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Feed Intake and Growth Rate of West African Dwarf Goats Fed Different Proportions of Rumen Waste, Poultry Waste and Cassava Peel Waste

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ABSTRACT

Purpose: Rumen waste, poultry waste and cassava peel waste are sources of environmental pollution but could serve as feed resources for ruminant animals. This study was undertaken to ascertain the nutritive value of composite diets with varied proportions of these waste in West African dwarf goats.

Methodology: Four experimental diets were formulated in which diet 1 was a standard (control) diet. Diets 2, 3 and 4 contained the wastes in varied proportions of 5, 15, and 25%. The goats where offered a basal diet of concentrate containing Brewer's dried grain (BDG), vitamin/mineral salts mixtures and Panicum maximum. A feeding trial was conducted using sixteen (16) West African dwarf (WAD) goats in a completely randomized design (CRD). Feed intake and weight changes were determined. Chemical composition of the experimental diets was analyzed.

Findings: Results of chemical composition of the diets showed absence of significant ($P > 0.05$) variation in nutritional composition except diet 3, which had greater ($P < 0.05$) value of Crude Protein (21.00 %) and NDF (61.00 %). Also, diets 2 and 3 had the least ($P < 0.05$) metabolizable energy of 3.91 and 5.65 MJ/Kg DM respectively. Results of feeding trial showed significantly ($P < 0.05$) low nutrient intakesfor composite diets 2, 3 and 4 compared to the control (diet 1). Growth performance result showed that goats on diet 1 and 4 significantly ($P < 0.05$) gained weight (1.07kg and 0.97kg respectively), while goats on diet 2 and 3 significantly ($P < 0.05$) lost weight (-1.63kg and -0.56kg respectively). Feed conversion efficiency followed a similar trend. Results shows that the goats on diet 1(control) and diet 4 (25% RW, 5% PW and 15% CP) were better utilized by the WAD goats during the feeding trial.

Unique Contribution to Theory, Policy and Practice: This difference can be attributed to poor palatability and acceptability of diets 2 and 3 as well as nutrient imbalance as required for proper rumen function. Therefore, an appropriate combination of these non-conventional feed materials or wastes, as indicated by diet 4, can be fed successfully to small ruminant animals.

Keywords: *Non-conventional Feed, Nutrient Intake, Weight Gain*

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INTRODUCTION

Food and wastes, like Siamese twins, are closely interconnected. There is an irreversible trend involving food production, wastes production and disposal, occurring in an ever-accelerating cycle, which ultimately results in waste disposal difficulties in cities and in peripheral rural areas. There is an increased demand for food in urban cities due to increasing population in the world which has led to production of huge quantity of agricultural wastes, both at farm, municipality and city levels (Sabiiti, 2011). Thus, municipalities are becoming increasingly burdened with garbage disposal; as a result, there are serious environmental pollutions. Also, some rural areas are increasingly having waste disposal problems.

Common agricultural wastes being considered in this study are poultry waste, cassava waste and rumen waste. Poultry waste (PW) has proven to be a good source of non-protein nitrogen for ruminants (Preston and Lengs, 1988). It has been fed adequately in the diets of West African Dwarf (WAD) goats without any depression in growth rate and efficiency of feed utilization (Ukanwokwo and Ibeawuchi, 2009).

Cassava wastes (CW) have been proved to be useful as a feed resource for raising goats, sheep and cows (Devendra, 1985). Cassava peels is rich in metabolizable energy and very well degraded in the rumen (Ndubueze *et al*., 2006). Cassava waste has been a household waste-product traditionally offered to sheep and goats in southern Nigeria (Adegbola *et al*., 1990). Except for research purposes, its use in practical cattle and sheep and goat production in Nigeria is still not common place (Belewu and Adeneye, 1996).

Rumen content or waste (RW) is an abattoir waste obtained from rumen of slaughtered ruminants (Adeniji, 2008). It contains a mixed population of microbes and undigested feed. It contains a considerable amount of crude protein and fibre. Rumen contents have been fed successfully to monogastrics (Adeniji, 2001). It has been utilized in the diet of rabbits to replace groundnut cake up to 10% dietary levels without any deleterious effect (Dairo *et al*., 2005).

