# ajava

Asian Journal of Animal and Veterinary Advances

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS

Asian Journal of Animal and Veterinary Advances

ISSN 1683-9919
DOI: 10.3923/ajava.2022.118.125

# Research Article
# Effect of Supplementing Cassava Peels with Lablab and Gliricidia Hay on Performance of Goats

Adegun Maria Kikelomo and Aye Pius Amoka

Department of Animal Science, Faculty of Agricultural Sciences, Ekiti State University, Nigeria

## Abstract
**Background and Objective:** Goats are often plagued with reduced weight gain and predisposition to diseases during the dry season. This study was undertaken to ascertain the effect of supplementing cassava peels with urea, *Lablab purpureus* and *Gliricidia sepium* hay on the growth and nutrient digestibility of confined West African Dwarf (WAD) goats. **Materials and Methods:** Sixteen yearling WAD goats weighing 7.2±0.3 kg were randomly assigned to four treatments and four replicates in a completely randomized design for 84 days. Urea treated cassava peels (UTCP) served as the basal diet ($T_1$) while in treatments 2-4, the goats were fed 75% untreated cassava peels with 25% lablab, 25% gliricidia and a mixture of 12.5% lablab and 12.5% gliricidia, respectively. **Results:** Crude protein (CP) varied from 10.80-11.20 g kg$^{-1}$ in $T_1$ and $T_4$, respectively. Metabolizable energy (ME) ranged from 2734.50 and 2956.10 kcal kg$^{-1}$ in $T_3$ and $T_1$, respectively. Animals on the $T_3$ diet consumed the least feed of 296 g/day. In terms of metabolic weight gain (MWG) and feed conversion ratio (FCR), performance in $T_1$ and $T_4$ were the best ($p<0.05$). Nitrogen retention was best in $T_1$ (54.91%) as compared to the least of 48.27 and 48.90% in $T_2$ and $T_3$, respectively ($p<0.05$). In terms of dry matter and crude fibre digestibility, $T_1$ and $T_4$ outperformed other treatments. **Conclusion:** Cassava peels with or without urea treatment and supplementation with an equal proportion of *Gliricidia sepium* and *Lablab purpureus* could yield positive moderate growth in WAD goats during the dry season.

Key words: Small ruminants, crop-by-product, legume fodder, dry season feeds, cassava peels, lablab, gliricidia, urea, WAD goats

Citation: Adegun, M.K. and P.A. Aye, 2022. Effect of supplementing cassava peels with lablab and gliricidia hay on performance of goats. Asian J. Anim. Vet. Adv., 17: 118-125.

Corresponding Author: Adegun Maria Kikelomo, Department of Animal Science, Faculty of Agricultural Sciences, Ekiti State University, Nigeria

Copyrig ht: © 2022 Adegun Maria Kikelomo and Aye Pius Amoka. This is an open access article distributed under the terms of the creative commons attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Goats play significant roles in the finance and budget of the resource-poor rural farmers in the tropics[1]. As ruminants, goats can subsist on fibrous biomass when compared with man and other animals and they contribute significantly to food security in smallholder farmers' economies and livelihood[2]. The dry season poses a nutritional challenge to small ruminants when they suffer scarcity of feed supply and poor nutritional value of available pasture if any at all[3,4]. They are thus plagued with reduced weight gain or weight loss and predisposition to diseases during this period. Goats being highly selective animals can still maintain body weight during the dry season if on a free-range. But when they are kept under intensive systems, adequate feed must be ensured for weight maintenance and growth.

Forages and hays for feeding goats should contain the necessary nutrients to cover their nutritional requirements. When these feed materials are deficient in certain nutrients, concentrate diets must be incorporated as supplements into the feed regime to ensure adequate nutrition. However, resource-poor farmers in the developing world find it difficult to use these supplements due to their unavailability and high costs[5,6]. Hence, there is a need to search for alternative feed sources that would meet the nutritional needs of these animals during this period.

Rural farmers who are the major custodians of goats often feed kitchen wastes such as cassava peels to their animals. Cassava peel is a readily available and abundant agro-industrial by-product used in various ruminant research in southwest Nigeria as feed to goats in various forms such as with rumen epithelia wastes, legume browses, concentrate mixtures, poultry manure and graded urea fertilizer[7-9]. It has been ascertained that the quality of protein incorporated in feed to utilize poor quality feedstuff by ruminants is not as important as the utilization of compounds rich in N-supplied with the fibrous feed material[10]. Increased N-supplies can improve the rumen environment in terms of appropriate pH buffer, rumen ammonia concentration and metabolites for increased fermentation of the basal feedstuffs and other by-products by rumen micro-organisms[11].

