

GROWTH PERFORMANCE AND HAEMATOLOGICAL INDICES IN YEARLING WEST AFRICAN DWARF BUCKS FED UREA-TREATED CORN COB-BASED DIETS SUPPLEMENTED WITH FRESH MANGO (*Mangifera indica*) Leaf During The Dry Season

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Target audience: Smallholder goat farmers, Ruminant Nutritionists, Extension officers.

Abstract

*Goats suffer from poor quality and inadequate quantity of forages during the dry season in the tropics. This results in stunted growth and poor meat yield. An 84-day feeding trial was conducted to evaluate the growth performance and haematological profile of yearling West African Dwarf bucks fed diets containing varying levels (0%, 20%, 40%, and 60%) of urea-treated corn cob supplemented with mango fresh (*Mangifera indica*) leaves during the dry season between January and March. Twenty bucks (8 ± 0.42 kg) were randomly assigned to four dietary treatments, with each treatment having 5 goats and each goat serving as a replicate, in a completely randomised design. Results showed that goats fed a 60% urea-treated corn cob-based diet exhibited significantly ($P < 0.05$) higher total weight gain (2.46 kg) and daily weight gain (29.36 g/day) compared to other treatments. Dry matter intake was highest at 20% inclusion. Haematological indices, including RBC, MCV, MCH, lymphocytes, eosinophils, and monocytes, were influenced ($P < 0.05$) but remained within normal physiological ranges, indicating no adverse health effects. It was concluded that up to 60% urea-treated corn cob can be included in the diets of yearling West African Dwarf bucks during the dry season to enhance growth without compromising health.*

Key words: Yearling West African Dwarf bucks; Urea-treated corn cob; mango leaves, growth performance and haematological indices.

Description of the problem

Every year, the global population continues to grow significantly. The population grew from 7,470,491,872 in 2015 to 8,231,613,070 in 2025 in just ten years (1). Nigeria's population is growing extremely quickly and in line with the worldwide trend. For example, according to World Metre (2), Nigeria's population increased from 190,671,878 in 2015 to 237,527,782 in 2025. Nigeria is now the sixth most populous nation in the world. The rapid increase in the human population will further heighten the increase in demand for animal protein. In Nigeria, the West African dwarf goat breed is very common and can increase the amount of protein available for human consumption (3). According to (4), during the dry season, inadequate and low-quality forage supply constrains ruminant growth, further driving global demand for livestock products. Better use of waste and agro-industrial byproducts as animal feed supplies will

be essential to feeding the world's population and ensuring their food security in the future (5).

Corn cobs, derived from the processing of harvested maize, constitute a significant class of non-traditional feedstuff in Nigeria. However, corn cob is highly fibrous with a poor nutritional profile. This means it must be improved before being incorporated into goat's diets. Various methods have been explored for the treatment of corn cobs; however, urea treatment has become the preferred method utilised at the tropical farm level since it is most suitable for subsistence farming (6). The aim of this study was, therefore, to evaluate the growth performance and blood profile of yearling West African Dwarf bucks fed diets containing varying levels of urea-treated corn cob supplemented with mango leaves during the dry season.

Materials and methods

Experimental Site

The Small Ruminant Unit Pen, Livestock Teaching and Research Farm, Joseph Sarwuan

Tarka University, Makurdi, was the site of this study. Latitude 7° 43' and longitude 800 3' E are the coordinates of Makurdi town, the Headquarters of Benue State (7). The elevation of the Benue floodplain ranges from 0 to 100 meters above sea level. With a minimum temperature of 24.20 ± 1.40°C and a high temperature of 36.33 ± 3.70°C, the region has a warm, tropical climate (8). Makurdi town may experience temperatures between 35°C and 40°C from February to April. Relative humidity ranges from 39.50 ± 2.20 to 64.00 ± 4.8%, rainfall ranges from 508 to 1016 mm, and the mean wind speed is 2.47 knots per second northeast (8).