Inweh *et al.* (2010) fed rumen content to goats up to 40% dietary level as a replacement for palm kernel cake (PKC) without any adverse effect on the goat's performance. However, there is a dearth of information on the nutritive value of rumen contents/waste, poultry waste and cassava peels waste mixtures, as well as the effect of this composite diet on growth rate of West African dwarf goats.

MATERIALS AND METHOD

The experiment was carried out at the Small Ruminant Unit of the University of Benin Farm Project, Benin City, Edo State, Nigeria. Rumen contents/waste were collected from slaughter houses (abattoirs) at Ewa Road in Benin City and transported in sacs to University of Benin farm project site. They were sun-dried on concrete slabs for 4-5 days to 10% moisture content. Poultry waste was collected from a deep litter poultry house at Ojemai farms, Ugbiohokho, Benin city.

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Sundried on concrete slabs until it was gritty to touch. Cassava peels waste were collected fresh from a "garri" processing plant, sun-dried for 6-8 days to produce a dry matter content of 85-87%. After proper sun drying, the rumen waste, poultry waste and cassava peels were milled separately in a hammer mill and bagged before usage in the formulation of experimental diets. Four (4) feed types were formulated with these mixtures of dried rumen contents, poultry waste and cassava peels at 0%, 5%, 15% and 25% inclusion levels respectively. While *Panicum maximum* served as a basal diet

The experimental diets shown on table 1 were used for feed intake and growth experiment. Sixteen West African dwarf goats of an average weight of 8.13kg, between 6 and 11 months old were used for this experiment. The goats were quarantined, treated for internal and external parasites and randomly allotted to the treatments in a Completely Randomized Design (CRD). Animals were fed twice daily based on 3 - 4% of their body weight at 0800 hours and 1600 hours for a period of 84 days which was preceded by two weeks adaptation period. Clean water was offered at *ad libitum.* Feed intakes were recorded daily in the morning prior to feeding while weight changes were recorded forth nightly. Samples of feeds were weighed and oven dried at 65^0C for a period of 24 hours to a constant weight for determination of dry matter. Ash was determined by igniting the samples in a muffle furnace at 525°C for 5 hr. Organic matter was determined by subtracting the ash values from 100%. Crude protein content was determined by the Kjeldhal method (AOAC, 2000). Neutral detergent fibre (NDF) and Acid detergent fibre (ADF) were analyzed as described by Van Soest *et al.* (1991).

Data obtained were analysed using statistical analytical system software (SAS, 2008). Variations among the treatment means that are significant was computed using Duncan Multiple Range Test (1955) of the same SAS (2008) software.

RESULTS AND DISCUSSION

The result in Table 2 showed that Crude protein (CP) of 12.25 % for RW obtained in this study was higher than 10.60 % reported by Inweh *et al.* (2010), lower than 14.40 % reported by El-Yassin *et al*. (1991), but agrees with 12.85 % reported by Olukayode *et al* (2008). Nevertheless it falls within the range of 9 – 20 % estimated by Dairo *et al.* (2005). Differences observed in CP content could be attributed to type of feed eaten by cattle before slaughtering (Basher *et al.*, 2002). Also, the time interval between feeding and slaughtering will influence the nutrient content of rumen waste collected (Adeniji and Balogun, 2001).

The proximate value obtained for poultry waste is lower than values reported by Ukanwoko and Ibeauwuchi (2009) and Yousuf *et al.* (2013). The former reported a dry matter (DM) value of 93.00 %, CP of 26.60 % and 27.00 % Ash. Yousuf *et al*. (2013) reported DM content of 90.25 % and CP of 26.17 %. Also, Bakshi and Fontenot (1996) reported a CP of 24.5 % which is higher than 21.88 % reported by Bello and Tsado (2013), 15.40 % reported by Lanyasunya *et al.* (2006)

and 20.3 % reported by Onimisi and Omage (2006) and Owen *et al* (2008) respectively. The Variation in CP values of the poultry waste may be attributed to type of bird reared, the age of the waste and level of feeding the birds.

