

Research Paper

Haematological Indices and Serum Biochemical Profile of Dwarf Goats Fed Elephant Grass and Vary Levels of Combined Plantain with Mango Peels.

Abstract

This study was conducted to assess the haematological indices and serum biochemical profile of dwarf goats fed elephant grass and plantain with mango peels. Eighteen West African dwarf goats with average weight of 6.00 ± 0.57 kg and aged between 6 to 7 months old were allotted to three dietary treatments (T_1 , T_2 and T_3) with six animals per treatment in a complete randomized design. The compared diets were; T_1 (elephant grass and concentrate in a ratio of 68:32 which served as control group), T_2 and T_3 (combination of plantain with mango peels and concentrate in ratios of 55:13:32 and 50:18:32 respectively). Results obtained showed that initial Hb, WBC, cholesterol, sodium, phosphorus, potassium and final WBC, cholesterol, creatinine, sodium, phosphorus were significantly ($P < 0.05$) highest for animals on T_1 , while animals on T_2 had the highest ($P < 0.05$) in glucose level. Initial cholesterol and final PCV, Hb, RBC, urea were significantly ($P < 0.05$) better for animals on T_3 . No significant ($P > 0.05$) difference was observed in initial PCV, total protein, PCV, albumin, globulin, creatine and final total protein, albumin, globulin, creatine and final total protein, albumin, globulin, glucose, calcium with potassium. It was concluded that plantain with mango peels in a ratio of 50:18 improved haematological indices and serum biochemical profile for dwarf goats.

Keywords: Plantain peels, mango peels, haematology, serum biochemistry, goats.

29 **Introduction**

30 The need to increase small ruminant livestock production as a means of
31 alleviating the overwhelming shortage of animal protein is very vital to humanity.
32 The supply of animal protein in Nigeria is lower than the demand, that is causing
33 acute shortage of animal protein in the diet of many Nigerians. Sheep and goats
34 serve primary as source of meat but also provide milk, skins and manure. They
35 produce only about 16% of the world's meat despite their high contribution of
36 the total world's milk and 15% of the world skin (Sowande *et al.*, 2008). To
37 improve small ruminant productivity their feeding regimes should be
38 reconsidered.

39 Poor nutrition is one of the main constraints of small ruminant livestock
40 productivity in the tropics. Even were forages resources are abound, seasonal
41 fluctuation in nutritive value make sustainable gains in production from good
42 management and diseases controlled programme unrealistic (Sanusi *et al.*,
43 2011). This is primarily because they are predominantly grazing on natural
44 pasture which are often poor in nutritive values, most especially during the dry
45 season. The steady increase in the cost of conventional feeds is additional factor
46 to scarcity of feeds, thus this necessitate investigation into the use of cheaper
47 alternative feed resources that are locally available and less competitive in
48 feeding ruminants.

49 Plantain and mango peels are such alternative feeds that can be used in
50 feeding small ruminants. Plantain (*Musa paradisiaca*) and mango (*Mangifera*

51 *indica*) are most important tropical and sub-tropical fruits of the world. Mango
52 consist of 33—85% edible pulp, 9—40% inedible kernel and 7—24% inedible
53 peel (Ajila *et al.*, 2007), while plantain contain 70—87% edible pulp and 8—26%
54 inedible peel (Franimmo and Oduronbi, 2006). However, a huge amount of waste
55 is generated from these fruits during industrial processing, which have a serious
56 disposal problem in the environments. The utilisation of these fruit peels as
57 alternative feeds that are readily available and cheaper have been researched in
58 details for ruminant livestock production. These peels are good sources of energy
59 and dietary fibre but low in crude protein. Ajila *et al.* (2010) also reported that
60 fibre from mango peels have a better nutritional quality than those found in
61 cereals due to their greater soluble dietary fibre to insoluble dietary fibre ratio.
62 Nevertheless, evidence is presented in literature to show that when fruit peels
63 are properly selected and combined according to their nutritional characteristics,
64 adequate and productive diets could be provided all-year round for sustainable
65 livestock productivity (Ogunsipe and Agbede, 2010).