Processing of the experimental test ingredient

Corn cobs were collected from village farmers around the university and its environs. The collected corn cobs were sundried, and all foreign materials were picked out. The sundried corn cobs were crushed into medium particle size (2.4 mm) using a hammer milling machine. The crushed corn cobs were treated with feed-grade

urea obtained from a reputable animal feed ingredients store in Makurdi, according to the procedure of (9). 5 kg of urea was dissolved in 50 litres of water to obtain a solution. The solution was then sprinkled by hand on 100kg of corn cob and thoroughly mixed. The urea-solution-treated corn cob was then put into polythene bags, stacked into a big drum with heavy objects placed on top. The drum was covered with another polythene and then with its cover and placed under a shade. This urea-treated corn cob was allowed to ferment for 72 hours (3 days) before it was removed and spread on a drying mat under a shade. The fermented urea-treated corn cob was dried until it became crispy. All the lumps formed in the course of drying were broken by kneading with the palms. The dried urea-treated corn cob was added at 0, 20, 40, and 60%, representing T1, T2, T3, and T4, respectively, as shown in Table 1. The mango leaves were cut from mango trees within the university community and served fresh at 12:00 noon daily.

Table 1: Gross Composition of the experimental diets

Ingredients	Treatments				Corn cob	Mango leaves
	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)		
Maize Offal	30	24	18	12		
Urea-treated Corn cob	0	6	12	18		
Palm Kernel Cake	12	12	12	12		
Brewer's dry grain	10	10	10	10		
Rice Offal	15	15	15	15		
Cassava Peel	25	25	25	25		
Limestone	2.0	2.0	2.0	2.0		
Bone meal	3.0	3.0	3.0	3.0		
Salt	2.5	2.5	2.5	2.5		
Grower premixal	0.5	0.5	0.5	0.5		
Total	100.00	100.00	100.00	100.00		
Chemical Composition						
Dry matter	94.52	94.53	94.56	94.78	94.50	22.55
Crude protein	8.13	7.68	7.88	7.88	7.88	21.47
Ether extract	5.19	4.76	5.17	3.81	1.99	0.62
Ash	16.78	18.08	16.69	20.45	2.30	11.42
Crude fibre	11.02	12.52	13.62	18.85	33.73	10.41
Nitrogen free extract	58.88	56.96	56.64	49.01	54.10	56.08
Neutral detergent fibre	40.30	40.50	45.00	43.10	46.15	44.28
Acid detergent fibre	30.47	32.45	36.93	34.43	33.33	34.87
Acid detergent lignin	10.62	15.49	21.23	23.42	27.98	17.46
Hemicellulose	9.83	8.05	8.07	8.67	12.82	9.41
Cellulose	19.85	16.96	15.70	11.01	5.35	17.41
ME (MJ/kg DM)	7.07	7.00	7.29	7.22	8.99	7.03

Premix (each kg contains): Vitamin A: 10,000 IU; Vitamin E: 70,000 IU; Vitamin D: 1,600,000 IU; Fe: 50 g; Zn: 40 g; Mn: 40 g; Co: 0.1 g; Cu: 10 g; Se: 0.1 g; I: 0.5 g, ME: Metabolizable energy.

Experimental Animals, Design and Management

Twenty Yearling West African bucks of average weight of 8 ± 0.42 kg were purchased in January 2025 from goat farmers around the university community. Two weeks before their arrival, the pens were thoroughly cleaned and disinfected. Upon their arrival, the goats underwent a 21-day acclimatisation period during which they received prophylactic treatments, including intramuscular injections of long-acting oxytetracycline (1 ml/10 kg BW) for bacteria diseases control, subcutaneous ivermectin (0.5 ml/10 kg BW) to control parasites, and a vaccination against *peste des petits ruminants* (PPR). During this acclimatisation phase, they were fed a mixture of cassava peel and maize offal, with *ad libitum* access to clean water. After acclimatisation, the goats were weighed and housed in individual open-sided pens (170 × 120 cm) under an intensive management system. At the commencement of the experiment, the animals were randomly assigned to one of the four dietary treatments containing 0%, 20%, 40%, or 60% urea-treated corn, with each treatment having 5 animals and each animal serving as a replicate. The urea-treated corn cob diets were served *ad libitum*, while mango leaves were served by 12:00 noon every day. The feeding trial lasted for 84 days. The experimental design was a completely randomised design (CRD).

