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DRY MATTER, FIBRE CONSUMPTION AND BODY WEIGHT GAIN OF WEST AFRICAN DWARF SHEEP FED SUN-DRIED OR FERMENTED RUMEN DIGESTA-POULTRY DROPPINGS MIXED DIETS

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Abstract
Fifty-six day experiment was conducted to estimate the dry matter, fibre fraction utilization and performance of West African Dwarf (WAD) sheep fed sun-dried or fermented rumen digesta-poultry droppings mixed diets. Allocation of animals with mean liveweight of 7.04 ± 3.50 kgW$^{0.75}$ and between 9 - 12 months old was into four treatments of four animals each. Four diets were formulated such that sun-dried rumen digesta (SRD) was not incorporated in control diet (A) but included in diet B, while sun-dried rumen digesta-poultry droppings (SRDPD) and fermented rumen digesta-poultry droppings (FRDPD) were included in diets C and D, all at 25% inclusion rate to replace cassava peels respectively. Feed and water were offered to animals ad libitum at 8.00am every morning. Findings indicated that DM, CP, CF, ADF and cellulose intake was influenced significantly ($P<0.05$) by inclusion of rumen digesta and poultry droppings mixed meals in the diets and improved intake and utilization of fibre fractions perhaps due to improved protein quality of diets B.C and D. Nutrients digestibility coefficients varied significantly ($P<0.05$), but the values recorded for CF ranged from 30.78% (diet A) to 43.96% (diet C). Average daily body weight gain values did not differ among treatments ($P>0.05$) however, nitrogen retention values were positive for all treatments indicated that dietary fibre contents were well utilized by rumen microbes and there was enough microbial protein that met the animals' requirement for body growth and maintenance. Result of feed conversion to flesh favoured the animals fed control diet, but any of the experimental diets could be fed to support the growth rate of the animals since inclusion of rumen digesta and poultry droppings mixed meal at 25% to replace cassava peels was acceptable and tolerable to the animals and there was no sign of ill health shown by the animals. Therefore processed rumen digesta and poultry droppings for ruminant feeding will be a purposeful outlet for the wastes and will reduce environmental pollution.

Key words: Fibre intake, rumen digesta, poultry droppings, weight gain, nitrogen retention.

Introduction

Scavenging nature of livestock cannot be relied on to provide adequate nutrients for optimum livestock production. Thus adequate supply of feeds (both in quality and quantity) is very necessary for optimum livestock performance (Maigandi and Owanikin, 2002).

Unfortunately, there are problems of feed scarcity or inadequate supply during the dry season in the northern part of Nigeria where the largest population of cattle, sheep, and goat are found and soaring cost of feed ingredients which are either imported or are keenly competed for in terms of consumption by humans (Adegbola *et al.*,1988). These result in slow rate of expansion of small ruminant production and performance of these animals in view of the non-availability and high cost of feed ingredients. Efforts to alleviate the constraints should be directed primarily towards harnessing locally available, cheap and nutritionally adequate non-conventional feed ingredients such as animal wastes and agro-industrial by products.

Animal waste such as poultry litter, poultry droppings and fore-stomach digesta have been found valuable and efficiently used for production functions of small ruminants (Maigandi and Owanikin, 2002; Fajemisin, 2002). Poultry droppings, urea activate sludge and urea have been used as replacements or supplements for groundnut cake (GNC) in sheep, goats, and cattle diet (Murthy *et al.*, 1995; Uza *et al.*, 2002 and Bayemi, *et al.*, 2004).

Rumen digesta or fore stomach digesta, an abattoir product can be obtained free from most abattoir in the country (Okorie, 2005). Rumen digesta not only serves as feed nutrients, recycling it will also reduce disposal and environmental pollution problem (Esonu, *et al.,* 2006 and Rojugbokan, *et al*.,2007). The trial herein reported was designed to evaluate the nutritional value, fibre consumption and weight gain of West African Dwarf (WAD) sheep fed rumen digesta-poultry droppings mixed meal.

