Original Research Article

Haematological and biochemical profiles of West African Dwarf goats fed *Cochlospermum planchonii* root powder in their diet

ABSTRACT

This study was conducted to investigate the effects of feeding varying levels of *Cochlospermum planchonii* using 25 WAD goats. The study lasted for 84 days during which feed intake and haematological and biochemical parameters were monitored in 25 goats using a completely randomized design. Five diets consisting of pulverized *Cochlospermum planchonii* rhizome at varying proportions of 0 %. 5 %, 10 %, 20 % and 40 % respectively and designated as T_1, T_2, T_3, T_4 and T_5 were compounded with other feed ingredients. Goats were offered concentrate and Gamba grass (*Andropogon gayanus*) at 08:30 am. The results obtained revealed that there was no significant difference in dry matter intake of forage but the amount of concentrate consumed by T_5 was significantly ($P < 0.05$) lower than the other treatments. Haematological parameters such as; PCV, Hb, RBC, MCV, MCH, MCHC, WBC, neutrophils, lymphocytes and eosinophils did not differ across the treatments, while biochemical parameters such as; total protein, albumin, globulin, glucose, creatinine, urea and ALT were also similar across the treatments, however, cholesterol, AST and ALP were significantly different ($P < 0.05$). The study revealed that inclusion of *Cochlospermum planchonii* in the diets of WAD goats had no adverse effects on the haematological and serum biochemical parameters. Therefore, dietary inclusion or drenching with the plant is safe especially at 20 % inclusion.

Keywords: Cochlospermum planchonii, haematology, WAD goats, feed intake

1. INTRODUCTION

Cochlospermum planchonii, which is called *Ghehutu* or *Feru* by the Yoruba people of Western Nigeria, *Abanzi* by the Igbo people of Eastern Nigeria, *N'Dribala* and *Rawaya* or *Kyamba* by the Fulani and Hausa people respectively of Northern Nigeria and *Kpavande* by the Tiv people of North-central zone of Nigeria, belongs to the family Cochlospermaceae. It is a West African species of shrub with several therapeutic uses in humans and livestock in the sub region. In livestock production for instance, the rhizome is used by the Fulani herdsmen as an anthelmintic for de-worming their cattle, while the Tiv people use the plant to manage diarrhoea in small ruminants. The plant is richly endowed with various phytochemical constituents such as; saponins, alkaloids, phenolics, carbohydrates, flavonoids, glycosides, cardiac

glycosides, triterpenes, tannins and steroids [1, 2]. Mineral analysis of *C. planchonii* shows its rich content of elements like Sodium (Na), Potassium (K), magnesium (mg), Iron (Fe), Calcium (Ca), Copper (Cu) and Selenium (Se), while Lead (Pb) and Cadmium (Cd) are in minute amount [1].

Drenching of animals with crude plant extracts or inclusion of pulverized plant materials in their diet may positively or negatively affect the physiological and biochemical processes in the body. Alterations in the normal physiological processes usually occur long before the death of an organism. Therefore, the need to evaluate physiological and biochemical indicators of health when animals are feed non-conventional feed stuffs is paramount in enhancing livestock production. One of the means of determining the toxicity of ingested feed in livestock is by evaluating their blood. This is because blood contains relevant parameters which reflect the well-being of an animal [3]. Examining blood for their constituents therefore, can provide vital information for the diagnosis and prognosis of diseases in animals. This study was designed to investigate the effects of dietary inclusion of *Cochlospermum planchonii* on the erythrocytic, leucocytic and serum biochemistry profiles of West African Dwarf goats.

2. MATERIALS AND METHODS

The study was conducted at the Veterinary Teaching Hospital Complex, College of Veterinary Medicine, Federal University of Agriculture, Makurdi, Benue State. Makurdi is located within the Guinea Savanna Zone on longitudes 7^{o} 47' E and latitudes 6^{o} 25' N, with an undulating topography of 1,500m to 3,000m.

2.1 Plant Collection and Processing

Rhizomes of *Cochlospermum planchonii* were harvested around the premises of the Federal University of Agriculture, Makurdi in the month of March. The rhizomes were peeled and carefully separated into small strands which were allowed to dry under the shade for 7-8 days. The dried plant materials were thereafter, milled into coarse powder using a hammer milling machine and stored until needed for use.

2.2 Experimental Animals

A total number of 25 intact male WAD goats were sourced from a local goat market for the study. Experimental animals were dewormed using 2.5 % oral suspension of Albendazole (Albidol®, Concept

Pharmaceuticals Ltd. India) a broad spectrum anthelmintic at the dose of 7.5mg/kg. They were treated prophylactically against trypanosomosis using diminazene diaceturate (Dimaze®, Vetoquinol India Animal Health Pvt Ltd.) at 3.5 mg/kg body weight and coccidiosis using 2.5 % oral suspension of Toltrazuril (Kepcox®, Kepro B.V. Holland) at the dose of 20mg/kg body weight. The experimental animals were also treated against external parasites (fleas, lice and ticks) using 0.6 % Permethrin powder which was dusted liberally all over the body of the animals, and then vaccinated against *Peste Des Petit Ruminants* (PPR), using *Peste Des Petit Ruminant* Vaccine (NVRI, Vom, Nigeria). Each animal was identified by a neck tag.