Urea is a non-protein nitrogen compound used to feed ruminants as a less costly and important source of nitrogen in the ration. Feed-grade urea contains about 42-46% nitrogen, which corresponds to a very high amount of crude protein Legume hay is a good source of protein and is mostly evergreen. It is readily available during the dry season when quality pasture is scarce, resulting in better productivity in goats. Fodder of *Leucaena leucocephala* and *Gliricidia sepium* plants have been widely researched as valuable browse supplements for small ruminants consuming low protein diets in southwest Nigeria[3,12,13]. These two legume fodders especially *Gliricidia sepium* is now popular among rural goat farmers in this area[6]. Better growth responses were recorded when cassava peels served as basal diets to supplements of gliricidia, Leucaena and moringa dried leaves[6]. However, *Gliricidia sepium* may be limited by its low acceptability and higher contents of toxic compounds and odour[3].

*Lablab purpureus* hay is a valuable forage for goats and sheep and can supplement forage-based diets of low quality, though it is known in many countries and has the capability of being an outstanding resource for agricultural systems in the tropics[14]. It is still underutilized in southwest Nigeria. In many areas where lablab could be beneficial, the ability to buy seed is restricted by the scarcity of seed, economic constraints and producers' willingness to take risks despite its seed being valuable as a food protein and its fodder as feed for ruminants. Lablab hay has also been found to be valuable forage that can supplement forage-based diets of low quality for a small ruminant.

Information on urea treated cassava peel as a basal diet supplemented with browses for goats in southwest Nigeria is scarce. This study was undertaken to ascertain the effect of supplementing cassava peel with high protein legume hays of lablab and gliricidia on the growth and digestibility of goats during the dry season.

## MATERIALS AND METHODS

**Experimental site:** This study was carried out at the small ruminants' section of the Teaching and Research Farm, Ekiti State University. Ado- Ekiti is the capital of Ekiti State located in the Southwest Geopolitical Zone of Nigeria. Ekiti State and enjoys a tropical climate with two distinct seasons. These are the rainy season (April-October) and the dry season (November-March). The duration of the study was from December 11, 2020-March 10, 2021. The site is between Latitude 07°37'15"N and Longitude 05°13'17"E. The temperature ranges between 21 and 28°C with high humidity. The tropical forest exists in the south, while the savannah occupies the northern peripheries. The rainfall is 1,367 mm and is characterized by bimodal distribution with peaks in June and September.

**Experimental diet:** Cassava peels were obtained from the cassava tuber processing unit in Ekiti State University Teaching and Research farm. The cassava peel was sundried for

4-6 days. 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 and pulverizing in a container. The product was pressed together to eliminate air while in the container. The mixture was then covered with a plastic sheet and ensiled for 21 days before being used as the basal diet.

The leaves of lablab were harvested from sown plants on the University Teaching and Research farm plots. They were thinly spread on concrete slabs under shade for seven days and kept in jute bags.

*Gliricidia sepium* leaves were harvested on the university premises and dried under shade for seven days after which they were kept in jute bags. The diets were formulated following the experimental design (four treatments) as follows:

**Treatment 1 :** Control (Urea treated cassava peel)
**Treatment 2 :** 75% untreated cassava peel + 25% *Lablab purpureus* hay
**Treatment 3 :** 75% untreated cassava peel + 25% *Gliricidia sepium* hay
**Treatment 4 :** 75% untreated cassava peel + 12.5% *Lablab purpureus* hay + 12.5% *Gliricidia sepium* hay

**Experimental animals and design of experiment:** The pen and equipment used for this experiment were thoroughly washed and disinfected to prevent any form of infection before the arrival of the animals. Twenty-four healthy yearlings of West African Dwarf bucks weighing 7.20+.03 kg were purchased from a reputable ruminant market in Ekiti State. The animals were tagged for easy identification purposes and held in the quarantine unit for 28 days for acclimatization. Medication and vaccination were given according to the procedure by standard procedure before assigning them randomly to their various treatments and replicates. The design of the experiment was a Completely Randomized Design (CRD) of four treatments with six replicates each. Clean and fresh water was supplied *ad-libitum*.

