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Performance, Haematological Parameters and Faecal Egg Count of Semi-intensively Managed West African Dwarf Sheep to Varying Levels of Cassava Leaves and Peels Supplementation

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ABSTRACT

Thirty West African dwarf (WAD) sheep aged 18-24 months with average weight of 17.96±0.89kg, managed under semi-intensive system, were used in a 56-day experiment to investigate the effects of varying levels of cassava leaves (CL) and cassava peels (CPL) supplementation on the performance, haematological indices and faecal egg count of sheep. Animals were subjected to 6 dietary treatments of 100% CL, 100% CPL, 75% CL/25% CPL, 25% CL/75% CPL, 50% CL/50% CPL, and natural pasture (0% CL/0% CPL) in a complete randomized design. Results showed that weight gain (g/day) varied ($P<0.05$) across treatments from 26.25 to 44.64 with sheep supplemented with 75CL/25CPL having the highest ($P < 0.05$) growth rate and the least values observed in sheep on control treatment. The dry matter and crude protein digestibilities were least ($P<0.05$) in sheep supplemented with 100%CPL relative to other treatments. The white blood cells and total protein of sheep varied ($P<0.05$) across treatments, while supplementary diets of CL reduced faecal egg count in sheep. It was therefore concluded that the performance of sheep managed under the semi-intensive system, grazing natural pasture could further be enhanced through the supplementation of cassava leaves and peels with dietary levels of 75% CL/25% CPL recommended for sheep's optimum performance.

Keywords: Cassava leaves, cassava peels, faecal egg count, haematology, performance, sheep

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INTRODUCTION

Sheep are important sources of animal protein in Nigeria. They adapt to a wide range of environments and utilize a variety of plant species. However, the productivity of these animals which are usually managed under the semi–intensive system is low due to various factors including poor feeding. The unavailability of traditional diets for sheep which consist mainly of grasses especially during the dry season (Sodeinde *et al.* 2007) has prompted farmers to search for alternative, readily available by-products.

With Nigeria being the largest producer of cassava worldwide (Daniels *et al.,* 2011), cassava harvesting and processing produce large amounts of leaves and peels and are generally considered to contribute significantly to environmental problems when left in the surroundings of processing plants or carelessly disposed off. Cassava peels, which account for 10-13% of the tuber weight, are left to rot away or burnt off to create space for the accumulation of new generation of waste heaps, emitting carbon dioxide and producing a strong offensive smell (Aro *et al.,* 2010).

However, cassava leaves and peels, if well processed, can be beneficial to livestock. To a limited extent, these by-products have been successfully used as livestock feeds, particularly in ruminant diets (Alli Balogun *et al.,* 2003; Fasae *et al.,* 2007). The peels of cassava are rich in protein oil and ash than the peeled portion. On a dry matter basis, cassava leaves have protein content that ranges between 14 and 69%, are fair in lysine content, marginal in tryptophan and isoleucine but deficient in methionine (Eruvbetine, 1995), whereas tannin in cassava leaves has been found to reduce faecal egg counts in ruminant animals (Netpana *et al.,* 2001).

This experiment therefore investigated into the effect of varying levels of cassava leaves and peels supplementation on the growth rate, haematology and faecal egg count of the semi-intensively managed West African Dwarf sheep.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Small Ruminant Experimental Unit of the Teaching and Research Farm Directorate Farms, Federal University of Agriculture, Abeokuta, Ogun State, South Western Nigeria. It has prevailing tropical climate with the mean annual rainfall of about 1037mm. The mean ambient temperature ranges from 28^{o}C in December to 36^{o}C in February, with a yearly average humidity of about 82%.

Preparation of the Cassava Leaves and Peels

Cassava leaves and peels were obtained from TMS 30572 variety of *Manihot esculenta.* Cassava peels were collected fresh from a gari processing plant after processing and sun dried on a flat concrete floor for three to four days, while cassava leaves were obtained from established plots and wilted for 24 hours so as to reduce hydrocyanic acid content present in the leaves. The Cassava leaves and peels were ground and mixed together at varying proportions before feeding to the animals.