Materials and Methods

Experimental site

The experiment was conducted at the small ruminant unit of Teaching and Research Farm of the Federal University of Technology Akure, Ondo State, Nigeria. Akure is a city in the rainforest zone of Nigeria, located on latitude 07^{o} 17N, longitude 05^{o} 18E with elevation of 350m above sea level. The mean annual rainfall is about 1200mm and mean annual temperature is about 25^{o}C (min. 19^{o}C and max. 34^{o}C).

Materials collection and processing

A silage pit of 2.4m x 1.2m x 1.2m was constructed at the experimental site for the fermentation procedure. Cassava waste was collected fresh from a gari processing plant in Akure, Ondo State, sun-dried for eight (8) days on a concrete slab, milled, packed into jute bags and stacked on a raised wooden planks in the farm house' store until required for feed preparation.

The poultry droppings were collected at the poultry unit of the Teaching and Research Farm of the Federal University of Technology within two days of being voided by the egg laying hens. The poultry droppings were sundried for three days by spreading to a thickness of about 3cm on polythene sheets on a concrete slab to eliminate the odour being generated by the droppings. When the manure was dry and gritty to touch, it was packed into jute bags and kept in the store until required for use.

Rumen digesta is an undigested rumen content still undergoing fermentation in the rumen of ruminant animal. This material was collected fresh, from slaughtered cattle at the Erekesan market's abattoir in Akure, immediately it is being disposed off by the butchers, thinly spread on polythene sheets and sun-dried until it was felt dry and gritty to touch. Thereafter, it was packed into jute bags and kept in the store on raised wooden planks until required for feed preparation.

Fermentation of rumen digesta-poultry droppings mixture

Rumen digesta and poultry droppings were mixed together in ratio 1:1 (w/w) and fermented in the constructed earth surface silage pit for fourteen days under a conducive anaerobic fermentative condition. The fermented product was further sun-dried for five days by spreading thinly (3cm thickness) on polythene sheets on a concrete slab, thereafter packed into jute bags and kept in the store until required for use.

Preparation of experimental diets

Four experimental diets were formulated such that rumen digesta which had a crude protein value of 13.87% was not included in control diet (A) but incorporated in diet (B) at 25%, while rumen digesta-poultry droppings mixed meal, sun-dried and or fermented was included in diets C, and D, all at 25% inclusion rate respectively (Table 1) at the expense of cassava peel.

Experimental layout

Sixteen (16) West African Dwarf (WAD) sheep (males) with average liveweight of 7.04 $\pm$ 3.50kgW$^{0.75}$ and 9 -12 months old were selected from the sheep flock of Teaching and Research Farm and treated against external and internal parasites with diasuntol® solution and bendamizole® bolus respectively.

The animals were randomly distributed into four treatment groups (four animals per group) using the completely randomized experimental design. The experiment lasted for fifty-six days during which the animals were allowed to adapt to both their individual pens and feed for a period of fourteen days before the commencement of data collection. During the experimental period, diets and fresh clean water were offered *ad libitum* at 8.00hr every morning. Feed left unconsumed was weighed and discarded.

Voluntary feed intake was estimated as the difference between daily feed offered and orts. The animals were weighed weekly to determine changes in liveweight. The last 14 days of the experimental period was used for digestibility trial during which the animals were kept in the individual metabolism cages. The first seven days of digestibility trial was allowed for adjustment to the environment followed by seven days of total faecal and urine collection.

Laboratory analysis

Samples of rumen digesta, mixed meals of rumen digesta and poultry droppings (sundried and fermented), experimental diets, faeces and urine were analyzed for nutrients according to AOAC (1990). Neutral detergent fibre (NDF), Acid detergent fibre (ADF) and Acid detergent lignin (ADL) were determined using the analytical procedure of Van Soest *et al.* (1991).

Statistical analysis

The data collected were subjected to one-way analysis of variance (SAS, 1999). Where significance differences were found, the means were compared using Duncan's New Multiple Range F-test (1955).

