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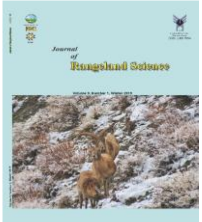


**Research and Full Length Article:**

# Nitrogen Metabolism, Digestibility and Blood Profile of West African Dwarf Goats Fed Dietary Levels of *Cajanus cajan* as Supplement to Cassava Peels

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**Abstract.** The effect of inclusion level on nutrient intake, digestibility, nitrogen metabolism and haematological parameters of West African Dwarf (WAD) goat fed *Cajanus cajan* as supplement to cassava peels was investigated in a completely randomized design experiment using twenty-four WAD goats with average initial weight of 10.75±0.85kg (March-September, 2016). There were four treatments as: A=100% Cassava peels (control); B=75% Cassava+25% *C. cajan*; C=50% Cassava+50% *C cajan*; D=25% Cassava+75% *C. cajan* hay. Result showed that *C. cajan* had better nutrient values with 15.53% Crud Protein (CP) and 30.55% Crude Finer (CF) contents than cassava peels with 4.70 % CP and 13.35 % CF. Inclusion of *C. cajan* as supplement to cassava peels in the diets of WAD goat significantly lowered ($p<0.05$) DM intake. CP intake increased with increased hay supplementation. CP, CF, NDF, ADF and ADL intakes were highest in goats fed diet D. Nutrient digestibility and N retained were best under treatment D-75% *C. cajan* inclusion. Consequently, the highest weight gain (16.98 g/day) was recorded for goats fed diet D. The higher values of 27.33% Packed cell volume (PCV), 9.12 g/dl Haemoglobin (Hb), 12.07 $x10^6$ ml Red blood cell (RBC) and 4.91 $x10^3$ ml White blood cell (WBC) counts for animals were obtained using treatment D that they were within the normal physiological range for healthy goat.

**Keywords:** Digestibility, Haematological profile, WAD goat, *Cajanus cajan*

## Introduction

One of the major factors limiting the productivity of small ruminants in developing countries like Nigeria is the over-dependence on low digestibility feeds which at certain periods of the year cannot meet even the maintenance requirements of these animals. These feed resources are categorized as high fibre low protein feeds; and they include native grasses, crop residues and fibrous agro-industrial waste products like cassava peels (Jayarasuriya, 2002). They form the bulk of feed consumed by small ruminants in tropics, because they are abundantly available, relatively cheap and are not competed for by man. Furthermore, with increasing demand for livestock products to bridge the gap of inadequate animal protein intake as a result of ever increasing human population, rapid growth in the world economies and shrinking land area, future hope of feeding the millions of people and safeguarding their food security will depend on the better utilization of non-conventional feed resources (Omotoso *et al.*, 2017). Thus, this has awakened the need for sustainable husbandry practices as a means of coping and managing the livestock sub-sector in Nigeria. Paramount among such innovative practices is the sourcing and utilization of non-conventional energy and protein feedstuffs for cost effective livestock production. Pigeon pea (*Cajanus cajan)* which is one of the most common legumes of the tropics and sub-tropics with a wide adaptability (Speranza *et al.*, 2007) is a good example.

Pigeon peas (*Cajanus cajan)* hay is emerging as common domestic forage plants as they are raised in traditional home gardens in many parts of Nigeria. Pigeon peas are ever green and could be used as potential source of forage for ruminant animals year round because they are drought tolerant, and they could supplement low quality roughages for better utilization.

