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Performance and Blood Profile of West African Dwarf Goat Fed Concentrate Supplement containing Varying Levels of Corncobs

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Authors' contributions

This work was carried out in collaboration between all authors. Authors FOO and FTA designed the study, wrote the protocol and wrote the manuscript. Author OAM assisted in blood collection and supervision. Author AAS performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was conducted to investigate the effects of feeding concentrate with varying level of corncobs using twelve West African dwarf goats (WAD).
Study Design and Duration: The study lasted for 84 days during which the performance and blood parameters were monitored in twelve WAD goats using a completely randomized design.
Methodology: Four diets consisting of milled corncob at varying proportions of 0%

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(control), 15%, 30% and 45% respectively were formulated with other feed ingredients. Goats were offered concentrates and guinea grass at 09:00 and 14:00 respectively. Parameters monitored were feed intake, weight gain, haematology and serum biochemical indices.

Results: Results obtained showed that bucks fed on 30% corncob inclusion had the highest dry matter intake (559g/d), feed conversion ratio (7.89) and weight gain (7.08g/d). There was no significant difference (P> .05) in the serum biochemical parameters of WAD goats among all the dietary treatments except in globulin and creatinine where goats on diet 3 had the highest values. No significant differences (P>.05) were also observed in the haematological parameters of WAD goats across all the dietary treatments.

Conclusion: The study revealed that inclusion of corncobs in the diets of WAD goats had no deleterious effects on the haematological and serum biochemical parameters and could therefore be included in ruminant diets up to 30%.

Keywords: Corncob; goats; haematology; serum biochemical indices; performance.

1. INTRODUCTION

Feed scarcity especially during the dry season is one of the major constraints hindering the development of ruminant livestock production in Nigeria [1]. According to FAO [2], livestock production is below 5% while human population is increasing at rate above 10%. The major constraint to livestock production has been identified as nutrition, which is mainly occasioned by seasonal fluctuations in quantity and quality of available forage which is the major source of feed for ruminants. However, one possible way to mitigate this incessant challenge ravaging ruminant livestock production is to explore alternative feed resource that are rarely consumed by man but which can meet the nutritional requirement of goats with little or no processing. This reduces the cost of animal production without a decrease in productivity.

In Nigeria, there is paucity of information on utilization of crop residues, agro-industrial by-products and non-conventional feed resources for livestock nutrition. In the classification of feed resources; soybean milk residue, cowpea seed waste and corncob have been regarded as non-conventional feed resources (NCFR). These residues or wastes have considerable potential as feed materials and their value can be increased if they are economically justifiable [3].

Corncobs are by-products of maize production and may be used as alternative feed resources for ruminants especially during dry season. Corncobs are important crop residue used by livestock farmers to supplement fodder during the dry season [4]. They are relatively available and abundant in the dry season; a major limiting factor in the utilization of this agricultural waste is its low digestibility and relatively poor nutrient composition [5]. However, ruminants generally had been known to be the best in the utilization of coarse materials such as corncobs for the production of meat and other products, thereby preferring feedstuffs relatively rich in crude fibre [6].

Haematological and biochemical indices of animals may give some insight into the production performance potentials of West African Dwarf goats [7]. Nutrition, breed, sex, age, reproductive status, environmental factors, stress and transportation are known to affect haematological and biochemical parameters [8]. The present study was designed to

determine the performance and blood profile of West African Dwarf Goats fed compounded ration consisting of varying levels of corncob as supplement.

2. MATERIALS AND METHODS

2.1 Location and Climate of the Study Area

The experiment was conducted at the Ruminant Unit of the Institute of Agricultural Research and Training, Moor plantation Ibadan, Nigeria. The experimental site was located in the derived savannah vegetation zone of south-western Nigeria. The area lies within the rainforest ecological zone, the temperature and relative humidity ranges from 30-35°C and 76-84% respectively.