Results and Discussion

Table 2 presents the proximate composition of the rumen digesta- poultry droppings (RDPD) mixed diets. The dry matter (DM) values ranged between 95.82 (diet B) and 96.80% (diet A), perhaps due to the high fibre fraction contents of the diets. The crude protein (CP) values of the experimental diets ranged from 14.78% to 18.96%, but diet A had highest values. The crude protein contents of the diets were above the critical value of 7.00% CP suggested for ruminants' maintenance (McDonald, *et al.*,1998). The observed CP values were similar to the values reported by Akangbe and Adeleye (2002) when poultry droppings were supplemented in the WAD sheep diets. The crude fibre content of diets A, C, and D was low compared to the value reported for animals fed diet B (13.90 %). However, the ADF and NDF observed values were moderate and varied from 54.60 (diet B) to 58.40% (diet A), and between 80.00 (diet B) and 83.00% (diets A and D) in respect of ADF and NDF respectively. It implied that the fibre fractions of the diet would enhance rumination in the fore-stomach of small ruminants. The observed values in this study compared favourably with values obtained by Bayemi *et al*, (2004) when cotton seed cake was replaced with poultry droppings in cattle's diets at Bambui, Cameroom. It was also observed in this study that hemicellulose values were low, this trend is corroborated by the findings of Akangbe and Adeleye (2002).

The dry matter and fibre fractions consumption values were shown in Table 3. The dry matter intake (DMI) values varied significantly ($p<0.05$) and ranged from 78.98 (Diet A) to 85.09g/kg$W^{0.75}$ (Diet D).

The DMI observed values expressed as percentage of the animal's body weight (3.5%) agreed with the recommended value of ARC (1980), an evidence that the diets were palatable and acceptable to the animals perhaps due to the protein quality of the diets. However, animals fed the diet that contained fermented rumen digesta-poultry droppings diet (FRDPD) had the highest DMI value compared to values recorded for other animals.

Table1. Percentage composition of experimental diets

Ingredients	Diets (%)				
	A	B	C	D	SEM
Cassava peels	56.24	30.56	30.96	31.24	
Groudnut cake	10.16	10.16	10.16	10.16	
Palm kernel cake	12.00	12.00	12.00	12.00	
Wheat offal	18.00	18.64	18.24	17.96	
SRD	-	25.00	-	-	
SRDPD	-	-	25.00	-	
FRDPD	-	-	-	25.00	
Bone meal	3.00	3.00	3.00	3.00	
Salt	0.32	0.32	0.32	0.32	
Premix	0.32	0.32	0.32	0.32	
Total	100	100	100	100	
Calculated nutrients					
CP (%)	12.40^{b}	14.80^{a}	14.76^{a}	15.59^{a}	0.40
CF (%)	12.80^{b}	15.39^{a}	14.27^{ab}	14.44^{ab}	0.35
Gross energy (KJ/100gDM)	15.45	15.69	15.54	15.53	0.23

SRD=Sun-dried rumen digesta, SRDPD= Sun-dried rumen digesta-poultry droppings
FRDPD = Fermented rumen digesta-poultry droppings

Table 2. Proximate composition (%) of the diets fed to WAD sheep

Parameters	Diets(%)						
	A	B	C	D	Mean	SD	CV (%)
Dry matter	96.80	95.82	95.84	96.08	96.14	±0.86	0.89
Crude protein	18.96	17.93	14.78	16.56	17.06	±1.79	10.49
Crude fibre	9.89	13.90	9.93	9.02	10.69	±2.07	19.36
Ether Extract	4.56	4.63	2.53	1.92	3.41	±1.29	36.44
Ash	54.09	49.47	53.93	61.78	54.80	±6.69	12.20
Nitrogen Free Extract	10.50	12.07	16.83	10.73	12.53	±2.73	21.79
NeutralDetergent Fibre	83.00	80.00	82.00	83.00	82.00	±4.86	5.93
Acid Detergent Fibre	58.40	54.60	56.80	57.90	56.93	±2.30	4.04
Hemicellulose	24.60	25.40	25.20	25.10	25.08	±1.07	4.27
Cellulose	32.61	28.03	30.46	31.64	30.69	±2.11	6.88