Data collection

Feed and dry matter intake: Feed offered to each animal was weighed daily, and the leftover was collected the next day and weighed before offering fresh feed. Feed intake and dry matter intake (DMI) were determined using the formulae:

$$\text{feed intake (kg)} = \text{feed offered} - \text{feed leftover}$$

$$\text{Dry matter intake} = \frac{\% \text{ dry matter}}{100} \times 100$$

Weight gain: The animals were weighed every week. The weekly weight gain was calculated as the difference between the weight of the previous week and the current week. Final weight was subtracted from initial weight to get the total weight gain during the research.

Feed conversion ratio: Total dry matter intake and body weight gain were used to determine the feed conversion ratio.

$$FCR = \frac{\text{Total dry matter intake (kg)}}{\text{Total weight gain (kg)}}$$

Blood collection and analysis: At the end of the feeding trial, blood samples were collected from three animals per treatment via the jugular vein in the morning before feeding. On the day of collection, 2.5 ml of blood was drawn using hypodermic syringes into labelled heparinised tubes containing ethylene diamine tetraacetic acid (EDTA) at 1 mg/ml as an anticoagulant. Samples in EDTA tubes were analysed for packed cell volume (PCV), haemoglobin (Hb), red blood cell count (RBC), white blood cell count (WBC), monocytes, mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), neutrophils, lymphocytes, basophil and eosinophils. The improved Neubauer Haemocytometer method described by Jain (10) was used to estimate the RBC and WBC. Hb, MCHC, MHC, were determined according to the methods of Jain (10); PCV was determined according to Wintrobe Microhaematocrit method (11)

Statistical Analysis

Data obtained in the course of the research were subjected to one-way analysis of variance, using (12). Treatment means with significant differences were separated using the Duncan Multiple Range Test.

Results and Discussion

Growth performance

The effects of feeding urea-treated-based diets supplemented with fresh mango (*Mangifera indica*) leaves on the growth performance in Yearling West African Dwarf bucks are presented in Table 2. The results show that total and daily weight gains were significantly ($P < 0.05$) influenced. Bucks fed diets containing 60% corn cob had a higher ($P < 0.05$) total weight gain (2.49 kg) and daily weight gain (29.36 g/d), while other treatments were similar ($P > 0.05$). The total concentrate, forage and dry matter intakes were influenced ($P < 0.05$) by the diet. The experimental animals fed diets containing 20% urea-treated corn cob had a higher ($P < 0.05$) concentrate intake (22.39 kg), followed by animals fed 0% urea-treated corn cob (22.04 kg), while 60% were

lower (19.83 kg). The total forage consumed was higher (6.77 kg) in bucks fed 60% corn cob, and was statistically the same of bucks fed 20% corn cob. The treatments with 0 and 40% had statistically the same forage intake. The highest total DMI (28.89 kg) was recorded in the group of bucks that received 20% corn cob, while the least was recorded in the bucks consuming a 40% urea-treated diet. The daily dry matter intake followed a similar pattern. The initial and final weights, as well as the FCR, remained non-significant ($P > 0.05$) across the treatments. The total weight gain obtained in this study was comparable to 1.4 ± 0.3 to 3.5 ± 0.4 kg, documented by (13) when West African dwarf goats were fed

dietary *Cochlospermum planchonii* rhizome. Thus, indicating that the inclusion of corn cob did not negatively affect the growth rate of the goats. The daily weight gain recorded in this study was similar to 17.86 ± 1.65 to 22.68 ± 1.09 g/d reported by (14) when West African dwarf goats were fed diets containing microbially treated corn cob. This similarity may be a result of the same test ingredient and breed of animal used. The daily dry matter intake obtained in this research was comparable to 320.16 to 390.21 g/d reported by (14) when WAD goats were fed urea-fortified corn cob diets. This points to the fact that the palatability of the diet was not compromised by including urea-treated corn cob.

