



Performance Response and Blood Profile of West African Dwarf Goats Fed Shea Butter (*Vitellaria paradoxa*) Leaves Supplemented with Diets Containing Different Levels of Sweet Orange (*Citrus sinensis*) Peels

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Authors' contributions

This work was carried out in collaboration between all authors. Author JO designed the study, wrote the protocol and wrote the first draft of the manuscript. Author OIAO viewed the experimental design and all drafts of the manuscript. All Authors were involved in the management of the experimental animals during the feed trial. Authors JO and JAP managed the analyses of the study. Authors JO and OIAO identified the plants while Authors JO and JAP performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Nine male grower West African Dwarf (WAD) goats with an average weight of 9.30 kg, aged between 5-7 months were used in a completely randomized design to assess the growth performance and blood profile of WAD goats fed shea butter (*Vitellaria paradoxa*) leaves and supplemented with concentrate diets containing different levels of sweet orange (*Citrus sinensis*) peel meal (SOPM). Three dietary treatments were formulated and compounded to contain 0%, 25%, and 50% SOPM, and were designated T₁, T₂, and T₃ respectively in an eighty-four day feeding trial. Results showed that mean daily weight gain (18.10-27.14 g/day), mean daily feed

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intake (426.6-462.0 g/day) and final weight (10.20-10.39 kg) were not significantly different ($P>0.05$) among the treatments. Packed cell volume (PCV), red blood cells (RBC), haemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and serum biochemical components showed no significant change among the treatments ($P>0.05$). This showed that WAD goats fed Shea butter as forage can be supplemented with diets containing up to 50% SOPM without compromising either the growth performance or the health status of the animals.

Keywords: Sweet orange peels; Shea butter leaves; growth performance; blood profile and WAD goats.

1. INTRODUCTION

In Nigeria, ruminant production is faced with problems of inadequate nutrition due to shortage of feed and all year round availability of quality forage. Long period of dry season affects feed availability adversely and this in turn affects development of the goat industry [1]. [2] had earlier reported that the forages are unimproved and low in nutritive values during the wet season while during the dry season proper, they are fibrous, lignified with low in protein values and even in short supply. [3] also reported that, the available forages for most part of the year are low in protein content which leads to marked decrease in voluntary intake and digestibility and substantial weight loss of the animals during this period. In spite of the challenges facing the livestock industry particularly in the third world nations, population pressure has not been on the decline, it has rather been progressively increasing. This increase has in turn subjected the demand for protein supply to intense pressure. [4] reported that the increase in world population especially in developing countries like Nigeria calls for urgent improvement in livestock production, in order to keep pace with the ever increasing human population. Without emphasis, small ruminants have the potentials of alleviating the low protein intake of the people in developing countries like Nigeria [5]. This is achievable if the available low quality feeds are supported by concentrate supplements. It is established that conventional feedstuffs are expensive primarily because of their use in human and monogastric nutrition. However, alternative feedstuffs which are nutritionally viable, cheap and not in high demand by humans are presently being exploited for livestock and indeed for goat production [6]. Sweet orange peels an agricultural by-product obtained from sweet orange fruits is available in Nigeria in large quantities, particularly in Benue state. The peels are usually piled in heaps on refuge dumps and by the roadsides by retailers who peel and sell the fruits for direct

consumption. The peels are easily processed by sun-drying for 48 hours. It is readily crushed into meal when crispy, and has been used in the diet of broiler chickens at low levels without harmful effect [7]. Several authors reported that plane of nutrition, disease, genotype, physiological phases such as lactation [8,9,10] affect blood values, which are indicators of the wellbeing of an animal.

Thus this study was designed to evaluate the performance response and blood profile of WAD goats fed Shea butter (*Vitellaria paradoxa*) forage supplemented with diets containing different levels of sweet orange (*Citrus sinensis*) peels.