Pigeon pea's low food value for humans due to low palatability when compared to cowpea and prolonged cooking time, coupled with no industrial use in Nigeria (Amaefule and Obioha, 2001), qualifies it as a suitable source of animal feed. It is rich in nitrogen (21-30% CP) (Obioha, 1992; Amaefule and Onwudike, 2000). Meanwhile, cassava peel is a major by-product of the cassava tuberous root processing industry which can serve as a source of energy in ruminant feeding systems, either as the main basal diet or as a supplement. It is rarely fed fresh because of the high level of cyanogenic glycoside in the material. Sun drying, ensiling and fermentation have been used to reduce the concentration of the glycosides to tolerable levels (Aro *et al.,* 2008; Pham and Preston, 2009). Evaluation of the blood profile of animals may give some insight as to the potentials of a dietary treatment to meet the metabolic needs of the animal; hence inference can be drawn on the nutritive value of a feed via the blood constituents. Thus, the crux of this study was to evaluate the digestibility, nitrogen metabolism and blood profile of WAD goats fed dietary levels of *Cajanus cajan* as supplement to cassava peels.

## Materials and Methods

### Experimental site, cassava peels collection and hay preparation

The experiment was carried out at the Small Ruminant Unit of the Teaching and Research Farm of the Federal University of Technology, Akure (Latitude $7^0$ 18" and Longitude $5^0$ 10"E) (Aro *et al.,* 2008) between March-September, 2016. One hectare of land was acquired at the Teaching and Research Farm of the Federal University of Technology, Akure, to establish *Cajanus cajan* pasture. The land was ploughed and harrowed; two to three seeds of pigeon pea were planted per pit using a planting space of 60 x 60cm and were managed for 3-4 months prior to the flowering stage and commencement of harvesting. Cassava peels were collected at cassava or "gari" processing industries in Akure, Ondo-State, Nigeria. The peels were treated by sun drying for 3-5 days depending on the intensity of the sun to reduce the cyanide content and moisture content while *Cajanus cajan* hay preparation was done by air-drying the cut forage for 3-4 days under tree-shade to preserve the green color and nutrients.

## Experimental animal and management

A total number of 24 matured West African Dwarf (WAD) female goats age range 12-18 months, with an average live-weight of 10.75±0.85kg were used. The goats randomly allotted to four dietary treatments of six goats per replicate and were balanced for weight per treatment in a completely randomized design. The goats were acclimatized for thirty days during which routine managements like feeding on grasses and concentrate supplement. The animals were vaccinated against *Pesté-Petit dé Ruminanté* (PPR/kata) using PPR vaccine at the rate of 1ml per animal, treated against ecto-parasite using Diasuntol® and were also treated against infections by using oxytetracycline LA® at the rate of 1ml per 10kg body weight of animal to stabilize the animals before the commencement of the study. The goats were divided into four groups of six animals each after balancing for weight and each group randomly assigned to one of four treatments namely: A=100% Cassava peels (control); B=75% Cassava peels+25% *Cajanus cajan* hay; C=50% Cassava peels+50% *Cajanus cajan* hay; D=25% Cassava peels+75% *Cajanus cajan* hay.

The animals were housed individually in pen measuring 1.8 x 0.5m. An acclimatization period of 7days (after quarantine) was allowed before commencement of data collection. Animals were fed 5% body weight early in the morning (8:00am) and supplied cool, fresh drinkable water (*ad libitum*) during the experimental period of 63 days. The daily feed intake was determined by deducting the refusals from the quantity offered. Meanwhile, the animals were repeatedly weighed weekly in the morning before feeding, to observe any weight change using spring-balance (hanging scale).

## Digestibility trial

In the last week of the experiment, total fecal and urinary outputs were collected from each animal daily and weighed. 10% of daily fecal output were dried, bulked together and stored until needed for chemical analysis while 10% of the daily urine output preserved with 10% sulphuric acid was frozen till it was required for nitrogen analysis. Feed and fecal samples were oven-dried, ground to pass through 1mm screen and analyzed for chemical compositions (AOAC, 2002). Nitrogen in urine was determined by microkjedahl methods. Results obtained were used to calculate the nutrients intake, digestibility, N balance and retention. The fibre fractions measured were Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), and Acid Detergent Lignin (ADL) and were determined according to (Van Soest *et al.,* 1991). Hemicellulose was calculated as the difference between NDF and ADF; while cellulose as the difference between ADF and ADL.

