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Research Article

NUTRIENT INTAKE OF WEST AFRICAN DWARF GOATS FED DIETARY MODELS OF ENSILED CASSAVA PEEL MEAL FORTIFIED WITH CALCIUM-PHOSPHORUS SALT

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ABSTRACT

Objective: This study was conducted to determine nutrient intake of growing West African Dwarf goats fed different dietary models of ensiled cassava peel meal fortified with Calcium-Phosphorus salt mix.

Methods: Twenty (20) growing West African Dwarf female goats aged 6–8 months with an initial weight of 8.2 kg ± 0.25 were used for the study. They were randomly allotted to four dietary treatments with five goats per treatment in a completely randomized design. The dietary treatments were Diet 1 (block), Diet 2 (crunchy), Diet 3 (pellet), and Diet 4 (mash).

Results: Results obtained indicated that dry matter intake ranged from 466.18 g/d to 575.53 g/day with significantly ($p<0.05$) higher value in pellet model while crude protein intake was higher in mash model than other treatments. Ether extract and crude fiber intake values were higher 40.13 g/day and 148.08 g/day in pellet feed model. Ash intake ranged from 61.32 g/day to 95.86 g/day. Block and crunchy models had significantly ($p<0.05$) higher value for ash intake while values obtained for nitrogen-free extract intake was also higher ($p<0.05$) in pellet model 22.62 g/day than other models. Values of fiber fractions intake obtained were significantly ($p<0.05$) influenced by dietary models with higher values for neutral detergent fiber, acid detergent fiber and hemicellulose in mash while acid detergent lignin was significantly ($p<0.05$) for pellet model.

Conclusion: It can be concluded that supplementing goat diets with different dietary models of ensiled cassava peel meal fortified with Calcium- Phosphorus salt mix can boost intake of goats for better productive performance and productivity.

Keywords: Nutrient, ensiled; WAD, models, cassava peel, calcium- phosphorus, salts.

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INTRODUCTION

Inadequate feed supply that confers adequate nutrients in ruminant nutrition has been a major challenge to goat producers and researchers. Small ruminants suffer scarcity of feed supply and pasture quality especially during the dry season when the nutritive value of natural vegetation declines [1], [2] stated that feed shortage is a major constraint in livestock production. Native rangelands produce the cheapest source of nutrients for goats but greater part of the grassland does not supply sufficient nutrients to livestock for greater productivity [3]. As a result, this leads to low productive performance of goats in terms of intake, digestibility and weight gain. However, in order to address problems of feed shortage, animals are often made to subsist on household wastes and crop residues [4] as supplements to their grazing activities on the available pastures. Such crop residue includes cassava peel, as an important by-product available from the processing of cassava (*Manihot esculentus*) root for food uses, starch, ethanol, and other by- products. Cassava has been used in feeding various classes of livestock [5]. However, during the dry season, the native rangeland and crop residues available for ruminants after crop harvest are usually fibrous and devoid of most essential nutrients including protein, energy, minerals and vitamins which are required for increased rumen microbial fermentation and improved performance of the host animal [6]. This often results in weight loss, low birth weight, lowered resistance to disease and reduced animal performance [7]. In response to these challenges, the recent approach has been to supplement livestock diets with protein-rich ingredients and fortification with minerals with further transformation into different dietary models to address the challenges associated with reduced growth performance and other productive parameters. This study was, therefore, conducted to investigate nutrient intake of West African Dwarf goats fed different dietary models of ensiled cassava peel meal fortified with Calcium-Phosphorus salt mix.

METHODS

Experimental site

This experiment was conducted at the Sheep and Goat Unit of the Teaching and Research Farm of Kogi State University, Anyigba in accordance with the Institution's animal ethical committee guideline. Kogi State University, Anyigba lies on latitude 7^0 15^1 and 7^0 29^1 North of the equator and longitude $7^0 11^1$ and 7^0 32^1 East of the Greenwich Meridian. The experimental location falls within the derived savannah zone of Nigeria, lying in the warm humid climate of the middle belt zone of Nigeria with a clear dry and raining season in May to October and October to March, respectively. The temperature ranges from 25 to 30°C with the highest in March and April [8].

