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Effects of high levels of water soaked sweet orange peel meal on the Performance response and blood profile of West African dwarf goats

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Abstract

A total of sixteen West African grower bucks of about 7-10 months were used in a completely randomised design to assess the effect of feeding diets with high levels of water soaked sweet orange peel meal (WSSOPM) on the performance response and blood profile of West African dwarf goats. Collected sweet orange peels were soaked in water and drained after 24 hours. The peels were then sun-dried on concrete floors for 48hour and afterwards crushed into a meal using a feed milling machine. The WSSOPM was used to compound four (4) experimental diets containing 0%, 60%, 80% and 100% WSSOPM, these were designated treatment T1, T2, T3, and T4, respectively. Each treatment had four (4) replicate. The study lasted for 11weeks. Results showed that, the mean daily feed intake, mean daily weight gain and the feed conversion ratio of the goats did not show treatment effect (P>0.05) among the treatments. The cost analysis showed that profitability increased with increasing levels of WSSOPM in the diets. The blood parameters measured did not show treatment effect, except the albumin values in which T2 (3.53g/dL) was higher than T1 (2.80 g/dL), T3 (2.68 g/dL) and T4(2.55 g/dL).The mineral indices measured showed variations (P<0.05) in only potassium values, treatment effect was not apparent on the serum calcium, phosphorus, magnesium, sodium and zinc values. Water soaked sweet orange peel meal can be used to replace maize offal at 60%, 80% and 100 % in the diets of West African dwarf goats without negatively affecting both performance and blood indices.

Keywords: Water soaked sweet orange peels, maize offal, West African dwarf goats, blood profile, cost analysis.

Introduction

Ruminants constitute a very important part of the livestock sub-sector of the Nigerian agricultural economy. Recently, more attention have been paid to small ruminant production in the tropics as their advantages are becoming more understood than ever before (Yashim *et al.*, 2016). Goats are prolific domestic livestock and they play significant roles in livelihoods of the rural populace in most of the developing countries. Apart from serving as a vital protein source, goats also provide income for meeting household needs. However, the challenge of feed availability all the year round has persisted; this is mainly because of grass seasonality. Lamidi *et al*. (2010) reported that the available forage for most part of the year are low in crude protein which leads to marked decreases in voluntary intake and digestibility with subsequent marked weight loss of the animal's body. There is thus the need for supplementation to enhance intake and digestibility. However, the high cost of formulating livestock feed has been a major constraint (Okoruwa *et al.*, 2013) in Nigeria. The shortage in feed supply due to high cost and seasonality has caused ruminant livestock farmers to search for alternative feed resources that are inexpensive and readily available and which are not directly required as a component of human dietaries and can economically supplement the feed ingredients in rations without adverse effects on the rumen microbial fermentation and performance of the

animals (Okoruwa *et al.,* 2013).

In Nigeria, a good number of agricultural by product and crop residues exist and sweet orange peels are part of these numerous existing by-products. Citrus is widely grown in Nigeria and many other tropical and subtropical regions (Piccinelli *et al.*, 2008).Most of the citrus fruits produced in Nigeria are consumed locally (Opeke, 2005), and Benue state is observed to be one of the high producing states for the commodity. The peels of these sweet oranges can easily be collected at minimal or no cost from sweet orange fruit retailers who peel and sell sweet orange fruits to consumers. Untreated sweet orange peel meal has been used in the diets of West African dwarf goats at up to 50% levels without adverse effects (Oloche *et al*., 2013).

Sweet orange peels contain anti-nutrients like tannin, saponin, oxalate, limonene, flavonoid and phenols (Oluremi *et al.,* 2007). There is thus the need to ascertain the suitability of these diets for WAD goats at higher levels. Olabanji *et al. (*2007) reported that a readily available and fast means of assessing the clinical and nutritional status of an animal on a feeding trial is the use of blood analysis. Haematological parameters are important and reliable medium used to monitor and evaluate health and nutritional status of animals (Gupta *et al.,* 2007). It is therefore imperative to evaluate blood parameters particularly when unconventional feeds are fed to animals in order to determine the performance of the experimental animals as well as the suitability of such feed on the specie of livestock that is been used (Babatunde *et al.,* 1992). The study was therefore designed to evaluate the effects of high levels of water soaked sweet orange peel meal on the Performance response and blood profile of West African dwarf goats.