## Haematological studies

Blood were collected from the jugular vein of the experimental animals at the termination of the experiment in a vial containing Ethylene Diamine Tetraacetic Acid (EDTA). The bottles were immediately capped and the content mixed gently for about a minute by repeated inversion or rocking. Blood samples were analyzed immediately after collection for packed cell volume (PCV) and haemoglobin (Hb) concentration as described by (Cork and Halliwell, 2002). Red blood cells (RBC), white blood cell (WBC) as well as the differential WBC counts were determined using the Neubauer haemocytometer after appropriate dilution (Lamb, 1981). Values for the constants: mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) were calculated from RBC, Hb and PCV values as described by (Jain, 1993).

## Statistical analysis

All data obtained were subjected to one-way analysis of variance using (SAS, 2008); and where significant differences are found, the means were compared using Duncan Multiple Range Test of the same package.

## Results

## Nutrients composition

The chemical composition of *Cajanus cajan* hay and cassava peels depicted in Table 1 show that both feed materials had comparable Dry matter (DM) contents (86.34% and 85.00% respectively). The Crude protein (CP) content of *C. cajan* hay at 15.53% was higher than that for cassava peels (4.70%). However, this CP value of 15.53% exceeds by far the minimum protein requirements (8% CP) for ruminants. The NDF and ADF content of *C. cajan* (61.05 and 41.71%) were higher than that of cassava peels (53.12 and 34.18%) respectively.

## Nutrients intake

Table 2 shows the nutrients intake by the WAD goats fed dietary inclusions of *C. cajan* and cassava peels. The DM intake ranged from 259.86g/day to 271.50g/day. Goats fed diet B had the highest intake value which was similar (P>0.05) to those fed diet A. CP intake varied significantly (p<0.05) across the treatment means; it ranged from 14.97g/day (diet A) to 44.52g/day (diet D). The CF intake was highest in animals fed diet D and least for animals fed diet A. Nitrogen free extract varied significantly (p<0.05), as animals fed diet A had the highest value while animals fed D had the least observed value. Goats fed diet D had the highest fibre fractions intake. The energy intake increased with increased inclusion of the *C. cajan* hay, though animals fed diet A had the highest recorded value.

## Nutrient digestibility

Table 3 shows the nutrients digestibility by WAD goats fed the experimental diets. The nutrient digestibility values were influenced by the inclusion of *C. cajan* in the diets. Animals fed diet D had the highest value recorded for all the nutrients. Conversely, the least DM, CP, CF, EE, cellulose digestibilities were obtained in treatment A.

## Nitrogen balance and performance characteristics by WAD goats fed experimental diets

Table 4 shows the effect of experimental diets on nitrogen (N) balance and performance characteristics when graded *C. cajan* hay were fed to WAD goats. N intake and nitrogen retention increased progressively from treatment A to D; it had significant (p<0.05) influence with the inclusion of *C. cajan* in the diets. Animals fed diet D had the highest nitrogen intake while those fed diet A had the least. Faecal nitrogen output was highest for animals fed diet C and least for animals fed diet A. Animals fed diet C had the highest urinary nitrogen output while those fed diet A had the least. The highest nitrogen retained was recorded for animals fed diet D and least for those placed on diet A.

There were no significant (P>0.05) variations amidst the observed values of initial and final live-weight however, animals fed diet A had the least value of final weight and the values increased numerically with increased inclusion levels of *C. cajan* in the diets. The weight gain per day and feed gain ratio values were influenced significantly ($p<0.05$) by the inclusion of *C. cajan* in the diets. The daily weight gain value reported for animals fed diet D was the highest while the least value was recorded for animals fed diet A. The weight gain increased with increased inclusion levels of *C. cajan* in the diets. The feed gain ratio values ranged from 15.06 (diet D) to 74.26 (diet A).