SD= Standard Deviation CV(%)= Coefficient of variation

Table 3. Nutrients intake (g/kgW$^{0.75}$) of WAD Sheep fed sundried and fermented rumen digesta- poultry droppings mixed diets

Parameters(g/kgW$^{0.75}$)	Diets				
	A	B	C	D	SEM
Dry Matter	78.98^{c}	80.30^{b}	81.04^{ab}	85.09^{a}	0.61
Crude Protein	15.91^{a}	17.40^{a}	13.66^{bc}	14.09^{b}	0.32
Crude Fibre	7.51^{c}	11.16^{a}	8.06^{b}	7.67^{bc}	0.59
Neutral Detergent Fibre	63.06	63.24	66.45	70.62	1.63
Acid Detergent Fibre	44.37^{bc}	43.84^{c}	46.03^{b}	49.27^{a}	0.53
Hemicellulose	18.69	20.39	20.42	21.36	0.77
Cellulose	24.78^{b}	22.51^{c}	24.68^{b}	26.92^{a}	0.84

abc= Mean within the same row with different superscripts are significantly (p<0.05) different. n=4 per treatment

The CF, ADF and cellulose intake values were influenced significantly (P<0.05) by treatments effect however, the animals fed the diet that contained FRDPD consumed more of NDF, ADF, hemicellulose and cellulose than other animals probably due to the non-protein nitrogen content of the diet that might enhanced fermentation by rumen micro-organism which in turn improved feed intake. The dietary treatment effect on NDF, and hemicellulose intake was not significant (P>0.05), but the observed intake values were improved by the inclusion of SRD, SRDPD and FRDPD meals in the diets. The report of Murthy *et al*, (1995) supports the improved intake values observed in this study.

The mean apparent dry matter and dietary fibre digestibility of the experimental diets is shown in Table 4. The results showed that the mean DM, CP, CF, ADF, NDF, cellulose and hemicellulose digestibility values for diets A, B, C and D were influenced (P<0.05) by the inclusion of SRD, SRDPD and FRDPD meals in the diets. However, the digestion coefficient value of DM ranged from 23.97% (diet B) to 36.32% (diet D) and improved with inclusion of SRD and RDPD meals. This observation might be due to presence of poultry droppings and rumen digesta in the diets which probably served as sources of dietary protein and energy which might have enhanced fermentative processes by the rumen micro organism (Fajemisin *et al.,* 2008).

The crude fibre (CF) digestibility values improved with inclusion of SRD and RDPD meals in the diets B and C, but the least digestibility value recorded for animals fed diet that contained FRDPD might be due to high content of ash in the diet. This observation opposes the report of Uza *et al.* (2002) when the diet of Bunaji cattle was supplemented with dried poultry manure. The digestion coefficient values of ADF and NDF were influenced significantly (P<0.05) by treatments effect, but diets B and C were poorly digested compared to digestibility values of diets A and D. The poor digestibility values reported for animals fed diets B and C could be due to high CF and NDF contents of the diets. This observation agreed with the findings of Belewu and

Table 4. Dry matter and fibre fractions digestibility of WAD Sheep fed sun-dried and fermented rumen digesta-poultry droppings mixed diets

Parameters	Diets (%)				
	A	B	C	D	SEM
Dry Matter	30.51[c]	23.97[d]	32.88[b]	36.32[a]	1.39
Crude Protein	36.84[b]	43.14[a]	26.03[c]	28.27[c]	2.11
Crude Fibre	30.78[c]	41.27[b]	43.96[a]	21.03[d]	2.75
Neutral Detergent Fibre	48.40[a]	41.22[b]	36.25[c]	42.03[b]	0.84
Acid Detergent Fibre	41.99[a]	39.22[b]	34.40[c]	42.88[a]	1.05
Hemicellulose	58.34[a]	45.46[c]	49.29[b]	56.79[a]	0.87
Cellulose	36.33[b]	32.61[c]	33.12[bc]	50.83[a]	0.92

