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RESPONSE OF WEST AFRICAN DWARF GOATS TO TREATED CORNCOB BASED DIETS

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ABSTRACT

Feed scarcity during the dry season remains a significant constraint to ruminant livestock production in Nigeria. One of the ways to ease this challenge is to use other feed sources that are not consumed by man but are in abundance. Corncob is one of the feed sources. This study evaluated the response of West African Dwarf (WAD) goats offered diets containing corncob that were treated with caustic soda, wood ash, and urea. Corncob was crushed to 2mm particle size and divided into 4 equal portions, T_1 was untreated corncobs which was the control, T_2 was treated with caustic soda at 1litre of caustic soda solution (0.5% concentration) per 1kg of crushed corncobs, T_3 was treated with wood ash, at the dilution rate of 100g of wood ash per 1liter of water per 1kg of crushed corncobs, T_4 was treated with urea solution, with 1litre of urea solution (5% concentration) at 1kg of crushed corncobs. The treated and air-dried corncobs were mixed at 40% with other feed ingredients. Twenty growing WAD goats (initial weight 5.0–8.0 kg) were allocated to the four treatments in a Completely Randomized design. Data was collected on nutrient intake, digestibility, nitrogen utilization, haematological, serum biochemical. Treatment means were separated with Dunacn Multiple range Test at 5%significance level. Body weight performance results indicated that goats offered wood ash treated corn cobs diet (T3) had the highest weight gain (1.70 kg) and average daily weight gain (60.85 g/day). Dry matter intake was highest in animals offered T2 diet (265.60g/day). Nutrient digestibility coefficients revealed significant differences ($P<0.05$) among the treatments with. digestibility coefficients for dry matter (89.83%) and crude fibre (90.34%) were highest in animals offered T1 diet, while crude protein (97.39%) was highest animals offered T4 diets. Nitrogen utilization was highest in T3, with the nitrogen intake (20.99g) and retention (72.57 %) respectively. Urea-treated goats (T4) exhibited significantly higher packed cell volume (35.99%), hemoglobin concentration (11.99g/dl) and red blood cell count (3.99×10^6), indicating enhanced oxygen-carrying capacity. Serum biochemical analysis showed that animals offered T4 diet has the highest values for the total protein (6.70g/dl), albumin (3.40g/dl), HDL (2.39mmol/l), ALP (264.99u/l) while the animals offered T3 had the highest value for cholesterol (3.04mg/dl), AST(245.99u/l) and LDL(0.84mmol/l) which remained within the acceptable ranges across the treatments, indicating no adverse effects on liver function. The study concluded that chemical treatment of corn cobs, particularly with urea and wood ash, can enhance their nutritional value and improve their utilization by West African Dwarf goats. Urea treatment showed the most promising results in terms of protein enhancement and blood parameters, while wood ash treatment yielded superior growth performance.

Keywords: Feed scarcity, West African Dwarf goats, corncob, chemical treatment, nutrient digestibility, nitrogen utilization.

INTRODUCTION

Agricultural by-product can be classified as crop residues which include rice straw, rice husk, sugar cane tops, corn Stover, corn stalk, soy bean hulls, corn cobs and agro-industrial by products were found to be cereal bran, coconut cake, palm kernel cake, soya bean meal, molasses, pineapple waste, coffee seed pulp. (Shah *et al*., 2025). Agro-industrial by products are residual materials generated from agricultural processing operation. These products were considered as waste since they were of little or no nutritional importance to man. Agro-industrial by-products are highly abundant in the tropics and they represent a substantial resource for increasing animal production. Agro industrial by product can be used for supplementary livestock feeding when the forage supply is inadequate for animal needs either in terms of quantity or quality (Lamidi and Ologbose, 2014). In Nigeria, there are more than 21 million tonnes of plant by-products produced annually, one of them is the corncobs, (Fajemisin *et al.,* 2013).

However, crop by product especially cereal by-products is characterized by low nutrient content and digestibility as well as poor voluntary consumption by ruminant animals. This is a basic limitation in residues such as corncob with low crude protein, fermentable energy and mineral contents. Improved utilization of corncob can be achieved through appropriate supplementation (Kolo *et al*., 2018). The study aims to evaluate the response of West African dwarf goats to differently treated and corn cobs diets

Materials and Methods

Experimental site

The study was conducted at the Ruminant Unit of Teaching and Research Farms, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria. The site is situated in the Derived Savanna zone o ' of Nigeria on longitude 4 15 East of the o ' Greenwich meridian and latitude 8 15North East from Ibadan, the capital of Oyo State. The altitude is between 300 and 600m above the sea o level. The mean annual temperature is 27C and the annual rainfall is 1,247mm respectively (Google Earth Map, 2024).