Experimental Animals and Management

A total of thirty West African dwarf sheep aged 18 -24 months managed under semi-intensive system and with average weight of 17.96±0.89kg sourced from the flock of sheep of the Teaching and Research farms of the University were used for the experiment. They were randomized based on their initial weight and allotted to six dietary treatments in a completely randomized design: 100% CL; 100% CPL; 75% CL and 25% CPL; 50% CL and 50% CPL, 25% CL and 75% CPL and natural pasture (control treatment) for treatments 1 to 6, respectively. The animals were allowed to graze on natural pasture between 0900h and 1400h and were later confined into individual pens for the remaining hours of the day, during which the supplementary diets of cassava leaves and peels were fed at varying levels at 4% body weight per day on DM basis, while water was given *ad libitum*.

Feed Intake and Weight Gain Measurement

Data on feed intake by individual animals were recorded daily and the leftover feed was weighed and subtracted from the total quantity offered to determine the feed intake. The sheep were weighed initially at the start of the experiment and on a weekly basis thereafter until the termination of the experiment. Meanwhile, weight gained by the animals was calculated by subtracting the initial weight of the animals from the final weight.

Digestibility Trial

At the end of the 56-day growth trial, each animal on the supplementary treatments was transferred into individual metabolic crates and offered varying levels of cassava leaves and peels. Water was given *ad libitum.* Each digestion trial involved an adjustment period of 14 days to allow the animals to adjust to the diets, followed by a collection period of 7 days. Faecal output from each animal was weighed and DM determined daily. The dried faeces collected was bulked and stored in cellophane bag at room temperature for 2 weeks before analysis. The nutrient digestibility of the feed was determined by subtracting faecal nutrient output from feed nutrient intake.

Collections of Faecal and Blood Samples

Faecal samples of about 2 – 4 grams were obtained directly from the rectum of each animal on the first and the last three days of the growth experiment and taken to the laboratory to determine the faecal egg count using the Mcmaster technique.

At the termination of the digestibility experiment, 10ml of blood was drawn from each animal through the jugular vein using hypodermic needle and syringe. Five millimetres of the blood samples were released into the sample bottles containing ethylene diamine tetra acetic acid (EDTA) as anti coagulant and the bottles were shaken to ensure proper mixing of the blood with the EDTA acid to prevent coagulation. The remaining 5ml of blood samples were collected into bottles without anti coagulant to harvest serum. The EDTA bottles containing the blood samples were kept in an ice – pack and taken to a standard laboratory for the analysis.

Chemical Analysis

The proximate compositions of cassava leaves, peels and faecal samples were determined by using the method of AOAC (1995). The DM was determined by oven drying at 100^0C for 24 hours, Crude protein (CP) by Kjedhal method and fat by Soxhlet fat analysis. The concentration of neutral detergent fibre (NDF), acid detergent fibre (ADF) and lignin both in the feed and faecal samples were also determined by using the method of Van Soest and Robertson (1985). The hydrocyanic (HCN) contents of the cassava leaves in the feed and faeces were also determined as described by Bradbury *et al.* (1999). Analyses of tannin were carried out by using the method described by Makkar *et al.* (2003).

The blood samples were taken on the same day to the hematological laboratory for the determination of some haematological indices: packed cell volume, white blood cell, red blood cell, haemoglobin, total protein and blood urea nitrogen (AOAC, 1995). The samples of faeces were analyzed using the Modified McMaster counting technique (Sloss *et al.,* 1994).

Statistical Analysis

All data generated were subjected to one-way analysis of variance (SAS, 1999), with significant means separated using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical compositions of the cassava leaves and peels fed as supplements to sheep are shown in Table 1. The proximate values for the cassava peels (CPL) fell within the range reported (Fasae *et al.,* 2007). However, lower values (with the exception of the CP contents) were reported (Omotoso *et al.* 2010). The CP content of the CL reported is comparable to the range 29.8 - 33.7% protein (dry basis) in the leaves of different cassava cultivars (Oni *et al.* 2012), but higher than that reported by Alli-Ballogun *et al.* (2003) for cassava foliage. The DM contents of CL reported in this study were lower compared to those reported in the earlier literatures (Fasina *et al.,* 2008; Fasae & Olatunji, 2011) but fell within the range reported by Alli-Ballogun *et al.* (2003). Other researchers have shown variations in the chemical composition among leaves of different cassava varieties (Ngi *et al.,* 2006; Oni *et al.,* 2012).