Table 5. Performance characteristics of WAD Sheep fed sundried and fermented rumen digesta-poultry droppings mixed diets

Parametrs	Diets				
	A	B	C	D	SEM
Dry matter intake (g/kgW$^{0.75}$)	78.98[c]	80.30[b]	81.04[ab]	85.09[a]	0.61
Crude protein intake (g/kgW$^{0.75}$)	15.91[a]	17.40[a]	13.66[bc]	14.09[b]	0.32
Crude fibre intake (g/kgW$^{0.75}$)	7.51[c]	11.61[a]	8.06[b]	7.67[bc]	0.59
Nitrogen retenton (g/kgW$^{0.75}$)	1.03	1.02	1.04	1.07	0.01
Initial LW (kgw$^{0.75}$)	7.04	7.04	7.04	7.04	0.01
Final LW (kgw$^{0.75}$)	8.84	8.81	8.85	8.92	2.01
Weight gain (g/kgw$^{0.75}$)Feed/ gain ratio	32.142.46	31.612.54	32.322.51	33.572.53	0.021.03

abc= Mean within the same row with different superscripts are significantly ($p<0.05$) different. n=4 per treatment

Afolabi (2000) and Belewu (2001) when chemically and biologically treated crop residues were fed to WAD sheep and goats in separate experiments.

The hemicellulose and cellulose digestibility values recorded for all animals fed the experimental diets varied significantly ($P<0.05$) but the values improved with inclusion of SRD, SRDPD and FRDPD in diets B, C and D. The observed values might be due to solubility of the two dietary carbohydrates and inclusion of rumen digesta and poultry droppings as good sources of micronutrients and non-protein-nitrogen provided factors that enhanced microbial activity that eventually improved the digestibility of diets B, C and D respectively.

The results of weight gain (WG), nitrogen retention and feed/gain ratio of sheep fed experimental diets are presented in Table 5. The treatment effect on average daily weight gain was not significant ($P>0.05$), but the weight gained values ranged between 31.61 g/kgW$^{0.75}$and 33.57g/Wkg$^{0.75}$, the animals fed control diet converted their feed to flesh better than other animals. The four experimental diets are good and supported the growth rate of the experimental animals since weight gain and feed conversion ratio were not influenced by treatments effect. However, this observation opposed the reports of Akangbe and Adeleye (2002) when nutritive values of poultry droppings and groundnut cake were compared in the diets of sheep.

Nitrogen retained is the proportion of N utilized by animal from total N intake for body processes. In this study the nitrogen retention values were positive and not influenced by treatments ($P>0.75$) effect, an indication that the diets furnished enough nitrogen required by the animals for body growth and maintenance (Ibeawuchi *et al.*,1993 and Akangbe and Adeleye, 2002).

The feed/gain ratio values were similar ($P>0.05$) and ranged between 2.46 (diet A) and 2.54 (diet B), but the feed utilization by animals fed diet A for flesh was marginally better than the animals fed diets B, C and D. This observation agreed with the findings of Murthy *et al*, (1995), when cage layer droppings and poultry litter were fed as supplement to lambs and kids.

Conclusion

The results showed improvement in intake and digestion of DM, CP, CF, and cellulose as well as nitrogen retention and feed conversion ratio. Animals fed control diet converted their diet to flesh better than other animals. However, all diets furnished enough nitrogen required by the animals for body growth and maintenance. The inclusion of SRD, SRDPD and FRDPD at 25% to replace cassava peels was acceptable and tolerable to the animals without any sign of ill health. Therefore the processed rumen digesta and poultry droppings in sheep'sdiets would be a valuable source of alternative feedstuffs, disposal route and reduce hazardous effects of the wastes on the environment.

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