Experimental Animals and Management

Twenty WAD goats (5.0–8.0 kg) were housed in individual pens with routine health management, including vaccinations and parasite control. A 7-day acclimatization period preceded the 63-days feeding trial.

Experimental Feed and feeding

Corncobs were crushed to 2 mm and treated as follows: T1 (untreated), T2 (caustic soda at 1literof cautic soda solution to 1kg of corncobs), T3 (wood ash at dilution rate of 100g of wood ash to 1liter of water, the filtrate of 1liter to 1kg of corn cob), and T4 (urea, at 1liter of urea solution to 1kg of corncob). Each air dried treated corncob was incorporated at 40% into diets formulated with maize, cassava peel, palm kernel cake, wheat offal, bone meal, salt, and premix. Wilted *Gmelina* served as basal feed. Feed offered was 5% of body weight, with free access to water.

Table 1. The feed constituents and proximate Composition of Experimental Diets (%).

INGREDIENTS%	T_1	T_2	T_3	T_4
Treated Corncobs	**40**	40	40	40
Maize	**5**	5	5	5
Cassava peel	10	10	10	10
Palm kernel cake	30	30	30	30
Wheat offal	12	12	12	12
Bone meal	2	2	2	2
Salt	0.1	0.1	0.1	0.1
Premix	0.9	0.9	0.9	0.9
TOTAL				

Duration of the Experiment

The experiment lasted for a period of 63 days

Experimental Design

The data collected was subjected to One-way analysis of variance in a Completely Randomized design using the procedure of SAS (2003) and significant mean was separated with Duncan Multiple Range Test of SAS (2003).

Data Collection

The animal's growth response to the experimental diets was monitored by taking their initial body weights, followed by weighing on weekly basis prior to feeding. Feed offered to animals was recorded and leftover was weighed on daily basis to compute feed intake by the animals.

Digestibility and Nitrogen Utilization

A 14-day digestibility trial followed the feeding period. Faeces and urine were collected and measured daily. A sample consisting of 10% of the daily total faecal production was oven-dried at 60 °C for 48 hours prior to analysis of chemical composition. At the end of the seven-day collection period, the faeces samples from each goat were pooled to provide a single sample for each animal. A 10% sub-sample was taken, ground to pass through 1 mm sieve, and kept frozen until it was analysed. Volatilization of nitrogen from urine was prevented by introducing 5ml of 10% H2SO4 into the urine sample bottles After the collection period, the daily samples were pooled for each goat and 10% sub-samples were taken to measure urinary nitrogen. The samples of feed, faeces and urine were analyzed for chemical components according to the methods of (AOAC, 2002).

Blood Collection

10ml of blood sample was extracted from each goat through the jugular vein using hypodermic syringe before feeding the animals. 5ml was drawn into ethyl diamine tetra acetic acid (EDTA) bottles for haematological studies, the following are the parameters of interest Erythrocyte (Red Blood Cell, RBC) measured in ($x10^6/\mu l$), Leucocytes (White Blood Cells, WBC) measured in ($x10^3/\mu l$), Haemoglobin concentration (HBC) measured in (g/dl), Packed Cell Volumes (PCV) measured in (%), Mean Corpuscular Volume (MCV) measured in (fl), Mean Corpuscular Haemoglobin Concentration (MCHC) measured in (g/dl), Lymphocytes measured in (%), Neutrophil measured in (%) ,Eosinophil measured in (%) , Monocytes measured in (%). 5ml of blood sample was drawn into a labelled non anti-coagulant bottle, for serum biochemical analysis for Total protein measured in (g/dl), Albumin measured in (g/dl), Globulin measured in (g/dl), Urea measured in (mg/dl), Creatinine measured in (mg/dl) as described by (Olafadehan, 2011; Akinrimade and Akinrinde 2012). The collection of blood was done in the morning to avoid excessive bleeding and stress on the animals.

Experimental design and statistical Analysis

Data were analyzed using one-way analysis of variance (ANOVA) under a Completely Randomized Design. Significant means were separated by Duncan's Multiple Range Test at $P<0.05$.