The proportion of NDF in CL and CPL was congruent to the concentration of 600g/kg considered as safe for acceptable intakes of forages (Meissner *et al.* 1991). The performance indices of the semi intensively managed West African dwarf sheep supplemented with cassava leaves and peels are shown in Table 2. The DM intake (g/day) differed significantly ($P < 0.05$) across the treatments, with the highest DM intake observed in sheep fed 75% CL and 25% CPL, similar to intake values obtained for the sheep supplemented with 50%CL/50%CPL diet. This might be due to the high energy content of the mixed diets, resulting in high degradability of cassava leaves and peels at these levels of mixture in the rumen (Smith, 1992). In addition, tannin contents in diets containing CL may even have been responsible for enhanced efficiency of utilizing the CP of the supplements by sheep. The tannin component of the supplementary diets, which is at the concentration level recommended for sheep (Pawelek *et al.,* 2008) could have impacted some qualities of ruminal undegradable protein thereby

TABLE 1
Chemical composition (g/kg) of cassava leaves and peels supplemented to semi intensively managed West African dwarf sheep

Composition	Cassava leaves	Cassava peels
Dry matter	286.0	255.0
Crude protein	200.6	42.6
Ether extract	83.9	16.5
Ash	160.7	52.3
Neutral detergent fibre	411.7	560.1
Acid detergent fibre	300.2	351.2
Acid detergent lignin	91.0	121.0
Energy (MJ/kg/DM)	14.25	18.17
Crude protein (g/kg)	200.65	42.61
Metabolizable energy (MJ/kg)	14.25	18.17
Tannin	32.4	17.0
Hydrocyanic acid (mg/kgDM)	352.2	285.5

TABLE 2
Effects of varying levels of cassava leaves and peels supplementation on the performance characteristics of semi-intensively managed West African dwarf sheep

Parameters	100% CL	100% CPL	75% CL/ 25%CPL	50%CL/ 50% CPL	25%CL/ 75% CPL	0%CL/ 0%CPL	SEM
Feed intake (g/day)	378.33^{b}	341.67^{c}	392.00^{a}	388.67^{a}	380.33^{b}	-	3.83
Metabolic feed intake (g/KgW$^{0.75}$)	85.78^{a}	79.44^{b}	88.09^{a}	87.54^{a}	86.12^{a}	-	1.76
Crude protein intake (g/day)	75.91^{a}	14.53^{c}	63.18^{a}	47.30^{b}	31.16^{b}	-	1.52
ME intake (MJ/day)	5.38^{b}	6.18^{a}	6.04^{a}	5.88^{b}	5.76^{b}	-	0.41
Initial weight (kg)	17.33	18.33	18.25	17.95	18.15	18.00	0.91
Final weight (kg)	19.03^{b}	19.80^{b}	20.75^{a}	20.18^{a}	20.13^{a}	19.30^{b}	0.96
Cumulative weight gain (kg)	1.70^{b}	1.47^{c}	2.50^{a}	2.23^{a}	1.98^{b}	1.30^{c}	0.35
Daily weight gain (g/day)	30.36^{b}	26.25^{c}	44.64^{a}	39.82^{a}	35.36^{ab}	23.21^{c}	1.63
Metabolic weight gain (KgW$^{0.75}$)	12.93^{bc}	11.60^{c}	17.27^{a}	15.85^{b}	14.50^{b}	10.57^{c}	0.77

^{a,b,c}: Means in the same row with different superscript are significantly different ($P<0.05$)
CL: Cassava leaves; CPL: Cassava peels; ME: Metabolizable energy; SEM: Standard error of mean

enhancing the utilization of its protein due to a potentially higher amino acid flow to the small intestine (Meissner *et al.,* 1991). The lowest feed intake observed in the sheep supplemented with 100%CPL diets corroborates the reports of Ahamefule *et al.* (2001) in the same breed of sheep fed with varying levels of cassava peel in poultry waste diets.

However, the intakes of diet (79.44 –87.54g/KgW$^{0.75}$) were remarkable and similar to 87 to 108g/KgW$^{0.75}$ reported by Adegbola *et al.* (1988) and Bawala *et al.* (2007), though higher than 59 to 68g/KgW$^{0.75}$ reported by Tual *et al.* (1992) when CPL was fed with adequate amount of nitrogen to WAD sheep.