Materials and methods

Study location

The study was carried out at the Teaching and Research Farm, University of Agriculture Makurdi, Nigeria. The site lies between latitude 70 43' N and longitude 803' E (Microsoft Encarta, 2008).

Collection of test ingredient and diet preparation

Sweet orange peels were collected from sweet orange sellers who peel and retail oranges for direct consumption at Wurukum, Wadata and North-bank markets within Markurdi metropolis. The peels were soaked using water in plastic drums for 24 hours after which, it was turned into palm frond baskets and allowed to drain. After draining the peels were sun-dried on concrete floors for 48hrs, and when it became crispy it was packed and crushed into a meal using a feed milling machine and stored in synthetic bags for use. Four experimental diets were formulated and compounded to contain 0%, 60%, 80% and 100% WSSOPM and designated T1, T2, T3 and T4 respectively.

Experimental animals and management

Sixteen grower WAD bucks aged 5-7 months and having an average weight of 7.692 kg were bought from Namu in Quampan Local Government Area of Plateau state. On arrival the bucks were weighed and randomly distributed into four treatment groups of four replicates each, and each animal was a replicate. The goats were daily fed 200g of the concentrate diets at 8:00hours and the grasses were fed *ad libitum* at 10:00hours and 14:00hours. *The grasses were tied with light ropes and suspended from the roof of each pen down to the animals. This was done to enhance feed intake and minimize feed wastage.* They were also provided daily with fresh cool and clean water. Two weeks were allowed for animals to acclimatize to the

environment and feed before data collection commenced.

Data collection and laboratory analysis

Daily records of feed served and feed remnants were kept, and feed intake was calculated by subtracting the quantity of remnant feed from the quantity of the feed that was given. The animals were weighed weekly to ascertain their weekly weight changes. On the last day of the experiment, before morning feeding, blood samples were collected from all the animals via the jugular vein for assay. The blood was collected into two sets of sample bottles, the bottles for haematological indices contained ethylene diamine tetra acetic acid (EDTA) an anti-coagulant, while the sample bottles for serum biochemical indices did not contain EDTA to enhance the harvest of the serum for analysis of its constituents. The feed samples were oven dried at a temperature of 100°C to constant weight and ground using the hammer mill to pass through 1mm sieve; these were then sealed in air tight containers for the analysis of their proximate constituents according to standard procedures described by AOAC (1996).

The cost incurred from the study was used to calculate the economic indices. The cost per kilogram feed and the cost of preparing each experimental diet were determined based on the current prices of feed ingredients in Makurdi. The cost of feeding the bucks on each treatment for the period of the study was also calculated as the product of the cost per kilogram of the diet and feed intake. Feed cost/kg weight gain was calculated by dividing the cost of feed intake/buck (₦) by the average total weight gain (kg). The net profit was calculated as the selling price of live weight of mature buck less the total cost of production.

Statistical analysis

Data generated from the study was subject to analysis of variance using the Minitab 14 (1991) of statistical software.

Results and discussions

The proximate composition of the experimental diets is presented in Table 1. The dry matter values were between 93.66 - 94.02%, this was appreciable and indicative that the diets would have long shelf life. The crude protein values were between 14.62% - 20.40%, this was within 14.55% - 30.96% reported by Fajemisin *et al*. (2015) for West African dwarf sheep fed differently processed corncob meal based diets but higher than 14.33% - 15.27%reported by Oloche *et al*. (2015) for West African dwarf goats fed treated and untreated sweet orange peels. The nitrogen free extract values were 53.55%, 55.97%, 52.23% and 43.74%, and this decreased slightly with increasing level of the WSSOPM. These values suggest appreciable fermentable carbohydrate for energy production for goats in all the treatments. Observed values were higher than 30.24 - 34.21% NFE reported by Aderinboye *et al*. (2014) for WAD sheep fed supplemental concentrate diets containing raw, wood ash treated and oil extracted cashew nut shell, while Odemelam *et al*. (2014)reported higher NFE values of 58.54 - 66.53% for WAD bucks fed *Panicum maximum* and bambara nut seed meal supplemented diets. Ether extract values ranged from 2.80% - 4.10% and this was adequate as too much of oil leads to quick spoilage of animal feeds as a result of rancidity (Arigbede *et al.,* 2010). The ash values were ranged between 9.35% - 13.70%, and the values seemed to increase from T2 - T4 as the level of WSSOPM increased in the treatment diets. Appreciable ash values implied that replacing maize offal with WSSOPM would improve the mineral availability in the diets with increasing levels of the WSSOPM and this also means adequate minerals supply to the animals in the respective treatments.