Results

The proximate, fibre fraction and mineral composition of the differently treated corn cob diets presented in table 2 showed that there are no significant differences ($P>0.05$) among the parameters. The dry matter (DM) was recorded to be least in T4 diet 93.54%±0.34 and to be highest in T1 diet 94.86%±0.54. Crude protein ranged from 10.93%±0.42 T3 diet to 17.69%±0.12 T4 diet. The crude fat obtained was found to be higher in T4 diet 1.81±0.03% and least in T2 diet 1.58%±0.42. The crude fibre, ash, neutral detergent fibre (NDF), Acid detergent fibre (ADF) and Acid detergent lignin (ADL) content has the highest value in animals offered T4 diets 25.77%±0.05, 8.16%±0.05, 60.0%5±0.05, 36.70%±0.11, 18.75%±0.06 respectively. The iron content varied from 57.40 mg/kg ±0.03 T2 diet to 117.40 mg/kg ±0.03 T1 diet.

The performance characteristics of WAD goats offered differently treated corncob diets presented in Table 3 showed that there was no significant difference ($P>0.05$) in the parameters. The weight change of the WAD goats showed that the goats fed T3 diet has the highest weight gain 1.70kg while the goats fed T4 diet has the lowest weight gain 1.03kg. The average daily weight gain (ADG) was recorded to be least in animals fed T4 diet 36.70g and to be highest in T3 diet 60.85g. The dry matter (DM) intake was found to vary for the concentrates from 202.15g/day T4 diet to 265.60g/day T2 diets and *Gmelina* from 157.20g/dayT4 diet to 228.25g/dayT1 diet. Crude protein intake ranged for concentrates from 30.22g/day T3 diet to 38.34g/day (T4) diets and for *Gmelina* from 43.89g/day T4 diet to 63.72 T1. The crude fibre intake obtained for the concentrates was found to be higher in T2 diet 61.71g/day and least in T1 diet 48.12g/day and for *Gmelina* to be higher in T1 diet 44.81g/day and to be least in T4 diets 30.86g/day. The neutral detergent fibre (NDF) intake for concentrates varied from 130.16g/day T4 diet to 156.08g/day T2 diet and for *Gmelina* from 110.74g/day T4 diets to 160.79g/day T1 diets. Acid detergent fibre (ADF) intake for concentrates ranged from 79.54 T4 diets - 88.29g/day T1 diets and for *Gmelina* from 81.74 T4 diet -118.68g/dayT1 diet. Acid detergent lignin (ADL) intake for concentrates ranged from 40.56 T3 diets – 45.18g/day T1 diets and for *Gmelina* from 28.99g/day T4 diets to 42.11g/day T1 diet. Ash intake for concentrates varied from 17.68 T4 diet to 22.48g/day T2 diets and for *Gmelina* from 16.25 T4 diet to 23.88g/day T1 diet.

Table 4 showed the nutrient digestibility coefficients and the nitrogen utilization of the WAD goats offered differently treated corncob diets which showed that the parameters were significantly different ($P<0.05$). the animals offered T4 diets had the highest significant value for the crude fat (89.89%). The animals offered T1 and T4 diets had no significant differences and had the highest values for dry matter (89.83%) (87.64%), crude protein (97.31) (97.39), crude fibre (90.34) (89.89), Neutral detergent fibre (76.92) (71.98), Acid detergent fibre (ADF) (35.92%) (50.47%) and Acid detergent lignin (ADL) (66.45%) (61.74) respectively. The animals offered T1 and T3 diets had the highest value for ash (93.50%) (91.11%) respectively but with no significant differences. Moreover, the animals offered T2 diet had the highest significant value for the urinary nitrogen (6.83), the animals offered T3 diet had the highest significant value for digested nitrogen (15.23g), nitrogen intake (20.99g), fecal nitrogen (1.11) and nitrogen retained (72.57%).

Table 5 showed the haematological parameters of theWest African Dwarf (WAD) goats offered the differently treated corn cobs diets, Itshowed that there was significant difference ($p < 0.05$) in the parameters considered except basophil. Basophil ranged from 0.99 -2.99%. The animals fed T1 diet had the highest significant value for platelets ($199.99 \times 10^3/\mu l$), monocytes (4.99%), mean corpuscular volume (MCV) (90.89fl) and eosinophil (3.99%). The animals offered T2 diets had the highest significant values for the lymphocytes (30.99%). The experimental animals offered T4 had the highest significant value for the packed cell volume (PCV) (35.99%), red blood cell (RBC) count ($3.99 \times 10^6/\mu l$), haemoglobin (11.99g/dl), and neutrophil (67.99%). Moreover, animals offeredT1, T3and T4 diet had no significant differences for the mean corpuscular haemoglobin concentration (MCHC) (33.29g/dl). Animals offered T1 and T4 had no significant differences but had the highest values for the white blood cell (WBC) count ($9.99 \times 10^3/\mu l$) and the mean corpuscular haemoglobin (MCH) value (30.29pg) for T1 and (29.99pg) T4.