## Haematological parameters of WAD goats fed experimental diets

Results of effect of experimental diets on haematological parameters of WAD goats are presented in Table 5. There were no significant differences in the values recorded for erythrocyte sedimentation rate (ESR), packed cell volume (PCV), and Haemaglobin (Hb). The parameters influenced ($p<0.05$) by the inclusion of varying levels of *C. cajan* hay in the experimental diets were Red blood cell (RBC), White blood cell (WBC) and mean corpuscular volume (MCV). The highest values of PCV, Hb, RBC and WBC were recorded for animals fed diet D. The MCV ranged from 22.64pg (diet D) to 23.95pg (diet A). There were no significant ($P>0.05$) variations among the mean corpuscular haemoglobin concentration (MCHC), but they deferred numerically. There were no significant ($P>0.05$) variations among the values obtained in respect of lymphocytes, neutrophils, monocytes and basophils. Eosinophils value was highest for animals fed diet D and least for animals fed diet A.

**Table 1.** Chemical and mineral compositions of *Cajanus cajan* hay and *Cassava* peels

| **Nutrients (%)** | ***Cajanus cajan* hay** | **Cassava peels** | **±SEM** |
|---|---|---|---|
| Dry matter | 86.34 | 85.00 | 0.21 |
| Crude protein | 15.53 | 4.70 | 1.38 |
| Crude fibre | 30.55 | 13.35 | 2.17 |
| Ether extract | 1.80 | 3.00 | 0.15 |
| Ash | 4.03 | 7.01 | 0.43 |
| Nitrogen free extract | 34.79 | 57.03 | 2.81 |
| Neutral detergent fibre | 61.05 | 53.12 | 0.87 |
| Acid detergent fibre | 41.71 | 34.18 | 0.98 |
| Acid detergent lignin | 19.20 | 7.92 | 1.49 |
| Hemi-cellulose | 19.34 | 18.94 | 0.35 |
| Cellulose | 22.51 | 26.27 | 0.79 |
| *****Gross energy (KJ/100gDM) | 14.18 | 15.80 | 0.26 |

*****Calculated according to (Ekanayake *et al.*, 1999). SEM =standard error of mean. (n=3)

**Table 2.** Nutrients intake (g/day) by WAD goats fed experimental diets

| **Components** | **Diet A** | **Diet B** | **Diet C** | **Diet D** | **±SEM** |
|---|---|---|---|---|---|
| Dry matter | 271.06$^{a}$ | 259.86$^{c}$ | 271.50$^{a}$ | 265.04$^{b}$ | 1.81 |
| Crude protein | 14.97$^{d}$ | 23.47$^{c}$ | 30.83$^{b}$ | 44.52$^{a}$ | 4.10 |
| Crude fibre | 42.55$^{d}$ | 47.72$^{c}$ | 59.93$^{b}$ | 79.39$^{a}$ | 5.36 |
| Ether extract | 9.57$^{a}$ | 8.76$^{b}$ | 7.53$^{c}$ | 6.54$^{d}$ | 0.44 |
| Ash | 22.34$^{a}$ | 23.50$^{a}$ | 16.88$^{b}$ | 14.50$^{c}$ | 1.42 |
| Nitrogen free extract | 181.63$^{a}$ | 168.04$^{b}$ | 144.68$^{c}$ | 120.09$^{d}$ | 8.86 |
| Neutral detergent fibre | 169.38$^{c}$ | 175.05$^{b}$ | 176.58$^{b}$ | 182.42$^{a}$ | 1.83 |
| Acid detergent fibre | 108.99$^{b}$ | 113.90$^{ab}$ | 115.28$^{ab}$ | 119.91$^{a}$ | 1.66 |
| Acid detergent lignin | 25.24$^{d}$ | 40.40$^{c}$ | 48.22$^{b}$ | 61.32$^{a}$ | 4.95 |
| Hemi-cellulose | 60.40 | 61.15 | 61.30 | 62.51 | 0.94 |
| Cellulose | 83.75$^{a}$ | 74.89$^{b}$ | 65.69$^{c}$ | 58.59$^{c}$ | 3.65 |
| Gross energy (KJ/100gDM) | 42.83$^{a}$ | 36.20$^{b}$ | 37.22$^{b}$ | 37.77$^{b}$ | 0.87 |

abc= means within the same row with different superscripts are significantly different ($p<0.05$). SEM =standard error of mean.