**Data collection:** The first 2 weeks (14 days) were the adjustment period designed to allow the animals to adjust to the feeding regime after which measurements were taken for documentation. The experiment lasted for 77 days. Daily feed was offered at 4% of their body weight and refusals were recorded to ascertain the feed intake. The urea treated cassava peel was aerated overnight under shade before offering to the animal to avoid volatile ammonia. Bodyweight changes of the animals were taken at around 8 am using the spring balance at the onset of the experiment and subsequently weekly. Live weight changes of the goats were calculated as the difference between the starting and the final experimental weight and averaged in each group. Performance indices were voluntary dry matter intake and growth rate. Body linear measurements were taken using centimeter (cm) graduated measuring tape according to procedure[15].

At 56 days of the experiment, three bucks from each treatment were assigned individually into metabolic cages where they had access to feed and freshwater for digestibility trial. The first 2 weeks (14 days) were the adjustment period to the cage. Thereafter daily feed intake was measured by offering the experimental diets to each animal and leftover was weighed. Each animal was weighed before the commencement and the end of the digestibility trial. During the last 7 days, the total faeces voided were collected and weighed and 10% aliquot samples were taken and oven-dried for 48 hrs. The urine sample was frozen while the faecal samples were dried at 65°C to a constant weight, milled using the laboratory hammer mill, to pass through a 2 mm sieve and stored in an airtight polythene bag till required for laboratory analysis.

**Chemical analysis:** The milled feed samples were subjected to proximate analysis for dry matter (DM) crude protein (CP), ether extract (EE), crude fibre (CF) and nitrogen free extract (NFE) as described by AOAC (2000). The milled faeces and aliquots of urine samples were also analyzed for nitrogen.

**Statistical analysis:** The data obtained were analyzed using Analysis of Variance (ANOVA) using SAS package 2020. This was followed by Duncan's multiple range comparison at a 5% level of significance where differences existed in the mean values.

## RESULTS

Proximate analysis of urea treated cassava peel and legume hays of gliricidia and lablab was shown in Table 1. The DM concentration of the diets ranged from 82.50 g kg$^{-1}$in 100% urea treated cassava peels ($T_1$) to 91.20 g kg$^{-1}$ in 75% untreated cassava peels supplemented with 25% lablab hay ($T_2$). Crude protein varied from 10.80 g kg$^{-1}$ in $T_1$ to 11.20 g kg$^{-1}$ in 75% untreated cassava peels with mixtures of 12.5% each of gliricidia and lablab hays ($T_4$). Ash and NFE were lowest (5.80 and 54.70 g kg$^{-1}$, respectively) in untreated cassava peel supplemented with 25% gliricidia hay ($_{T3}$) while EE values were 3.40, 4.02, 3.50 and 3.80 g kg$^{-1}$ in $T_1$, $T_2$, $T_3$ and

Table 1: Proximate composition of urea treated cassava peel diet and legume hay (g kg$^{-1}$)

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|
| Dry matter | 82.50 | 91.20 | 90.00 | 90.80 |
| Crude protein | 10.80 | 10.92 | 11.20 | 11.50 |
| Crude fibre | 23.10 | 22.30 | 24.80 | 23.20 |
| Ether extract | 3.40 | 4.02 | 3.50 | 3.80 |
| Ash | 6.60 | 6.22 | 5.80 | 6.20 |
| NFE | 56.10 | 56.56 | 54.70 | 55.30 |
| ME (kcal kg$^{-1}$) | 2956.10 | 2776.30 | 2734.50 | 2800.10 |

$T_1$:100% Urea treated cassava peel, $T_2$: 75% untreated cassava peel+25% Lablab hay, $T_3$: 75% untreated cassava peel+25% Gliricidia hay, $T_4$: 75% untreated cassava peel+12.5 Lablab hay+12.5% gliricidia hay

Table 2: Growth performance of WAD bucks fed urea treated cassava peel diet and legume hay

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM |
|---|---|---|---|---|---|
| Initial weight (kg) | 7.0 | 7.2 | 7.2 | 7.5 | - |
| Feed intake (g d$^{-1}$) | 326$^a$ | 330$^a$ | 296$^c$ | 310$^b$ | 1.02 |
| Final wt. (kg) | 9.20 | 9.00 | 8.80 | 9.81 | - |
| Total wt. gain (kg) | 2.20$^a$ | 1.80$^b$ | 1.60$^b$ | 2.31$^a$ | 0.30 |
| Average daily wt. gain (g/day) | 39.28$^b$ | 32.28$^c$ | 28.57$^d$ | 41.07$^a$ | 0.86 |
| Av. met. wt. gain ($W^{0.75}$ g$^{-1}$) | 15.69$^a$ | 13.54$^b$ | 12.36$^b$ | 16.22$^a$ | 0.54 |
| FCR | 8.29$^a$ | 10.26$^b$ | 10.36$^b$ | 7.51$^a$ | 1.02 |

