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Growth Performance, Haematology and Serum Biochemical Indices of West African dwarf (WAD) Goats Fed Boiled Wild Cocoyam and *Panicum maximum* as Basal Diet.

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Abstract

*Reductions in the quality and quantity of forages during dry season, as well as an increase in production cost of feed, militate against West African dwarf goat productive performance. Wild cocoyam (*Caladium bicolor*) is an alternative feedstuff which is readily available and not in competition with man therefore suffices. This has led to the investigation of the growth performance, hematology and serum biochemical indices of West African dwarf (WAD) goats fed boiled *Caladium bicolor* and *Panicum maximum* as basal diet. Four diets containing 0 (control), 10, 20 and 30% of boiled *Caladium bicolor* meal (BCBM) designated as T₁, T₂, T₃, and T₄ respectively were compared. Sixteen (16) WAD goats of about 6-9 months of age were randomly assigned to the 4 treatments groups, each having 4 replicates in a completely randomized design. At the end of the study, result showed that there was no significant difference (P>0.05) recorded for final body weight. There were significant differences (P<0.05) in the value of total and daily weight gains, of which WAD goats fed 30%BCBM (T₄) based diet recorded 2.26, 46.74 respectively when compared with 1.30, 23.22 recorded by goats fed the control (T₁) diet. Daily feed intake (DFI) showed significant (P<0.05) differences across the treatment groups with T₄ (163.62) recording the highest value. Goats fed 10%BCBM (T₂) (100.85) based diet had the least feed intake value. Animals fed 30%BCBM had a superior feed conversion (FCR) ratio of 2.94, while the control group (T₁) recorded the poorest FCR of 7.01. The result revealed the ability of animals on T₄ to convert the feed consumed to a better weight gain. The result obtained in this study showed no significant difference (P>0.05) in hematology. But significant differences (P<0.05) only occurred in total protein and aspartate aminotransferase components of serum biochemical in this experiment, indicating that the animals were not in health danger. This study however, revealed that BCBM can be included in WAD goat's diets up to 30% without any deleterious effect on animal.*

Key words: Elephant ear, West African Dwarf Goats, Serum, Haematology, Performance

1.0 Introduction

The domestic goat is a subspecies of goat which is domesticated from the wild goat of southwest Asia and some parts of Eastern Europe. Over 300 distinct breeds of goat have been identified (Hirst& Kris, 2008). Domestic goats have been used for their milk, meat, hair, and skins in many parts of the world (Alphonsus et al., 2010; Coffey et al., 2004; Sam, 2012). Goat production has over the years, proven to be an excellent tool in achieving food and economic securities in developing country like Nigeria. The production of local goats is a function of the level of feeding, which constitutes about 70-80% of the total cost of livestock production under intensive system of management in Nigeria (Sam et al., 2017; FAO, 2001).

The performance of livestock in terms of weight gain, health status, meat production and feed conversion efficiency are determined by quality of feed. Age, body weight and stage of production are also factors affecting nutrient requirement of livestock. The dry periods especially in the tropics come with their complexities, one of which is the inadequacy of quality feeds. These have necessitated the use of alternative feed resources. However, some of these feed resources are unpalatable to animals, low in nutrient and may even contain anti-nutritional factors with low digestibility coefficient (Olorunnisomo & Ibhaze, 2013). *Caladium bicolor* (Elephant ear or heart of Jesus)— an alternative feedstuff, cheaply and abundantly available and non-edible by man with relatively high nutritive value (7.15% CP, 90.70% DM, 82.02% NFE, 5.12% Ash) as reported by Udo (2020) suffices as potential feed material for diet formulation for animals. In view of these, this study was conducted to evaluate the growth performance and blood profiles of WAD goats fed various inclusion levels of boiled *Caladium bicolor* meal-based diets.

2.0 Materials and methods

2.1 Study site

The experiment was carried out at the Goat Unit of the Akwa Ibom State University Teaching and Research Farm, Obio Akpa campus. The area is situated between latitude 4°622'N and longitude 7°750'E. The average annual rainfall of Obio Akpa is 4205.3-5381.2mm with mean annual temperature of 24-30°C. (SLUK-AK, 1994).