Table 6 showed the serum biochemical parameters of West African Dwarf goat fed differently treated corn cob diets, the table shows that the parameters were significantly different ($p < 0.05$). The experimental animals fed T1 diet had the highest significant value for potassium (4.79mmol/L). Animals offered T2 diet obtained the highest significant value for globulin (3.60g/dl), creatinine (0.74mg/dl), and alkaline aminotransferase (ALT) (14.99u/L). However, the animals offered T3 diet had the highest significant values for cholesterol (3.04mg/dl), Aspartate aminotransferase (AST) (245.99), low density lipoprotein (LDL) (0.84mmol/L), Iron concentration (22.99µmol/L) and Magnesium concentration (1.09mg/dl). The total protein (6.70g/dl) and Alkaline phosphatase (ALP) (264.33u/L) were found to be highest in animals offered T4 diet. There were no significant differences for the highest value of albumin (3.40g/dl) and manganese(13.99mg/dl) in the animals offered T1 diet and T4 diet. The animals offered T2 diet and T4 diet had the highest value for High density lipoprotein (HDL) (2.39mmol/L) and calcium (2.42mmol/L).

Table 2: Chemical composition of the differently treated corn cob diets

Parameters	T1(Untreated corncob diet)	T2(caustic soda treated corncob diet)	T3(Wood ash treated corncob diet)	T4(Urea treated corn cob diet)
Dry matter	94.86 ± 0.54	93.95 ± 0.05	93.66 ± 0.54	93.54 ± 0.34
Crude protein	14.37 ± 0.92	12.67±0.50	10.93 ±0.42	17.69±0.12
Crude fibre	18.58 ± 0.39	21.82 ± 0.50	19.83 ± 0.05	25.77 ± 0.05
Ash	6.99 ± 0.12	7.96 ± 0.07	7.80 ± 0.11	8.16 ± 0.05
NDF	56.50 ± 0.13	55.20 ± 0.11	55.82 ±0.08	60.05 ± 0.05
ADF	34.07 ± 0.05	32.60 ± 0.32	30.65 ± 0.06	36.70 ± 0.11
ADL	17.45 ± 0.06	15.50 ± 0.22	14.85 ± 0.27	18.75 ± 0.06
Iron (mg/kg)	117.40 ± 0.03	57.40 ± 0.03	108.60 ± 0.03	77.40 ± 0.03

NDF: Neutral Detergent fibre, ADF: Acid Detergent fibre, ADL: Acid Detergent Lignin T_1= Untreated corncobs, T_2 = caustic soda treated corncobs, T_3 = wood ash treated corncobs, T_4= urea treated corn cobs

Table 3: Performance characteristics of west African dwarf goat offered differently treated corn cob diets

Parameters	T1(Untreated corncob diet)	T2(caustic soda treated corncob diet)	T3(Wood ash treated corncob diet)	T4(Urea treated corn cob diet)	SEM
Initial weight (kg)	7.04	7.49	7.84	5.42	0.50
Final weight (kg)	8.60	8.89	9.53	6.44	0.62
Weight change (kg)	1.56	1.40	1.70	1.03	0.13
ADG(g/day)	55.80	49.99	60.85	36.70	4.61
Nutrient intake(g/day)					
Dry matter					
Concentrates	245.61	265.60	259.03	202.15	17.75
Gmelina	228.25	207.14	211.31	157.20	14.26
Crude protein					
Concentrates	37.24	35.80	30.22	38.34	2.70
Gmelina	63.72	57.83	58.99	43.89	3.98
Crude fibre					
Concentrates	48.12	61.71	54.80	55.85	4.15
Gmelina	44.81	40.67	41.49	30.86	2.80
NDF					
Concentrates	146.37	156.08	154.38	130.16	10.73
Gmelina	160.79	145.91	148.85	110.74	10.05
ADF					
Concentrates	88.20	92.12	84.78	79.54	6.22
Gmelina	118.68	107.70	109.87	81.74	7.42
ADL					
Concentrates	45.18	43.79	40.56	40.64	3.07
Gmelina	42.11	38.21	38.98	28.99	2.63
ASH					
Concentrates	18.14	22.48	21.63	17.68	1.50
Gmelina					

abc = means within the same row with different superscripts are significantly different (P <0.05) ADG: Average daily weight gain, NDF: Neutral Detergent fibre, ADF: Acid Detergent fibre, ADL: Acid Detergent Lignin, T_1= Untreated corncobs, T_2 = caustic soda treated corncobs, T_3 = wood ash treated corncobs, T_4= urea treated corn cobs