2. MATERIALS AND METHODS

The experiment was carried out in the Small Ruminant Unit of the Teaching and Research farm, University of Agriculture Makurdi, Benue State, Nigeria. Makurdi is located on latitude $7^{\circ} 41'N$ and longitude $38^{\circ}31' E$, 9 metres above sea levels [11]. Peels of sweet oranges were collected from retailers who peel and sell the oranges for direct consumption. The peels were sun-dried for 48 hrs, when it became crispy; it was packed and crushed using a cereal grinding mill. The SOPM was used to replace maize offal at 0 %, 25 %, and 50 % in three dietary treatments designed T_1 , T_2 and T_3 respectively. Nine WAD grower goats of about 9.300 kg were purchased from Akwanga local government of Nassarawa State. The Animals were vaccinated against Peste de petite ruminants (PPR) from source, using the PPR vaccine, while Ivermectin was used to check endo and ecto parasites. A week to the arrival of the animals to the farm, the experimental pens were properly washed using disinfectants (Izal), and allowed to dry. Thereafter, the cemented floor was spread with wood shavings which served both as litter materials and beddings for the animals. Upon arrival, the animals were weighed and randomly

distributed into three treatment groups of three replicates each, and each animal was a replicate. Each goat was housed in a separate compartment equipped with feed and water troughs. 200 g of concentrate supplement was fed by 8:00 hr daily to the goats and after an hour, the forages were served *ad libitum* by suspending the forages from the roof of the cages to the animals using light ropes. This was to enhance feed in take as well as reduce wastage through trampling. Clean fresh water was served to animals daily *ad libitum*. Animals were weekly weighed to evaluate average weight changes. Average feed in take was calculated by subtracting the quantity of feed remaining from quantity that was fed. On the last day of the experiment, blood samples were collected via the jugular vein into two sets of sample bottles for haematology (with ethylene diamine tetra acetic acid (EDTA) and serum biochemistry (without EDTA). After collection, the blood samples were taken immediately to the laboratory for analysis. The PCV, Hb, RBC and the WBC were determined as reported by [12], the MCV, MCH and MCHC were calculated from the PCV, Hb and the RBC as described by [13]. The serum total protein was determined by the biuret method as described by [14], while the serum albumin was determined by the bromocresol green method of [15]. The globulin was calculated from the total protein and the albumin, while the SGOT and SGPT were determined calorimetrically. Data collected were subjected to the analysis of variance (ANOVA) as outlined by [16] using the [17] statistical software.

3. RESULTS AND DISCUSSION

The dietary composition of the experimental diets is presented in Table 1. The performance of WAD goats fed the experimental diets is presented in Table 2. Final weights were 10.39 kg, 10.33 kg and 10.20 kg and there were no significant differences among the treatments. Mean daily feed in take ranged between 426.60 g - 462.00 g/day and were similar across the treatments. This perhaps suggests the acceptability of the diets containing the different levels of SOPM to the goats. Observed feed intake values were lower than 525.14-546.26 g/day reported by [18] for WAD goats fed diets containing graded levels of SOPM, but comparable with 402.80 - 446.00 g/day reported by [19] for goats in the humid tropics. Mean daily body weight gain ranged from 18.10-27.70 g and did not show any significant difference ($P>0.05$) among the treatments. This may mean that diets containing SOPM were also adequate for goat production. Observed values were higher than the 6.85 g -20.54 g/l day reported by [20] for WAD goats feed diets containing sweet orange peels. Table 3 shows the effects of sweet orange peel meal on haematology of the experimental goats. There were no significant differences ($P>0.05$) among the treatments in all the haematological indices. The PCV value ranged from 20.67-22.67% and was within the reference values of 21-35% for WAD goats [21]. Red blood cells values were 10.55, 12.20 and 12.10 $\times 10^6 \mu/l$ for T_1 , T_2 and T_3 respectively, this was within normal values for clinically healthy goats,