The growth performance of the experimental goats is presented in Table 2.There were no significant differences (P>0.05) among the treatments in any of the parameters measured. The mean feed intake values were between 500.78 - 553.12 g/day, and these values were similar, meaning that the presence of the WSSOPM in the diets did not depress feed intake and that the diets containing the test ingredients were all accepted by the goats. Observed values were higher than 334.94 - 365.97g/day reported by Sanwo *et al.* (2011) for goats fed melon husk and palm oil slurry at 30% inclusion level, but comparable with 525.14 - 546.26 g/day reported by (Oloche *et al*., 2013) for WAD goats fed diets containing graded levels sweet orange peel meal. The mean daily weight gain of the goats ranged between 28.98-36.04g/day. Although values were similar (P>0.05) among the treatments, there seemed to be slight increases from T2 - T4 as the level of WSSOPM increased. Similarities in the mean daily weights of the animals implies that the treatment diets with WSSOPM also for provided adequate nutrients for the growth of the animals and these diets can be used for profitable goat production. Observed values were higher than 19.42 - 31.57g/day reported by Sanwo *et al*. (201) for goats fed melon husk and palm oil slurry at 30% inclusion level, but similar with 24.27 – 39.78g/day reported by Yashim *et al*. (2016) for WAD rams. Fasae and Owodunni (2015) reported comparable values of 23.21 - 44.64 for WAD sheep grazing natural pasture and supplemented with cassava leaves and peels. The feed conversion ratio values were 19.60, 16.68, 15.29 and 14.70 for T1, T2, T3 and T4 respectively, although significant differences (P>0.05) were not observed, FCR seemed to improve from T1 - T4 as the level of WSSOPM increased in the diets. This showed that replacing maize offal WSSOPM in the diets of the experimental animals had a positive impact on the feed conversion ratio. Observed values were comparable with those of Sanwo *et al.* (2011) who reported 11.59 - 17.24 for goats fed melon husk and palm oil slurry at 30% inclusion level.

Table 1: Composition of experimental diets fed to the goats

Feed Ingredients (%)	Experimental Diets			
	T1 (0%)	T2 (60%)	T3 (80%)	T4 (100%)
Rice Offal	10.000	10.000	10.000	10.000
Maize Offal	67.170	26.864	13.430	0.000
WSOPM	0.000	40.300	53.730	67.160
Soybean Meal	19.840	19.840	19.840	19.840
Bone Ash	2.000	2.000	2.000	2.000
Common Salt	1.000	1.000	1.000	1.000
Total	100.000	100.000	100.000	100.000
Determined Analysis (%)				
Dry matter	93.84	93.64	94.02	93.66
Crude protein	17.42	14.62	16.46	20.40
Crude fiber	14.96	15.96	15.66	19.36
Nitrogen free Extract	53.52	55.97	52.23	43.74
Either extract	4.10	4.10	3.30	2.80
Ash	10.50	9 .35	12.35	13.70

WSSOPM = Water soaked sweet orange peel meal,
T1 = 0 % WSSOPM, T2 = 60% WSSOPM, T3 = 80 % WSSOPM, T4= 100% WSSOPM

Table 2: Performance of the WAD goats fed the experimental diets

Parameters	Experimental diets				SEM
	T1 (0%)	T2 (60%)	T3 (80%)	T4 (100%)	
Initial weight (Kg)	7.665	7.675	7.775	7.662	0.41^{ns}
Final weight (Kg)	9.887	9.988	10.487	10.512	0.51^{ns}
Total weight gain (Kg)	2.231	2.313	2.712	2.850	0.49^{ns}
Mean weight gain (g)	28.98	30.03	35.23	36.04	6.44^{ns}
Total forage intake (Kg)	32.40	29.16	28.86	30.87	1.49^{ns}
Total concentrate intake (Kg)	10.19	9.40	12.61	9.94	0.96^{ns}
Total feed intake (Kg)	42.59	38.56	41.47	40.82	2.21^{ns}
Mean feed intake (g)	553.12	500.78	538.57	530.13	7.82^{ns}
Feed conversion ratio	19.09	16.68	15.29	14.70	4.43^{ns}

ns =not significantly different (P> 0.05), SEM = Standard Error of the Mean
WSSOPM = Water soaked sweet orange peel meal,
T1 = 0 % WSSOPM, T2 = 60% WSSOPM, T3 = 80 % WSSOPM, T4= 100% WSSOPM