The crude protein intake (g/day) differed significantly (P < 0.05) across the treatments with the highest (P < 0.05) CP intake observed in sheep fed with 100% CL and 75% CL/25%CPL. The CP intakes seemed to be reflections of the CP contents of the dietary supplements and their corresponding DM intake levels. This corroborates the reports of Mtenga and Shoo (1990) of a positive correlation between crude protein intake and dry matter intake. Moreover, the metabolizable energy intake (MJ/day) was the highest (P < 0.05) in sheep fed with 100% CPL and 75% CL/25%CPL.

The cumulative weight gain (kg) and daily weight gain in sheep supplemented with CL and CPL differed significantly (P < 0.05) across the treatments, with sheep fed all the supplementary diets gained weight. Sheep supplemented with a mixed diet of CL and CPL containing diets 75% CL/25%CPL and 50%CL/50%CPL had higher (P < 0.05) gains, which could be attributed to the amount of protein, minerals, vitamins and energy levels in cassava leaves which had been reported to increase weight gain in sheep (Alli-Balogun *et al.,* 2003; Fasae & Olatunji*,* 2011).

Sheep supplemented with 100% CPL with the lowest (P>0.05) weight gain, which ranked the same with sheep on the control treatment, could be indicative of the deficiency of rumen degradable nitrogen in the CPL that led to poor interaction of ruminal microorganism in the diet. Earlier studies carried out on sheep and goats showed weight loss after consuming only cassava peels (Baah *et al.,* 1999; Fasae *et al.,* 2007).

The average daily weight gain (g/day) values reported in this study (23.21 – 44.64) were comparable to some earlier reports (Anaeto *et al.,* 2013) on the same breed of sheep fed cassava peels supplemented diets while the metabolic weight range of 10.57 to 17.27KgW$^{0.75}$ is higher than 6.14 to 6.70KgW$^{0.75}$ in sheep fed with cassava peels (Tual *et al*., 1992).

Table 3 shows the dry matter and nutrient digestibility coefficient of WAD sheep fed CL and CPL. The diets did not have any significant (P>0.05) effect on the fat and ash digestibility coefficients, while DM, crude protein and fibre fractions digestibility coefficients differed significantly (P<0.05). The dry matter digestibility (DMD) coefficient of CL and CPL in this study is similar to that obtained by Fasae and Olatunji (2011) when sheep were subjected to different cassava leaves processed under different methods, but higher than those obtained by Ukanwoko *et al.* (2009) in WAD bucks fed with cassava peel-cassava leaf meal based diets. This might be as a result of the difference in the feed composition as well as the breed of animals used.

The high CP digestibility observed with higher levels of inclusion of CL could be due to the high protein and essential amino acids in CL (Eruvbetine, 1995), as well as the energy contents of CPL mixture, which were more degradable by the rumen microbes. The high intake resulting in higher digestibility might be connected with the nature of the diet. Higher CP and energy in diets have been considered as important factors that enable high intake of feed.

The low DMD value of sheep supplemented with 100% CPL was probably due to non inclusion with CL which probably reduced acceptability, palatability and digestibility, while on the other hand, the high values of DMD of diets containing CL might therefore be due to the high intake as a result of palatability of the diets. This is in consonance with the findings of Van Soest and Robertson (1985) that increased protein supplementation tends to improve intake by increasing nitrogen supply to the rumen microbes. This has a positive effect by increasing microbial population and also improves the rate of breakdown of digesta. Therefore, high DMD is an evidence of high palatability and acceptability of the diet.

Table 4 presents some haematological parameters of the sheep supplemented with varying levels of cassava leaves and peels. The data showed that white blood cell count (WBC) and total protein (TP) differed significantly ($P < 0.05$) across the treatments but fell within recommended range for healthy sheep. The values obtained for red blood cell counts, the packed cell volume and the haemoglobin concentration in this study were within the normal physiological range for sheep (Jain, 1993)

TABLE 3
Apparent nutrient digestibility (g/Kg DM) of varying levels of cassava leaves and peels in West African dwarf sheep

Parameters	100% CL	100% CPL	75% CL/ 25% CPL	50%CL/ 50% CPL	25%CL/ 75% CPL	SEM
Dry matter	63.83^{a}	51.78^{b}	65.14^{a}	64.30^{a}	61.99^{a}	0.83
Crude protein	63.01^{a}	40.10^{c}	69.30^{a}	64.40^{a}	54.40^{b}	0.91
Ether extract	68.06	58.85	67.41	60.38	66.40	0.75
Ash	65.50	66.05	65.92	66.36	68.12	0.63
Neutral detergent fibre	60.11^{a}	49.17^{b}	61.08^{a}	58.45^{a}	51.03^{b}	0.61
Acid detergent fibre	63.41^{a}	43.64^{c}	60.67^{a}	57.77^{ab}	51.82^{b}	0.57
Acid detergent lignin	57.24^{a}	45.05^{b}	56.49^{a}	55.12^{a}	49.56^{ab}	0.55