**Table 3.** Nutrient digestibility (%) by WAD goats fed experimental diets

| Nutrients | Diet A | Diet B | Diet C | Diet D | ±SEM |
|---|---|---|---|---|---|
| Dry matter | 54.54$^{c}$ | 54.70$^{c}$ | 68.05$^{b}$ | 72.68$^{a}$ | 3.04 |
| Crude protein | 79.18$^{c}$ | 84.92$^{b}$ | 86.02$^{b}$ | 87.82$^{a}$ | 3.18 |
| Crude fibre | 51.32$^{d}$ | 53.73$^{c}$ | 65.71$^{b}$ | 71.66$^{a}$ | 1.23 |
| Ether extract | 68.82$^{c}$ | 74.11$^{b}$ | 83.06$^{a}$ | 85.05$^{a}$ | 2.51 |
| Nitrogen free extract | 47.56$^{d}$ | 51.39$^{c}$ | 64.51$^{b}$ | 67.00$^{a}$ | 3.14 |
| Neutral detergent fibre | 70.16$^{d}$ | 74.49$^{c}$ | 79.36$^{b}$ | 82.00$^{a}$ | 1.72 |
| Acid detergent fibre | 70.19$^{d}$ | 73.13$^{c}$ | 78.96$^{b}$ | 81.80$^{a}$ | 1.75 |
| Acid detergent lignin | 70.90$^{c}$ | 73.97$^{b}$ | 79.86$^{a}$ | 81.90$^{a}$ | 1.69 |
| Hemi-cellulose | 70.10$^{b}$ | 76.74$^{a}$ | 80.45$^{a}$ | 82.38$^{a}$ | 1.85 |
| Cellulose | 69.64$^{d}$ | 72.88$^{c}$ | 78.46$^{b}$ | 81.69$^{a}$ | 1.80 |
| Gross energy | 67.72$^{a}$ | 61.92$^{b}$ | 61.96$^{b}$ | 62.18$^{b}$ | 1.71 |

abc= means within the same row with different superscripts are significantly different ($p<0.05$). SEM=standard error of mean.

**Table 4.** Nitrogen utilization and performance characteristics by WAD goats fed experimental diets

| Components | Diet A | Diet B | Diet C | Diet D | ±SEM |
|---|---|---|---|---|---|
| **Nitrogen Utilization(g/day)** | | | | | |
| Nitrogen intake | 2.40$^{d}$ | 3.76$^{c}$ | 4.93$^{b}$ | 7.12$^{a}$ | 0.66 |
| Faecal nitrogen | 0.36$^{c}$ | 0.46$^{b}$ | 1.03$^{a}$ | 1.00$^{a}$ | 0.11 |
| Urinary nitrogen | 0.08$^{c}$ | 0.09$^{b}$ | 0.18$^{a}$ | 0.17$^{a}$ | 0.02 |
| Nitrogen retained | 1.96$^{d}$ | 3.20$^{c}$ | 3.72$^{b}$ | 5.95$^{a}$ | 0.55 |
| **Performance characteristics** | | | | | |
| Initial weight (kg) | 10.18 | 10.75 | 10.78 | 10.72 | 0.85 |
| Final weight (kg) | 10.40 | 11.13 | 11.62 | 11.78 | 0.87 |
| Weight gain (kg) | 0.23$^{c}$ | 0.38$^{bc}$ | 0.83$^{ab}$ | 1.07$^{a}$ | 0.13 |
| Weight gain (g/day) | 3.65$^{c}$ | 6.03$^{bc}$ | 13.17$^{ab}$ | 16.98$^{a}$ | 2.03 |
| Feed/gain ratio | 74.26$^{c}$ | 45.02$^{b}$ | 19.73$^{a}$ | 15.06$^{a}$ | 8.86 |

abc= means within the same row with different superscripts are significantly different ($p<0.05$). SEM=standard error of mean.

