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Effects of fertilized maize leaf concentrate diets on the growth, haematology and carcass characteristics of West African dwarf sheep

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***Target Audience:** Ruminant farmers, Ruminant scientists, Extension agents*

Abstract

The effects of fertilized maize leaf concentrate (MLC) diets as feed supplements on the performance of the West African Dwarf (WAD) breed of sheep were evaluated. The 90-day experiment involving twenty-five (25) WAD sheep with average body weight of 11.14 ± 0.88kg in a completely randomized design were fed five diets containing concentrate from maize leaves fertilized with manure of poultry, swine, sheep for treatments 1 to 3 while NPK and the control made up treatments 4 and 5, respectively. Data were obtained on feed intake, weight gain, haematological and serum parameters as well as carcass characteristics and meat sensory evaluation. Results showed that manure fertilized MLC had a positive effect ($p<0.05$) on dry matter (DM) intake and weight gain of sheep. Among treatments, animals supplemented with sheep manure MLC showed better DM intake (466.79g/day), weight gain (46.44g/day) and feed conversion ratio (10.06). Results on the blood indices showed variation ($p<0.05$) in values observed in white blood cells (7.05-8.4 $x10^{9/L}$) and serum glucose (82.90-97.55mg/dl) while other parameters were similar among the treatment groups. Carcass traits of sheep varied ($p < 0.05$) across treatments with sheep fed manure MLC having better values. Dressing percentage varied ($p < 0.05$) from 50.58 to 58.86% in sheep fed sheep manure MLC and the control treatment, respectively. Following sensory assessment, panelists rated eating quality traits similar ($p > 0.05$) across treatments with variation ($p < 0.05$) observed in the ratings for flavour. It was concluded that sheep offered manure fertilized MLC improved performance with animals fed sheep manure MLC having better plane of nutrition, thereby supporting higher growth rates and carcass traits.

***Keywords:** Carcass, dry season, haematology, maize leaves, manure, performance, sensory, sheep*

Description of Problem

Sheep play a valuable role in sustainable agricultural systems in Nigeria as they are useful in converting vast renewable resources from rangeland, pasture and crop residues into food edible for humans. They are majorly owned by smallholder rural farmers for whom this resource is critical for nutrition and income as they are majorly reared for meat and are also important sources of milk, skins and manure. They also serve as an important and secure form of investment (1). However, the inadequacy of all year-round feed which is occasioned by seasonality of the major feed resource and protracted dry season has hampered the productivity of these animals. This has been a major problem to smallholder farmers as very little pasture exists during the season. Moreover, the use of crop residues as alternative and strategic cheap source of feed

for ruminants have been attempted over the years to alleviate the problem of feed shortage in ruminant production systems (2).

Maize is a common crop cultivated year in year out in quantum in most communities in Nigeria. They generate a lot of underutilized leaves which remains under-exploited as feed materials. Moreover, if well harnessed, these leaves could be capitalized on for the enhancement of sustainable agriculture, serving as cheap sources of nutrients especially dietary energy and fermentable products for sheep production. Though maize leaves have been used as fodder for ruminants, its nutrient potential can further be improved upon when fertilized with farmyard manure. Manure fertilization of maize has been reported to increase its growth parameters, producing superior fodder in terms of dry matter yield and nutritive quality (3), which if utilized by ruminants could serve as a potential feed resource. This project therefore evaluates the performance, haematology, carcass and sensory traits of meat from West African Dwarf sheep fed manure fertilized maize leaf concentrate diets as a supplementary source of dry season feed.