2.3 Feeding of Experimental Animals

The experimental animals were acclimatized for four (4) weeks with the intensive management system (zero grazing), and the new feeding regime. The goats were fed twice daily: between 08.30 – 09.30 am and 04:00- 05:00 pm local time, while water was provided *ad libitum*. One kilogramme of fresh *Andropogon gayanus* (Gamba grass) was fed to the goats in divided ration (i.e 500g in the morning and another 500 g in the evening) and this was supplemented with 250g concentrate. Every morning before fresh feed was given; leftover of the previous day feed was carefully recovered and weighed. Weighing of feed and the leftover was done with an electronic metler balance (Zhongshan Camry Electronic Co. Ltd. Hong Kong, China). The difference between what was given and the leftover was recorded as feed consumed. Total feed consumption was determined by adding daily feed consumed over the total number of days for the study, while the average daily feed consumed was determined by dividing the total feed consumed (in grammes) by the number of days of the study.

2.4 Feed Analysis

Samples of pulverised *Cochlospermum planchonii*, concentrate feed ingredients (maize, soya bean meal, rice bran and palm kernel cake) and *Andropogon gayanus* were oven dried at 60^0C until a constant weight was obtained for proximate analysis as described by [4]. Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to the methods of [5] using an ANKOM 220 Fibre Analyzer (ANKOM Technology Corporation, NY, USA). Hemicellulose was calculated as NDF – ADF and cellulose as ADF – ADL [6].

Table 1: Proximate composition of experimental diets

Ingredient	Diets						
	T_1	T_2	T_3	T_4	T_5	CP	Forage
Maize	49	44	38	27	5		
SBM	13	13	14	15	17		
PKC	15	15	15	15	15		
Rice bran	20	20	20	20	20		
CP	0	5	10	20	40		
Bone ash	2	2	2	2	2		
Salt	1	1	1	1	1		
Total	100	100	100	100	100		
Chemical composition							
Dry matter (%)	93.5	94.1	91.2	94.2	94.1	89.2	90.1
Crude protein (%)	14.5	14.0	15.4	15.7	14.0	3.20	5.94
Crude fibre (%)	5.89	7.38	8.68	10.1	16.0	18.1	39.9
Ether extract (%)	7.50	6.60	4.10	4.20	7.00	3.20	1.30
Ash (%)	5.30	5.45	6.40	6.75	9.20	6.00	6.65
ME (KJ/KG/DM)	3.21	3.13	2.83	1.79	1.63	1.06	1.02

SBM = soyabean meal, PKC = palm kernel cake, CP = Cochlospermum planchonii

2.5 Blood Collection for Haematology and Serum Biochemistry

Blood samples were collected from each goat by jugular venipuncture. Blood samples for haematology (2 ml) were immediately transferred from the syringe into vacutainer (Trittau, Germany) containing Ethylene Diamine Tetracetic Acid (EDTA) as anti-coagulant. The sample bottle was then rocked gently for proper mixing of the blood with the EDTA to prevent clotting. Haematological assay was done using an auto-analysing machine (Mindray Auto Haematology Analyser BC 2800, Mindray Building, High-Tech Industrial Park, Nashen, Shenzhen 518057, P.R. China). For biochemical studies, three millilitres (3ml) were

dispensed into clean sample bottles with no anti-coagulant and allowed to stand for 2 hours at room temperature and then centrifuged at 3000 rpm for 10 minutes using a micro centrifuge. The resulting serum was immediately harvested into serum tubes for the determination of serum biochemical parameters was done using Erba® Mannheim kits (Erba® Laboratories Ltd., USA).

2.6 Statistical Analysis

All statistical analysis were done using SPSS version 21.0 for windows and results summarized as means ± standard errors of means. Data were analysed by Repeated measure (Rm) ANOVA [7]. Variant means were separated by the Duncan's multiple range test and probabilities (*P*) of 0.05 or less were considered significant.