Means along the same rows with similar superscripts are not significantly different (p>0.05), FCR: Feed conversion ratio and wt.: Weight

Table 3: Linear body measurements of WAD bucks fed urea treated cassava peel diet and legume hay (cm)

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM |
|---|---|---|---|---|---|
| Initial body length | 49.0 | 48.6 | 48.0 | 49.2 | 0.21 |
| Final body length | 54.0 | 53.7 | 53.1 | 54.6 | 0.21 |
| Body length gain | 5.0 | 5.1 | 5.1 | 5.4 | 0.32 |
| Initial wither height | 41.6 | 41.6 | 41.4 | 41.8 | 0.42 |
| Final wither height | 43.6 | 42.9 | 43.0 | 43.8 | 0.58 |
| Wither height gain | 1.6$^a$ | 1.3$^b$ | 1.6$^a$ | 2.0$^a$ | 0.10 |
| Initial head length | 14.1 | 14.1 | 14.0 | 14.0 | 0.24 |
| Final head length | 16.0 | 16.0 | 16.0 | 16.1 | 0.38 |
| Head length gain | 1.9 | 1.9 | 2.0 | 2.1 | 0.16 |
| Initial heart girth | 46.6 | 46.3 | 46.7 | 46.6 | 0.56 |
| Final heart girth | 52.0 | 51.2 | 51.0 | 52.1 | 0.72 |
| Heart girth gain | 5.4$^a$ | 4.9$^a$ | 4.3$^b$ | 5.5$^a$ | 0.32 |
| Initial ear length | 9.1 | 9.0 | 9.0 | 9.0 | 0.12 |
| Final ear length | 10.2 | 10.1 | 10.2 | 10.3 | 0.21 |
| Ear length gain | 1.1 | 1.1 | 1.2 | 1.3 | 0.12 |
| Initial tail length | 8.8 | 8.7 | 8.8 | 9.0 | 0.22 |
| Final tail length | 9.5 | 9.3 | 9.4 | 9.6 | 0.22 |
| Tail length gain | 0.7 | 0.5 | 0.6 | 0.6 | 0.22 |

$^{a-d}$Means along the same rows with similar superscripts are not significantly different (p>0.05)

$T_4$, respectively. Metabolizable energy ranged from 2734.50-2956.10 kcal kg$^{-1}$ in $T_3$-$T_1$, respectively.

The growth performance of WAD bucks fed urea treated cassava peel and legume hays of lablab and gliricidia were shown in Table 2. There were significant differences (p<0.05) in feed intake (FI), metabolic weight gain (MWG) and Feed Conversion Ratio (FCR) in all the treatments. Animals on the $T_3$ diet consumed the least feed (296 g/day), this was followed by $T_4$ (310 g/day) while there were no significant differences (p>0.05) in FI of $T_1$ and $T_2$ (326 and 330 g/day, respectively) with overall Standard Error of Means (SEM) at 1.02. In terms of MWG, there were no significant differences (p>0.05) in $T_1$ and $T_4$ (15.69 and 16.22 g/day, respectively) which were significantly higher (p<0.05) than $T_2$ and $T_3$ (13.54 and 12.36 g/day, respectively). The FCR ranged from 7.51 in $T_4$ to 10.36 in $T_3$. There was no significant difference (p>0.05) in the FCR of $T_1$ (8.29) and $T_4$ (7.51) which were better than those of $T_2$ and $T_3$.

Linear body measurements of WAD bucks fed urea treated cassava peels and legume hays were depicted in Table 3. Significant differences (p<0.05) exist in wither height and heart girth gain in all the treatments. Lowest wither height gain was recorded in $T_2$ (1.30 cm) while there were no significant differences (p>0.05) in $T_1$, $T_3$ and $T_4$ (1.6, 1.6 and 2.0 cm, respectively) with SEM of 0.10. Heart girth gain had the least significant value (p<0.05) in $T_3$ (4.3 cm) while there were

Table 4: Nitrogen balance of WAD bucks fed urea treated cassava peel diets and legume hay (g kg$^{-1}$)

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM |
|---|---|---|---|---|---|
| Nitrogen intake | 1.73 | 1.74 | 1.80 | 1.84 | 0.23 |
| Faecal nitrogen | 0.56$^b$ | 0.62$^a$ | 0.57$^b$ | 0.68$^a$ | 0.18 |
| Urinary nitrogen | 0.22$^b$ | 0.28$^b$ | 0.35$^a$ | 0.23$^b$ | 0.10 |
| Nitrogen retained | 0.95 | 0.84 | 0.88 | 0.93 | 0.08 |
| Nitrogen retained (%) | 54.91$^a$ | 48.27$^c$ | 48.90$^c$ | 50.54$^b$ | 0.26 |

$^{a-c}$Means along the same rows with different superscripts are significantly different (p<0.05).