66 Blood is an important index of physiological and pathological changes in
67 an organism, that is used in assessing the body's ability to respond to
68 haematological and serum biochemical upset. Ogunbajo *et al.* (2009) observed
69 that nutritional studies should not be limited to performance alone, but the effect
70 on the blood constituents is also vital tools that help to detect any deviation from
71 normal in the animal's body. Currently in veterinary practices a diagnosis is
72 considered incomplete or not definitive, if information obtained from history and

clinical examination is not combined with laboratory test of blood constituents. The present study was therefore designed to assess the haematological and serum biochemical profiles of dwarf goats fed elephant grass and vary levels of combined plantain with mango peels.

Materials and Methods

Experimental Site: The study was conducted at the small ruminants section of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Edo State, Nigeria. The site is located in the Longitude 6.09⁰E and Latitude 6.42⁰N with average rainfall and temperature of about 1556mm and 30⁰C per annum respectively.

Experimental Diets: Elephant grass was harvested within the Teaching and Research Farm and chopped manually into small sizes. Plantain and mango peels were collected fresh in their processing centre located within Edo State. They were also chopped and dried under shade before milled. The experimental diets comprised basal and concentrate supplement. The basal diets constituted elephant grass and plantain with mango peels while the gross compositions of the concentrate supplement diet is shown in Table 1. The basal and concentrate supplement diets in ratio of 68:32 respectively, were offered to the animals at the rate of 5% (DM basis) of their body weight. The comparative experimental diets were: T₁ = which was the control group consisted of elephant grass and concentrate supplement in a ratio of 68:32. While T₂ and T₃ = constituted

combination of plantain with mango peels and concentrate supplement in ratios of 55:13:32 and 50:18:32 respectively.

Table 1: Gross composition (% DM basis) of the concentrate supplement diet.

Ingredients	Composition
Wheat offal	78.00
Brewery dried grain	20.00
Limestone	0.75
Dicalcium phosphate	0.50
Salt	0.50
Vitamin premix	0.25
Total	100

Experimental Animals, Feeding and Management: Eighteen (18) growing West African dwarf (WAD) goats, aged between 6 and 7 months with mean body weight of 6.00 ± 0.57 kg were used for the study. The experimental animals were source from the livestock market at Ekpoma. On arrival, the animals were given prophylactic treatments against ecto and endo parasites. The animals were later allotted to the three dietary treatments after adaptation period in a completely randomized design with six animals per treatment. Experimental diets were fed to animals at 8.00am in the morning daily. Animals were also having free access to water.

Blood Samples Collection and Analysis: Blood samples were collected from each animal before commencement of the feeding trial and at the last week of the study before terminating the experiment. Blood samples were collected by jugular-venipuncture of each animal using disposable syringes and sterile

needles 18 gauge X1¹/₂ inches. Prior to feeding in the morning, bleeding was done and an average of 10ml of blood was collected from each animal. The blood samples were placed in three vacuitainers. One containing ethylene diamine tetra-acetic acid (EDTA) for haematological studies as described by AL-Eissa and Alkahtani (2011). Another containing sodium oxalate fluoride for glucose preservation, before blood glucose levels were determined by enzymatic colourimetric test as reported by Waziri *et al.* (2010). While the third universal bottles without anticoagulant were placed with the remaining blood sample and allowed to stand for about 2 hours at room temperature. The universal bottles were thereafter centrifuged at 700 x g for 15 minutes, the serum separated were decanted and stored in a freezer at -10⁰C for blood biochemical parameters test as reported by Gamb *et al.* (2011).

Chemical and Statistical Analyses

Samples of the experimental diets were analyzed for proximate analysis using the procedures of AOAC (1990).

Data generated from the haematological indices and serum biochemical profiles were subjected to analysis of variance (ANOVA). Significant difference between treatment means were separated using Duncan's Multiple Range Test (SAS, 1999).