3. RESULTS AND DISCUSSION

Table 1 shows the dietary composition of experimental diets fed to the WAD goats. The total forage intake, total concentrate intake, total feed intake and mean feed intake are presented in Table 2. There were no significant differences in the total and mean forage intake across the treatments. The total and mean concentrate intake was significantly different (P = .05) between T_5 and the rest of the treatments (Fig. 1 and 2). Weekly concentrate consumption showed no variation across the treatments in the first three weeks (Fig. 1). Similarly, mean and total feed intake followed the same pattern as concentrate intake (Fig. 3 and 4). There was a significant (P = .05) effect of time on feed consumption following analysis by repeated measures ANOVA. The crude protein obtained in all the diets exceeded the 8 % which is said to be the minimum limit needed by rumen microbes for optimum activity [8]. This suggests that the diets were adequate to meet the protein requirement of experimental animals and for effective rumen function. Dry matter intake of the concentrate decreased as the level of *C. planchonii* increased in the diets. The average daily concentrate intake ranged from 143 to 207 g/day and this is lower than the range of 364-457 g/day obtained by Adedeji et al. [9] who fed concentrate and groundnut husk to West African Dwarf goats and 529-559 g/day by Ajayi et al [10] who also fed concentrate diets to WAD goats. Meanwhile, Min et al [11] did not observe any changes in dry matter intake (DMI) of goats when they fed experimental animals with concentrate containing 30 % pine bark (pine bark contains 11% condensed

tannins), but Min et al [12] reported an increase in DMI of goats fed pine bark containing 3.2 % condensed tannins.

Table 2: Feed intake of goats fed varying levels of *C. planchonii*

Parameters	Inclusion levels						
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (20%)	T5 (40%)	SEM	*p* value
Total forage intake (kg)	17.9	17.9	18.3	18.0	17.5	0.12	0.34
Mean forage intake (g/d)	213	213	218	213	208	1.47	0.34
Total conc. intake (kg)	17.4[a]	15.3[a]	15.6[a]	16.4[a]	12.1[b]	0.46	0.01
Mean conc. intake(g/d)	208[a]	183[a]	185[a]	195[a]	144[b]	5.49	0.01
Total feed intake (kg)	35.2[a]	33.3[a]	33.9[a]	34.3[a]	29.6[b]	0.48	0.01
Mean feed intake (g/day)	421[a]	396[a]	403[a]	409[a]	352[b]	5.86	0.01

[abc] *Means with different superscripts within a row differ significantly*

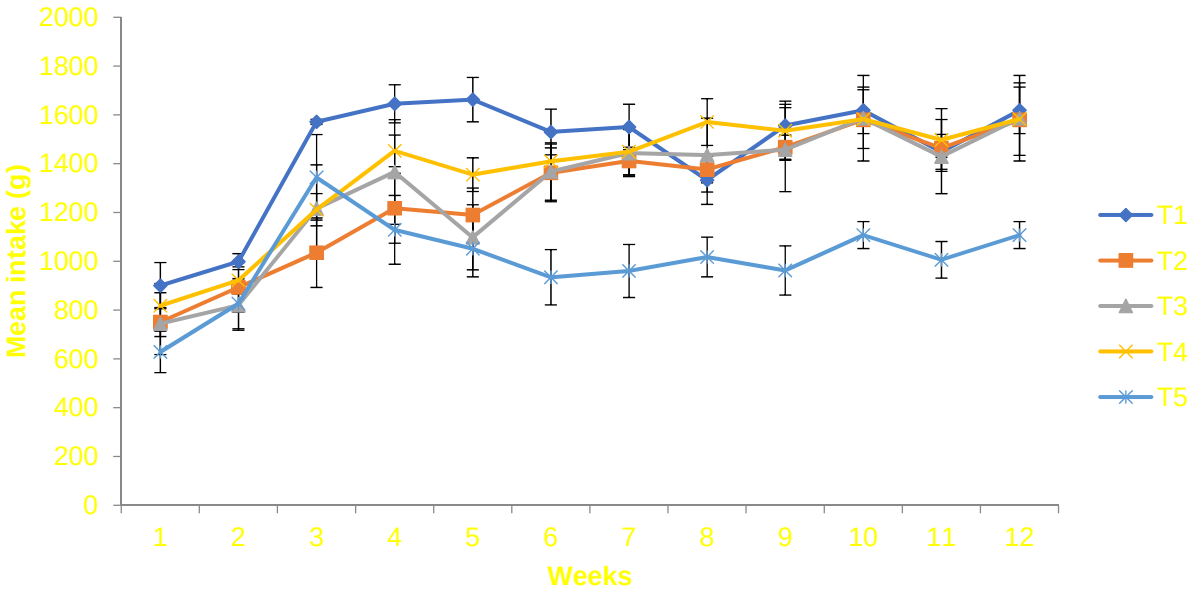

Fig. 1: Mean weekly concentrate intake of experimental goats fed graded levels of dietary *C. planchonii*.