**Table 5.** Haematological parameters of WAD goats fed experimental diets

| Parameters | Diet A | Diet B | Diet C | Diet D | ±SEM |
|---|---|---|---|---|---|
| Erythrocyte Sedimentation Rate (mm) | 3.17 | 3.80 | 4.50 | 4.83 | 0.45 |
| Packed Cell Volume (%) | 24.50 | 25.00 | 27.20 | 27.33 | 0.94 |
| Red Blood Cell (x10$^{6}$/ml) | 10.23$^{c}$ | 11.21$^{b}$ | 11.37$^{b}$ | 12.07$^{a}$ | 0.25 |
| White Blood Cell (x10$^{3}$/ml) | 3.98$^{d}$ | 4.09$^{c}$ | 4.41$^{b}$ | 4.91$^{a}$ | 0.07 |
| Haemoglobin (g/dl) | 8.18 | 8.33 | 9.06 | 9.12 | 0.32 |
| MCH(pg) | 7.43 | 7.57 | 7.95 | 7.99 | 0.13 |
| Mean Corpuscular Volume (μ$^{3}$) | 22.64$^{b}$ | 22.99$^{b}$ | 23.92$^{a}$ | 23.95$^{a}$ | 0.36 |
| MCHC (%) | 33.38 | 33.31 | 33.32 | 33.38 | 0.03 |
| Lymphocytes (%) | 60.67 | 60.80 | 61.00 | 62.38 | 0.37 |
| Nentrophils (%) | 29.75 | 30.60 | 31.00 | 31.17 | 0.55 |
| Monocytes (%) | 5.25 | 5.33 | 5.50 | 5.80 | 0.25 |
| Eosinophils (%) | 2.00 | 2.06 | 2.10 | 2.20 | 0.36 |
| Basophils (%) | 0.50 | 0.50 | 0.60 | 0.83 | 0.10 |

abc= means within the same row with different superscripts are significantly different ($p<0.05$).
MCH-Mean Corpuscular Haemoglobin; MCHC-Mean Corpuscular Haemoglobin Concentration; SEM=standard error of mean.

## Discussion

The *Cajanus cajan* hay had a high dry matter content of 86.36% and this was in line with the findings of (Karbo *et al.*, 1998), who reported the value of 85.90% DM when fed pigeon pea to livestock in