Results and Discussion

The proximate composition of elephant grass (EG), plantain peels (PL), mango peels (MP) and concentrate supplement (CS) are shown in Table 2. The dry matter of the experimental diets varied from 85.24% in CS to 88.90% in PL.

Table 2: Proximate composition (% DM basis) of the basal and supplementary diets.

Parameters	Basal diets			Concentrate supplement
	EG	PL	MP	CS
Dry matter	86.75	88.90	87.52	85.24
Crude protein	8.12	7.92	9.14	19.98
Ether extract	1.15	1.24	0.24	1.06
Ash	10.95	6.52	3.34	7.95
Crude fibre	29.55	5.81	5.24	12.06
Nitrogen free extract	50.23	78.51	81.86	58.95

EG = Elephant grass, PL = Plantain peels, MP = Mango peels, CS = Concentrate supplement.

The high dry matter observed in the feeds implied that, they can be stored for all-year feeding and used as feeds for all class ruminant livestock. Crude protein content ranged from 7.92% in PL to 19.98% in CS. The crude protein obtained in EG, PL and MP appeared to be low, hence CS was added to augment the protein content of the diets. The crude protein value of the CS was higher than the crude protein requirement of 15 to 18% for growing kids and lambs as reported by Aruway *et al.* (2009). Ether extract and ash values were 1.15 and 10.95, 1.24 and 6.52%, 0.42 and 3.34, 1.06 and 7.95% for EG, PL, MP and CS respectively. The low ether extract and ash contents observed in MP indicated that MP contributed low oil and minerals to the diets. Crude fibre was low in MP (5.24%) and PL (5.81%) than CS (12.06%) and EG (29.55%), thus PL

with MP and CS were combined in dietary treatments (T_2 and T_3). The nitrogen free extract that ranged from 50.23% in EG to 81.86% in MP was ranked as energy rich feeds due to their relatively high content in the diets. However, the crude protein and crude fibre observed in PL and MP were compared favourable to what were reported by Fanimó and Oduronbi (2006); Ajila *et al.* (2010).

Table 3: Effect of elephant grass and plantain with mango peels on haematological parameters of dwarf goats.

Parameters	Treatments			SEM $\pm$
	T_1	T_2	T_3	
PCV (%)				
Initial	25.00	24.96	24.98	1.04
Final	24.67 ^b	25.00 ^a	25.02 ^a	1.05
Hb (g/dl)				
Initial	8.08 ^a	7.26 ^b	7.99 ^b	0.62
Final	8.35 ^b	10.65 ^a	11.01 ^b	0.75
RBC ($\times 10^{12}/L$)				
Initial	10.01 ^a	9.04 ^b	8.25 ^c	0.42
Final	10.00 ^b	10.26 ^b	11.21 ^a	0.38
WBC ($\times 10^9/L$)				
Initial	8.96 ^a	7.28 ^b	8.07 ^a	0.79
Final	11.02 ^a	10.02 ^b	9.99 ^b	0.92

^a, ^b, ^c means within the same row with different superscripts differ significantly ($P < 0.05$). SEM = Standard error of mean.

Table 3, presents the result for the haematological parameters of the experimental animals. Waziri *et al.* (2010) reported that haematological parameters of most goats have been studied with the aim of establishing normal value ranges and deviation from them may indicate a distance in the physiological process. The initial packed cell volume (PCV) which were 25.00,