Table 1. Gross composition of experimental diets

Ingredients	T1 (0%SOPM)	T2 (25%SOPM)	T3 (50%SOPM)
Rice offal	20.00	20.00	20.00
Maize offal	48.80	36.60	24.40
Sweet orange peel meal (SOPM)	0	12.20	24.40
Soya bean (full fat)	28.20	28.20	28.20
Bone ash	2.00	2.00	2.00
Common salt	1.00	1.00	1.00
Total	100.00	100.00	100.00
<i>Calculated</i>			
Crude protein	17.00	16.97	16.94
Crude fibre	15.37	15.41	15.45
Ether extract	11.95	10.82	9.69
Ash	6.76	7.02	7.29
Nitrogen free extracts	48.92	49.78	50.63
Metabolizable energy (kcal/kg)	3333.61	3271.50	3209.04

indicating that the goats were not anaemic. Hb values were between 6.88-7.56 g/dl, this was also normal and similar across the treatments, implying that diets containing SOPM also supported adequate oxygen carrying capacity. The WBC values (16.28-17.33 x 10³ µ/l) were also not significantly different (P>0.05) among the treatments, indicating that the animals were not battling with any disease condition. The effect of SOPM on the serum biochemistry of WAD goat is presented in Table 4. None of the biochemical indices was significantly different (P>0.05) among the treatments. The total protein

(59.83-61.37 g/l) and albumin (32.70-35.17 g/l) were normal and similar with the control. This implies that the quality of protein in the diets containing SOPM were not inferior to the control and also that the experimental animals were not in a poor health status. SGOT and SGPT are liver enzymes, the similarity (P>0.05) in the values of SGOT and SGPT with the control treatment shows that observed values for these indices were normal and the function of the liver was not compromised as a result of replacing maize offal with sweet orange peel meal.

Table 2. Performance response of the WAD goats fed experimental diets

Parameters	Experimental diets			SEM
	T ₁ (0% SOPM)	T ₂ (25% SOPM)	T ₃ (50% SOPM)	
Initial weight (kg)	9.43	9.29	9.57	0.42
Final weight (kg)	10.39	10.33	10.20	0.30
Total weight (kg)	0.95	1.04	0.63	0.36
Mean daily weight (g)	27.14	27.70	18.10	10.31
Total forage intake (kg)	11.47	12.35	11.70	0.72
Total concentrate intake (kg)	4.99	3.83	3.22	0.73
Total feed intake (kg)	15.79	16.17	14.93	0.72
Mean feed intake (g)	451.20	462.00	426.00	20.66

Table 3. Effect of sweet orange peel meal on the haematology of experimental goats

Parameters	Experimental diets			SEM
	T ₁ (% SOPM)	T ₂ (25% SOPM)	T ₃ (50% SOPM)	
Packed cell volume (%)	22.67	20.67	20.67	1.85 ^{ns}
Red blood cells (x 10 ⁶ µ/l)	10.55	12.20	12.10	0.62 ^{ns}
White blood cells (x 10 ³ µ/l)	17.33	16.53	16.28	0.83 ^{ns}
Haemoglobin (g/dl)	7.56	6.88	6.89	0.62 ^{ns}
MCV (fl)	21.45	17.31	17.10	2.02
MCH (pg)	7.15	5.77	5.70	0.67 ^{ns}
MCHC (g/l)	33.33	33.34	33.33	0.01

MCV= Mean corpuscular volume, MCH= Mean corpuscular haemoglobin, MCHC= Mean corpuscular haemoglobin concentration

Table 4. Effect of sweet orange peel meal on serum biochemistry of experimental goats

Parameters	Experimental diets			SEM
	T ₁ (0% SOPM)	T ₂ (25% SOPM)	T ₃ (50% SOPM)	
Total protein (g/l)	61.37	59.83	51.90	6.66 ^{ns}
Albumin (g/l)	35.17	33.13	32.70	1.24 ^{ns}
Globulin (g/l)	26.20	24.53	28.10	2.35 ^{ns}
SGOT (iµ/l)	64.30	174.00	183.00	8.94 ^{ns}
SGPT (iµ/l)	21.00	19.00	17.67	3.70 ^{ns}

SGPT=Serum glutamic pyruvic transaminase, SGOT=Serum glutamic oxaloacetic transaminase
SEM=Standard error of mean, ns=Not significant.

4. CONCLUSION

From the results of the study, it is concluded that, WAD goats on forages can be fed concentrate supplements containing up to 50% SOPM particularly during the period of feed scarcity to improve feed intake and digestibility as well as minimize production cost without adverse effect on growth and the health status of animals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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