The cost analysis of the experimental animal is presented on Table 3. Results show that the cost of production per goat (₦) for T1 (5165.44), which was the control was higher than T2 (4992.98), T3 (5126.33), and T4 (4941.07) which had the WSSOPM. Treatment 4 (100%WSSOPM) which was total replacement of the maize offal had the least cost value (4941.07) for cost of production. The profit per buck (₦) was least for T1 (2244.56) and highest for T4 (2941.43). Profit margin per buck increased from T2 - T4 with increasing level of the WSSOPM in the diets. Although all the treatments had profit, T4 showed the highest profit this may have been so because the energy source of the concentrate supplements (WSSOPM) was at very minimal cost but it was viable.

Table 3: Cost analysis of the experimental goats

Parameters	Experimental diets				SEM
	T1 (0%)	T2 (60%)	T3 (80%)	T4 (100%)	
Concentrate feed cost/kg (₦)	69.69	57.20	53.00	48.87	-
Total conc. feed intake/buck (kg)	10.19	9.40	12.61	9.94	-
Cost of feed intake/buck (₦) (conc)	710.14	537.68	668.33	485.77	-
Cost of buying/young buck (₦)	3935.00	3935.00	3935.00	3935.00	-
Miscellaneous (₦)	520.30	520.30	520.30	520.30	-
Cost of production/goat (₦)	5165.44	4992.98	5126.33	4941.07	-
Selling price/kg live weight/buck (₦)	750	750	750	750	-
Cost of Selling/buck (₦)	7410.00	7492.50	7867.50	7882.50	-
Profit/buck (₦)	2244.56	2499.52	2743.87	2941.43	-

The blood profile of the experimental goats is presented in Table 4. Apart from the albumin values, treatment effects were not apparent(P>0.05) among the treatments for all the parameters measured. The packed cell volume and the white blood cells values which were 26.00 - 28.00% and 6.30 - 10.15g/dL respectively, and these were normal and within reference values for clinically healthy goats(Daramola *et al.*, 2005). The similarities (P>0.05) in the total protein values was an indication that there was no protein-energy malnutrition (Fasina *et al.*,

2010) as a result of replacement of maize offal with WSSOPM even up to 100% replacement, it also means that the crude protein level of the experimental diets which contained the test ingredient were adequate. The albumin values of T2 (3.53g/dL) were significantly higher (P<0.05) than those of T1 (2.80g/dL), T3 (2.68g/dL) andT4 (2.55g/dL). Albumin values reflect the health status of animals, Kaslow (2009) reported that albumin is a very strong predictor of health; a low albumin is a sign of poor health and a predictor of bad outcome. Observed values in this study were normal and within reference range of 2.40 - 4.40 g/dl reported by Plumb (1999) for healthy goats. Observed values were higher than 1.28 - 2.65g/dl reported by Odemelam *et al.* (2014) for WAD bucks fed *Panicum maximum* and bambara nut seed meal supplemented diets. Oloche *et al*. (2015) reported comparable albumin values of 2.85 - 3.33g/dL for WAD goats fed complete diets containing graded levels of sweet orange peel meal. The SGOT, SGPT and ALT are all liver enzymes and these were similar (P>0.05) across the treatment means. The similarities in the means of these enzymes means that dietary treatments containing WSSOPM were safe and did not hamper with the levels of these enzymes nor their normal functioning as to give deleterious effects on the liver. The creatinine values were between 0.63 - 1.60 mg/dl this was similar with0.70 - 1.50 mg/dL reported MVM (2015) for goats, suggesting that there were no adverse effects on the lean muscle tissues of the experimental goats. Observed values were comparable with 0.90 - 1.5mg/dl creatinine values reported by Saka *et al.* (2016) for goats.Cholesterol levels were normal, meaning that diets containing WSSOPM did not impair normal heart functioning through narrowing of coronary arteries. Alabi (2012) reported that continuous deposition of cholesterol may lead to narrowing of the coronary arteries which can lead to cases of cardiac arrest, heart failure and heart attack. Observed values were higher than 72.77 - 106.97mg/dL reported by Oloche *et al*. (2017) for WAD goats, but within the normal range of 64.60 - 136.40 mg/dL reported by Plumb (1999) for healthy goats.