24.96 and 24.99% for T_1 , T_2 and T_3 respectively were not significantly differ (P>0.05) between treatment groups. Final PCV also showed no significant (P>0.05) difference between T_2 (25.00%) and T_3 (25.02%) but T_1 (24.67%) was significantly (P<0.05) lower than T_2 and T_3 . The increase in final PCV values for animals on T_2 and T_3 might be due to improve nutrient in the diets which indicates high tendency for compensatory accelerated production of PCV. Compensatory accelerated production has been shown to return PCV to normal following infection and stress in animals (Opara *et al.*, 2010). The PCV values observed in this study were comparable with the range of values (25.30—31.30%) earlier reported for WAD goats by Daramola *et al.* (2005). The initial and final haemoglobin (Hb) concentration values were 8.08 and 8.35, 7.26 and 10.65, 7.99 and 11.01g/dl for T_1 , T_2 and T_3 respectively. Though significant difference (P>0.05) existed between treatments in initial Hb concentration, the values were low. The low Hb concentration of the animals before the feeding trial implies improper utilization of protein intake for the formation of Hb and parasite infection. Final Hb concentration were significantly (P<0.05) higher T_2 and T_3 compared to T_1 . The higher values obtained for animals on T_2 and T_3 after the feeding trail suggest their superiority in terms of their capability of supporting high oxygen carrying capacity of the blood (Baiden *et al.*, 2007). Initial red blood cell (RBC) for animals on T_1 ($10.01 \times 10^{12}/L$) were significantly (P<0.05) highest, followed by T_2 ($10.26 \times 10^{12}/L$) and T_3 ($8.25 \times 10^{12}/L$) but final RBC was higher in T_3 ($11.21 \times 10^{12}/L$) compared to T_2 ($10.26 \times 10^{12}/L$) and

189 $T_1(10.00 \times 10^2/L)$. The low final RBC counts recorded for animals on T_1
190 corroborates the relatively low final PCV and Hb concentration observed in T_1
191 which reveals the possible susceptibility of animals to iron deficiency anaemia
192 and depression of hypochromasia (Isikwenu *et al.*, 2012). The Hb and RBC
193 values observed in this study confirmed with the $Hb(7.60 \text{ to } 10.30 \text{ g/dl})$ and
194 $RBC(8.32 \text{ to } 11.80 \times 10^2/l)$ range of values reported by Daramola *et al.* (2005) for
195 WAD goats. Initial white blood cell (WBC) concentration was not significantly
196 ($P>0.05$) different between $T_1(8.96 \times 10^9/L)$ and $T_3(8.07 \times 10^9/L)$ but
197 $T_2(7.28 \times 10^9/L)$ was significantly ($P<0.05$) lower than T_1 or T_3 . Final WBC were
198 also similar for animals on $T_2(10.02 \times 10^9/L)$ and $T_3(9.99 \times 10^9/L)$ but significantly
199 difference ($P<0.05$) from $T_1(11.02 \times 10^9/L)$. This observation implies that feeding
200 plantain with mango peels to goats on T_2 and T_3 did not cause health hazard to
201 the animals, though animals on T_2 may support some haemopoietic function
202 which might be attributed to the increase in immune cells to offer good health
203 and defence mechanism as observed in T_1 . The WBC counts obtained in this
204 study were comparable with the range of values ($9.42 \text{ to } 13.08 \times 10^9/L$) reported
205 by Waziri *et al.* (2010) for sahel goats.

206

Table 4: Serum biochemical parameters of dwarf goats fed experimental diets.

Parameters	Treatments			SEM $\pm$
	T_1	T_2	T_3	
Total protein (g/l)				
Initial	6.09	5.79	5.99	0.09
Final	6.10	6.12	6.41	0.10
Albumin (g/dl)				
Initial	4.00	3.89	3.94	0.02
Final	4.01	4.02	4.10	0.01
Globulin (g/dl)				
Initial	2.09	2.01	2.04	0.05
Final	2.10	2.10	2.13	0.03
Cholesterol (mg/dl)				
Initial	65.97 ^b	64.82 ^b	70.42 ^a	1.07
Final	69.03 ^a	66.09 ^a	62.01 ^b	1.05
Creatinine (mg/dl)				
Initial	1.08	1.12	1.16	0.06
Final	1.02 ^a	0.93 ^b	0.99 ^b	0.01
Urea (mg/dl)				
Initial	18.26 ^a	15.02 ^b	16.01 ^b	0.52
Final	19.95 ^b	20.06 ^b	23.38 ^a	0.60
Glucose (mg/dl)				
Initial	69.99 ^b	76.02 ^a	75.99 ^a	1.14
Final	90.07	91.01	91.28	1.20

^{a, b, c} means within the same row with different superscripts differ significantly ($P < 0.05$). SEM = Standard error of mean.