Ghana. This high value might be attributed to plant age during harvesting, season, soil type and processing into hay. The CF value of *C. cajan* hay (30.55%) observed in this study also agreed with the value (31.26%) reported by the same author. The presence of lignin in the forage could also be a contributing factor. The fibre are highly lignified, as such they are only degraded slowly in the rumen, which means that the nutrients they contain are released slowly. The fibre contents may fill up the available space in the rumen coupled with slow rate of degradation in the rumen and this may reduce greatly the animals' ability to eat. However, the role of chewing and bite size is to reduce the surface area of the cassava peels, facilitate easy swallowing and makes the nutrients more available for utilization. Crude protein (15.53%) of *C. cajan* hay recorded in this study was in line with 13.68% reported by (Karbo *et al*., 1998). The high CP of the *C. cajan* hay compared with that of cassava peels was thought to be associated to nitrogen content of the plant, also the stage of cutting/harvesting of the forage (before flowering) is said to contribute to the high value recorded. The CP and CF value of 4.70% and 13.35%, respectively observed for cassava peels was in line with (<6% DM crude protein) and CF within the range of 10-30% DM (Heuzé *et al.*, 2012). However, the CP content of *C. cajan* was above the critical level of 8% required by ruminants for optimum microbial activities in the rumen (Norton, 2003). The highest DM intake in goats fed diet C might be attributed to the 1:1 inclusion of *Cajanus cajan* in the diet and high palatability of the diet; might be due to the ratio of stem to leaf in the hay (Table 4). Hence, this could be the probable reason for increased CF intake as CP intake increases. Goats fed diet A had the highest energy intake but least CP intake; this might be one of major factors responsible for the poor performance of the animals. However, (Ranjhan, 1993) reported that the amount of fermentable energy available to the rumen bacteria influenced their growth rate, which in turn may enhance digestibility and growth of the animals. The DM digestibility is an indication that the diets were palatable and digestible. The higher CF digestibility in treatment D equally suggests an increase in the activities of fibrolytic bacteria in the rumen probably as a result of the availability of essential nutrients especially protein, energy and minerals in balanced proportions to enhance microbial growth and multiplication (Fadiyimu *et al*., 2006; Ranhjan, 1993) reported that higher protein intake may increase the digestibility of the crude fibre of feed; this is because the activities of microorganisms are increased on high protein ration and consequently they attack the crude fibre more vigorously. The N intake and balance by animals is probably due to increased CP intake with increasing level of *C. cajan* in the diets reported above. Hence, they are well digested and absorbed in the rumen and according to (Brooker *et al*., 1995), when feed is high in soluble plant protein, N metabolism occur mainly in the rumen rather than in the lower digestive tracts leading to the production of large quantities of ammonia N in excess of the requirements of rumen microorganisms. The ammonia N not utilized by the bacteria is converted to urea by the animal and excreted in urine. This means that more rumen ammonia would be produced with the *C. cajan* supplemented diets which would have increased as N intake increases from treatments B to D. This perhaps explain why significantly higher ($p<0.05$) values of urinary N and total N output were recorded as the level of *C. Cajan* supplementation increased in this study. Animals fed diet D had the highest weight gain and best feed gain ratio; this might be attributed to the palatability, crude protein intake, considerably high DM intake, better digestibility of the diet and best nitrogen utilization. This agreed with the findings of (Fajemisin *et al*., 2013) that weight gain was dependent on dry matter intake, protein intake and digestibility of the nutrients. This could also be attributed to the suited ratio of 25% cassava peels and 75% *Cajanus cajan* hay, as well as the improved nitrogen content of the diet which might had improved microbial population in the rumen, improved energy-nitrogen ratio and consequently improved the growth of the animals. According to (Togun and Oseni, 2005), haematological indices such as RBC, WBC, PCV and Hb have been found useful for disease prognosis and for therapeutic and feed stress monitoring. The result of this study with respect to ESR tend to suggest that the *C. cajan* hay did not give rise to acute general infection as high values of sedimentation rates (Table 6) could precipitate acute general infections and malignant tumours (Frandson, 1986). However, while the PCV, RBC and WBC values compared favorably though a bit lower than those values reported for WAD sheep fed graded levels of dietary pigeon pea seed meal (Okah and Ibeawuchi, 2001).The reduction in the number of blood cells and their content of haemoglobin causes anaemia. The packed cell volumes (24.50 - 27.33%) were within the range of 21 to 35% reported for healthy goats (Daramola *et al*., 2005). The packed cell volume was noted to increase with the increased *C. cajan* hay in the diets and this suggests the better protein quality of the diets. The values of haemoglobin concentration in the goats suggested that the animals had sufficient blood pigment for proper transportation of oxygen, thus healthy living. The RBC indices aids in the characterization of anaemia and also low quality of RBC could be due to low quality of feed and protein deficiency (Merck's veterinary Manual, 1979). (Akinmutimi, 2004) suggested that high value of white blood cells above normal values could be due to the effects of toxicity of diets or poor detoxification process which lead to increased production of white blood cell to fight foreign substances in the body (Robert *et al*., 2003) but a low value suggest susceptibility to infection (Nwakolor, 2001). Goats fed diet B to D had their white blood cell (WBC) values within the normal range (4-13(x$10^3$/ml)) reported by (Plumb, 1999). The value obtained for animals fed diet A showed that the animals would have less defense ability against any infection. High MCV values could imply the presence of haematological features of megaloblastic anaemia due to folic acid or vitamin B deficiencies, however, the amino acids of the diets were not assessed in this study. The relevance of MCHC, MCH and MCV measurement lies in their use in the diagnosis of anaemia (Aletor and Egberongbe, 1992). The lymphocytes values gotten implied that the experimental animals were well protected against viral infections. The low level of eosinophils observed in this study indicated that there was no allergic reaction imposed by the diets.