Table 4: Blood profile of the experimental goats

Parameters	Experimental Diets				SEM
	T1 (0%)	T2 (60%)	T3 (80%)	T4 (100%)	
Packed cell volume (%)	26.00	26.25	28.00	26.75	0.97^{ns}
Haemoglobin (g/dL)	8.75	8.73	9.33	8.83	0.33^{ns}
White blood cells ($x10^9$/L)	10.15	6.30	8.40	8.70	1.27^{ns}
Total protein (g/dL)	4.50	4.28	4.93	4.93	0.48^{ns}
Albumin (g/dL)	2.80^{b}	3.53^{a}	2.68^{b}	2.55^{b}	0.17*
SGOT (U/L)	44.30	71.30	53.10	47.10	18.35^{ns}
SGPT (U/L)	45.07	64.40	42.20	34.00	11.89^{ns}
ALP (U/L)	64.75	58.60	56.10	47.90	13.17^{ns}
Creatinine (mg/dL)	1.60	0.75	0.75	0.63	0.33^{ns}
Cholesterol (mg/dL)	144.90	176.18	178.80	184.65	12.90^{ns}

a,b = Means on the same row with different superscripts are significantly different

The mineral composition of the experimental goats is presented in Table 5. The experimental diets did not significantly vary the Ca, mg, Na and Zn composition of the serum of the goats. Treatment effect was apparent on the potassium values. Potassium is a major cation of the intracellular fluid and functions as sodium

does by influencing acid base balance (Adedeji, 1992). Although potassium values were different (P<0.05) among the treatments, observed values were within the normal range of 3.0 - 6.0mmol/Las reported by Daramola *et al*. (2005) for goats. There was no effect of treatment (P>0.05) on phosphorus values. Whitten (1971) reported that ruminants by their character endeavor to uphold phosphorus at a relatively constant concentration in the blood plasma, this is possible by absorption of phosphorus from the digestive tract and release of phosphorus from the bones to balance the loss of phosphorus from plasma in the course of metabolic processes. Sodium values showed no apparent variations between treatments values, this agrees with the report of Mansten and Rowland (1973) that K and Na concentrations in the blood are constant and may not be affected by diets.

Table 5: Mineral composition of the experimental diets

Parameters	Experimental diets				SEM
	T1 (0%)	T2 (60%)	T3 (80%)	T4 (100%)	
Calcium (Ca) (mg/dL)	5.65	6.88	5.10	7.23	1.02^{ns}
Phosphorus (P) (mg/dL)	3.15	3.00	3.60	3.40	0.59^{ns}
Potasium (K) (mEq/L)	3.15^{ab}	3.00^{b}	4.88^{a}	3.40^{ab}	0.59*
Magnesium (Mg) (mg/dL)	1.70	1.48	1.68	1.48	0.11^{ns}
Sodium (Na) (mEq/l)	102.25	183.53	171.35	170.57	46.97^{ns}
Zinc (Zn) (mmol/L)	136.13	135.97	117.25	128.25	14.7^{ns}

*** = Significant, ns = Not significant, SEM = Sum of error mean**
ab =Means with difference superscript letters along the rows differs significantly at p<0.05.

Conclusion

From the study, replacing maize offal with WSSOPM up to 100% level did not have negative effects on the performance and blood profile of the goats, therefore farmers can replace maize offal with WSSOPM in the diets of their goats. This will improved productivity at lower cost, while profitability will be enhanced.

References

Adedeji, A. O. 1992. Rapid interpretation of routine clinical laboratorytests. 1st Edition, pub. S. A. Sekome, and Co., Samaru, Zaria, Nigeria. pp.1016.

Aderinboye, R. Y., Akintade, O. A. and Adelusi, O. O., Yusuf, K. O., Ojo, V. O. A., Oni, A. O., Isah, O. A. and Aduku, A. O. 2014. Evaluation of rumen microbial population in West African dwarf sheep fed supplemented concentrate diets containing raw wood as treated and oil-extracted cashew-nut shell. Nig. J. Anim. Sci. 16(1&2): 74-105.