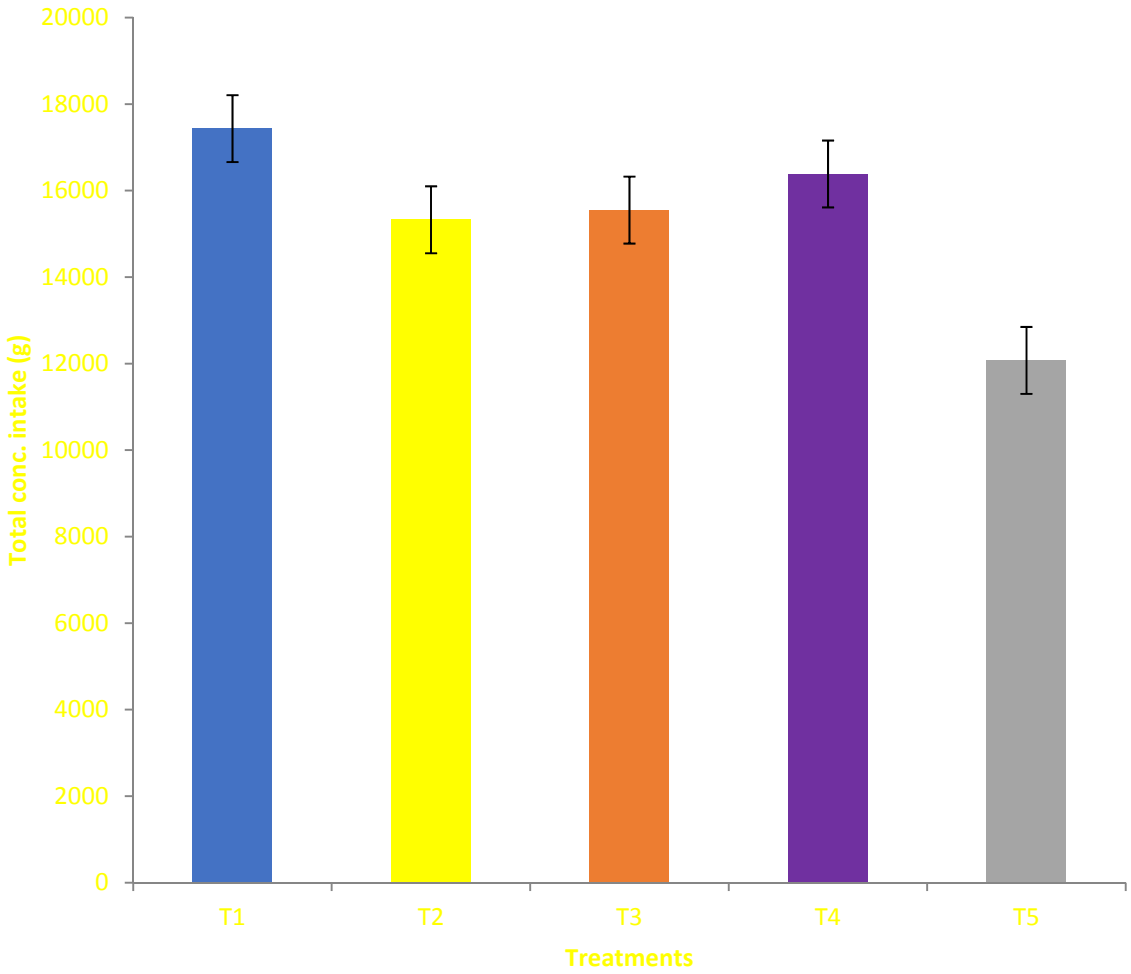

Fig 2: Total concentrate intake of experimental goats fed graded levels of dietary *C. planchonii*

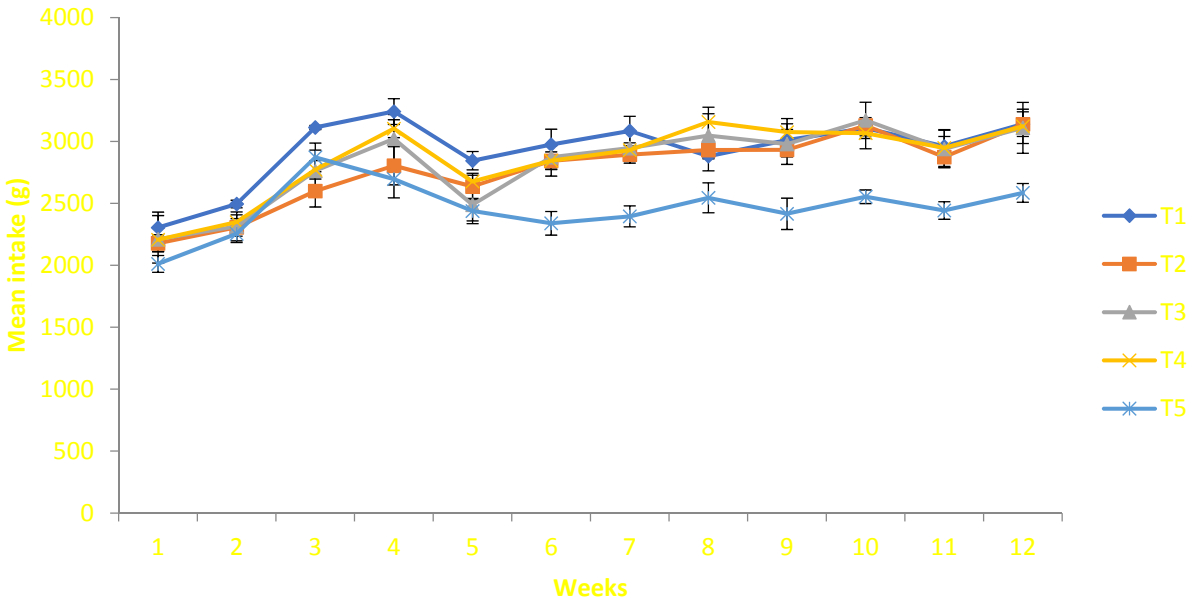

Fig. 3: Mean weekly total feed intake of goats fed graded levels of dietary *C. planchonii*.