2.2 Experimental Animals and Their Management

Twelve West African Dwarf (WAD) Goats weighing between 6.5–8.5kg were used for this study. The goats were housed intensively in well-ventilated individual pens disinfected with morigad® solution two weeks prior to the experiment. On arrival, the animals were kept in the pens for proper routine management. All the goats were given antibiotic injection (Oxytetracycline Long Acting) while Ivomec injection was administered to control both the endo and ecto-parasites. The goats were vaccinated against *Peste des Petit* Ruminant (PPR). Concentrate feed and Guinea grass was fed to the goats during the 14 days adaptation period. Feed and fresh clean water were supplied *ad-libitum*.

2.3 Experimental Diets

Wilted and chopped Guinea grass (*Panicum maximum*) was fed as basal diet to the goats. Four experimental concentrate diets were compounded to include corncob at 0%, 15%, 30%, and 45%. Other ingredients in the diets were brewers dried grain, wheat offal, palm kernel cake, groundnut cake, limestone, salt and premix (Table 1). After two weeks of adaptation period, the animals were divided into four treatment groups of three animals each and thereafter assigned to one of the four different experimental diets formulated in a completely randomized design. Each animal was kept and fed separately during the entire period of the experiment. The concentrate supplements were given to the animals at morning while wilted and chopped panicum maximum that had been harvested the previous day was given to the animals in the evening. During the 84-day experimental period, quantities of feeds offered and that refused were measured daily to compute feed intake while weight changes of the goats were recorded weekly.

2.4 Collection of Blood Samples

Blood samples (approximately 10ml) were collected from each goat via jugular vein puncture using hypodermic syringes before feeding at the end of the feeding trial. Five ml of blood was drawn into ethyl diamine tetra acetic acid (EDTA) bottle for haematology; the remaining 5ml was deposited in anticoagulant free plastic tubes and allowed to clot at room temperature. The PCV (packed cell volume) was measured using the micro- haematocrit method. Haemoglobin concentration was measured using Sahl's (acid haematin) method [9]. RBC (red blood cell), WBC (white blood cell) and the WBC differential counts i.e. the lymphocyte, heterophils, eosinophils and monocytes were measured with the aid of Neubauer counting chamber (haemocytometer). Plasma glucose was measured in fluoride

oxalate using the enzymatic glucose oxidase method [10]. The MCV (Mean Corpuscular Volume), MCH (Mean Corpuscular Haemoglobin) and MCHC (Mean corpuscular Haemoglobin Concentration) values were calculated from PCV, Hb and RBC values [11]. Total serum protein was measured in serum for individual animal using the biuret method. Serum albumin and globulin were measured using bromocresol purple method [12]. Serum creatinine was determined using the principle of Jaffe reaction as described [13].

Table 1. Gross composition of experimental diet containing varying levels of corncobs

Ingredient (Kg)	Diet 1 (control)	Diet 2	Diet 3	Diet 4
Brewers dry grain	60	45	30	15
Corn cob	-	15	30	45
Wheat offal	10	10	10	10
Palm kernel cake	20	20	20	20
Groundnut cake	5	5	5	5
Limestone	4.5	4.5	4.5	4.5
Salt	0.25	0.25	0.25	0.25
Grower premix	0.25	0.25	0.25	0.25
Calculated Analysis				
Crude protein (%)	18.35	16.18	14.00	11.83
Metabolizable Energy (Kcal/Kg DM)	1942	1990	2038	2086

2.5 Chemical Analysis

Aliquot of daily feed samples (concentration and forage) was collected, oven-dried, ground and sieved through a 2-mm sieve and stored in airtight containers for proximate [14] reference ID Number DM 930.15, CP 984.13) and fibre [15] analyses.

2.6 Statistical Analysis

Data obtained were subjected to one way analysis of variance (completely randomized design) and significant means were separated using Duncan Multiple Range test [16].

3. RESULTS AND DISCUSSION

The chemical composition of the diet, crude protein, and ether extract and ash concentration decreased as the proportion of CC increased in the diet compounded whereas the NDF, ADF and ADL increased. The crude protein of grass was 8.4% with the lowest value of ether extract. Corncob has the lowest crude protein (2.8%) and the highest EE and NDF which were 4.2% and 63.3% respectively.