The CP of Cassava Peel of 5.52% observed in this study is higher than 4.20 % reported by Adegbola *et al.* (1990) and 3.20 % reported by Ukanwoko and Ibeawuchi (2009), but agrees with 5.25 % reported by Okoruwa *et al*. (2012). The Neutral Detergent fibre and Acid Detergent fibre values of 57 % and 36 % for cassava peels in this study agrees with those of Fasae *et al.* (2015) who reported 56 % NDF and 35 % ADF. Which is higher than 34.90 % and 24.60 % reported by Bawala *et al.* (2007) and lower than 68.48 % and 47.4 1 % NDF and ADF respectively, reported by Okoruwa *et al*. (2012). NDF and ADF fraction of cassava peel expectedly varied for various researches since the peels carry different proportion of cassava tissue. Also, NDF and ADF values (of 74 % and 50 %) reported in this study for rumen waste are higher than 62.81 % and 30.83 % reported by Inweh *et al*. (2010). Olukayode *et al.* (2008) reported an NDF of 80.60 % which is higher than that reported in this study and ADF of 42.80 % which is lower.

Ash content of rumen waste observed in this study of 11.22% is higher than 7.42% reported by Inweh *et al.* (2010) and 8.36% reported by Olukayode *et al*. (2008). Ash content of cassava peel of 7.38 % is higher than 5.23 % reported by Fasae *et al.* (2015) and lower than 11.77 % reported by Kalio *et al.* (2014). Also, the ash content of poultry waste of 15.36 % is lower than 17.66 % reported by Asrat *et al.* (2008), and higher than 7.81 % reported for cooked poultry waste by El-Sabban *et al.* (1970).

The intake values on table 3 showed that dry matter intake (DMI g/day) DM1 of diet 1 (control diet) of 320.7g was significantly ($P<0.05$) higher than the DM1 of 148.55g, 120.77g and 154.97g for diets 2, 3 and 4 respectively. A similar trend was observed for organic matter intake, crude protein intake, neutral detergent fibre and acid detergent fibre intake.

Mean Dry Matter intakes (DM1) of an average of 186.25g/day observed during feeding trials were quite lower than that reported by Bawala *et al*. (2003). It constituted an average of 2.3 % of the animal's body weights, which falls within the recommended value range of 1.9 — 5% for ruminants (NRC, 1981; Devendra and Mcleroy, 1982).

In this study, DM1 (g/day) decreased with increasing dietary levels of poultry waste in the composite diet. Goats fed diet 3 containing 25 % dry poultry waste, 5 % cassava peel & 15% rumen waste, recorded the lowest DM1 of 120.77g. Although, there was no statistical difference between the DM1 (g/day) for all the diets, except diet 1 (control diet); however, a decrease in DM1 values despite an increasing level of crude protein (CP) in the diets was observed. This is contrary to findings by Bawala *et al*. (2003) and Ukanwako and Ibeawuchi (2009).

But the decrease in DMI in diet 3 agrees with findings by Yousuf *et al*. (2013), who reported a decrease in dry matter intake at 22% inclusion level of poultry waste. But Asrat *et al.* (2008) reported an increase in total feed intake of goats fed poultry waste up to 28% inclusion level. But, feed intake begins to decline at 45% inclusion level. Nadeem *et al*. (1993) reported a reduction in total DM1 at 30% inclusion level of broiler litter in the diet of Barbari goats. Furthermore, Tinnimit *et al*. (1972) reported that goats even refused to consume ration containing more than 30% poultry litter.

Feeding high level of dry poultry waste at low dietary energy level may cause low palatability and a low feed intake. Energy contents of diets have been shown to decrease with increasing level of dry poultry waste (Ukanwoko and Ibeawuchi, 2009). But this trend was not entirely the case in this study as the energy level of diet 2 (3.91MJ/Kg DM) is lower than that of diet 3 (5.65MJ/Kg DM). The decrease in dry matter intake in diet 3 despite an increase in energy level can be attributed to a lower amount of readily fermentable energy necessary for rumen microbes for effective fermentation. Studies by Tan *et al* (2002) showed that rumen microbes need a specific amount of non-structural carbohydrates for proper functioning.