2.2 Experimental feed procurement and processing

The corms of wild Cocoyam (*Caladium bicolor*) were harvested from the surroundings of Akwa Ibom State University, Obio Akpa campus. The harvested corms were washed to remove dirt before being boiled in water to a temperature of 100°C for 30 minutes according to the method of Babayemi & Bamkole (2009). After boiling, the corms were peeled then sliced into small pieces for quick drying. The sliced products were sun dried to 10% moisture content, then milled to obtain boiled *Caladium bicolor* meal (BCBM) (Udo, 2020). Composition and proximate constituent of the experimental diets is shown in Tables 2.1.

2.3 Animal management and experimental design

Sixteen (16) growing West African dwarf goats of about 6-9 months of age were purchased from small holder farmers in Etinan Local Government Area of Akwa Ibom State. The goats, upon arrival, were quarantined for a period of 21days prior to the commencement of the research. Oxytetracycline and tylosine were administered to the animals during this period. Ivormectin was also administered against ecto and endo parasites. After the quarantine period,

the animals were grouped into four dietary treatment groups (T₁, T₂, T₃, and T₄) of four animals for each treatment and their weights were also balanced.

The pens were equipped with feeding and watering trough and fed at ad-libitum during the quarantine period. The experiment lasted for fifty-six (56) days. Animals fed the control diet received a diet of 0% of boiled *Caladium bicolor* meal (BCBM). Animals in group 2 to 4 were placed on the remaining three experimental diets formulated to contain 10%BCBM, 20%BCBM and 30%BCBM respectively. The ration was supplemented with *Panicum maximum* as basal diet for each of the treatment groups. The animals were weighed at the commencement of the experiment and subsequently on weekly basis before morning feeding. Two kilogramme of *Panicum maximum*, (the basal diet) was given daily by 2.00pm, while 500 g of the formulated diets were given by 8.00 am daily. Weight gain values were obtained by subtracting the initial weight from the final weight of each of the experimental animals. Feed intake was computed by subtracting the value of the quantity of left over feed from the amount previously offered. Total feed intake was calculated by adding the daily feed intake of the animals for 56 days that the experiment lasted. The experiment was arrayed in a completely randomized design.

2.4 Haematological and biochemical analysis

On the day of the commencement of the investigation, blood samples were collected (via the jugular veins of the goats) from all animals for haematological and serum biochemical investigation and recorded for each animal according to their treatment group. Blood samples (5ml) for hematological parameters were collected using a sterile needle into blood sample bottles containing ethylene, diamine tetraacetate (EDTA), to prevent coagulation. Likewise, blood samples for serum biochemistry were collected into bottles devoid of EDTA to allow blood clot for easy serum separation. Blood indices measured for haematology include; packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), neutrophils, lymphocytes, monocyte, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) (Margi, 1995). Likewise, total protein (TP), albumin, aspartate aminotransferase (AST), globulin, urea, creatinine, alanine aminotransferase (ALT), glucose and cholesterol were the biochemical indices considered as described by Margi (1995). The above processes were also repeated on all animals at the end of the experiment. The values obtained on the parameters of haematological and biochemical constituents were however compared with the previous values recorded for each treatment group before the commencement of the experiment on the same parameters.

2.5 Chemical analysis of experimental diets

Samples of the experimental diets were collected and analyzed for proximate composition using standard procedures (AOAC, 2005).

2.6 Statistical analysis

All data generated were subjected to analysis of variance (ANOVA). Significant means were separated using Duncan's multiple range test (Duncan, 1955).

Table 2.1: Composition and chemical constituent of experimental diets

Ingredients	T ₁ (0%BCBM)	T ₂ (10%BCBM)	T ₃ (20%BCBM)	T ₄ (30%BCBM)
Cassava peels	40.00	40.00	40.00	40.00
Brewer's dried grain	40.50	30.50	20.50	10.50
BCBM	0.00	10.00	20.00	30.00
Palm kernel cake	17.00	17.00	17.00	17.00
Bone meal	2.00	2.00	2.00	2.00
Common salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Chemical composition %				
Dry matter	89.85	98.96	90.06	90.10
Crude protein	13.41	12.36	11.34	10.35
Ether extract	5.58	5.32	5.17	4.78
Ash	5.27	5.28	5.22	5.20
Nitrogen free extract	56.07	57.55	58.91	60.20
Gross energy (Kcal/kg)	4.02	4.01	4.01	4.00

BCBM = boiled *Caladium bicolor* meal

3.0 Results and discussion

Table 2.1 showed dry matter (DM) range of 89.85 to 98.96%, of which the highest value (98.96) was observed in T₂ (10%BCBM), while the lowest was observed in control diet (T₁). The crude protein (CP) values of 13.41%, 12.36%, 11.34% and 10.35% for diets A, B, C and D respectively. T₁ (0%BCBM) had the highest crude protein (13.41%) value. With ruminant, the protein range of 11.34-13.41% was enough for growth and production performance. The DM was adequate to support the rumination in the goats and digestion of the diets by the rumen microbes.

