stresses [25]. Also, in feeding trials, blood could be the means of assessing clinical and health status of animals [26]. Packed Cell Volume (PCV) is involved in the transport of oxygen and absorbed nutrients [27], when the value of PCV falls below normal range, it is an indication of poor quality of protein in diets [28] and anaemia [29]. Hence, with the value obtained in this study for goats fed cassava peels with UMMB supplements, it could be inferred that the protein content in the diets was adequate since the PCV values were within normal range for WAD goats [30].

Haemoglobin (Hb) is blood pigment that carries oxygen. Its high concentration is an indication of good carriage capacity of oxygen to various parts of the body which results in healthy living of animals. In this study as the values for RBC and Hb indicated that UMMB supplements had no detrimental effect on oxygen carriage capacity of the goats since the concentrations of Hb and RBC were within normal range for healthy WAD goats.

The major functions of the white blood cell (WBC) and its differentials are to fight infections, defend the body by phagocytocis against invasion by foreign organisms and to produce or at least transport and distribute antibodies in immune response. White blood cells of the goats were influenced by dietary treatments; values were higher in goats fed cassava peels with UMMB supplements. However, the observed WBC values were within normal range for healthy WAD goats [30], hence the immune system of the goats were not compromised by UMMB supplementation.

Erythrocyte sedimentation rates, lymphocyte, heterophils, monocytes, basophils and eosinophils were not significantly (P>0.05) affected by the dietary treatments. ESR is believed to be the mostly determined by the gravitation pull on the erythrocyte and the frictional force of the surrounding which holds the plasma [31]. High values of ESR could cause acute general infection and malignant tumours [31]. The numeric values recorded from the five experimental groups ranged; 1.0 – 1.70 (mm/hr) and fall within range of 1 - 2.49 (mm/hr) reported by Talebi et al. [32]. Lymphocytes are known to play key roles in immune defense system of both man and animals [33]. The authors further emphasized that when WBC (leucocytes), neutrophils, basophils and lymphocytes fall within the normal range, it indicates the feeding patterns do not affect the immune system. In the present study, neutrophils and basophils of the goats were within normal range for goats which implies that UMMB supplementation do not have adverse effect on the immune system of WAD goats.

Table 6. Haematological profile of WAD goats fed cassava peels supplemented with UMMMB

Haematological parameters	Treatments					±SEM
	1	2	3	4	5	
ESR (mm/hr.)	1.65	1.67	1.00	1.17	1.17	0.18
Packed cell volume (%)	16.67^{b}	23.33^{a}	21.67^{a}	23.33^{a}	22.33^{a}	0.96^{a}
Red blood cells (X 10^4 /cubic mm)	723.33	872.0	826.33	843.33	790.00	64.39
White blood cells(X 50/cubic mm)	193.33^{b}	251.00^{a}	257.00^{a}	212.67^{b}	251.67^{b}	11.81
Haemoglobin (g/100 ml)	5.43	7.47	6.97	7.10	7.33	0.30
Lymphocytes (%)	52.67	60.67	60.33	61.00	61.67	1.07
Neutrophils (%)	23.33	27.33	27.67	27.67	27.00	1.77
Monocytes (%)	6.00	6.67	6.67	7.67	7.33	0.31
Eosinophil (%)	1.67	2.33	2.33	2.00	2.67	0.14
Basophils (%)	1.00	1.00	1.33	1.67	1.33	0.11

**a, b =Means with different superscripts on the same row are significantly different (P<0.05). n=4*
TREATMENT 1 = Cassava peels only
TREATMENT 2 = Cassava peels + UMMB supplement containing 0% urea; 0% molasses
TREATMENT 3 = Cassava peels + UMMB supplement containing 5% urea; 45% molasses.
TREATMENT 4 = Cassava peels + UMMB supplement containing 10% urea; 40% molasses.
TREATMENT 5 = Cassava peels + UMMB supplement containing 15% urea; 35% molasses.