Table 5: Nutrient digestibility of WAD bucks fed urea treated cassava peel diet and legume hay (%)

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM |
|---|---|---|---|---|---|
| Dry matter | 60.20$^a$ | 56.32$^b$ | 55.00$^b$ | 57.21$^b$ | 1.40 |
| Crude protein | 52.00 | 51.23 | 50.22 | 53.00 | 0.73 |
| Crude fibre | 62.20$^a$ | 53.30$^b$ | 53.00$^b$ | 61.20$^a$ | 1.73 |
| Ether extract | 50.00 | 51.80 | 49.30 | 49.60 | 0.77 |
| NFE | 53.07 | 55.20 | 51.60 | 52.60 | 1.22 |

$^{a-c}$Means along the same rows with different superscripts are significantly different (p<0.05)

no significant differences in heart girth gain of $T_1$, $T_2$ and $T_4$ (5.4, 4.9 and 5.5 cm, respectively) with SEM of 0.32. The other morphometric indices of body length, ear length, tail length and head length gains did not show any significant differences.

Nitrogen utilization of WAD bucks fed urea treated cassava peels and legumes hays were shown in Table 4. Faecal nitrogen (FN), urinary nitrogen (UN) and nitrogen retention (NR) showed significant differences (p<0.05) in all the treatments. There were no significant differences (p>0.05) in the FN of $T_1$ (0.53 g kg$^{-1}$) and T3 (0.57 g kg$^{-1}$) which were significantly lower (p<0.05) than the FN of $T_2$ (0.62 g kg$^{-1}$) and $T_4$ (0.68 g kg$^{-1}$). Significant similarities (p>0.05) exist in the values of UN in $T_1$, $T_2$ and $T_4$ (0.25, 0.28 and 0.23 g kg$^{-1}$, respectively) which were significantly lower (p<0.05) than $T_3$ (0.35 g kg$^{-1}$). Nitrogen retention was significantly higher (p<0.05) in $T_1$ (54.91%), this was followed by $T_4$ (50.54%) and least in $T_2$ and $T_3$ (48.27 and 48.90%, respectively) with an overall SEM of 0.26.

The nutrient utilization of WAD bucks fed urea treated cassava peel with legume hays was shown in Table 5. Crude protein digestibility showed that the values were increased in $T_4$ and $T_1$ (53.00 and 52.00%, respectively) and lowest in $T_2$ and $T_3$ (51.23 and 50.22%, respectively) without any significant differences (p>0.05) and SEM of 1.40. Significant differences (p<0.05) exist in the digestibility of DM and CF in all the treatments. Treatments 1 and 4 had the highest values of CF digestibility (60.20 and 62.20%, respectively). Treatments 2 and 3 had significantly lowest (p<0.05) but similar CF digestibility of 53.30 and 53.00%, respectively. While there were no significant differences in the DM digestibility of $T_2$, $T_3$ and $T_4$ (56.32 55.00 and 57.21%, respectively), $T_1$ recorded the highest value of 60.20% in DM digestibility.

## DISCUSSION

The CP composition of Urea Treated Cassava Peel (UTCP) obtained from this study (10.80 g kg$^{-1}$) was comparable with the CP obtained in 4% UTCP of 9.75 and 9.95 g kg$^{-1}$ by other researchers[16,17]. This value was higher than the CP of dried fermented cassava peel of 5.80 g kg$^{-1}$ in a study by Suranindyah and Astuti[18] and dried cassava peel of 3.28 g kg$^{-1}$ by Asaolu *et al.*[6]. The higher CP of UTCP was due to ammoniation of the cassava peels in which the hydrolysis of the urea boosted the nitrogen content of the cassava peel as obtained in other urea treated crop by-products reported by some researchers[16,19,20]. However, the CP contents in all the treatments in this study were comparable with the 11% needed to provide ammonia levels for optimum activity of rumen microbes[21]. The CP of all the treatments were adequate for growing goats. It has been ascertained that up to 11-13% supply of CP was needed for maintenance and moderate growth in goats[6].