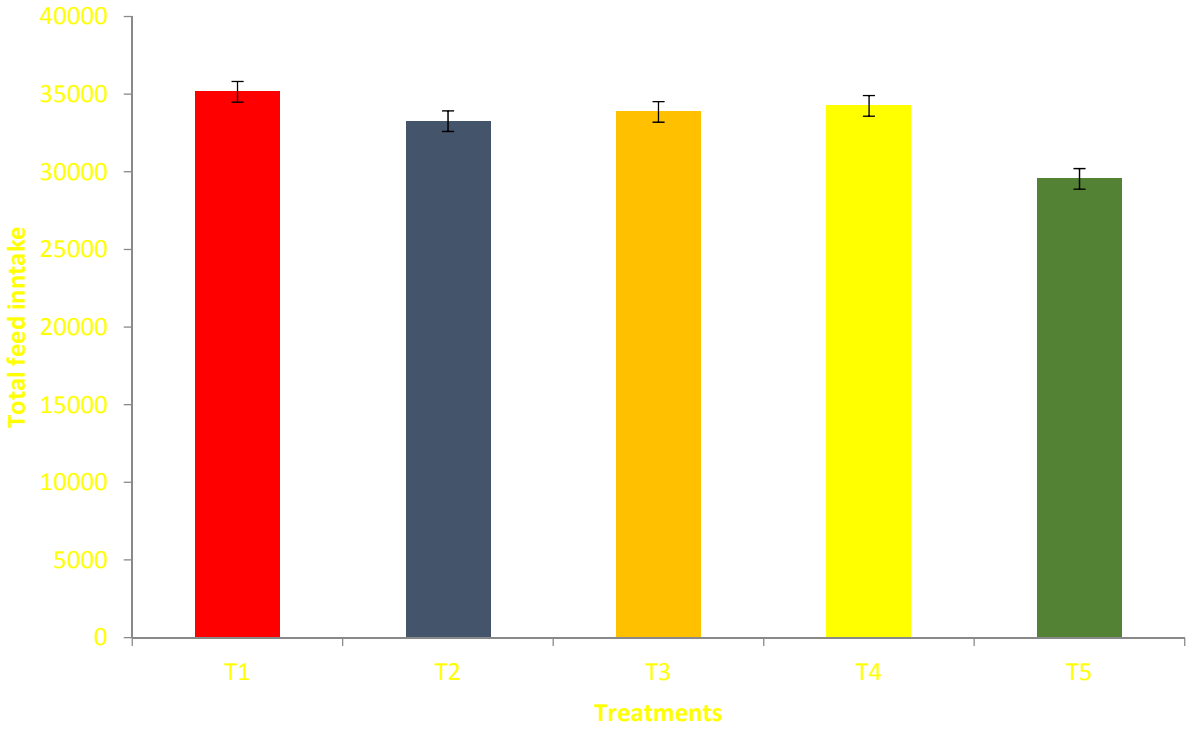

Fig .4: Total feed intake of goats fed graded levels of dietary *C. planchonii*.

Erythrocytic profile of WAD goats fed varying levels of *C. planchonii* is presented in Table 3. The mean values of PCV, Hb, MCV, MCH and MCHC of all the treatments were comparable throughout the study duration. The packed cell volume (PCV) did not differ across the groups in the course of the study and values were within the reference values of 21- 35 % for clinically healthy WAD goats [13,14]. Although there was a decline in the PCV of the goats between D21 and D35 to a range of 21 – 25 %, this decline was observed to be due to flea infestation because from D42, the PCV appreciated after the flea infestation was controlled. The increased PCV to the range of 28- 33 % at D84 agrees with the report of [15] that all the animals on the various diets had increased tendency for a return of PCV to normal level following an infection through compensatory accelerated production. The haemoglobin concentration was within the normal range of 7 – 15 g/dl for WAD goats as reported by [13]. The values were however higher than the 5 - 6 g/dl reported by [16] who fed *Jatropha curcas* kernel cake rations to WAD goats. With the moderate haemoglobin concentration of 9.6 – 11.18 g/dl obtained in this study, all the inclusion levels appeared to be capable of supporting high oxygen carrying capacity blood in goats. The red blood cell (RBC) counts did not vary significantly across the treatments. The mean RBC counts in the present study (15.1 – 17.3 $x10^6$/µl) fell within the range of 9.9 – 18.7x 10^6/µl reported by [17]. In contrast [18] and [13] reported lower values of 10.3 – 12.9 $x10^6$/µl and 9.2 – 13.5 x 10^6/µl respectively. Mean values of MCV, MCH MCHC indicate that *C. planchonii* inclusion at varying levels even at the 40 % inclusion level did not affect red blood cell indices. The MCV, MCH and MCHC values reported in this study were within the normal ranges for clinically healthy goats [19] which are 16-25 fl, 5-8 pg and 28-34 % respectively.