## Conclusion

This study revealed that combining cassava peels with *Cajanus cajan* hay at 1:3 improved the nitrogen content, digestibility, body weight gain, feed/gain ratio and haematological characteristics were optimal level. Therefore, goat production will be enhanced; and ruminant farmers should be sensitized on potentials of this forage for better crop residues utilization and also, encourage them to cultivate such plants.

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# بررسی متابولیسم نیتروژن، هضم‌پذیری و مشخصات خون بزهای بومی آفریقای غربی با رژیم غذایی شامل مکمل گیاه *Cajanus cajan* با پوست کاساوا

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**چکیده.** این تحقیق تاثیر گنجاندن میزان مصرف مواد مغذی، هضم‌پذیری، متابولیسم نیتروژن و عوامل خونشناسی بر بزهای کوتاه قد آفریقای غربی که با مکمل *Cajanus cajan* و پوست کاساوا تغذیه شده را بررسی می‌نماید. ۲۴ بز WAD با میانگین وزن اولیه ۰/۸۵± ۱۰/۷۵ کیلوگرم بصورت طرح کاملا تصادفی و آزمایشی مورد بررسی قرار گرفت(فروردین-مهر ۱۳۹۵). چهار تیمار آزمایشی مورد نظر شامل: پوست A=٪۱۰۰ Cassava؛ B=٪۷۵ Cassava +٪۲۵ *Cajanus cajan*؛ C=٪۵۰ Cassava+٪۵۰ *Cajanus cajan*؛ D=٪۷۵ *Cajanus cajan* یونجه +٪۲۵ Cassava. نتایج نشان داد که *Cajanus cajan* ارزش غذایی بیشتری با ٪۱۵/۵۳ پروتئین خام(CP)، و ٪۳۰/۵۵ فیبر خام(CF) نسبت به پوست Cassava با ٪۴/۷۰ پروتئین خام و ٪۱۳/۳۵ فیبر خام دارد. همچنین نتایج نشان داد که بکارگیری *C. cajan* و مکمل پوست Cassava در رژیم‌های غذایی بز WAD بطور قابل ملاحظه‌ای باعث کاهش مصرف DM شد و با افزایش مکمل یونجه میزان CP افزایش یافت. ADF، CP, CF, NDF و ADL بالاترین رژیم غذایی مصرفی بزها هستند. بهترین رفتار هضم و حفظ دام در تیمار D با گنجاندن ۷۵ درصد *C. cajan* است. در نتیجه بیشترین افزایش وزن(۱۶/۹۸ g/day) برای بزهایی که با تیمار D تغذیه شده بودند ثبت شد. بالاترین ارزش محتویات سلول(PVC) هموگلوبین ۹/۱۲ g/dl، گلبول قرمز ۱۲/۰۷ x ۱۰$^{۶}$ ml و شمارش سلول-های خونی ۴/۹۱ x۱۰$^{۳}$ ml برای حیواناتی بدست آمد که از تیمار D استفاده کرده بودند و آنها بین محدوده نرمال فیزیولوژیکی برای بزهای سالم بودند.

**کلمات کلیدی:** هضم پذیری، مشخصات خونشناسی، بز بومی آفریقا، *Cajanus cajan*