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# Nutrient intake and digestibility of graded dietary levels of dried cassava peel meal as replacement for maize offal fed to Goats

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***Target Audience:*** Livestock Farmers and Ruminant Nutritionists

## Abstract

*The study was undertaken to determine the nutrient intake and digestibility of graded dietary levels of dried cassava peel meal (CPM) as replacement for maize offal fed to West African dwarf (WAD) goats. Four (4) intact WAD bucks aged 1-2 years with mean initial body weight of 16.00 ± 0.71kg were used for the study. Four diets were formulated with cassava peel meal replacing maize offal at 0, 60, 80 and 100 %, designated $T_1$, $T_2$, $T_3$ and $T_4$, respectively. Each of the animals received one of the four (4) treatment diets in a 4 x 4 Latin Square design. The data obtained from this study were subjected to analysis of variance (ANOVA) applicable to a 4 x 4 Latin Square design experiment. The results on proximate composition of the diets showed that significant differences ($P<0.05$) existed in crude protein, ash, crude fiber, ether extract and metabolizable energy (ME), whereas no significant differences ($P>0.05$) were observed in dry matter and nitrogen – free extract (NFE). The control diet had significantly ($P<0.05$) higher crude protein (CP), ash, ether extract (EE) and metabolizable energy than the other treatments except for crude fiber of $T_4$ and ME of $T_2$.The $T_4$ group had the highest ($P<0.05$) crude fiber. The dry matter intake as percentage body weight was significantly ($P<0.05$) higher in $T_2$ among the treatments with $T_3$ recording the lowest value. Diets $T_1$, $T_2$ and $T_4$ had similar ($P>0.05$) N-intake (g/d/Wkg$^{0.75}$), N- absorbed (g/d/Wkg$^{0.75}$) and apparent nitrogen digestibility values. The animals fed $T_2$ had significantly higher ($P<0.05$) urinary-nitrogen (g/d) and urinary- N (g/d/Wkg$^{0.75}$) than those fed the other treatment diets, whereas the control ($T_1$) recorded the lowest ($P<0.05$) values in these parameters. The N – intake (g/d), urinary – N output (g/d) and apparent nutrient digestibility coefficients differed significantly ($P<0.05$) among the treatment groups. The dry matter, crude protein, crude fiber, ether extract and nitrogen – free extract were better digested ($P<0.05$) in the control diet ($T_1$) than in the CPM diets. The metabolic faecal nitrogen (MFN) values were similar ($P>0.05$) in all the diets. The values for endogenous urinary nitrogen (EUN) were 0.689, 1.403, 0.880 and 0.956 (g/d/Wkg$^{0.75}$) for $T_1$, $T_2$, $T_3$ and $T_4$, respectively. The Biological values were 95.46, 89.33, 90.89 and 92.76 for $T_1$, $T_2$, $T_3$ and $T_4$, respectively. The diet ($T_4$) containing 100% CPM is recommended among the other CPM diets for feeding goats, as it had better performance with respect to nutrient digestibility and utilization.*

***Keywords:*** Nutrient, intake, digestibility, cassava peel meal, maize offal, goats

**Description of problem**

Feed availability has been the major factor limiting the expansion of ruminant animal production in Nigeria. It has become imperative for ruminant nutritionist to focus their research interest on alternative feedstuffs that have no direct nutritional value to man for feeding various classes of ruminant (1). A potential alternative feed ingredient must not be a staple item of food that is directly eaten by man to avoid scarcity (2).

Cassava peel is one of the alternative sources of feed ingredient which are generally less expensive, readily and locally available in large quantity, and is not directly consumed by humans as food. Okah *et al.* (3) reported ranges of proximate composition of processed cassava peel as 88.2-89.7% DM, 8.7-10.2% CP, 5.2 – 6.9% CF, 3.0-3.5% EE, 2.0-4.9%ash and 62.7-68.8% NFE.