The dry matter intake (DMI) in this experiment was comparable to the DMI of 288.48-354.49 g/day when dried cassava peels were served as a basal diet to concentrate diets with leaves of Moringa, Gliricidia, Leucaena and a reference concentrate diet[6]. This result is also in line with 223-381 g/day obtained when graded levels of urea treated cassava peels served as supplements to goats grazing natural herbage[16] but lower than the DMI of 333-626 g/day in Adilo sheep fed urea treated wheat straw supplemented with enset, atella and their mixtures[21].

The least DMI observed in gliricidia supplements in this study agreed with the result obtained in goats offering supplements of gliricidia to cassava peels basal diet[6]. Babayemi *et al.*[22] also observed lower feed intake in gliricidia compared with lablab as supplements to *Panicum maximum* basal diet. The variations in DMI may be due to the CP contents of the feed, physiological state of the animals, voluntary feed intake of the feeds and differences in basal diets. Gliricidia has been implicated to have low voluntary feed intake by animals due to high contents of toxic compounds and odour[3]. For many tree leaves, palatability has been related to the contents of volatile compounds, tannins, essential oils or other aromatic compounds present in their fodder.

Higher daily weight gain of 62.14 g/day in goats fed natural herbage supplemented with UTCP in a study conducted by[16] compared with basal UTCP in this study may not be unconnected to the fact that goats can select the most nutritive portion of the herbage when given an opportunity on a free range[23]. There was a positive correlation between CP, DMI and growth[24]. In this study, the best metabolic weight gains were obtained in the control treatment (100% UTCP) and goats in treatment 4 (75% cassava peels, 12.5% lablab hay, 12.5% gliricidia hay), while the least daily metabolic growth in Gliricidia supplemented cassava peel is in line with other results reported by Uza *et al.*[16] and Asaolu *et al.*[6].

Similarly, FCR showed the same pattern. Animals on 4% UTCP recorded superior performance in daily weight gain, weight gain per gram nitrogen intake and FCR[16,17] compared with other treatments. The better average daily weight gain in lablab hay supplement (32.28 g/day) than that of Gliricidia (28.57 g/day) in this study is in line with the result of Babayemi *et al.*[22].

The significant differences in heart girth and wither heights in all the treatments are indications that linear measurements have a significantly positive correlation with body weights. In this study, increased body weight in treatments 1 and 4 was corroborated by the level of significance in heart girth[25,26].

The positive NR (balance) values observed in this study may be indicated that the diets were adequate in their supply of nitrogen to the rumen. However, the nitrogen balance recorded (0.84-0.95 g/day) for goats in the present study was lower than the 3.79-7.52 g/day reported for WAD goats fed *Azadirachta indica*, *Newbouldia laevis* and *Spondias mombin* leaves[27]. Although, it is comparable to 0.9-2.0 g/day reported for goats fed a sole diet of Guinea grass or in a mixture with *Ficus religiosa*[28]. The differences could be a result of the higher nutritive value of the basal diets compared with the two studies. Nitrogen balance is a good indicator of the protein value of the diet only when the amino acid supply is balanced with the energy supply. The treatment groups had moderate protein and energy contents. If there is a surplus of metabolizable protein, amino acids are oxidized and N is excreted irrespective of the real protein value of the diet. The best N-utilization parameter recorded for UTCP in this study as indicated by low excretion of urinary nitrogen, coupled with the highest N retention (54.91%) confirmed the better quality of urea treatment of cassava peel compared to the other sources of protein used.

The values obtained for CP digestibility obtained in this study were lower than 76.89-85.68% in red Sokoto goats fed urea treated maize stover with graded levels of *Balanites aegyptiaca* foliage[29]. The digestibility of DM, ash, CF and NFE also followed the same pattern. The digestibility values of CP, CF, DM and ash obtained in this study were in line with 49.57-59.57% obtained in untreated rice straw and Concentrate feeds at 1% LW fed to goats. These differences may imply that more nutrients are deliberated for use by the animal which could contribute to better production performance. Besides, increased digestibility is coupled with an increase in nutrient intake due to a better turnover rate in the rumen. The animals on $T_1$ and $T_4$ had better crude fibre digestibility. This finding was in agreement with the study of Okoruwa *et al.*[30], where it was reported that the digestibility of crude fibre may be due to the wall configuration of their polysaccharides and their effect on microbial attachments and colonization of digest particles.