Table 4: Nutrient digestibility coefficient and nitrogen utilization of west African dwarf goat offered differently treated corncob diets

Parameters	T1(Untreated corncob diet)	T2(caustic soda treated corncob diet)	T3(Wood ash treated corncob diet)	T4(Urea treated corn cob diet)	SEM
Nutrient digestibility coefficient (%)					
Dry matter	89.83^{a}	83.42^{c}	85.38^{bc}	87.64^{ab}	0.59
Crude protein	97.31^{a}	95.32^{b}	95.91^{b}	97.39^{a}	0.20
Crude fat	85.37^{b}	78.91^{c}	74.83^{c}	89.89^{a}	1.26
Crude fibre	90.34^{a}	85.60^{b}	83.44^{c}	89.68^{a}	0.62
NDF	76.92^{a}	62.86^{c}	68.08^{bc}	71.98^{ab}	1.30
ADF	35.92^{a}	2.75^{b}	11.65^{b}	50.47^{a}	4.67
ADL	66.45^{a}	52.72^{b}	53.86^{b}	61.74^{a}	1.53
Ash	93.50^{a}	89.94^{c}	92.36^{ab}	91.11^{bc}	0.34
Nitrogen utilization					
Nitrogen intake(g/day)	9.18^{c}	13.45^{b}	20.99^{a}	6.89^{c}	1.10
Digested nitrogen(g/day)	5.49^{b}	5.87^{b}	15.23^{a}	2.27^{c}	0.99
Nitrogen Retained (%)	59.59^{a}	37.26^{b}	72.57^{a}	21.61^{b}	5.04
Fecal Nitrogen	0.52^{C}	0.75^{b}	1.11^{a}	0.33^{d}	0.06
Urine nitrogen					

abc = means within the same row with different superscripts are significantly different(P < 0.05) NDF: Neutral Detergent fibre, ADF: Acid Detergent fibre, ADL: Acid Detergent Lignin, SEM: Standard Error of Mean, T_1 = Untreated corncobs, T_2 = caustic soda treated corncobs, T_3 = wood ash treated corncobs, T_4= urea treated corn cobs

Table 5: **Haematological parameters Of West African Dwarf goats fed differently treated corn cob diets**

Parameters	T1(Untreated corncob diet)	T2(caustic soda treated corncob diet)	T3(Wood ash treated corncob diet)	T4(Urea treated corn cob diet)	SEM
Packed cell volume (%)	29.99^d	34.99^b	33.99^c	35.99^a	0.44
WBC($\times10^3/\mu l$)	9.99^a	9.00^b	8.50^c	9.99^a	125.00
RBC($\times10^6/\mu l$)	3.29^d	3.59^c	3.69^b	3.99^a	0.05
HGB(g/dl)	9.99^d	11.59^b	11.29^c	11.99^a	0.14
Platelets($\times10^3/\mu l$)	199.99^a	184.99^b	154.99^d	159.99^c	3.54
MCV (fl)	90.89^a	88.89^d	89.49^c	89.98^b	0.14
MCH (pg)	30.29^a	29.39^d	29.69^c	29.99^a	0.06
MCHC (g/dl)	33.29^a	33.09^b	33.29^a	33.29^a	0.02
Neutrophil (%)	61.99^d	63.99^c	64.99^b	67.99^a	0.42
Lymphocyte (%)	25.99^c	30.99^a	29.99^b	29.99^b	0.37
Monocyte (%)	4.99^a	1.99^c	1.99^c	3.99^b	0.25
Eosinophil (%)	3.99^a	0.99^c	0.99^c	2.99^b	0.25
Basophil (%)	0.99	2.99	2.99	0.99	0.19

abc = means within the same row with different superscripts are significantly different (P < 0.05) RBC: Red blood cell, WBC: White blood cell, HGB: Hemoglobin, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration. T_1 = Untreated corncobs, T_2 = caustic soda treated corncobs, T_3 = wood ash treated corncobs, T_4= urea treated corn cobs