Cassava peel, contains cyanogenic glycosides lostraulin and linamarin (4), both are anti-nutritional compounds of hydrogen cyanide derivative. The substance (HCN) has been shown to be toxic to livestock (5) and therefore limits the use of cassava peels in the raw state as food for livestock (4). These anti-nutritional factors in cassava peel could be detoxified possibly through sun-drying (6,3) by boiling (3) by ensiling and by soaking (3) which have been found to reduce the hydrocyanic acid (HCN) contents to tolerable levels. Earlier studies have shown that raw cassava peel is toxic and processing by sun-drying only gave partial detoxification (7).

The objective of the study was to determine the nutrient intake and digestibility by West African Dwarf (WAD) goats fed graded dietary levels of cassava peel meal as a replacement for maize offal.

**Materials and Methods**

**Location of experiment**

The experiment was carried out at the small ruminant unit of the Teaching and Research farm

of the Michael Okpara University of Agriculture, Umudike (MOUAU), situated within latitude 05$^{o}$, 28$'$ and longitude 07$^{o}$32$'$ E, and lies within altitude 122 meters above sea level. It falls within the humid rain forest zone of Nigeria and is characterized by long duration of rainfall (5-7 months) and short duration of dry season. Average rainfall is 2169 mm in 148-155 rainy days. Monthly ambient temperature is between 20$^{o}$C and 36$^{o}$C, while relative humidity ranges from 50 - 60 % depending on season (8).

**Composition of the experimental diets**

The cassava peel was collected from the National Root Crops Research Institute, Umudike, Abia State, sun-dried, milled to form cassava peel meal.

Four experimental diets were formulated (Table 1) to contain 0%, 60%, 80% and 100% replacement levels of cassava peel meal for maize offal, and designated $T_1$, $T_2$, $T_3$, and $T_4$, respectively.

**Table 1: Composition of experimental diets containing different replacement levels of cassava peel meal for maize offal**

| Ingredient (%) | $T_1$ (0%CPM) | $T_2$ (60%CPM) | $T_3$(80%CPM) | $T_4$(100%CPM) |
|---|---|---|---|---|
| Maize offal | 63.75 | 25.50 | 15.75 | - |
| Cassava Peel Meal | - | 38.25 | 51.00 | 63.75 |
| PKC | 30.00 | 30.00 | 30.00 | 30.00 |
| Soybean Meal | 2.00 | 2.00 | 2.00 | 2.00 |
| Blood Meal | 1.00 | 1.00 | 1.00 | 1.00 |
| Bone Meal | 2.50 | 2.50 | 2.50 | 2.50 |
| Salt (NaCl) | 0.50 | 0.50 | 0.50 | 0.50 |
| Vit./ Min Premix* | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| CP (%) | 14.05 | 10.80 | 9.70 | 8.60 |
| ME(kcalKg$^{-1}$) | 2328.69 | 2596.44 | 2685.69 | 2774.94 |

*The premix contain per kg of diet: Vit A 10000 – 15000 iu; Vit D3 2000 – 5000 iu; Vit E 5 – 20 iu; Vit K 2.2 – 3mg; Thiamine 1.5 – 2.0 mg; Riboflavin 5.5mg; Niacin 25mg; calcium pantothenate 10mg; pyridoxine 2mg; choline chloride 120 – 350mg; folic acid 1mg; Vit B12 0.01mg; manganese 56 – 80mg; zinc 50 mg; copper 10 – 20 mg, iron 20mg, iodine 0.4 – 1.0 mg; cobalt 0.6 – 1.25 mg

**Experimental animal and management**

Four (4) West African Dwarf (WAD) bucks aged 1-2 years with mean initial body weight of 16.00 ± 0.71kg were obtained from Sheep and Goat Unit of the Teaching and Research farm, Micheal Okpara University of Agriculture, Umudike. The animals were sprayed with acaricide to control ecto-parasite and were dewormed and then vaccinated against peste des petitit ruminants (PPR) diseases. Prior to the digestive trial the goats were managed intensively and allowed access to fresh clean water *ad-libitum*.