AOAC 1996. Official Methods of Analysis. Association of Official Analytical Chemists. Arlington.VA.

Alabi, O. M. 2012. Cholesterol-A controversial component of poultry egg. A review. Proc. of the 37th Conf. of Nig. Soc. for Anim. Prod. Held at University of Agriculture Makurdi, 18th - 21st March 2012. Makurdi. pp.683 - 685

Arigbede, O. M., Bolaji, O. J., Sanusi, I. M., Olanile, J. O. and Jolaosho, A. O. 2010. Nutrient intake and performance of West African dwarf sheep fed graded levels of wildyam (*Achomones differmis*) and *Pennisetum purpureum*. Proc. 35th Conf. of The Soc. for Anim. Prod. Held on the 14th - 17th of March, 2010 at the Univ. of Ibadan, Nigeria. pp. 485 – 488.

Babatunde, G.M., Fajimi, A.O. and Oyejide, A.O. 1992. Rubber seed

oil versus palm oil in broiler chicken diets. Effects on performance, nutrient digestibility, haematology and carcass characteristics. *Animal Feed Science and Technology pp* **35:**133 -146

Daramola, J. O., Adeloye, A. A., Fatoba, T. A. and Soladoye, A. O. 2005. Haematological and biochemical parameters of West African Dwarf goats. *Lives. Res. for Rural Deve.* 17 (8): 3 - 5.

Kaslow, J. E. 2009. Globulins, total protein.*http://www.drkaslow.com/html/protein.albumin..globulin.html.*

Fajemisin, A. N. and Adeleye, I. O. A. 2005. Time related qualitative changes in the haematological values of rat blood kept at room temperature. Proceeding of 30th Ann. Conf. of Nig. Soc. for Anim. Prod. 30:41 – 44.

Fasina, O. E., Oguntade, S. B. and Adebanjo, A. B. 2010. Haematological and biochemical values of West African Dwarf goats fed cassava chips and hay (TME 419 and TMS 98/0581). Proc. 38th Conf., Nig. Soc. for Anim. Prod. 14th - 17th March, 2010, Univ. of Ibadan, Nigeria. pp. 514 - 596.

Fasae, A. O. and Owodunni, A. 2015. Growth and faecal egg count response of sheep grazing natural pasture to cassavaleaves supplementation. Proc. 40th Ann. Conf., Nig. Soc, for Anim. Prod. Held 15th – 19th March 2015. NAPRI/ABU, Zaria. pp 549 -552.

Gupta, A. R., Putra, R. C., Sani, M. and Swarup, D. 2007. Haematology and serum biochemistry of Chital (*Axis axis*) and barking deer (*Muntiacusmuntijax*) reared in semi-captivity. *Vet.Res. Comm.***31:** 801 - 808.

Lamidi, A.A., Aina, A.B.J., Sowande, S.O. and Jolaosho, O. 2010. Assessment of *Panicum maximum* (Jacq), *Glincia sepium* (Jacq) and *Gruelina arborea* (Roxb) based diets as all year round feed for WAD goats. Proc. of 14th Ann. Conf. of Anim. Soc. of Nig. Held at LAUTH on the 13th - 17th Sept. 2010. Ogbomosho.

Mansten, R. and Rowland, H. N. 1980. Sodium requirements of grazing ruminants. *J.Dairy Res.*46:85 - 92.

MVM 2015. Merck Veterinary Manual.

MINITAB 14. 1991. Statistical Software. V.10. 2 MINITAB Inc. P.A., USA.

Microsoft Encarta. 2008. Microsoft Corporation

Ngele, M. B., Adegbola, T. A., Bogoro, S. E. F., Abubakar, M. and Kalla, D. I. U. 2010. Nutrient intake, digestibility and growth performance of Yankasa sheep fed urea-treated or untreated rice straw with supplements. *Nig. J. Anim. Prod.* 37 (1) 61-70.

Opeke, L. K. 2005. Tropical commodity tree crops.Spectrum books Ltd Ibadan, Nigeria. pp.503.