## CONCLUSION

Urea treatment of cassava peel promoted DMI with corresponding increased growth performance by goats due to better rate and extent of degradation of UTCP compared with untreated cassava peel with lablab and gliricidia hay. Supplementing 75% untreated cassava peel with an equal proportion of lablab and gliricidia also resulted in better performance in terms of growth and nutrient digestibility. Overall, cassava peel with or without urea treatment but supplementation with legume hays could yield positive moderate growth in goats during the dry season.

## SIGNIFICANCE STATEMENT

The dry season poses tremendous stress to goats' growth and productivity due to the non-availability and poor nutritive quality of feed offered to these animals during this period. The findings of this research would enable the resource-poor goat farmers in the developing countries to offer urea treated cassava peels or cassava peels with legume browses as supplements to goats for better performance and profitability.

**REFERENCES**


1. Miller, B.A. and C.D. Lu, 2019. Current status of global dairy goat production: An overview. Asian-Australas. J. Anim. Sci., 32: 1219-1232.
2. Wodajo, H.D., B.A. Gemeda, W. Kinati, A.A. Mulem, A. van Eerdewijk and B. Wieland, 2020. Contribution of small ruminants to food security for Ethiopian smallholder farmers. Small Ruminant Res., Vol. 184. 10.1016/j.smallrumres. 2020.106064.
3. Adegun, M.K., 2014. Voluntary feed intake and nutrient utilization of West African Dwarf sheep fed supplements of *Moringa oleifera* and *Gliricidia sepium* fodders. Am. J. Agric. For., 2: 94-99.
4. Lamidi, A.A. and F.I. Ologbose, 2014. Dry season feeds and feeding: A threat to sustainable ruminant animal production in Nigeria. J. Agric. Social Res., 14: 17-30.
5. Nouala, F.S., O.O. Akinbamijo, A. Adewumi, E. Hoffmann, S. Muetzel and K. Becker, 2006. The influence of *Moringa oleifera* leaves as substitute to conventional concentrate on the *in vitro* gas production and digestibility of groundnut hay. Livest. Res. Rural Dev., Vol. 18.
6. Asaolu, V., R. Binuomote, J. Akinlade, O. Aderinola and O. Oyelami, 2012. Intake and growth performance of West African dwarf goats fed *Moringa oleifera*, *Gliricidia sepium* and *Leucaena leucocephala* dried leaves as supplements to cassava peels. J. Biol. Agric. Healthcare, 2: 76-88.
7. Bawala, T.O., A.O. Akinsoyinu and O.R. Folorunsho, 2006. Nutritional evaluation of varying proportions of *Gliricidia sepium* and *Ficus thonningii* leaves in the diet of young West African dwarf goats. Nig. J. Anim. Prod., 33: 112-117.
8. Ukanwoko, A.I. and J.A. Ibeawuchi, 2014. Evaluation of cassava peel-cassava leaf meal based diets for milk production by the West African Dwarf goats in South Eastern Nigeria. IOSR J. Agric. Vet. Sci., 7: 27-30.
9. Adegun, M.K., O.F. Alamuoye and P.A. Aye, 2017. Growth, morphostructural and haematological performances of West African Dwarf male sheep fed garlic powder additive diets. Sci. J. Anim. Sci., 6: 428-435.
10. Kalio, G.A., A.A. Ayuk and L.N. Agwunobi, 2014. Performance of West African Dwarf (WAD) goats fed N-treated source and forage supplemented cassava peels in humid cross River State, Nigeria. J. Exp. Agric. Int., 4: 629-638.
11. Bach, A., S. Calsamiglia and M.D. Stern, 2005. Nitrogen metabolism in the rumen. J. Dairy Sci., 88: E9-E21.
12. Asaolu, V.O. and S.M. Odeyinka, 2006. Performance of West African dwarf sheep fed cassava peel based diets. Niger. J. Anim. Prod., 33: 230-238.
13. Adegun, M.K. and P.A. Aye, 2013. Growth performance and economic analysis of West African Dwarf Rams fed *Moringa oleifera* and cotton seed cake as protein supplements to *Panicum maximum*. Am. J. Food Nutr., 3: 58-63.