The performance characteristics of the goats fed the experimental diets differed significantly ($P \leq .05$) among the treatments (Table 3). The highest dry matter intake was observed in goats fed diet 3 with value of 559g/day and was followed by that of goats on diet 1 (540g/day); values observed for goats fed diet 2 and 4 were similar ($P > .05$). Similarly, goats on diet 3 had the highest crude protein intake (16.4g/KgW$^{0.75}$/day) while goats on diet 4 had the least CPI (11.2 g/KgW$^{0.75}$/day), the best feed conversion ratio (7.89) was also observed in goats on diet 3 and this culminated to the highest weight gain (70.83g/day) observed when compared to goats on diet 1, 2 and 4. The grinding of the corncob to reduce the

particle size increased the surface area for rumen microbial action. Factors affecting feed intake include dietary crude protein, palatability, gut fill, rumen outflow rate/retention time in the rumen [17]. Highest weight gain of 70.83g/day is higher than reported value for goats fed cassava leaf meal in corn bran based diet [18].

Table 2. Chemical composition of the diets containing varying levels of corncobs

Parameters (%)	Diet 1 control	Diet 2 (15%)	Diet 3 (30%)	Diet 4 (45%)	Guinea grass	Corncob
Dry matter	90.1	90.2	90.3	90.1	36.1	88.4
Crude protein	17.2	16.7	16.3	15.8	8.4	2.8
Ether extract	3.66	3.62	3.58	3.54	2.44	4.2
Ash	9.9	8.8	9.6	9.0	9.9	3.8
NDF	51.4	53.7	52.8	55.2	61.4	63.3
ADF	42.4	44.2	43.2	46.3	46.8	30.2
ADL	6.8	7.8	6.9	7.0	9.7	9.5

NDF= Neutral detergent fibre; ADF= Acid detergent fibre; ADL= Acid detergent lignin

Table 3. Performance characteristics of goats fed diet containing corncob in varying proportions

Parameters	Diet 1 (0%)	Diet 2 (15%)	Diet 3 (30%)	Diet 4 (45%)	SEM
Dry Matter (g/day)					
Grass	350	351	362	349	
Concentrate	190	182	197	180	
Total	540^{b}	533^{c}	559^{a}	529^{c}	5.44
Nutrient intake (g/KgW$^{0.75}$/day)					
Dry matter	99.1	96.0	97.4	97.1	
Crude protein	15.1	15.7	16.4	11.2	
NDF intake	61.5	57.7	55.5	56.0	
ADF intake	43.4	45.2	44.4	47.4	
ADL intake	6.6	8.7	8.4	9.2	
Feed conversion ratio	10.19^{a}	9.18^{a}	7.89^{b}	10.79^{a}	1.24
Initial weight (Kg)	7.43	7.40	7.37	7.53	
Final weight (Kg)	11.88	12.28	13.32	11.65	
Live weight (g/Kg W$^{0.75}$/day)	5.45	5.56	5.77	5.45	0.25
Weight gain (g/day)	52.98^{b}	58.09^{b}	70.83^{a}	49.04^{b}	5.12

abc=Mean in the in the row with similar superscript are not significantly different (P>.05)
NDF= Neutral detergent Fiber; ADF= Acid detergent fiber; ADL= Acid detergent lignin

The haematological parameters of West African Dwarf goats fed diets containing varying levels of corncobs showed that there was no significant (*P*>.05) differences in all the parameters measured Table 4. The PCV values obtained in this study were within the range of 25-30% reported [19] for clinically healthy WAD goats and sheep. The Hb range in this study fell within the range of 7-15g/dl reported for clinically healthy WAD goats [20]. Due to relatively higher Hb concentration obtained in this study, the dietry treatments seemed to have the wherewithal of supporting high oxygen carrying capacity blood in the goats. The

RBC counts obtained in this study were within the range of 9.2-13.5 $x10^6$/µl reported for West African dwarf goats [21] and 9.9-18.7 $x10^6$/µl reported [7]. The WBC count obtained in this study fell within the range of 6.8-20.1 $x10^6$/µl reported for clinically healthy WAD goats [20]. There was no breakdown in the immunity of the goats fed the experimental diets.