Table 3.1: Growth performance of WAD goats fed graded levels of BCBM

Parameters	T ₁ (0%BCBM)	T ₂ (10%BCBM)	T ₃ (20%BCBM)	T ₄ (30%BCBM)	SEM
Initial body weight (kg)	6.50	6.38	6.50	6.38	0.39
Final body weight (kg)	7.80	8.32	8.87	8.99	0.38
Total weight gain (kg)	1.30 ^c	1.94 ^b	2.37 ^{ab}	2.62 ^a	0.14
Daily weight gain (kg/day)	0.2322 ^c	0.3469 ^b	0.4228 ^{ab}	0.4674 ^a	2.53
Total feed intake (kg)	8.16 ^{ab}	5.65 ^b	7.07 ^{ab}	9.16 ^a	0.93
Daily feed intake (kg/day)	0.145 ^{ab}	0.100 ^b	0.126 ^{ab}	0.163 ^a	16.56
Feed conversion ratio	6.27 ^a	2.91 ^b	2.98 ^b	3.50 ^b	0.82

^{abc} means on the same row with different superscripts differed significantly (P<0.05), BCBM=Boiled *Caladium bicolor* meal, SEM=Standard error of mean.

The growth performances of WAD goats fed BCBM are presented in Table 3.1. Significant differences (P<0.05) were recorded among treatment groups for total weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio. Highest statistical value for total and daily weight gains were recorded in WAD goats fed T₄ based diet (2.26kg, 0.4674kg) while the lowest value was recorded in goats fed the control diet (1.30kg, 0.2322kg) respectively.

The steady increase in weight gain with an increase in the inclusion levels of BCBM could be attributed to an increase in the energy content of the feed. This agrees with the findings of Diego (2000) who asserted that as the amount of total digestible nutrient (TDN) increases in a ration, the rate of weight gain usually increases. Daily feed intake (DFI) recorded significant

(P<0.05) differences across treatment groups with T₄ (0.163kg) recording the highest value. Goats fed T₂ (100.85) based diet on the other hand recorded the least feed intake. This may be attributed to a decrease in energy content of the feed (Diego, 2000). The three treatment groups (T₁, T₂, and T₃) with BCBM inclusions (10%, 20% and 30%) were statistically similar (2.91, 2.98 and 3.50 respectively). However, the three treatment groups were significantly different (P<0.05) from the control group. As the inclusion level BCBM increases from 10-30% BCBM, the FCR also increases indicating that *Caladium bicolor* can influence the digestion of diet in WAD goat negatively. However, the control group recorded the poorest FCR (6.27). The better utilization of diets with BCBM than the control may be attributed to the cooking effect on *Caladium bicolor* thereby making nutrient utilization easy (Onu & Madubuike, 2006).

Table 3.2: Hematological profile of WAD goats fed graded levels of BCBM

Parameters	T ₁ (0%)	T ₂ (10%)	T ₃ (20%)	T ₄ (30%)	SEM	Normal range
Packed cell vol.	25.00	25.50	27.50	24.00	0.60	22.0-38.0
Hb (g/dl)	7.15	7.45	7.70	6.95	0.15	8.0-12.0
RBC (x10 ⁶ /ul)	8.20	8.70	9.95	9.80	0.34	8.0-18.0
WBC (x10 ³ /ul)	10.90	10.75	10.65	9.25	0.39	4.0-13.0
Neutrophils (%)	56.50	59.50	59.50	56.00	0.97	35-40
Lymphocytes	42.00	40.50	39.00	43.00	0.86	20.90
Monocytes	1.50	0.00	1.50	0.50	0.48	0-1.0
MCV (fl)	31.10	29.65	27.65	24.50	1.27	16.0-25.0
MCH (pg)	87.20	86.50	77.65	70.90	3.05	52-80
MCHC (g/l)	280.30	293.75	280.35	289.85	6.84	300-360

Normal range value: Rodostits et al. (2000)

Hb = hemoglobin, RBC= red blood cell, WBC = white blood cell, MCV = mean corpuscular volume, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration

Haematological profile of WAD goats fed BCBM is presented in table 3.2. The result revealed that the determined hematological indices were not significantly (P<0.05) influenced by the varied inclusion level of BCBM in the experimental diets. The pack cell volume (PCV) value that ranged from 24.00 - 27.50% fell within the normal range recommended for a healthy goat (22 - 38%) Rodostits et al. (2000). This indicates that the goats were neither stressed nor anaemic. Hemoglobin range of 6.95-7.70g/dl obtained in this investigation was lower than the normal range (8-12g/dl) reported by Rodostits et al. (2000), pointing to abnormality in oxygen transportation. This was however not attributed to the effect of feed (but due to an unknown factor either in the animal or in the environment that could not be traced) as the control group also recorded a value lower than the normal range (8-12g/dl).

The RBC count in goats fed T₃ (30%BCBM) based diet has the highest value ($9.95 \times 10^6 \mu\text{L}$), while goats fed T₁ (control) had the lowest RBC count ($8.20 \times 10^6 \mu\text{L}$). The values however, fell within the normal range ($8.0-18.0 \times 10^6 \mu\text{L}$). White blood cell (WBC) values showed a ranged between $9.25-10.90 \times 10^6 \mu\text{L}$. This fell within the normal range indicating that the animals did not have health a challenge due to the tested diet. Lymphocyte, neutrophils, monocytes and MCH values were within the normal range (20-90, 35-40, 0-1 and 50-80 respectively), signifying that the goats had no infection. On the other hand, MCV and MCHC recorded values which were below the normal ranges (16-25 and 300-360 respectively). However, the goats did not show any unhealthy status.

Serum biochemical profile of WAD goats fed BCBM is presented in table 3.3. Total protein and aspartate aminotransferase (AST) were significantly ($P \leq 0.05$) influenced by the level of BCBM inclusion. All other serum biochemistry parameters were however, not influenced by the test material. The total protein values observed ranged between 5.70 (T₁) and 6.45g/dl (T₃). This implied that the diet was high in crude protein because total serum protein is an indicator of level of protein in a feed (Radiostitset al., 2000). Albumin concentration ranged from 3.65 to 4.20g/dl and was within the normal range (2.8-4.3g/dl). Albumin helps to reduce loss of blood by facilitating blood clot. Globulin values were lower than the normal range. The low globulin value is an indicator of poor liver, heart and kidney functioning in animal (Radiostis et al., 2000). The values for the AST ranged from 31.50u/l in T₃ to 41.50u/l in T₂. The values were lower than the normal range (67u/l -87u/l) (Radiostits et al., 2000).

Depressed AST level are usually a sign of low toxicity of a substance as a result of a substance in the animal body (Udo, 2015).

Table 3.3: Serum biochemical parameters of WAD goats fed graded levels of BCBM

Parameters	T ₁ (0%)	T ₂ (10%)	T ₃ (20%)	T ₄ (30%)	SEM	Normal range
Total protein (g/dl)	5.70 ^b	6.05 ^{ab}	6.45 ^a	6.00 ^{ab}	0.12	5.9-7.4
Albumin (g/dl)	3.65	3.75	4.20	3.80	0.11	2.8-4.3
Globulin (g/dl)	1.55	2.30	2.25	2.20	0.15	2.85-3.6
Urea (mg/dl)	23.50	26.00	19.50	26.50	1.68	0.8-9.7
Creatinine (mg/dl)	0.30	0.55	0.55	0.35	0.06	0.70-1.50
AST (u/l)	40.50 ^a	41.50 ^a	31.50 ^b	36.00 ^{ab}	1.72	67-87
ALT	15.00	15.50	15.50	15.00	1.37	9.90-12.95
Glucose (mg/dl)	63.50	57.00	68.00	61.50	3.33	2.7-10
Cholesterol (mg/dl)	130.00	146.80	134.50	140.50	2.82	40-146

^{abc}means on the same row with different superscripts differed significantly ($P < 0.05$)AST = Aspartate aminotransferase, ALT = Alanine aminotransferase

4.0 Conclusion

The inclusion of boiled *Caladium bicolor* meal in the diets of WAD goat improved feed intake and increased weight gain, leading to improved growth performance. Animals in T₄ group were observed to perform better compared to other treatments. This indicates that BCBM can be included in goat diets up to 30% without any deleterious effect. Haematology and serum biochemical profile were not adversely affected. This therefore makes *Caladium bicolor* an alternative feed stuff for the formulation of supplementary diets for goat.

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