Table 3: Erythrocytic profile of goats fed varying levels of *C. planchonii*

Parameter/days	Inclusion levels					
	T1	T2	T3	T4	T5	SEM
PCV (%)						
0	29.6	29.4	28.0	27.9	30.8	1.01
21	23.8	24.4	25.6	22.4	22.7	0.65
42	27..1	24.1	26.9	27.5	22.8	0.83

63	26.5	24.0	24.9	27.8	26.0	0.79
84	33.2	32.7	29.9	33.6	28.9	0.76
Hb (g/dl)						
0	9.9	9.8	9.3	9.1	10.3	0.21
21	7.9	8.1	8.5	7.5	7.6	0.25
42	9.0	8.0	9.0	9.2	7.6	0.26
63	8.8	8.0	8.3	9.3	8.7	0.25
84	11.1	10.9	10.0	11.2	9.6	0.24
RBC (**x**						
10^6/µl)						
0	14.8	16.0	16.2	14.9	14.2	0.34
21	16.2	15.5	16.5	15.3	13.9	0.46
42	17.5	16.7	15.5	15.8	14.7	0.49
63	19.5	19.5	17.6	19.0	17.3	0.43
84	18.8	16.5	16.3	18.2	17.0	0.48
MCV (fl)						
0	16.3	15.3	15.8	16.5	16.1	0.27
21	16.8	15.6	16.2	17.1	16.6	0.26
42	16.8	16.5	16.3	18.2	17.0	0.27
63	16.9	16.8	17.0	18.4	17.5	0.27
84	17.3	16.9	17.0	18.6	17.5	0.27
MCH (pg)						
0	5.58	5.46	5.56	5.92	5.52	0.08
21	5.72	5.52	5.72	5.98	5.66	0.07
42	5.70	5.78	5.72	6.12	5.76	0.08
63	5.68	5.82	5.74	6.02	5.90	0.07
84	5.44	5.54	5.56	5.76	5.50	0.06
MCHC						

0	34.5	36.1	35.6	34.2	34.6	3.18
21	34.1	35.8	35.5	34.2	34.4	2.77
42	34.2	35.2	35.5	33.9	34.4	2.70
63	33.8	35.0	34.3	33.1	33.9	3.18
84	32.3	32.7	33.1	31.2	31.9	2.84

PCV = packed cell volume, Hb = haemoglobin, RBC = red blood cells, MCV = mean corpuscular volume, MCH = mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration

The leucocytic profile of experimental animals is presented in Table 4. The mean white blood cell counts and differential WBC counts of experimental goats did not show any significant difference among the treatments. However an increase in the number of circulating eosinophils above the their pre-treatment levels was observed on D21 where T_2, T_3 and T_4 recorded eosinophil values of 9.6, 10.6 and 11.6 % respectively compared to 2.8 % and 1.8% on D0. The elevation in the eosinophil counts was due to flea infestation which was put under control immediately and not as a reaction to experimental diets. The white blood cell (WBC) values (11.3 – 18.1 x 10^3/µl) obtained in this study were similar across the various dietary inclusion levels and within the normal range of 6.8 – 20.1 x 10^3/µl values reported by Daramola *et al*. (2005) for clinically healthy goats. This result is also in agreement with the 16.3 – 17.3 x 10^3/µl values reported by [20] who fed sweet orange peels to WAD goats, but contradicts that of [21] who reported elevated WBC values of 18.7 – 26.4 10^3/µl in WAD goats fed fermented Baobab (*Adansonia digitata*) seed meal. There was eosinophilia on D21 in experimental goats especially those that were placed on 5, 10 and 40 % inclusion levels. The elevated circulating eosinophils in this study occurred during the period of flea infestation and agree with the report of [22] who reported eosinophilia in ticks infested calves.

Table 4: Leucocytic profile of goats fed varying levels of *C. planchonii*

Parameter/days	Inclusion levels					
	T1	T2	T3	T4	T5	SEM
WBC (**x 10^3/µl)**						
0	13.0	14.8	16.4	16.1	15.5	0.68