Table 7. Serum biochemical indices of WAD goats fed cassava peels supplemented with urea-molasses multi-nutrients block

Serum parameter	Treatments					±SEM
	1	2	3	4	5	
Total proteins (g/dL)	5.29	6.17	5.42	6.87	6.10	0.48
Albumin (g/dL)	2.84	3.18	3.01	3.92	3.42	0.19
Globulin (g/dL)	2.45	2.9	2.41	2.95	2.68	0.22
Albumin/Globulin ratio	1.16	1.07	1.25	1.32	1.27	0.04
Alkaline Phosphatase (IU/L)	2.58	2.27	2.80	3.32	2.68	0.10
Alkaline Aminotransferase (IU/L)	10.81^a	8.33^c	10.33^b	11.33^a	11.00^a	1.13
Aspartate Aminotransferase(IU/L)	31.52	29.67	32.00	26.33	31.67	3.46
Creatinine (mg/dL)	2.31	2.27	1.92	1.86	2.11	0.78

a, b, c = mean with different superscripts in the same row are significantly different. n=4
TREATMENT 1 = Cassava peels only
TREATMENT 2 = Cassava peels + UMMB supplement containing 0% urea; 0% molasses
TREATMENT 3 = Cassava peels + UMMB supplement containing 5% urea; 45% molasses.
TREATMENT 4 = Cassava peels + UMMB supplement containing 10% urea; 40% molasses.
TREATMENT 5 = Cassava peels + UMMB supplement containing 15% urea; 35% molasses

3.6 Serum Biochemical Indices of WAD Goats Fed Cassava Peels with UMMB Supplements

The Serum biochemical indices of WAD goats fed cassava peels with UMMB supplements are presented in Table 7. The total protein (TP) and albumin observed in this trial, ranged: 5.42 – 6.87 g/dl, and 3.01 – 3.92 g/dl respectively and fell within the normal range of 6.3 – 8.5 g/dl, and 2.8 – 4.30 g/dl reported by Daramola et al. [30] for WAD goats and [34] for goat kids fed urea-molasses granules. The information obtained with respect to TP and albumin, indicated that there were adequate protein in the diets [26] and the blood of the goats had excellent clotting ability thereby could prevent haemorrhage [35]. Globulins values ranged between 2.41 g/dL (diet T_2) and 2.95 g/dL (diet T_3), this was higher than 0.16-1.6 g/dL reported by Daramola et al. [30] for WAD goats. The highest values of globulin concentration was observed in goats fed diets $T_{3,}$ T_4 and T_5. This implied that UMMB supplementation has the potential of improving immunity in the goats since higher value of globulin has been observed to enhance better defense against infection because globulin is well-known for its immunological functions.

The serum alanine phosphatase (ALP) concentration in all the goats fell within normal ALP values for WAD goats reported by Daramola et al. [30], but higher than the report of Nisha et al. [34]. This enzyme is believed either to increase the local concentration of inorganic phosphate or to activate the collagen fibres in such a way that they cause deposition of calcium salts [36]. Thus, the higher values of ALP observed in the goats fed diets $T_{3,}$ T_4 and T_5 is an indication that UMMB supplementation has the potentials to facilitate bone formation especially in growing animals This observation agrees with the findings of Nisha et al. [34] who reported marginal increase in ALP among goat kids given urea-molasses mineral granules.

The level of alkaline aminotransferase (ALT) and aspartate aminotransferase (AST) were found to be statistically non-significant (p>0.05) among the groups and fell within the normal range for WAD goats [30]. This indicates that the animals were maintained in normal health condition without any cellular dysfunction, since values higher than the normal range would affect cellular synthesis of proteins and growth performance.

Creatinine is removed from the blood chiefly by the kidneys, primarily by glomerular filtration. Little or no tubular reabsorption of creatinine occurs. If the filtration in the kidney is deficient, creatinine blood levels rise. Therefore, creatinine levels in blood and urine may be used to calculate the creatinine clearance, which correlates with the glomerular filtration rate [37]. In this study, the creatinine was not influenced by the diets and this sugested that the kidney might be in good condition.

4. CONCLUSION

The results of this study revealed that that higher nutrients digestibility and nitrogen utilization could be sustained by providing UMMB containing 10 - 15% urea and 35-40% molasses. The results further revealed that haematological and serum biochemical parameters of WAD goats fed cassava peels with UMMB supplements containing 5-15% urea were within normal range for healthy goats. Therefore feeding cassava peels with urea-molasses multi-nutrients block supplements to goats would serve as a better alternative feed resource during dry season.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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