Table 2: Growth performance of Yearling West African Dwarf bucks fed diets containing urea-treated corn cob supplemented with mango (*Mangifera indica*) during the dry season

Parameter	Treatments				SEM	P-value
	T1(0%)	T2(20%)	T3(40%)	T4(60%)		
Initial weight (kg)	8.58	8.87	8.47	8.53	0.81	0.933
Final weight (kg)	9.59	9.70	9.77	11.00	0.63	0.83
Total weight gain (kg)	1.01 ^b	0.83 ^b	1.30 ^b	2.46 ^a	0.50	0.017
Daily weight gain (g)	12.02 ^b	9.88 ^b	15.47 ^b	29.36 ^a	6.03	0.017
Total concentrate intake (kg)	22.04 ^b	22.37 ^a	14.24 ^d	19.83 ^c	0.52	0.000
Total forage intake (kg)	5.58 ^b	6.52 ^a	5.67 ^b	6.77 ^a	0.55	0.000
Total dry matter intake (kg)	27.62 ^b	28.89 ^a	19.91 ^d	26.61 ^c	0.32	0.000
Daily dry matter intake (g/d)	328.88 ^b	348.98 ^a	237.10 ^d	316.82 ^c	3.84	0.000
FCR	27.37	58.70	18.86	11.11	27.83	0.246

^{abcd} Means along the same row with different superscripts are significantly ($P < 0.05$) different; SEM = standard error of mean; P = probability level; kg= kilogram; g = gram; g/d= gram per day; FCR = feed conversion ratio.

Haematological indices

Table 3 shows the results of the effects of feeding urea-treated corn cob based-diets supplemented with mango leaves on the haematological parameters of yearling West African Dwarf bucks. The results reveal that red blood cells (RBC) were significantly ($P < 0.05$) influenced by the diet. Goats fed a diet containing 40% urea-treated corn cob had the highest ($17.25 \times 10^{12}/L$) RBC values, while 0% had similar values to all the treatments. The experimental animals fed a diet containing 40% of the test ingredient had higher (25.95 FL) mean corpuscular volume (MCV) values, while 0, 20 and 60% had similar values. The mean corpuscular haemoglobin (MCH) was significantly ($P < 0.05$) influenced. Goats fed diets containing 0 and 40% urea-treated corn cob had similar mean corpuscular haemoglobin (MCH). The lymphocytes were

significantly ($P < 0.05$) affected by the diet, with goats fed on diets containing 60% urea-treated corn cob having the highest (69.50 %) values. The experimental animals fed 20% urea-treated corn cob had similar values to 0, 40 and 60%, respectively. The eosinophil values were equally affected ($P < 0.05$) and decreased as the level of urea-treated corn cobs were increased. Goats fed a diet containing 0% urea-treated corn cob had the highest (3.50%) eosinophil values, while 60% had the least (2.00%), which was similar to 20 and 40%. The monocyte was significantly ($P < 0.05$) influenced by goats fed diets containing 0, 20 and 40% urea-treated diets, having similar and higher monocyte values, while 60% had the least (3.00%).

The RBC values obtained in this study fell within the normal range ($8-18 \times 10^{12}/L$) recommended by (15) for clinically healthy goats, indicating that

the ability of the experimental animals to transport oxygen around the body was not interfered with by urea-treated corn cob and the goats were not vulnerable to anaemia. The values of the RBC were similar to 12.53 to 16.12 x 10¹²/L reported by (16), when WAD does were fed diets containing varying levels of cassava leaf meal-based diets. The mean corpuscular haemoglobin (MCH) reported in this study was lower than 6.23 to 7.23 pg reported by (16), when WAD does were fed diets containing varying levels of cassava leaf meal-based diets, but fell within the range (5.2-8.0%) for clinically healthy goats recommended by (15). Lymphocytes are actively involved in the protection of the body from infections caused by viruses. High levels are an indication of an active viral infection, and a low value suggests an exhausted immune system (17). The lymphocyte values obtained in this study were comparable to 60.50% reported by (18) when West African dwarf goats were fed treated maize cob and maize husk-based diets with a mixture of microorganisms. They were all within the normal range of 50 – 70% documented by