21	14.5	15.5	17.3	17.2	12.3	0.98
42	11.3	13.7	14.7	14.2	12.0	0.61
63	18.1	16.8	15.4	16.6	11.8	1.10
84	12.8	14.7	15.0	14.7	13.0	0.73
Lymphocytes						
(%)						
0	73.6	56.0	57.6	65.4	67.2	2.88
21	37.4	39.0	44.0	48.2	44.2	2.29
42	52.0	48.2	58.0	44.0	41.8	2.58
63	62.2	59.0	63.2	62.2	55.0	2.08
84	58.0	52.4	61.2	58.0	54.6	1.75
Neutrophils (%)						
0	24.8	41.2	40.6	32.6	30.0	2.92
21	37.6	39.0	44.0	48.2	44.2	2.28
42	52.0	49.4	43.6	54.4	52.4	1.94
63	35.0	39.0	33.4	35.8	43.0	2.08
84	40.6	45.6	37.2	40.2	43.6	1.65
Eosinophils (%)						
0	1.6	2.8	1.8	2.0	2.8	0.33
21	7.6	9.6	10.6	4.0	11.6	1.35
42	1.4	2.4	2.6	1.4	5.8	0.69
63	2.4	2.0	3.4	1.8	2.0	0.29
84	1.6	1.8	2.2	1.8	1.8	0.31
Basophils (%)						
0	-	-	-	-		-
21	0.2	-	-	-	-	0.04
42	0.2	-	-	0.2	-	0.06
63	-	-	-	0.2	-	0.04

84	-	-	-	-	-	-
Monocytes (%)						
0	-	-	-	-	-	-
21	-	-	-	-	-	-
42	-	-	-	-	-	-
63	-	-	-	-	-	-

WBC = white blood cells

The result of biochemical parameters as presented in Table 5a did not differ significantly between treatments from D0 to D84. There was no significant difference in the total protein, serum albumin, globulins, glucose and creatinine levels across the treatments. However, the cholesterol level of T_5 was significantly (*P* = .05) higher than the control. On D84, group E cholesterol level became significantly (*P* = .05) higher than those of all the groups. The mean cholesterol level of T_5 on D42 was 142.6 mg/dl and this appreciated to 178.1 mg/dl on D84. These values were significant (*P* = .05) higher than their D0 values of 105.8 mg/dl. The mean serum urea, AST, ALT, ALP, calcium and phosphorus as presented in Table 5b showed no significant alteration in the levels of serum urea, ALT and calcium. Meanwhile, the mean serum AST, ALP and phosphorus showed some level of variation across the groups but the values were however, within normal range for healthy goats. Although the values of total protein were similar throughout the period of the experiment, the result showed that from D0 to D42, the values in all the groups were within the range reported by [13] for WAD goats. However, by D84, the 40 % inclusion group had 5.98 g/dl which was slightly below the lower limit of 6.1 and 6.3 g/dl respectively reported by [23] and Daramola et al. [13]. The serum albumin and globulin levels were within normal ranges of 2.3 -3.9 g/dl and 2.7 – 4.4 g/dl [23] suggesting that *C. planchonii* inclusion in the diet of goats is safe. The blood glucose values of the experimental animals did not differ across the groups and remained within the established range (48 – 76 mg/dl) for healthy goats [23]. The maintenance of blood glucose levels within the normal range could be attributed to the ability of the various diets to conform to the recommended energy value for an average diet (6 – 13 MJ/kg/DM) [24]. Blood glucose could serve as an indicator of the nutrient status in goats as observed by [25]. The serum creatinine levels for WAD goats fed varying

inclusion levels of *C. planchonii* were similar. Creatinine levels in blood and urine may be used to calculate creatinine clearance (CrCl), which reflects the glomerular filtration rate (GFR). The GFR is clinically important because it is a measurement of renal or kidney function [26]. In the present study, serum creatinine levels in WAD goats were within the normal range (1-1.8 mg/dl) reported by [23]. These values were however, higher than the values of 0.25 – 0.30 mg/dl, 0.7 – 1.5 mg/dl and 0.48 – 0.88 mg/dl reported by [14, 27, 28] respectively, for WAD goats. The maintenance of creatinine levels amongst the experimental animals within normal reference values during this study suggests there was no damage caused by the diet to the kidneys. The range (24.18 – 28.76 mg/ dl) of urea recorded in this study was higher than the values (12.6 – 25.8 mg/dl) obtained by Aiello [29], but lower than the 32.25 – 37.30 mg/dl and 31.6 – 34.02 mg/dl values respectively reported by [14] and [30] for WAD goats. High blood urea level have been reported to be associated with poor protein quality in the diet of the animal [31], while [32] suggested that increased catabolism of amino acids when proteins of lower biological value are used as feed could result in high blood urea levels. The similarity in serum urea levels in goats across the various inclusion levels is an indication that the quality of the diets was not compromised, and also suggests that the kidneys and the liver were functioning optimally. The serum cholesterol level of T_5 was elevated above the reference value of 80 – 136 mg/dl [23], while the other treatments remained within the normal reference range. According to [33], high serum cholesterol level is an indication of heart disease. Therefore, the result of this study showed that *C. planchonii* is safer with inclusion of up to 20%, but above this, the animal could be predispose to heart disease and possibly render the carcass unfit for human consumption. Serum enzymes such as alanine transaminase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) are used as an index of feed quality [34]. Although the values of AST and ALP on D84 for T_5 were significantly higher than the rest of the treatments, the values remained within the broad range of 66 -230 IU/L and 61- 283 IU/L recorded for WAD goats [23]. The maintenance of all the serum enzymes within the normal range is an indication of the high quality of experimental diets [35]. The range of serum calcium (Ca) and phosphorus (P) reported in the current study (7.8 – 9.4 mg/ dl and 4.7 – 5.6 mg/dl respectively) were found to be within the established reference range of 8.9 – 11.7 mg/dl and 4.2 – 9.1 mg/dl for WAD goats [23]. Lack of decrease in serum mineral concentration below the normal values, which reflect changes in absorption from the gut, implies that the absorption of these