Presented in Table 4, is the serum biochemical parameters of dwarf goats fed experimental diets. The initial and final total protein for animals were not significantly affected ($P > 0.05$) by the dietary treatments. The total protein values for initial and final were 6.09 and 6.10, 5.97 and 6.12, 5.99 and 6.41g/dl for T_1 , T_2 and T_3 respectively. Initial and final albumin followed similar pattern of

variation as observed in total protein. The initial albumin values ranged from 3.89g/dl for T₂ to 4.00g/dl for T₁ while the final albumin values ranged from 4.01g/dl for T₁ to 4.10g/dl for T₃. Dairo (2005) reported that albumin is an important blood cloth factor due to its ability to prevent haemorrhage, therefore the higher the value the better it is to the animals. The initial and final globulin of the experimental animals were similar, hence no significant difference ($P>0.05$) existed among treatment groups. The globulin initial and final values ranged from 2.01 to 2.09g/dl and 2.10 to 2.13g/dl respectively. However, final total protein, albumin and globulin increased slightly compared with initial total protein, albumin and globulin. This could probably due to inadequate nutrition of the animals before the experiment which was improved and ascribed to proper balancing of the ingredients in the experimental treatment diets. Oboh *et al.* (2011) reported that serum total protein of an animal is an indirect indices for measuring the nutritional protein adequacy of the animal. The values obtained from total protein were close to the average value (7.30g/dl) reported by Taiwo and Ogunsanmi (2003) for WAD goats. Initial cholesterol was significantly ($P<0.05$) higher in T₃ (70.42g/dl) than those in T₁ (65.97g/dl) and T₂ (64.82g/dl), while final cholesterol was higher in T₁ (69.03g/dl) and T₂ (66.09g/dl) compared with T₃ (62.01g/dl). The initial serum cholesterol concentration for animals on T_C appeared to have increased in mobilization of cholesterol from the liver or involvement of the diet altering the plasma low density of lipoprotein (Ikhimioya and Imasuen, 2007) before the commencement

of the feeding trial, but final cholesterol levels appeared to declined slightly with increasing levels of plantain peel inclusion in the diets. Thus the trend of data appeared to suggest high levels of elephant grass and plantain peel increased serum cholesterol concentration in the animals. The initial and final serum creatinine values range from 1.08 to 1.16mg/dl and 0.93 to 1.02mg/dl respectively. Initial creatinine was not significantly ($P>0.05$) influenced across treatments with lowest value being obtained for animals on T_1 and highest on T_3 . Final serum creatinine was highest in T_1 followed by T_3 before T_2 but significant difference only existed between T_1 and T_2 or T_3 . Values of serum creatinine obtained at the beginning and end of the study fell within the average value (0.94mg/dl) for sahel goat as reported by Waziri *et al.* (2010) but higher than values reported by Ikhimioya and Imasuen (2007) for WAD goats. Prvulovic *et al.* (2012) reported that creatinine level in serum has direct correlation with muscle mass and kidney function in animals. The initial urea concentration was significantly higher ($P<0.05$) in T_1 (18.26mg/dl) compared to T_2 (15.02mg/dl) and T_3 (16.01mg/dl). Final urea concentration was similar between T_2 (20.06mg/dl) and T_1 (19.95mg/dl) but significant ($P<0.05$) difference existed between T_3 (23.38mg/dl) and T_1 or T_2 . The higher value obtained in final serum urea for animals on T_3 was an indication of inferiority of efficiency utilization of nitrogen and urea recycling which might have affected the amino balance. This fact confirmed from the low value observed in serum total protein for animals on T_3 , which are indicators of low utilization protein as reported by Cetin *et al.*

(2009). Glucose levels of initial and final values were 69.99 and 90.97, 76.02 and 91.01, 75.99 and 91.28mg/dl for T_1 , T_2 and T_3 respectively. Initial glucose level was significantly ($P<0.05$) higher in T_3 and T_2 compared with T_1 . No significant ($P>0.05$) difference existed between treatments in final glucose level though value observed on T_3 was the highest and T_1 was the lowest. Konlan *et al.* (2012) reported that blood glucose level is maintained as a result of glucose exclusion from the tissue together with an increase in the use of ketone and non esterified fatty acids.