Odoemelam, V. U., Ahamefule, F. O., Ibeawuchi, J. A., Nwachukwu, E. N. and Etuk, I. F. 2014. Milk yield and composition of WAD does fed bambara nu meal based diets. *Nig. J. of Anim. sci.* 15:34 -144.

Olabanji, R. O., Ojebiyi, O. O., Tona, G. O. and Ologun, O. 2007. Haematological and serum biochemical response of growing rabbits fed diets containing processed mango (*Mangiferaindica*). Proc. 14th Ann. Conf. of Anim. Sci. Assoc. of Nig. Held at Ladoke Akintola Univ. of Tech. Ogbomoso, OyoState, Nigeria: 170 - 173.

Oloche, J., Ayoade, J. A. and Oluremi, O. I. A. 2013. Performance of West African dwarf (WAD) goats fed diets containing graded levels of sweet orange (*Citrus sinensis*) peel meal. Proc. 18th Ann. Conf., Anim. Sci. Assoc. of Nig. Held 8th - 12th Sept. 2013. National centre for women development, Garki, Abuja. Nigeria. Pp 267 - 270.

Oloche, J., Oluremi, O. I. A. and Shaapera, S. S. 2015. Performance of West African dwarf goats fed gamba grass and supplemented with diets containing treated and untreated sweet orange peels. Proc. 14th Ann. Conf. of Nig. Soc. for Anim. Prod. Held 15th-19th March 2015, NAPRI/ABU, Zaria.pp. 488 – 490.

Oloche, J., Paul, D. L. and Ikyume, T. T. 2017. Blood profile of West African dwarf goats fed diets containing unfermented and fermented sweet orange peel meal with gamba as basal feed. Proc. 6thASAN-NIAS joint Ann. Meeting. Held 10-14thSept. 2017. Abuja. pp. 592 -595.

Oluremi, O. I. A., Ngi, J. and Andrew, I. A. 2007. Phytonutrients in citrus fruit peel meal and nutritional implication for production.Proc. of the 32nd Ann. Conf. of Nig. Soc. for Anim. Prod. held at University of Calabar on the 18th – 21st of March 2007. Calabar, Cross River, Nigeria. Pp 329 – 332.

Okoruwoa, M. I., Adewumi, M. K. and Igene, F. U. 2013. Thermophysiological processes of West African bucks fed *Pennisetum purpureum a*nd unripe plantain peels. *Nig. J. of Anim. Sci*. 15:168 - 178.

Opeke, l. K. 2005. Tropical commodioty tree crops. Spectrum books Ltd Ibadan. Pp.503.

Plumb, D. C. 1999. Veterinary Drug Handbook. Lower State University press veterinary clinic pathology practice publishing co. 1984.

Piccinelli, A. L., Mesa, M. G., Armenteros, D. M., Alfoso, M. A., Arevalo, A. C., Compone, L. and Rastrelli, L. 2008. HPLC-PDA-MS and NMR Characterisation of *C. glycosyl* flavones in hydroalcoholic extract of *Citrus aurantifolia* leaves with anti-platelets activity. *J. Agric. Food Chem*. 56:1574-1581.

Saka, A. A., Adekunjo, R. K., Ogunleke, F. O., Ogunfolabo, L. A., Adetola, O. O., Awodele, O. A., Lawrence-azua, O. O. and Okuneye, O. J. 2016. Performance characteristics and Blood profile of West African dwarf goats fed diets containing graded levels of malted sorghum sprout mixed with pineapple waste based diets. *Nig. J. of Anim. Sci*.(1):145 - 153.

Sanwo, K. A., Iposu, S. O., Osa, A. O., Fanimo, A. O. and Abiola, S. S. 2011. Growth performance, nutrient intake and digestibility of goats fed melon husk and palm oil slurry at 30% inclusion level. *Nig. J. Anim. Prod. Vol*. 38(2): 148-153.

Whitten, L. K. 1971. Disease of domestic animals in New Zealand. Edit. Serv, Wellington, New Zealand. pp. 341-342.

Yashim, S. M., Haniel, B., Makama, S. R. and Adama, H. Y. 2016. Growth Performance, nutrient digestibility and nitrogen balance of Red Sokoto bucks fed Irish potato (*solanum tuberosum* L.) peels as a replacement for maize offal. *Nig. J. Anim. Prod. Res*. 28(1):245-253.

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