Materials and Methods

Animal management

Twenty-five (25) West African Dwarf (WAD) yearling sheep purchased from smallholder farmers within the study area were subjected to a 90-day growth trail to evaluate their growth, haematology and serum biochemical parameters as well as carcass and meat sensory evaluation at the small ruminant unit of the Teaching and Research farms, Federal University of Agriculture, Abeokuta. Prior to the experiment, the animals were quarantined for 30 days during which they were dewormed, given a prophylactic treatment of antibiotics and treated against ectoparasites with vaccines administered against *Pestes des Petit Ruminante* disease. The animals were housed individually in pens and assigned to 5 dietary supplementary treatments of concentrate made from maize leaf fertilized with different sources of manure with the proportion of ingredients comprising of fertilized maize leaves, 26%; corn bran, 10%; wheat offals, 20%; palm kernel cake 21%; rice bran, 18.5%; bone meal, 2%; vitamin- mineral premix, 1.5% and salt, 1%. The manure treatments were made up of poultry, swine, sheep for treatments 1 to 3 while NPK and the control made up treatments 4 and 5, respectively. Each treatment was replicated 5 times with animals balanced for body weights in a completely randomized design. The animals were allowed to adapt to the experimental diets for two weeks before the commencement of the feeding trial. Concentrate feed was offered daily at 200g/animal with a basal diet of *Panicum maximum* provided *ad libitum*. Daily feed offered and feed refusals were taken while the animals were weighed weekly.

Blood parameters evaluation

Blood samples were collected via the jugular vein puncture for hematology and serum biochemical analysis as described (4) using a 10ml hypodermic syringe from the animals before the commencement of the experiment and at the end of the experiment. 5ml of the blood samples were collected into plastic tube containing EDTA for haematological studies and the remaining 5ml of blood samples were deposited into plain tubes for serum biochemistry for the determination of total protein, albumin, globulin, glucose and urea.

Carcass characteristics and meat sensory evaluation

The animals were slaughtered after starving for 20hours according to the local method by severing the jugular vein and the carotid arteries. After thorough bleeding, the

hair was scalded from the skin using boiling water. Empty body weight was computed and the hot carcass weight weighed as described (5). The carcasses were cut into retail and each part was weighed and the dressing percentage calculated. In evaluating the sensory qualities, samples of meat from each treatment were collected after de-boning, cut into chops of an average weight of 150g and cooked in water at a temperature of 65^0C for 30 minutes in a pot using a gas cooker. Ten trained panelists were used in the assessment procedure to masticate sample from each treatment and score it for flavour, tenderness, juiciness and overall degree of acceptability. The evaluators scored each sample on a nine (9) point hedonic as described (6).

Data collected was subjected to analysis of variance and differences separated using Duncan multiple range test (7).

Results and Discussion

The result of the chemical composition of the experimental concentrate and *Panicum maximum* diets fed to WAD sheep is as shown in Table 1. Similar amount of dry matter (DM) was obtained in the concentrate diets across treatments and these falls between 86.50 to 94.54% reported for concentrate diets fed to ruminants for optimal performance (8, 9). The crude protein content of concentrate diets varied from 14.25 to 15.92% DM and shows that the feed value of the concentrate was suitable as it contains crude protein values above the 8% CP which is the critical level required by ruminant animals, necessary for proper rumen function (10). The variation in CP content observed in the control diets indicates the non - inclusion of unfertilized maize leaves in comparison to the other diets. (11) reported increased crude protein content of forages with the application of fertilizer in the field, which was brought about by stimulating new growth of tissue and by accumulation of NPN compounds in the tender region of the plant. The NDF level of diets in this study was lower than the safe upper limit of 60% guaranteed for forage intake by sheep (12).

Table 1: Chemical composition (%) of experimental diets fed to West African Dwarf sheep

Parameters	PMLC	SWMLC	SHMLC	NPKMLC	UMLC	PM	SEM
Dry matter	87.78	88.01	87.74	87.91	88.28	71.29	1.83
Crude protein	15.12	15.38	15.92	15.31	14.25	8.01	1.21
Ether extract	11.29	11.36	11.31.	11.56	11.28	11.25	1.19
Ash	7.43	7.52	7.73	7.46	7.45	5.63	0.52
Neutral detergent fibre	43.97	43.03	40.91	41.56	42.79	61.21	1.62
Acid detergent fibre	29.15	28.26	27.64	27.64	28.54	35.53	1.43
Acid detergent lignin	5.18	5.16	4.63	5.98	5.31	8.82	0.44

PMLC- Poultry manure maize leaf concentrate; SWMLC- Swine manure maize leaf concentrate; SHMLC - Sheep manure maize leaf concentrate; NPKMLC- Nitrogen Fertilized maize leaf concentrate; UMLC - Unfertilized maize leaf concentrate; PM – *Panicum maximum*

The *Panicum maximum* is higher in fibre fractions but lower in CP compared to the concentrate diet. This corroborates earlier reports (13) that roughages such as grasses contain greater quantities of structural components and therefore more fibre than other livestock feed resources. However, the composition of the *Panicum maximum* in this study differed slightly with earlier reports (14, 15) which may be attributed to season as well as the stage of forage harvest, amount of edible part and the processing methods before feeding.