^{a,b,c}: Means in the same row with different superscripts are significantly different (P<0.05)
CL - Cassava leaves; CPL - Cassava peels; SEM - Standard error of mean

and comparable to those previously reported (Egbe Nwiyi *et al.,* 2000) for apparently healthy sheep. The WBC values reported in the sheep supplemented with CL indicate high immunity status of the animals to fight against infection (Aikhuomobhogbe & Orheruata, 2006).

The values for TP obtained in the CL supplemented sheep are similar to 59.27 – 74.00g/l (Taiwo & Ogunsanmi, 2002). Deficiency of protein impairs both humoral and cell mediated immunity, thus predisposing an animal to disease (Titgemeyer & Loest, 2001).

Table 5 shows the effects of varying level of cassava leaves and peels supplementation on the faecal egg counts (FEC) of sheep managed semi-intensively. There is an evidence of positive effect of anthelmintic activity of cassava foliage on the basis of observed reductions in animals fed the supplementary diets. This could be attributed to phytochemicals, particularly the complex phenolics which are generally referred as tannins present in cassava leaves. Earlier findings in sheep as well as in grazing cattle and buffaloes respectively show much lower EPG after feeding cassava leaf supplements

TABLE 4
Haematological parameters of semi intensively managed West African Dwarf Sheep supplemented with varying levels of cassava leaves and peels

Parameter	100% CL	100% CPL	75% CL/ 25% CPL	50%CL/ 50% CPL	25%CL/ 75% CPL	0%CL/ 0%CPL	SEM
Packed Cell Volume (%)	35.00	30.00	35.00	33.00	36.00	35.00	0.45
Haemoglobin (g/dl)	11.80	11.20	12.00	10.10	10.10	11.90	0.23
White Blood Cells($x10^{9/l}$)	8.80^b	13.80^a	9.11^b	9.30^b	9.50^b	11.20^a	0.20
Red Blood Cell $X10^{12/l}$	12.01	11.89	10.55	10.70	12.45	12.13	0.21
Total Protein(g/l)	81.20^a	52.20^c	80.40^a	79.10^a	69.20^{bc}	60.00^c	0.56
Blood Urea Nitrogen (mg/dl)	23.40	18.40	19.20	22.20	18.90	20.55	0.31

^{a,b,c} : Means in the same row with different superscripts are significantly different (P<0.05)
CL - Cassava leaves; CP - Cassava peels; SEM - Standard error of mean

TABLE 5
Faecal Egg Count (Egg per gram) of West African Dwarf sheep before and after supplementation with cassava leaves and peels

Treatments	Pre-treatment	Post –treatment	Percentage Reduction
100%CL	1620	310	80.86
100%CPL	1640	1670	-1.7
75%CL	1580	340	78.48
50%CL	1490	410	70.59
25%CL	1530	720	52.94
0%CL/0%CPL	1580	1690	-6.96
Average EPG	1573.33	856.77	-

CL - Cassava leaves; CP - Cassava peels

(Seng Sokenya & Rodriguez, 2001; Netpana *et al.,* 2001).

However, the results of this study further showed that FEC in sheep reduced with an increase with the CP content of the supplementary feed, suggesting the positive effects of high dietary CP in reducing FEC. This corroborates well with earlier reports (Brunsdon, 1964; Osoro *et al.*, 2007) that a high level of dietary protein benefited animals with established parasitic infections resulting in an improvement in their clinical condition, reduction in faecal egg count and increased resistance to re-infection.

CONCLUSION

This study showed that the response of WAD sheep managed semi intensively to supplementation of cassava leaves and peels resulted in significantly higher performance in terms of feed intake, weight gain and nutrient digestibilities. The optimum inclusion levels of cassava leaves and peels at 75CL/25CPL resulted in the best performance characteristics and this can be adopted in sheep production for improving the nutritional status, growth rate and reducing faecal egg count for maximum performance.

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