The bucks were transferred into separate metabolism cages constructed for the comfort of the animals with provision for separate collection of faeces and urine. The cages were constructed with wood each fitted with an under drawer for easy collection of faeces and a metal pan for channeling of urine with urine receptacle as described by Ibeawuchi and Tuli (9). Each of the animals received one of the four (4) treatment diets containing 0, 60, 80 and 100% cassava peel meal in a 4 x 4 Latin Square design arrangement. The experiment was conducted in four periods of 28 days each. The first 21 days was adaptation period, while the last 7 days was for sample collection. During period 1, each animal was offered 1 kg of one of the four treatment diets for 28 days. In period ii – iv, each animal was offered 1kg of one of the four treatment diets in a rotational period of 28 days each as described by Okah and Antia (10) and portable water was offered to the animals *ad libitum.*

Daily voluntary feed intake was determined by weighing the feed offered and the refusal. Total faeces and urine voided by the experimental animals were collected in the morning before feeding and offering water during the last 7 days of the experimental periods.

The faeces were weighed fresh dried and bucked for each animal. A sub- sample from each animal was dried in forced draft oven at 100 to 105$^oC$ for 48 hours for dry matter (DM) determination.

Another sample was dried at 60$^oC$ for 48 to 72 hours for determination of proximate composition.. The urine was collected in calibrated transparent container placed under each cage and to which 10 ml of concentrated Sulphuric acid was added daily to prevent volatilization of ammonia and microbial growth in the urine. The total urine output per animal was weighed and 10 % of the daily outputs were saved in plastic bottles, labeled and stored in refrigerator for determination of nitrogen content according to AOAC (11).

At the end of the 7 days collection period, the faecal samples collected were bulked for each animal and sub- samples taken for analysis. Samples of the diets were also analysed for dry matter and proximate composition. The animals were weighed at the beginning of the experiment and at the end of each period.

**Statistical Analysis**

The data obtained from this study were subjected to analysis of variance (ANOVA) as applicable to 4 x 4 Latin Square design experiments (12). Differences between means were separated using SAS (13). Simple linear regression and correlation were used to assess the degree of relationship between some of the digestion components using SAS (13).

**Results and Discussion**

Table 2 represents the proximate composition of experimental diets containing different replacement levels of cassava peel meal for maize offal.

There were significant differences ($P < 0.05$) in crude protein, ash, crude fiber, ether extract and metabolizable energy (ME) whereas no significant differences were observed in dry matter and nitrogen free extract (NFE) values. This implies that the dry matter and nitrogen free extract were not influenced ($P>0.05$) by dietary levels of cassava peel meal.

The control diet had significantly ($P<0.05$) higher crude protein (CP), ash, ether extract (EE) values. Metabolizable energy value was higher ($P<0.05$) in the control diet, the value however did not differ ($P>0.05$) from $T_{2.}$ The control diet had lowest crude fiber. The crude protein showed a decreasing trend as the level of cassava peel was increased in the diets. This might be attributed to the low protein content of the cassava peel meal.

Crude fiber increased as the level of cassava peel meal increased in the diet. This indicates that the level of fibre in CPM is higher than that of the maize offal. This resulted in higher ($P<0.05$) crude fibre of $T_4$ (CPM 100%) diet. The higher levels of crude protein, ash, and ether extract in the control diet ($T_1$) compared to the test diets shows that apparently, maize offal contains higher CP and ether extracts, consequently, the diets containing higher levels of CPM are lower in these nutrients. The lower EE % of CPM is also the main reason for lower energy levels with increase in dietary CPM.

**Table 2: Proximate composition of experimental diets containing different replacement levels of cassava peel meal for maize offal**

| Parameters (%) | $T_1$ (0%CPM) | $T_2$ (60%CPM) | $T_3$(80%CPM) | $T_4$(100%CPM) | SEM |
|---|---|---|---|---|---|
| Dry matter | 92.30 | 92.30 | 92.18 | 92.22 | 0.46 |
| Crude protein | 17.85[a] | 15.75[b] | 14.70[c] | 14.18[c] | 0.39 |
| Ash | 19.12[a] | 17.62[b] | 17.53[b] | 17.44[b] | 0.19 |
| Crude fibre | 15.12[c] | 17.54[b] | 18.88[b] | 20.54[a] | 0.55 |
| Ether extract | 6.42[a] | 5.65[b] | 5.25[b] | 5.25[b] | 0.14 |
| Nitrogen free extract | 33.81 | 36.01 | 35.86 | 34.56 | 0.42 |
| ME ($KcalKg^{-1}$) | 3249.81[a] | 3254.37[a] | 3226.59[c] | 3236.40[b] | 3.08 |

[a, b,c,] Means across the rows with different superscripts differ significantly at $P<0.05$; SEM= Standard error of mean

Table 3 shows the nutrient intake and nitrogen utilization of WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal.