The lymphocytes (%) values obtained in this study fell within the range of 47- 82% [20] and 51.6% reported [21] for WAD goats.

Table 4. Haematological parameters of West African dwarf goats fed diet containing varying levels of corncobs

Parameters	Diet 1 (0%)	Diet 2 (15%)	Diet 3 (30%)	Diet 4 (45%)	±SEM
Packed cell volume (%)	24.00	22.50	24.00	20.00	0.80
Haemoglobin (g/dl)	10.10	9.10	9.20	9.85	0.42
Red blood cell ($x10^6$/µl)	11.25	10.58	10.59	10.92	0.35
White blood cell ($x10^3$/µl)	17.03	13.33	17.20	12.55	19.76
Lymphocyte (%)	50.50	55.00	50.50	54.00	1.69
Heterophils (%)	45.50	42.50	46.00	43.00	1.76
Monocytes (%)	2.50	2.50	2.50	2.00	0.18
Eosinophils (%)	1.50	1.00	1.00	1.00	0.35
Platelets ($x10^4mm^3$)	20.40	19.50	16.10	15.30	1.89
MCV (fl)	21.54	21.37	22.71	18.28	0.81
MCH (pg)	0.90	0.86	0.87	0.90	0.01
MCHC (g/dl)	4.22	4.04	3.85	4.95	0.22

MCV= Mean Corpuscular Volume; MCH= Mean Corpuscular Haemoglobin
MCHC = Mean Corpuscular Haemoglobin Concentration; SEM = Standard Error of Mean

Table 5 shows the Serum Biochemical parameters of goats fed diets containing varying levels of corncob. Similar ($P \leq .05$) total protein, globulin, urea and glucose values were obtained for all the goats in the four treatment groups. However, highest ($P \leq .05$) and least creatinine levels of 16.00 and 7.00mg/dl were obtained in goats fed diets containing 30% corncob and the control diet respectively. Goats fed the control diet contained the highest ($P \leq .05$) cholesterol level (85.86mg/dl). However, goats fed diet containing 45% corncob had the least ($P \leq .05$) cholesterol level which did not differ significantly ($P > .05$) from the cholesterol content in goats fed diets containing 15% and 30% corncob based diet. The lower values for the total protein, albumin and globulin in this study indicated that there were no traces of antinutritional factors that could diminish nutrient permeability in the gut walls. Serum urea levels reported in this study were high compared to values reported for apparently healthy WAD goats [20]. This may probably have been due to persistent hypoglycemia and increased catabolic activity for gluconeogenesis thus resulting to high serum urea levels.

Table 5. Serum biochemical parameters of West African dwarf goats fed diets containing varying levels of corncobs

Parameters	Diet 1 (0%)	Diet 2 (15%)	Diet 3 (30%)	Diet 4 (45%)	SEM
Total protein (g/dl)	5.08	5.40	5.33	5.11	0.13
Albumin (g/dl)	3.87^{ab}	3.80^{ab}	4.52^{a}	3.40^{b}	0.17
Globulin (g/dl)	1.21	1.61	0.81	1.72	0.20
Urea (mg/dl)	28.20	31.29	33.07	27.31	1.04
Creatinine (mg/dl)	7.00^{b}	11.13^{ab}	16.00^{a}	11.00^{ab}	1.38

abc= Means in the same row with different superscript are significantly (P≤=.05) different

4. CONCLUSION

It is concluded from this study that corncobs can be included in the diets of goats up to 30% in compounded ration without deleterious effect on the performance, haematology and serum biochemical indices of the goat. The nutrient intake, feed conversion ration and weight gain observed in goats on 30% inclusion showed that corncob in compounded ration can support optimal performance of goats.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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