Experimental feed and treatment

Fresh cassava peel, free from stumps were collected and grated before being subjected to hydraulic press for dewatering. The dewatered peels were then pulverized and sieved to obtain the coarse mash, which was then sun-dried for 2–5 days before being loaded into bags for feeding animals [9]. Four kilograms (4 kg) of urea fertilizer was dissolved in 100 L of water and then used to treat 100 kg of cassava peels by spraying. The product was then pressed together to eliminate air while in the

container. The product in the container was then covered with plastic sheet and ensiled for 21 days before being used for diet formulation [10]. After then, it was air dried for 1–3 days. The feed was fortified with trona and single superphosphate (Calcium-Phosphorus salt mix) before being transformed into different forms viz: block, crunchy, pellet and mash as dietary treatments(Table 1). A mash form is coarse in nature. The crunchy form was made by mixing the feed ingredients with water and cement as a binding agent, moulded on a flat surface structure then air dried for about 3–4 days. The block form was obtained by mixing the feed ingredients with water and cement as a binding agent and then placed in container (mould) in a well-ventilated environment for about 4–7 days to assume the shape of the container [1]. The pellet form was obtained by mixing all the ingredients then transformed into pellets using pelleting machine.

Experimental animals and management

Twenty (20) growing West African Dwarf female goats aged 6–8 months with an initial weight of 8.2 kg ± 0.25 were used for the study. The goats were bought from Anyigba market, Kogi State and were allowed 14-days adaptation before the start of the feeding trial. All the animals were subjected to recommend vaccination procedures including treatment against endo and ectoparasites after which the animals were randomly assigned to four experimental dietary forms derived from urea treated cassava peel meal fortified with trona and single superphosphate viz block, crunchy, pellet and mash forms in a completely randomized design. The goats were allowed 6–7 h grazing daily before concentrate supplements were offered in their individual pens at 5% body weight for 60 days. Data on feed intake were collected throughout the experimental period. Nutrient intake was determined as the product of feed intake and percentage nutrient composition.

Chemical analysis

Samples of experimental diets were collected and analyzed for nutrient composition using methods of the Association of Official Analytical Chemist [11]. Feed samples were separately evaluated for fibre components in accordance with the methods of [12].

Statistical analysis

All data collected were subjected to Analysis of Variance. Means were separated by using Least Significant Difference according to the procedure of analysis in SPSS version 19.

RESULTS

Nutrient composition of experimental diets

Nutrient composition of supplementary diet is presented in Table 2. Dry matter content of the experimental diet ranged between 85.01% and 86.50% with block having slightly higher value than other models. Organic matter ranged from 67.95% to 75.98% with pellet having higher value. Crude protein content comparably varied from 17.06% to 17.54% with crunchy model having lowest value but pellet having the highest value. Crude fiber content ranged from 20.59% to 22.08%. Higher value of crude fiber was observed in block model 22.08% than other diets. Ether extract showed higher value in pellet diet 5.93% than other dietary models. Ash content varied between 9.06% and 18.55%. The higher value for ash content was observed in block 18.55% and crunchy model (15.94%) while pellet had the lowest value 9.06%. Nitrogen free extract was higher in mash 44.85% but lower in block 23.56%. Neutral detergent fiber ranged from 39.50% to 64.50%. Higher value of 64.50% was observed in mash than other models. Acid detergent fiber was also higher in mash 88.67% whereas acid detergent lignin showed the highest value in block form 23.08. Hemicellulose had the lowest value 17.52% in block, but higher value of 24.17% was obtained in mash.

Nutrient intake of West African dwarf goats fed dietary models derived from urea treated cassava peels fortified with Ca-P Salt Mix