Table 2 shows the performance characteristics of WAD sheep fed the experimental diets. Intake values obtained for the animals varied ($p < 0.05$) across treatments and ranged between 402.05 to 466.79 g/day, with animals consuming all the concentrate mixture given to them. Total DM intake were however better ($p < 0.05$) and similar ($p > 0.05$) in sheep fed manure fertilized maize, which is an indication that the sheep were well adjusted to the experimental diets.

The better performance observed in sheep fed concentrate consisting of maize leaves fertilized with could be attributed to the higher nutrient composition of these leaves in the concentrate diets which could be more consumed by animals compared to the other treatments. (16) reported that the application of manure interferes differently with plant growth and development than chemical fertilization which has been observed to produce better growth and development of plants (17) due to the provision of various elements and nutrients during mineralization processes of the manure.

Table 2: Performance indices of West African Dwarf sheep fed manure fertilized maize leaf concentrate diets

	Dietary Treatments					
Parameters	PMLC	SWMLC	SHMLC	NPKMLC	UMLC	SEM
DM Intake (g/day)						
Concentrate intake (g/day)	200.00	200.00	200.00	200.00	200.00	1.23
Grass intake (g/day)	244.68^{ab}	237.52 ^{ab}	266.79^{a}	202.05^{b}	219.06^{b}	2.71
Total DM intake (g/day)	444.68^{ab}	427.52^{ab}	466.79^{a}	402.05^{b}	419.06^{b}	3.03
Initial weight kg)	10.97	11.69	11.16	11.01	10.85	0.91
Final weight (kg)	14.61^{b}	15.45^{a}	15.34^{a}	14.40^{b}	13.90^{a}	1.15
Weight gain (kg)	3.64^{b}	3.76^{b}	4.18^{a}	3.39 ^{b}	3.05^{b}	0.67
Daily weight gain (g/day)	40.44^{b}	41.78^{b}	46.44^{a}	37.67^{bc}	33.88^{c}	2.62
Weight gain (W $^{0.75kg}$)	16.04^{b}	16.43^{ab}	17.15^{a}	15.21^{b}	14.04^{a}	1.13
Feed conversion ratio	10.99^{b}	10.23^{bc}	10.06^{c}	10.67^{b}	12.36^{a}	1.31

^{abc} *Means in the same row with the same superscripts are significantly different ($p<0.05$)*

PMLC- Poultry manure maize leaf concentrate; SWMLC- Swine manure maize leaf concentrate; SHMLC - Sheep manure maize leaf concentrate; NPKMLC- Nitrogen Fertilizer maize leaf concentrate; UMLC - Unfertilized maize leaf concentrate

The average daily weight gain (g/day) ranked the same ($p>0.05$) in animals fed manure fertilized MLC (maize leaves concentrate) which were significantly higher compared to the other treatments. This observation could be attributed to the better utilization of MLC which has led to a better performance, thus reflecting the greater potential of the sheep for improved productivity. However, the live weight gain of sheep on all the diets were within the range of 32.5 to 47.5g/day earlier reported for the same breed of sheep fed concentrate and forages (18).

Feed conversion ratio were best in animals fed MLC fertilized with sheep manure compared to the other treatments; thereby suggesting better feed utilization compared to the other treatments, hence a higher body weight gain. The highest daily gain in weight and feed conversion ratio showed by animals fed MLC fertilized with sheep manure suggest the adequacy of the nutritional plane for such an outstanding performance.