minerals from the gastrointestinal tract was not hampered at least in the short run. Consequently, feeding phytochemicals-rich *C. planchonii* concentrate did not cause any sign of mineral depletion. This result agrees with previous reports [36,37,38,39].

Table 5a: Effect of *C. planchonii* inclusion on serum biochemistry, enzymes and electrolytes of WAD goats

Parameter/days	Inclusion levels					
	T1	T2	T3	T4	T5	SEM
Total protein (g/dl)						
0	6.90	6.52	6.92	6.23	7.68	0.32
42	7.14	6.21	6.95	6.68	6.71	0.20
84	6.96	6.25	7.17	6.78	5.98	0.24
Albumin (g/dl)						
0	3.0	2.8	2.4	2.3	2.7	0.12
42	3.5	3.3	3.6	3.5	3.0	0.17
84	3.7	2.7	3.1	3.2	2.4	0.22
Globulin (g/dl)						
0	3.88	3.74	4.50	3.93	4.98	0.32
42	4.10	2.89	3.35	3.18	3.25	0.30
84	4.56	3.57	4.07	3.06	2.80	0.37
Glucose (mg/dl)						
0	74.6	71.5	68.0	75.2	72.1	3.27
42	73.3	67.3	74.7	69.7	67.9	2.35
84	58.3	51.4	53.9	62.3	57.9	1.94

Creatinine (mg/dl)						
	1.80	1.80	1.90	1.80	1.90	0.10
	1.50	1.82	1.52	1.54	1.52	0.71
	1.40	1.68	1.70	1.80	1.86	0.13
Cholesterol (mg/dl)						
0	105	109	127	102	106	4.76
42	123^{b}	127^{ab}	131^{ab}	137^{ab}	143^{a}	2.64
84	115^{b}	119^{b}	129^{b}	130^{b}	178^{a}	7.26

^{ab} *Means with different superscripts within a row differ significantly*

Table 5b: Effect of *C. planchonii* inclusion on serum biochemistry, enzymes and electrolytes of WAD goats

Parameter/days	Inclusion levels					
	T1	T2	T3	T4	T5	SEM
Urea (mg/dl)						
0	31.7	28.4	27.1	23.8	22.5	1.39
42	23.3	28.0	23.4	21.0	24.4	4.09
84	24.2	25.9	28.8	26.2	28.2	1.0
AST (IU/l)						
0	77.8	86.0	82.9	81.3	75.5	2.33
42	60.9^{b}	61.0^{b}	64.2^{ab}	64.7^{ab}	67.1^{a}	0.82
84	60.9^{b}	62.0^{b}	63.3^{ab}	65.5^{ab}	68.1^{a}	0.82

ALT (IU/l)						
0	16.3	18.5	14.8	16.6	11.2	2.25
42	13.0	12.7	13.0	11.2	16.9	0.92
84	9.6	11.8	12.4	12.4	13.2	0.66
ALP (IU/l)						
0	73.0	63.2	75.5	77.8	69.0	3.25
42	68.8	67.4	69.8	72.7	75.5	1.71
84	60.8^{b}	61.7^{b}	62.0^{b}	62.0^{b}	63.5^{a}	0.24
Calcium (mg/dl)						
0	7.22	8.20	8.22	7.20	11.08	0.71
42	8.18	8.70	8.26	9.16	9.10	0.36
84	8.06	8.36	9.30	8.38	8.12	0.40
Phosphorus (mg/dl)						
0	5.18	4.22	5.52	4.54	4.70	0.25
42	5.90^{a}	5.80^{a}	5.88^{a}	5.76^{a}	5.32^{b}	0.21
84	5.70	5.02	5.40	5.56	5.56	0.16

AST = aspartate aminotranferase, ALT = alanine aminotranferase, ALP = alkaline phosphatase

^{ab} *Means with different superscripts within a row differ significantly*

4. CONCLUSION

In conclusion, this study has demonstrated that inclusion of *Cochlospermum planchonii* rhizome in diets of West African Dwarf goats had significant effect on their performance. The experiment showed that including up to 20 % of *C. planchonii* in diets of WAD goats had beneficial effects as seen in improved feed intake, haematology and serum biochemical parameters. Therefore, it use in ethnoveterinary practices will not compromised the health status of the animal.

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