There were significant differences ($P < 0.05$) in all the parameters except faecal nitrogen.

The animals fed control diet ($T_1$) had lower DMI (g/day) and metabolic DMI $WKg^{0.75}$) than those fed $T_2$ and $T_4$, which seem to suggest that high crude protein and low crude fibre lead to reduced DMI(g/day) in goat, while those with low crude protein and high crude fibre promoted DMI (g/day). The dry matter intake as % body weight differed significantly ($P<0.05$) among the treatment means. However, $T_1$, $T_2$ and $T_4$ were within the recommended 3.5- 5% range (14) while T3 (2.51%) was lower than the recommended range for no identifiable reason.

The crude protein intake (CPI) (g/day) of the $T_1$ group was significantly ($P<0.05$) higher than those of the $T_2$, $T_3$ and $T_4$, probably as a result of a higher dietary crude protein content of $T_{1.}$

Nitrogen intake which determines CPI was similar ($P>0.05$) in the in $T_1$ and $T_2$ group but higher ($P<0.05$) than the $T_3$ group, while $T_2$ and $T_4$ were similar ($P>0.05$). The $T_2$ group had significantly ($P<0.05$) higher urinary nitrogen than the $T_1$, though with higher N-intake. This suggests that N-intake may not exclusively determine urinary-N but other intrinsic factors like individuality and physiological status of the animal.

N – Balance (g/day) was higher ($P<0.05$) in the $T_I$ group than the groups containing CPM. Absorbed N – (g/day) however, was significantly ($P<0.05$) higher in $T_1$, $T_2$ and $T_4$ than $T_3$, but $T_2$ and $T_4$ were similar ($P>0.05$). Although the nitrogen balance of the group fed 100% CPM was also similar ($P>0.05$) with the 60 % CPM, the former had lower urinary nitrogen loss, indicating higher quality of the diet.

Apparent – N digestibility was also similar ($P>0.05$) in $T_1$, $T_2$ and $T_4$ groups but lower ($P<0.05$) in the $T_3$ group. The reason for poor performance of the animals fed diet $T_3$ (80%CPM) could not be identified; however the ratio of dietary protein to fibre might play a significant role in nutrient intake and utilization by animals.

**Table 3: Nutrient intake and nitrogen utilization of WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal**

| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
|---|---|---|---|---|---|
| **Parameters** | **0%CPM** | **60%CPM** | **80%CPM** | **100%CPM** | **SEM** |
| Average Weight (Kg) | $15.00^{b}$ | $15.13^{b}$ | $15.50^{b}$ | $17.00^{a}$ | 0.27 |
| DMI (g/day) | $496.09^{c}$ | $556.78^{b}$ | $388.91^{d}$ | $580.99^{a}$ | 22.37 |
| DMI ($WKg^{0.75}$) | $105.12^{c}$ | $114.62^{b}$ | $87.58^{d}$ | $118.34^{a}$ | 0.29 |
| DMI as % Body weight | $3.31^{ab}$ | $3.68^{a}$ | $2.51^{b}$ | $3.42^{ab}$ | 0.18 |
| CP Intake (g/day) | $95.94^{a}$ | $94.99^{b}$ | $62.02^{d}$ | $89.33^{c}$ | 4.17 |
| N- intake (g/day) | $15.35^{a}$ | $15.20^{ab}$ | $9.92^{c}$ | $14.29^{b}$ | 0.68 |
| Faecal N (g/day) | 0.70 | 0.76 | 0.70 | 0.76 | 0.03 |
| Urinary N (g/day) | $0.66^{c}$ | $1.54^{a}$ | $0.84^{bc}$ | $0.98^{b}$ | 0.10 |
| N- Balance (g/day) | $13.99^{a}$ | $12.90^{b}$ | $8.38^{c}$ | $12.55^{b}$ | 0.65 |
| Absorbed-N(g/day) | $14.65^{a}$ | $14.44^{ab}$ | $9.22^{c}$ | $13.53^{b}$ | 0.67 |
| N-intake (g/d $WKg^{0.75}$) | $7.75^{a}$ | $7.70^{a}$ | $5.59^{b}$ | $7.35^{a}$ | 0.29 |
| Urinary-N (g/d $WKg^{0.75}$) | $0.73^{c}$ | $1.38^{a}$ | $0.88^{bc}$ | $0.98^{b}$ | 0.08 |
| Absorbed-N (g/d $WKg^{0.75}$) | $7.49^{a}$ | $7.41^{a}$ | $5.29^{b}$ | $7.05^{a}$ | 0.30 |
| N-Balance (g/d $WKg^{0.75}$) | $7.23^{a}$ | $6.81^{a}$ | $4.93^{b}$ | $6.67^{a}$ | $6.67^{a}$ |
| Apparent-N Digestibility (%) | $95.00^{a}$ | $95.00^{a}$ | $93.00^{b}$ | $95.00^{a}$ | 0.29 |