Fraser and Mays (1986) for clinically healthy goats. This points to the fact that urea-treated corn cob did not make the goats vulnerable to viral infections. According to (17), eosinophil is used to protect the body against allergic reactions and parasites, and a low level of eosinophils indicates no allergic reactions. The eosinophil values obtained in this study were within the normal values (3-8%) recommended by (15) for goats. This means that the goats were not allergic to the diets containing urea-treated corn cob. Monocytes are the largest type of white blood cells, which play a critical role in fighting infections and tissue inflammation. The monocyte values obtained in this study were lower than 6.5-8.0% reported by (18) when West African dwarf goats were fed treated maize cob- and maize husk-based diets with a mixture of microorganisms, but were comparable to the recommended levels of 0-4% reported by (15) for goats. This is an indication that the immune system of the goats fed the experimental diets was not challenged.

Table 3: Haematology of Yearling West African Dwarf bucks fed diets containing urea-treated corn cob supplemented with mango (*Mangifera indica*) during the dry season.

Parameter	*Normal Value	Treatments				SEM	P-value
		T1(0%)	T2(20%)	T3(40%)	T4(60%)		
Packed cell volume (%)	22 – 38	26.00	25.00	24.00	26.50	1.25	0.147
Red blood cells (x 10 ¹² /L)	8-18	13.70 ^{ab}	10.45 ^b	17.25 ^a	10.90 ^b	12.24	0.005
White blood cells (x10 ⁹ /L)	4-13	10.70	10.00	9.60	11.20	0.73	0.107
Haemoglobin (g/dl)	8-12	8.66	8.33	8.00	8.83	0.41	0.147
Mean corpuscular volume (Fl)	-	24.80 ^b	23.85 ^b	25.95 ^a	24.15 ^b	0.55	0.007
Mean corpuscular haemoglobin (pg)	5.2 – 8.0	8.45 ^a	7.95 ^b	8.65 ^a	8.05 ^b	0.15	0.001
Mean corpuscular haemoglobin concentration (g/dL)	30 – 36	33.30	33.35	33.30	33.35	0.06	0.596
Lymphocytes	50 – 70	66.00 ^b	66.50 ^{ab}	65.50 ^b	69.50 ^a	1.71	0.079
Neutrophil (%)	30 – 48	35.00	36.00	37.00	35.00	1.32	0.270
Eosinophil (%)	3 – 8	3.50 ^a	2.50 ^b	2.50 ^b	2.00 ^b	0.43	0.017
Basophil (%)	0 – 2	1.00	0.00	0.50	0.50	0.35	0.052
Monocyte (%)	0 – 4	4.50 ^a	5.00 ^a	4.50 ^a	3.00 ^b	0.61	0.019

^{abcd} Means along the same row with different superscripts are significantly (P<0.05) different; SEM = standard error of mean; P = probability level; %= percent, g/dl= gram per decilitre; Fl= fomtolitre; *Normal value according to (15).

Conclusion and Application

Sequel to the findings of the study, it is concluded that goats fed 60% urea-treated corn cob consumed higher forage and maintained growth, suggesting good palatability and nutrient utilisation. The haematological indices remained

within normal physiological ranges at all inclusion levels, indicating no adverse effects on the health or immunity of the bucks. Hence, smallholder farmers can adopt the inclusion of 60% urea-treated corn cob in goat diets during the dry season as a cost-effective alternative to

conventional feeds. Also, extension officers and nutritionists can promote on-farm urea treatment of crop residues as a practical method to enhance feed quality during periods of forage scarcity.

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