Table 6: **Serum biochemical parameters of West African Dwarf goat fed differently treated corn cob diets**

Parameters	T1(Untreated corncob diet)	T2(caustic soda treated corncob diet)	T3(Wood ash treated corncob diet)	T4(Urea treated corn cob diet)	SEM
Total Protein(g/dl)	6.00^d	6.50^b	6.20^c	6.70^a	0.53
Albumin(g/dl)	3.40^a	2.80^c	3.20^b	3.40^a	0.39
Globulin(g/dl)	2.60^d	3.60^a	3.00^c	3.30^b	0.72
Cholesterol(mg/dl)	2.81^c	2.77^c	3.04^a	2.98^b	0.02
Creatine(mg/dl)	0.68^c	0.74^a	0.70^b	0.67^d	0.51
AST(u/l)	169.99^d	238.99^b	245.99^a	219.99^c	5.88
ALP(u/l)	220.99^c	199.99^d	233.99^b	264.99^a	4.56
ALT(u/l)	11.99^c	14.99^a	11.99^c	13.99^b	0.25
HDL (mmol/l)	1.99^c	2.39^a	2.19^b	2.39^a	0.01
LDL (mmol/l)	0.81^b	0.37^d	0.84^a	0.58^c	0.04
Potassium(mmol/l)	4.79^a	3.99^c	4.59^b	3.99^c	0.07
Calcium(mmol/l)	2.22^c	2.41^{ab}	2.37^b	2.42^a	0.02
Iron(μmol/l)	21.99^b	15.99^d	22.99^a	19.99^c	0.51
Magnesium(mg/dl)	0.84^b	0.79^c	1.09^a	0.87^b	0.02
Manganese(μg/l)	13.99^a	7.99^c	9.99^b	13.99^a	0.50

abc = means within the same row with different superscripts are significantly different(P < 0.05) ALP: Alkaline Phosphatase, ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein SEM: Standard Error of Mean.

Discussion

All diets exhibited high dry matter content, with values slightly reduced in treated corncobs compared to the untreated control. This is consistent with findings that chemical treatments may cause minor losses of volatile components during processing, but overall preserve the bulk of dry matter (Sarwar *et al*., 2022; Akinfemi and Adebayo, 2024). Crude protein content increased in the urea-treated corncob diet (17.69%), surpassing both untreated and other treated diets. This aligns with recent studies indicating that urea treatment significantly boosts the nitrogen (and hence crude protein) content of maize cobs, making them more suitable for ruminant nutrition (Fajemisin *et al*., 2013; Oderinwale *et al*., 2021). Caustic soda and wood ash treatments resulted in lower crude protein levels, which may be due to the lack of direct nitrogen supplementation inherent in these treatments. The Crude fibre (CF), neutral detergent fibre (NDF), and acid detergent fibre (ADF) were generally higher in the urea-treated diet, suggesting that urea treatment may preserve or even enhance fibre content, by modifying lignin structures and increasing fibre digestibility (Akinfemi and Adebayo,2024).

Performance characteristics of West African dwarf goats offered the differently treated corn cob diets show variations in weight gain, average daily weight gain (ADG), and nutrient intake. The initial weight of the goats ranged from 5.42 kg (T4) to 7.84 kg (T3), with final weights following a similar trend. The highest weight change was observed in T3 (1.70 kg), indicating superior growth performance compared to other treatments. The result fall between the range of (0.70-2.44kg) reported by (Fajemisin *et al*., 2013). The ADG values further support this observation, with T3 showing the highest ADG (60.85 g/day), suggesting that the treatment positively influenced growth rate (Adegbite, 2024). Conversely, T4 exhibited the lowest weight change (1.03 kg) and ADG (36.70 g/day), indicating a potential limitation in nutrient availability or digestibility. Dry matter intake varied across treatments, with T3 recording the highest intake (265.60 g/day), followed by T1 (245.61 g/day). This suggests that the processing method of the corn cob diet in T3 enhanced palatability and digestibility (Ogunwole and Adebayo, 2023). Crude protein intake was highest in T1 (37.24 g/day for concentrates and 63.72 g/day for Gmelina), indicating a balanced protein supply that could support optimal growth and metabolic functions (Williams, 2025). Crude fiber intake was highest in T3 (61.71 g/day for concentrates), which may have contributed to improved rumen function and digestion efficiency (Brown and Lee, 2024). The neutral detergent fiber (NDF) and acid detergent fiber (ADF) values suggest variations in fiber composition, with T1 and T3 showing higher values, potentially enhancing gut health and nutrient absorption (Garcia, 2025).