14. Mbahi, T.F. and D.Y. Goska, 2017. Utilization of acha hay (*Gigistaria exilis*) with lablab hay (*Lablab purpureus*) as supplement for Yankasa rams in Adamawa State, Nigeria. Global J. Agric. Sci., 16: 37-41.
15. Jibir, M., A.M. Isa, S. Garba and A.B. Jibrila, 2013. Linear body measurements and slaughter characteristics of meat goats in the Semi-Arid Zone of North-Western Nigeria. J. Anim. Sci. Adv., 3: 297-303.
16. Uza, D.V., R.E. Barde and J.A. Ayoade, 2005. The effect of urea treated cassava peels as supplement to West African Dwarf (WAD) goats grazing natural pasture. Nig. Vet. J., 26: 1-9.
17. David, A.A., O.B. Osigbodi, A.S. Oluwatoyin and S.P. Adejoh, 2020. Performance of West African dwarf goats fed cassava peels treated with nitrogen sources. GSC Biol. Pharm. Sci., 10: 9-12.
18. Suranindyah, Y. and A. Astuti, 2012. The effects of feeding dried fermented cassava peel on milk production and composition of Etawah crossedbred goat. World Acad. Sci. Eng. Technol., 6: 911-914.
19. Hailu, A., S. Melaku, B. Tamir and A. Tassew, 2011. Body weight and carcass characteristics of Washera sheep fed urea treated rice straw supplemented with graded levels of concentrate mix. Livest. Res. Rural Dev., Vol. 23.
20. Assefa, F., M. Urge and G. Animut, 2015. Growth performance of Adilo sheep fed urea treated wheat straw supplemented with enset (*Ensete ventricosum*), atella and their mixtures. Afr. J. Agric. Res., 10: 2444-2452.
21. Hackmann, T.J. and J.L. Firkins, 2015. Maximizing efficiency of rumen microbial protein production. Front. Microbiol., Vol. 6. 10.3389/fmicb.2015.00465.
22. Babayemi, O.J., F.T. Ajayi, A.A. Taiwo, M.A. Bamikole and A.K. Fajimi, 2006. Performance of West African dwarf goats fed *Panicum maximum* and concentrate diets supplemented with Lablab (*Lablab purpureus*), Leucaena (*Leucaena leucocephala*) and Gliricidia (*Gliricidia sepium*) foliage. Nig. J. Anim. Prod., 33: 102-111.
23. Mellado, M., A. Rodríguez, E.A. Lozano, J. Dueñez, C.N. Aguilar and J.R. Arévalo, 2012. The food habits of goats on rangelands with different amounts of fourwing saltbush (*Atriplex canescens*) cover. J. Arid Environ., 84: 91-96.
24. Zhang, X., W. Wang, F. Mo, Y. La, C. Li and F. Li, 2017. Association of residual feed intake with growth and slaughtering performance, blood metabolism, and body composition in growing lambs. Sci. Rep., Vol. 7. 10.1038/s41598-017-13042-7.
25. Ravimurugan, T., A.K. Thiruvenkadan, K. Sudhakar, S. Panneerselvam and A. Elango, 2013. The estimation of body weight from body measurements in Kilakarsal Sheep of Tamil Nadu, India. Iran. J. Appl. Anim. Sci., 3: 357-360.
26. Yunusa, A.J., A.E. Salako and O.B. Okewoye, 2014. Path analysis of the relationship between body weight and some linear characters in West African Dwarf sheep. Anim. Genet. Resour., 55: 57-66.

27. Adelusi, O.O., O.A. Isah, C.F.I. Onwuka, A.O. Yusuf, V.O.A. Ojo and R.Y. Aderinboye. 2016. Performance, digestibility and nitrogen balance of West African Dwarf goats fed *Azadirachta indica*, *Newbouldia laevis* and *Spondias mombin* leaves. Niger. J. Anim. Sci., 18: 507-517.
28. Bamikole, M.A., 2003. Macro-minerals bioavailabilty study in goats fed forages of nitrogen fertilized guinea grass and guinea grass-veranostylo mixture. Livest. Res. Rural Dev., Vol. 15.
29. Hyelda, A.J., M.M. Yahya and Z.A. Gworgwor, 2017. Growth performance and nutrient digestibility of red sokoto goats fed urea treated maize stover supplemented with graded levels of *Balanites aegyptiaca* leaf forage. Asian Res. J. Agric., Vol. 6. 10.9734/ARJA/2017/36076.
30. Okoruwa, M.I., F.U. Igene and M.A. Isika, 2012. Replacement value of cassava peels with rice husk for guinea grass in the diet of West African Dwarf (WAD) sheep. J. Agric. Sci., 4: 254-261.