The haematological parameters of West African dwarf sheep fed manure fertilized maize leaf concentrate diets are presented in Table 3. The packed cell volume (PCV) and haemoglobin (Hb) levels were generally within the recommended reference range reported for sheep (19, 20), suggesting that the quality of the test feeds was good enough to maintain the good health of the animals. The PCV range of 22.50 to 30.33% obtained in this study were within values (22.00 to 37.00%) reported for normal healthy sheep (21). The non-significant values observed for PCV and Hb of sheep fed the experimental diets relative to the control treatment is an indication that the animals were not anaemic.

Table 3: Haematological parameters of West African dwarf sheep fed manure fertilized maize leaf concentrate diets

	Dietary Treatments					
Parameters	PMLC	SWMLC	SHMLC	NPKMLC	UMLC	SEM
Packed cell volume (%)	27.50	36.50	29.00	30.00	30.00	2.93
Haemoglobin (g/dl)	9.30	11.90	9.65	9.90	10.10	0.95
Red blood cell ($x10^{12/L}$)	7.55	9.05	7.45	8.00	8.05	0.46
White blood cell ($x10^{9/L}$)	7.95^{ab}	8.40^{a}	7.35^{b}	7.05^{b}	8.10^{a}	0.72
Neutrophils (%)	28.00	30.50	31.50	31.00	30.33	2.35
Lymphocytes (%)	70.33	67.50	67.50	68.00	67.33	2.65
Eosinophils (%)	0.50	0.50	0.00	0.50	0.50	0.02
Basophils (%)	0.00	0.50	0.50	0.00	0.50	0.01
Monocytes (%)	1.50^{a}	1.00^{a}	0.50^{b}	0.50^{b}	1.50^{a}	0.09

^{a,b,c,d} *Means in same row with different superscripts are significantly ($p<0.05$) different.*

PMLC- Poultry manure maize leaf concentrate; SWMLC- Swine manure maize leaf concentrate; SHMLC - Sheep manure maize leaf concentrate ; NPKMLC- Nitrogen Fertilized maize leaf concentrate; UMLC - Unfertilized maize leaf concentrate.

The RBC values obtained in this study were within the normal values reported for healthy sheep (22). The white blood cell counts varied among the treatment groups and fell within the normal range (5 to 11 $x10^{6}$/dl) reported by (23) for sheep. This is an indication of the ability of the experimental sheep to fight against the presence of foreign body in the circulating system.

The values for neutrophils, eosinophil, lymphocyte and monocyte were within normal range reported for clinical healthy sheep (23)., thus suggestive of a well-developed immune system in WAD sheep with such number of immune cells to offer good health.

The serum biochemical parameters of West African dwarf sheep fed manure fertilized maize hay diets are shown in Table 4. The total protein of the WAD sheep fed the experimental diets were significantly (p <0.05) higher in sheep fed manure fertilized maize leaf concentrate diets compared to the other treatments. However, the serum protein values obtained in this study were within the normal range values of 5.70 to 9.10g/dl (24). The mean serum albumin and globulin of the animals assessed in this study, were not significantly influenced by the dietary treatments. However, serum urea and glucose were significantly (p < 0.05) affected by the dietary treatments but were within the normal values reported for healthy sheep.

Table 4: Serum biochemical parameters of West African dwarf sheep fed manure fertilized maize leaf concentrate diets.

	Dietary Treatments					
Parameters	PMLC	SWMLC	SHMLC	NPKMLC	UMLC	SEM
Total protein (g/dl)	7.80 [a]	7.50 [a]	7.70 [a]	6.60 [b]	5.80 [b]	2.93
Albumin(g/dl)	4.45	3.55	4.10	4.05	2.15	0.95
Globulin (g/dl)	2.35	2.95	1.60	2.35	2.65	0.46
Urea (mg/dl)	21.35[a]	18.70[b]	17.75[b]	20.00[a]	18.20[ab]	0.72
Glucose (mg/dl)	97.55[a]	92.85[a]	82.90[b]	98.35[a]	88.65[b]	2.35

[a,b,] Means in same row with different superscripts are significantly ($p<0.05$) different.
PMLC- Poultry manure maize leaf concentrate; SWMLC- Swine manure maize leaf concentrate; SHMLC - Sheep manure maize leaf concentrate; NPKMLC- Nitrogen Fertilized maize leaf concentrate; UMLC - Unfertilized maize leaf concentrate

The comparison of the carcass characteristics of West African dwarf (WAD) sheep fed manure fertilized maize leaves concentrate are shown in Table 5. The carcass components observed varied ($p < 0.05$) among treatments with sheep fed manure fertilized MLC having higher ($p < 0.05$) values relative to the other treatments. The carcass yield of WAD sheep in this study is comparable to that obtained for the same breed of sheep fed concentrate and forage but lower compared with those reported for some tropical sheep breeds (25, 26). This could be attributable to the breed, management system and nutrition.