The result of nutrient intake is presented in Table 3. The dry matter intake ranged from 466.18 g/d to 575.53 g/d with pellet model having significant ($p<0.05$) higher value. Organic matter intake followed similar trend. Crude protein intake varied from 100.71 g/d to 88.56 g/d significantly ($p<0.05$) higher value 102.26 g was observed in mash feed model than other treatments. Values of ether extract and crude fibre intake were significantly ($p<0.05$) higher 40.13 g/d and 148.08 g/d in pellet feed model. Ash intake ranged from 61.32 g/d to 95.68 g/d. Block and crunchy models had significant ($p<0.05$) higher value for ash intake. The value of nitrogen free extract intake was significantly ($p<0.05$) higher in pellet model 224.62 g than other treatments. Fiber fractions intake (neutral detergent fibre, acid detergent fibre, acid detergent lignin and hemicellulose) were significantly influenced by dietary models. Neutral detergent fibre significantly ($p<0.05$) ranged from 487.51 g/d to 270.08 g/d. Its intake was significantly affected by enrichment and fortification of cassava peel meal with higher value in mash model 487.51 g/d. Acid detergent lignin significantly ($p<0.05$) varied between 600.88 g/d and 309.59 g/d with mash model having higher value 600.88 g/d than other dietary treatments. Acid detergent lignin intake was higher in pellet form 129.20 g/d while significant ($p<0.05$) higher value of hemicellulose intake was observed to be higher in mash model 163.79 g/d than other dietary models.

Table 1: Gross composition of different dietary models (%)

Ingredients	Block	Crunchy	Pellet	Mash
Urea treated cassava peel	92	92	95	95
Cement	3	3	-	-
Trona	4	4	4	4
Single superphosphate	1	1	1	1
Total	100	100	100	100

Table 2: Nutrient composition of dietary models derived from urea-treated cassava peels fortified with Ca- P salts (%)

Nutrients (%)	Block	Crunchy	Pellet	Mash
Dry matter	86.50	85.97	85.04	85.01
Organic matter	67.95	70.03	75.98	74.40
Crude protein	17.17	17.06	17.54	17.09
Crude fibre	22.08	20.59	21.88	21.67
Ether extract	5.14	4.94	5.93	5.78
Ash	18.55	15.94	9.06	10.61
NFE	28.56	32.41	35.19	49.85
NDF	32.50	39.50	47.50	64.50
ADF	50.02	59.49	69.47	88.67
Hemicellulose	17.52	19.99	21.97	24.17
ADL	23.08	15.79	19.09	18.01

NFE: Nitrogen free extract, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent Lignin

Table 3: Nutrient intake of WAD goats fed dietary models derived from urea treated cassava peels fortified with Ca-P salt mix (g/day)

Parameters	Block	Crunchy	Pellet	Mash	SEM
Dry matter	446.18^{d}	506.33^{c}	575.53^{a}	547.62^{b}	2.47
Organic matter	350.49^{d}	413.42^{c}	514.21^{a}	504.18^{b}	2.45
Crude protein	88.56^{c}	100.71^{a}	98.40^{ab}	102.26^{a}	1.59
Ether extract	26.51^{c}	29.16^{b}	40.13^{a}	39.17^{a}	0.86
Crude fibre	113.89^{c}	121.55^{b}	148.08^{a}	146.85^{a}	5.19
Ash	95.68^{a}	94.10^{a}	61.32^{c}	71.90^{b}	0.49
NFE	121.52^{d}	161.81^{c}	224.62^{a}	187.51^{b}	10.32
NDF	270.08^{c}	233.18^{d}	321.46^{b}	487.51^{a}	12.28
ADF	309.59^{d}	351.19^{c}	470.15^{b}	600.88^{a}	24.13
Hemicellulose	90.37^{d}	118.01^{c}	148.69^{b}	168.79^{a}	5.20
ADL	119.05^{c}	93.21^{d}	129.20^{a}	122.05^{b}	2.05

$^{a, b, c, d}$Means in the row with different superscripts are significantly different ($p<0.05$), SEM: Standard error of the mean, NFE: Nitrogen free extract, NDF: Neutral detergent fiber, ADF: Acid detergent fibre, ADL: Acid detergent Lignin

DISCUSSION

Dry matter content of the dietary models across the treatments ranged between 85.01% and 86.50%. This value range is comparable to 87.52% reported by Ukanwoko and Ibeawuchi [13] for cassava based diets fed to WAD goats. But lower than 90.30–91.84% reported by Guimaraes *et al*. [14] for diets containing cassava peels fed to goats. The values of organic matter content observed is comparable to the values obtained by Guimaraes *et al*. [14] but lower than 92.52% to 93.70% reported by Uza *et al*. [15] for urea treated cassava peels offered WAD goats. Crude protein content obtained was higher than 15.29% -15.75% reported by Guimaraes *et al*. [14].