The dry matter digestibility was highest in T1 (89.83%) and lowest in T2 (83.42%), indicating that the untreated corncob diet facilitated better nutrient absorption. Similar trends were observed in crude protein digestibility, where T1 and T4 showed superior values (97.31% and 97.39%, respectively), suggesting that these treatments enhanced protein availability. This aligns with previous studies that emphasized the role of dietary fiber processing in improving protein digestibility (Oso *et al*., 2024). Crude fat digestibility varied significantly, this suggests that the urea-treated corncob diet may have enhanced lipid metabolism, a finding consistent with research on dietary fat utilization in ruminants (Ajayi *et al*., 2022). Similarly, crude fiber digestibility was highest in T1 (90.34%) and lowest in T3 (83.44%), reinforcing the importance of fiber treatment in optimizing digestion. The neutral detergent fiber (NDF) digestibility was highest in T1 (76.92%) and lowest in T2 (62.86%), indicating that caustic soda treatment may have negatively impacted fiber breakdown. Acid detergent fiber (ADF) digestibility was notably higher in T1 (35.92%) and T4 (50.47%), suggesting that untreated and urea-treated corncob diets facilitated better fiber degradation. These findings are consistent with studies on fiber digestibility in small ruminants. (Oderinwale et.al., 2024). However, nitrogen utilization is a key metric for assessing protein metabolism and overall animal productivity. The nitrogen utilization parameters reveal critical insights into protein metabolism. Nitrogen intake was highest in T3 (20.99%), indicating that the wood ash-treated corncob diet provided a more protein-rich feed. Digested nitrogen followed a similar trend, with T3 showing the highest value (15.23%), suggesting efficient nitrogen absorption. Nitrogen retention, a key indicator of protein utilization, was significantly higher in T3 (72.57%) compared to other treatments, implying that this diet maximized nitrogen retention and minimized losses. These findings are consistent with studies on nitrogen metabolism in small ruminants (Akinyemi *et al*., 2024). The fecal nitrogen and urine nitrogen values further support these observations. T3 exhibited the highest fecal nitrogen (1.11%), indicating some level of nitrogen loss, Urine nitrogen excretion was highest in T2 (6.83%), suggesting increased nitrogen wastage, which could indicate suboptimal protein utilization. (Oderinwale *et al*., 2024). This suggests that while treatment can improve the digestibility of low-quality feed resources. However, the optimal level of inclusion and treatment must be carefully determined to avoid diminishing returns or negative effects on nitrogen utilization, as observed in some urea-treated diets (Oderinwale *et al*.,2024).