The dressing percentage (DP) observed for WAD sheep in this study is comparable to those reported by (27, 28) for the same breed of sheep under zero grazing. Moreover, lower values have been observed for traditionally managed West African dwarf and other tropical breeds of sheep (29, 5)**.**

Table 5: Carcass characteristics of West African dwarf fed manure fertilized maize leaf concentrate diets

	Dietary Treatments					
Components	PMLC	SWMLC	SHMLC	NPKMLC	UMLC	SEM
Slaughtered weight	14.61[b]	15.45[a]	15.34[a]	14.40[b]	13.90[b]	1.15
Empty body weight	13.28[b]	14.37[a]	14.01[a]	13.30 [ab]	12.49[b]	1.60
Hot carcass weight	11.77[b]	12.83[ab]	13.63 [a]	12.13[b]	11.14[b]	1.72
Cold carcass weight	8.01[ab]	8.36[a]	9.03[a]	7.53[b]	7.03[b]	1.05
Dressing percentage (%)	54.82[ab]	54.11[ab]	58.86[a]	52.29[b]	50.58[b]	3.22

[a,b] *mean values in the same row with the same superscripts are not significantly different ($p>0.05$)*
PMLC- Poultry manure maize leaf concentrate; SWMLC- Swine manure maize leaf concentrate; SHMLC - Sheep manure maize leaf concentrate; NPKMLC- Nitrogen Fertilized maize leaf concentrate; UMLC - Unfertilized maize leaf concentrate

Table 6 shows the mean values of the sensory properties of WAD sheep fed manure fertilized maize leaves concentrate. Following sensory assessment, there were no significant differences between parameters for eating quality traits with exception of the flavour. The panelists rated meat from sheep same ($p > 0.05$) in juiciness, texture, tenderness and overall acceptability. Flavour ratings however varied ($p < 0.05$) across treatments with meat

from sheep fed manure fertilized maize leaves concentrate having higher ratings relative to the other treatments. Although, reports have shown that flavour ratings appear to be largely related to the panellists' preference and previous exposure to lamb (30).

Table 6: Sensory evaluation of meat from West African dwarf sheep fed manure fertilized maize leaf concentrate diets.

	Dietary Treatments					
Parameters	PMLC	SWMLC	SHMLC	NPKMLC	UMLC	SEM
Flavour	7.80[a]	7.00[a]	7.00[a]	5.60[b]	6.00[b]	0.15
Tenderness	7.20	6.80	7.22	7.20	6.80	0.21
Texture	6.20	6.80	7.22	6.20	6.80	0.22
Colour	7.60	7.88	7.03	7.53	7.03	0.16
Juiciness	7.60	7.88	7.03	7.53	7.03	0.18
Acceptability	7.80	8.20	7.60	8.22	7.66	0.29

[a,b] *mean values in the same row with the same superscripts are not significantly different (p>0.05)*
PMLC- Poultry manure maize leaf concentrate; SWMLC- Swine manure maize leaf concentrate; SHMLC - Sheep manure maize leaf concentrate; NPKMLC- Nitrogen Fertilized maize leaf concentrate; UMLC - Unfertilized maize leaf concentrate

Conclusion and Applications

From the results of the study, it was concluded that:

1. Concentrate diets from maize leaves fertilized with different types of manure had a positive effect on the performance of the experimental animals with sheep manure fertilized maize leaf concentrate diets resulting in better weight gain, feed conversion ratio and carcass traits of WAD sheep.
2. For optimum performance and increase meat production, sheep manure fertilized maize leaf concentrate diets is recommended as supplementary feed for WAD sheep without adverse effect on the animal's health status.

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