[a,b,c,d] Means with different superscripts across the rows are significantly different at P<0.05; SEM= Standard error of the mean

Table 4 represents apparent nutrient digestibility coefficients of WAD goats fed diets containing different levels of cassava peel meal.

Significant differences (P<0.05) were observed in all the parameters: dry matter, crude protein, crude fiber and ether extract (%). The control diet was significantly (P<0.05) higher in nutrient digestibility coefficient for all the parameters. Increased digestibility at higher nitrogen levels had earlier been reported to be associated with low fibre levels (16).

The animals fed $T_4$ (100% CPM) had higher (P<0.05) coefficient of digestibility than those fed $T_2$ (60% CPM) and $T_3$ (80% CPM), this suggests that proper crude protein and fibrer ratios might be necessary for adequate nutrient utilization by the animal.

The fibre content of the $T_4$ (100% CPM) diet seems to have encouraged rumen motility and microbial functions which resulted in high nutrient utilization and comparable performance with the control group T1 (0%CPM).

**Table 4: Apparent nutrient digestibility coefficients of WAD goats fed diets containing different levels of cassava peel meal**

| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
|---|---|---|---|---|---|
| Parameters (%) | 0%CPM | 60%CPM | 80%CPM | 100%CPM | SEM |
| Dry Matter | 84.10[a] | 59.20[c] | 54.95[d] | 64.54[b] | 3.37 |
| Crude protein | 95.83[a] | 87.05[b] | 85.81[c] | 87.57[b] | 1.20 |
| Crude fibre | 69.62[a] | 34.40[c] | 36.51[c] | 56.57[b] | 4.40 |
| Ether extract | 94.68[a] | 94.13[c] | 94.12[c] | 95.47[b] | 0.46 |
| Nitrogen free extract | 88.83[a] | 70.58[c] | 65.76[d] | 72.07[b] | 2.63 |

[a, b, c, d] Means with different means across the rows are significantly different at $p<0.05$; SEM= Standard error of the mean

Table 5 shows the regression analysis and correlation coefficient between faecal nitrogen (g/kg DM) (Y) and N-intake (g/day) (X) in WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal.

Faecal nitrogen was positively correlated with N-intake in all the treatments. The regression equation shows that any g/day increase in N-intake will lead to 0.006 g/kg DM, 0.000 and 0.001 increases in faecal nitrogen in $T_I$, $T_3$ and $T_4$, respectively. Whereas, any g/day increases in N-intake will lead 0.001 decrease in faecal nitrogen in $T_2$.

The correlation coefficient was positive between faecal nitrogen and nitrogen intake in all the treatments, although only significant in $T_1$ ($P<0.05$) and $T_4$ ($P<0.01$). The significant and positive correlations observed in the treatments suggest that increase in nitrogen intake leads to increase in faecal nitrogen output by the animals fed $T_1$ and $T_4$.The metabolic faecal nitrogen (MFN) was lowest (0.061g/100gDM) in $T_I$, suggesting that this treatment had the least faecal nitrogen loss from metabolic process not directly from the diet.