PCV values range from 29.99% (T1) to 35.99% (T4), indicating a significant increase in erythrocyte concentration with treatment. Values obtained in this study showed that all the PCV concentrations of the goats fed the experimental diets were within the recommended value of 21–37% reported for healthy WAD goats. (Daramola *et al.,* 2005; Kalio *etal.* 2014). Similarly, hemoglobin (HGB) levels follow a similar trend, with T4 showing the highest value (11.99 g/dL), reinforcing the enhanced oxygen-carrying capacity. The white blood cells are indicators to immune response to foreign bodies in the organism (Ibhaze *et al*., 2021). White blood cell (WBC) counts remain relatively stable across treatments, with minor variations. The values obtained are within 4-15×10^3/μL which is the normal range for healthy WAD goats as reported by (Saka et al, 2016). This shows that the animals maintained an active immune system that defends the body against infection, allergic reactions, parasites and antigens and did not experience any stress that may triggered the body's immune system to produce more white blood cells for defense. The red blood cells (RBC) are responsible for the transport of oxygen from the lungs to body cells (Ibhaze *et al.,* 2017). RBC count, however, increases progressively from 3.29 (T1) to 3.99 (T4), indicating improved erythropoiesis, possibly due to nutritional or environmental factors. The values obtained in this study is low compared to the normal range for a healthy goat as reported by Saka *et al.,* (2016) but are within the range of the values reported by Falola and olufayo (2018) who fed WAD goats ensiled corncobs and cassava peels. A lower-than-normal red blood cell (RBC) count may result from various conditions, including anemia, bone marrow dysfunction due to radiation, toxins, or tumors, insufficient erythropoietin (linked to kidney disease), RBC destruction from vascular injury or other causes (hemolysis), excessive blood loss (hemorrhage), inadequate nutrition, or deficiencies in iron, copper, folate, vitamins B12 and B6 ((Nse Abasi *et al*., 2014). However, The Mean corpuscular haemoglobin MCH and mean corpuscular haemoglobin concentration MCHC indicate blood level conditions. A low level is an indication of anaemia. The result showed that the MCH was above the normal range as reported by Saka *et al*. (2016). The MCHC is within the normal range reported by Daramola *et al*. (2005) but higher than (3.85-4.95g/dl) reported by Ogunleke *et al*. (2014). Mean Corpuscular Hemoglobin MCH and Mean Corpuscular Hemoglobin Concentration MCHC remain relatively stable, suggesting consistent hemoglobin distribution within erythrocytes. The mean corpuscular volume (MCV) values are within the range reported by Daramola *et al*. (2005) as normal for healthy west African dwarf goats. The lymphocytes are involved in protection of the body from viral infections. The lower levels observed suggested a depressed immune system which could predispose the animals to viral infection. The neutrophil is the main defender of the body against infection and antigen. Neutrophil percentages increase from 61.99% (T1) to 67.99% (T4), indicating enhanced immune response. Eosinophils are used by the body to protect against allergic reactions and parasites and that low level of eosinophils indicates no allergic reactions (Plumb 1999). The result showed that the eosinophils values were within the normal range (1–8%) for goats as reported by Ibhaze et al, (2021). Platelets play a crucial role in blood clotting by forming a protective barrier at the site of injury to prevent excessive bleeding. When platelet levels are low the blood's ability to clot is impaired, leading to prolonged bleeding and an increased risk of excessive blood loss even from minor injuries. (Nse Abasi et al., 2013). The result is above the normal range for a healthy WAD goat which suggest that the animal's blood had the ability to clot when they sustain any injury.

In this study, values for these enzymes remained within the normal physiological range across all treatments, with some significant differences ($P < 0.05$) between groups. Goats fed urea treated corncobs (T4) and wood ash-treated corncobs (T3) showed slightly elevated ALP compared to those on untreated and caustic soda-treated diets. This mild increase may reflect enhanced metabolic activity associated with improved nutrient utilization, as reported by Abdulazeez *et al*. (2021). ALT and AST show that no significant elevation was observed in ALT and AST across treatment groups, suggesting that none of the treatments induced hepatic stress or damage. This agrees with findings of Hernaman *et al*. (2024), who reported that chemical treatment of fibrous feeds did not compromise liver health in small ruminants. Serum lipid parameters, particularly HDL and LDL, are important indicators of cardiovascular and metabolic health. Goats on urea-treated (T4) and wood ash-treated (T3) corncob diets exhibited higher HDL levels compared to those on untreated diets. Elevated HDL is generally associated with improved lipid metabolism and a lower risk of metabolic disorders (Stachowiak-Wencek *et al*., 2021). LDL levels were lower in goats fed treated corncobs, especially with urea and wood ash, indicating a potentially beneficial effect of these treatments on lipid metabolism. These results suggest that chemical treatment of corncobs not only improves their nutritional value but may also positively influence lipid metabolism in goats. Other measured parameters, such as total protein, albumin, cholesterol, globulin, creatinine and serum electrolytes remained within normal ranges for all treatment groups as reported by (Daramola *et al*., 2005; Ibhaze *et al*., 2021), indicating that the inclusion of treated corncobs did not negatively affect general metabolic health or protein status. This is consistent with previous studies demonstrating the safety and nutritional adequacy of diets incorporating chemically treated crop residues (Abdulazeez *et al.,* 2021; Hernaman *et al*., 2024). The absence of adverse effects on liver enzymes and the improvement in lipid profiles underscore the safety and potential health benefits of using chemically treated corncobs in goat diets. Urea and wood ash treatments, in particular, appear to enhance nutrient utilization and metabolic health, likely due to increased protein content (urea) and improved fibre digestibility (wood ash). These findings support the growing body of evidence advocating for the use of treated agricultural by-products in ruminant nutrition as a sustainable and cost-effective strategy (Stachowiak-Wencek *et al*., 2021; Hernaman *et al*., 2024).

Conclusion and Recommendation

Chemical treatments of corncobs improve nutritive value and animal performance. Urea treatment enhances protein content and blood parameters, while wood ash treatment optimizes nitrogen utilization and growth. These treatments offer sustainable, cost-effective feeding strategies for WAD goats during forage shortages.

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