The values observed indicated that pellet model had higher crude protein. More so, all the diets seemed to be isoproteic due to similar values obtained. Crude fiber content obtained was higher than 16.60% reported by Ukanwoko and Ibeawuchi [13]. The values of ether extract are comparable across the dietary treatment but slightly lower than 6.04% reported by Kalio *et al*. [16] for urea treated cassava peel fed to WAD goat. Ash content was higher in treatment group with block form than other diets forms. The high value of ash content in block form followed by crunchy might be attributed to cement powder used as binder in block form. This is applicable to crunchy form also. The inclusion of trona and superphosphate minerals buffers might as well contributed to increased ash content. This is in harmony with a report of Hoffman and Tayson [17] who opined that mineral buffer supplementation may contribute to high dietary ash content. Nitrogen free extract was higher in pellet model treatment group. The value of nitrogen-free extract obtained in this study was lower than 62.67% reported by Aye [18] for cassava peel supplemented with *Moringa oleifera*, *Gmelina arborea* and *Tithonia diversifolia* based multinutrient block. The value was also higher than 32.36% reported by Kalio *et al*. [16] for cassava peels supplemented with N sources. Variations might be due to urea treatment of cassava peel used in this study. Urea treatment might have interfered with the protective effect of cellulosic material of the feed thereby making it more digestible. Neutral detergent fibre and acid detergent fibre were higher than 30.06% and 16.00% reported by Kalio *et al*. [16] respectively. Acid detergent lignin content was higher than 7.94–10.97% reported by Guimaraes *et al*. [14]. The variation in the results obtained might be attributed to stage of maturity of cassava, processing methods adopted in obtaining the cassava peels used in the different experiments, soil condition and environmental factors. Dry matter intake and organic matter intake were higher in pellet model than other dietary groups. Lower intake in block and crunchy may be attributed to the nature of the diet. The higher dry matter and organic matter intake obtained may be due to the pelletized form of the diet which enabled ease of picking and mastication of feed. This agrees with the findings of [19] who reported that grinding and pelleting agro-by product help in increasing the palatability of the feed which correlates to better intake. The result of dry matter intake obtained in this study was higher than 426.71 g/day–478.08 g/day reported by Faria [20] on a research carried out involving different methods of processing cassava peel. The values obtained for dry matter and organic matter intake is in contrast with [21] who reported that organic matter and dry matter intake were not affected by inclusion of cassava peel supplements. Crude protein intake ranged between 88.56 g/day and 102.26 g/day.

The values of crude protein intake were lower than 127.31 g/day, 120.14 g/day and 118.30 g/day reported by Menezes *et al*. [22] for varying levels of cassava peel fed to ruminants. The crude protein intake was influenced by dietary supplements in this study and is in contrast to [14] who obtained 132 g/day in their study on performance of lambs fed diets containing cassava peels. Ether extract and crude fibre intake were higher in dietary groups fed pellet diet. Increase palatability and digestibility of pellet rations together with efficient utilization of absorbed nitrogen maybe responsible for increased intake. Ash intake was influenced by dietary feed models whereby block diet group had the highest value 95.68% this might be attributed to cement used as a binder in block dietary group. This is supportive with the higher value 94.00% of ash intake obtained in crunchy diet wherewith cement was also used as a binder. Hoffman and Tayson [17] reported that mineral inclusion may contribute to high ash content because cement contains calcium carbonate as one of the major components.

Nitrogen free extract intake was higher in pellet diet than other treatments. Result obtained agrees with [23] that higher intake of nitrogen free extract was observed with pelletized diet. Intake of neutral detergent fibre, acid detergent fibre was high in mash model than other dietary groups while acid detergent lignin was higher in pellet group. The higher intake of fibre component obtained in this study is a proof of better degradability of the diet in the rumen of the animals which favoured better rumen environment. The results of fibre fractions intake obtained in this study agree with [24] who reported that neutral detergent intake, acid detergent fibre were influenced by levels of cassava peels in pellet model.

CONCLUSION

Based on the results obtained from this study, it was concluded that supplementing diets of grazing West African Dwarf goats with urea-treated cassava peels fortified with Calcium – Phosphorus mineral mix (Trona and Single superphosphate fertilizer) in different dietary models can boost nutrient intake of goats which invariably results to better productive performance of the animals.

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