**Table 5: Regression analysis and correlation coefficient between faecal nitrogen (g/kg DM) (Y) and N-Intake (g/day) (X) in WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal**

| **TRT** | **Regression equation** | **Correlation Coefficient (r)** | **$R^2$** | **SEM** | **Intercept on Y-axis** | **MFN** g/100gDM |
|---|---|---|---|---|---|---|
| $T_1$ | Y= 0.607+0.006X | 0.518* | 0.269 | 0.036 | 0.607 | 0.061 |
| $T_2$ | Y=0.767-0.001X | 0.327 | 0.107 | 0.009 | 0.767 | 0.077 |
| $T_3$ | Y= 0.702+0.000X | 0.194 | 0.380 | 0.004 | 0.702 | 0.070 |
| $T_4$ | Y= 0.738+0.001X | 0.775** | 0.600 | 0.004 | 0.738 | 0.074 |

MFN=Metabolic faecal nitrogen
TRT= Treatment; $T_1$= 0% CPM; $T_2$=60% CPM; $T_3$= 80% CPM; $T_4$= 100% CPM; SEM = Standard error of the mean;
** Correlation significant at $P<0.01$; * Correlation significant at $P<0.05$; NS = Not significant

Table 6 represents regression analysis and correlation coefficient between urinary nitrogen (g/d $WKg^{.075}$) (Y) and absorbed nitrogen (g/d $WKg^{0.75}$) (X) in WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal.

The degree of reliability ($R^2$) was low 17.5% in $T_2$ and 0% in $T_3$ but moderately reliable (53.4% and 46.4%) in $T_I$ and $T_{4,}$ respectively, indicating that metabolic urinary nitrogen prediction in $T_I$ and $T_4$ were moderately reliable.

The correlation coefficient was strongly positive (P<0.01) between metabolic urinary nitrogen and metabolic absorbed nitrogen in $T_I$ and $T_{4,}$ whereas the correlation was not significant in $T_2$ and $T_3$. The positive correlation in $T_I$ and $T_{4,}$ suggests direct and positive relationship between metabolic urinary nitrogen and metabolic absorbed nitrogen.

The endogenous urinary nitrogen (EUN) was lowest (0.689g/$Wkg^{0.75}$) in $T_I$ compared to the test diets ($T_2$, $T_3$ and $T_4$) which recorded 1.403, 0.880 and 0.964 g/d$Wkg^{0.75}$, respectively, implying that animals on these treatment groups required higher dietary nitrogen to maintain their body tissues than the control group ($T_1$).

**Table 6: Regression analysis and correlation coefficient between urinary nitrogen (g/d $WKg^{.075}$) (Y) and absorbed nitrogen (g/d $WKg^{0.75}$) (X) in WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal**

| TRT | Regression equation | Correlation Coefficient (r) | $R^2$ | SEM | Intercept On Y-axis | EUN (day/$Wkg^{0.75}$) g/100g |
|---|---|---|---|---|---|---|
| $T_1$ | Y= 0.689+0.005X | 0.731** | 0.534 | 0.007 | 0.689 | 0.689 |
| $T_2$ | Y= 1.403-0.003X | 0.419 | 0.175 | 0.009 | 1.403 | 1.403 |
| $T_3$ | Y= 0.880+0.000X | 0.014 | 0.000 | 0.010 | 0.880 | 0.880 |
| $T_4$ | Y= 0.964+0.003X | 0.682** | 0.464 | 0.005 | 0.964 | 0.964 |

TRT= Treatment; $T_1$= 0% CPM; $T_2$=60% CPM; $T_3$= 80% CPM; $T_4$= 100% CPM; SEM Standard error of the mean; **Correlation significant at P<0.01;NS = Not significant; Endogenous urinary nitrogen =EUN

Table 7 shows the regression analysis and correlation coefficient between nitrogen balance (g/d $WKg^{0.75}$) (x) in WAD goats fed replacement levels of cassava peel meal (CPM) maize offal.