Table 5: Plasma minerals in dwarf goats fed elephant grass and plantain with mango peels.

Parameters	Treatments			SEM $\pm$
	T_1	T_2	T_3	
Sodium (mmol/L)				
Initial	119.62 ^a	110.43 ^b	103.92 ^c	2.01
Final	130.72 ^a	120.01 ^b	119.32 ^c	2.03
Calcium (mg/dl)				
Initial	8.77	8.81	8.90	0.91
Final	8.97	8.85	8.96	0.89
Phosphorous (mg/dl)				
Initial	4.00 ^a	3.08 ^b	3.94 ^b	0.02
Final	4.01 ^a	3.90 ^b	3.96 ^b	0.05
Potassium (mmol/L)				
Initial	4.59 ^a	3.96 ^b	3.00 ^b	0.04
Final	4.16	4.08	4.03	0.03

^{a, b, c} means within the same row with different superscripts differ significantly ($P<0.05$). SEM = Standard error of mean.

Table 5, shows plasma minerals of dwarf goats fed experimental diets.

The initial and final plasma sodium values were 119.62 and 130.72, 110.43 and

276 120.01, 103.92 and 119.32 mmol/L for T₁, T₂ and T₃, respectively. Sodium levels
277 were significantly ($P<0.05$) highest in T₁ and lowest in T₃. The low initial and
278 final sodium levels observed for animals on T₃ could be as a result of variable
279 dietary intake of salt and loss of sodium ion in urine. Sodium values observed in
280 this study were comparable to the mean value (131.97 mmol/L) reported by
281 Taiwo and Ogunsanmi (2003) for sheep. There were not significant ($P>0.05$)
282 difference between treatment for initial and final calcium levels across the dietary
283 treatments. The calcium initial and final values were 8.77 and 8.79 mg/dl in T₁,
284 8.81 and 8.85mg/dl in T₂ as well as 8.90 and 8.96mg/dl in T₃. The final calcium
285 levels in this study were similar among treatment groups and slightly higher
286 compared with initial calcium levels. This means that quality of the test feeds
287 were good enough to maintain the calcium levels of the animals. The initial and
288 final phosphorus levels in T₂ (3.08 and 3.90 mg/dl) and T₃ (3.94 and 3.96 mg/dl)
289 were similar and significantly ($P<0.05$) lower than T₁ (4.00 and 4.01mg/dl). The
290 increased levels of phosphorus in T₁ could probably due to improve phosphorous
291 in the diet intake that was well utilized by the animals. Initial potassium
292 concentration levels were significantly ($P<0.05$) higher for animals on T₁
293 (4.59mmol/L) compared to T₂ (3.96mmol/L) and T₃ (3.00mmol/L). Final
294 potassium values were 4.16, 4.08 and 4.03 for T₁, T₂ and T₃ respectively. No
295 significant ($P>0.05$) difference existed between treatments in final potassium.
296 This implies that the ability of the animals to respond lactic acidosis, circulating
297 failure infection and renal diseases were compromised with the inclusion levels of

the test feedstuff in the diets. The potassium values obtained in this study were compared favourably with the mean value (4.70mmol/L) reported by Waziri *et al.* (2010).

Conclusion

Results obtained in the present experiment confirm a positive effect of using plantain with mango peels as alternative feeds for dwarf goats. The response in terms of haematological indices and serum biochemical profiles by dwarf goats indicated that plantain with mango peels in a ratio of 50:18 can serve as a sustainable feedstuff for dwarf goats most especially during the dry-season without adverse effects. The decreased of serum cholesterol level in the diet was additional advantage in the treatment of arteriosclerosis and other cardiovascular disorders associated with hypercholesterosis.

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- 394