The $R^2$ which is the degree of reliability have the same value (10%) in all the treatments. The coefficient of correlation (r) also showed significant (P<0.01) differences. The gradient of the lines relating faecal nitrogen and N-intake were the indices of biological value (BV) while the N-intake at zero and faecal nitrogen when multiplied by 6.25 gave the digestible crude protein (DCP) requirement for maintenance. The BV obtained for WAD goats in this study ranged from 89.33 in $T_2$ to 95.45 in $T_{1.}$ Mean BV obtained in this study (92.11) is however comparable to

97.00% for WAD goat fed 60% P.max. and 40% G. arboria (10) but higher than the value (65.25) reported by Okah *et al.* (15) for WAD sheep. The BV obtained on any study depends on the type of diet, on the nutrient profile of diets, and also on the animal species and physiological status of the animals (15). The mean DCP (3.56) in this study did not agree with the range (0.35-0.82g/d/WKg$^{0.75}$) DCP for WAD goats fed different browse combinations (10). The nitrogen in the diets was adequately digested with minimal losses, hence resulting in high DCP. The animals therefore had adequate supply of protein for absorption and metabolism. The variation in DCP may be attributed to type of diet consumed, physiological state and age of the animal.

The correlation coefficient (r) were significant (P<0.01), unitary and positive between metabolic nitrogen balance and metabolic absorbed nitrogen in all the treatments. The positive correlations in this study suggest that any increase in absorbed nitrogen is associated with an increase nitrogen balance. The positive regression coefficient 1.010, 1.033, 1.036 and 1.019 implies that for any unit change in absorbed nitrogen in these treatments, there was a corresponding increase in nitrogen balance as indicated by regression coefficient.

**Table 7: Regression analysis and correlation coefficient between nitrogen balance (g/d WKg$^{0.75}$) (Y) and absorbed nitrogen (g/d WKg$^{0.75}$) (X) in WAD goats fed replacement levels of cassava peel meal (CPM) for maize offal.**

| TRT | Regression equation | Correlation Coefficient (r) | $R^2$ | SEM | N-absorbed at zero balance | BV | DCP g/d/WKg$^{0.75}$ |
|---|---|---|---|---|---|---|---|
| $T_1$ | Y= 0.327+1.010X | 1.000** | 0.100 | 0.01 | -0.327 | 95.46 | 2.04 |
| $T_2$ | Y=-0.846+1.033X | 1.000** | 0.100 | 0.01 | -0.846 | 89.33 | 5.29 |
| $T_3$ | Y=-0.582+1.036X | 1.000** | 0.100 | 0.035 | -0.582 | 90.89 | 3.64 |
| $T_4$ | Y=-0.525+1.019X | 1.000** | 0.100 | 0.011 | -0.525 | 92.76 | 3.28 |

TRT= Treatment; $T_1$= 0% CPM; $T_2$=60% CPM; $T_3$= 80% CPM; $T_4$= 100% CPM; SEM Standard error of the mean; ** Correlation significant at P<0.01; NS = Not significant; BV= Biological value; DCP; Digestible crude protein ;The R-Square which is the degree of reliability; SEM=Standard Error of Mean

## Conclusion and Application

This study on the replacement of maize offal with cassava peel meal revealed the following:

1. That West African dwarf (WAD) goats fed diet 4 ($T_4$) (100%CPM) gave comparable results to the control group with respect to nutrient intake and nitrogen utilization.
2. In terms of relationship studies, the degree of reliability were also high in $T_I$ and $T_4$; suggesting that nitrogen intake can reliably predict faecal nitrogen. The correlation coefficient was positive between faecal nitrogen and nitrogen intake in all the

treatments.

3. The feeding potential of cassava peel meal was comparable to maize offal and, maize offal could be effectively replaced with cassava peel meal (CPM) up to 100% for adequate nutrient intake and utilization by goats.
4. Further studies on the replacement value of CPM for maize in the diets of other breeds of goats might be necessary especially on performance trials like growth, milk yield and even reproductive.

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