The increased DMI in diet 4 could be attributed to the effect of increased rumen waste and cassava peels (i.e. 25% & 15% respectively), which increases the substrates available to cellulolytic microbes with a consequent increase in the population of these micro-organisms and are liable to increase food intake. There is evidence that a source of readily degradable fibre can result in increased intakes of poor quality roughage diets (Ndlovu and Buchanan-Smith, 1987).

The weight changes of WAD goats fed the experimental diets are presented in Table 5.

Goats on diet 1 (control diet) and diet 4 (25 % Rumen waste, 5 %Poultry Waste and 15 % Cassava Peel) gained weight, but those on diets 2 and 3 lost weight. There was however no significant ($P<0.05$) variations between values (of 1.07kg and 0.97kg) for live weight gained on diets 1 and 4.

Feed Conversion Efficiency (FCE) for diets 1(0.07) and 4 (0.14) showed no significant ($P<0.05$) variation, but were significantly ($P>0.05$) higher than FCE for diets 2 (-0.28) and 3 (-0.16).

Average daily feed intake of 225.77g for diet 1 was significantly ($P<0.05$) higher than those of diets 2, 3 and 4.

CONCLUSION

Results of this study showed that feed intake of diets by the goats reduced as the level of inclusion of poultry waste in the diets increased. This can be attributed to reduced palatability and/or accepttability of diets as poultry waste increases. The level of poultry waste inclusion in diets should therefore be moderated, such as 5 % in diet 4 of this research.

Furthermore, cassava peel is a good source of highly degradable or fermentable energy that facilitates microbial digestion, but it metabolizable energy supply is too low for efficient growth of goats and therefore the need to provide other energy supplement where it serves as a sole energy source.

An appropriate proportion of rumen waste, poultry waste and cassava peel wastes as in diet 4 (25% Rumen waste, 5% Poultry waste and 15% Cassava peels) which will ensure efficient usage of these wastes as composite diets can be used as feed for goat, especially in developing nations of the world where there is shortage of conventional feed stuffs.

However, further supplementation can be done to enhance the palatability and by consequence the acceptability of these wastes as composite diets.

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Table 1: Composition of experimental diets (g/kg)

Ingredients	DIET1	DIET 2	DIET 3	DIET 4
Cattle rumen waste	-	5.00	15.00	25.00
Poultry waste	-	15.00	25.00	5.00
Cassava peels	-	25.00	5.00	15.00
Palm kernel meal	23.00	-	-	-
Wheat Offals	18.00	-	-	-
Maize	4.00	-	-	-
Brewer Dried Grains	51.00	51.00	51.00	51.00
Bone meal	1.00	1.00	1.00	1.00
Limestone	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Vit./Min Premix	1.50	1.50	1.50	1.50
Total	100.00	100.00	100.00	100.00

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Table 2: Chemical composition (%) of ingredients

Variables	Rumen waste	Poultry waste	Cassava peel	*Panicum maximum*	SEM
DM(%)	86.02ab	82.91b	78.00b	93.21a	7.53
OM(%)	88.78a	84.64a	82.62a	89.89a	7.27
CP(%)	12.25a	23.92b	5.52c	9.04d	2.67
NDF(%)	74.00a	63.00b	57.00b	41.00c	5.97
ADF(%)	50.00a	26.00b	36.00c	25.00b	3.65
Hemicellulose(%)	24.00a	37.00b	21.00ac	16.00c	4.31
ASH(%)	11.22a	7.38b	15.36c	11.11a	1.05

DM - Dry matter; OM-Organic matter; CP- Crude protein; NDF - Neutral detergent Fibre; ADF - Acid detergent fibre.

abc, – means along the rows with the same letters are not significantly different.

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Table 3: Chemical composition (%) of experimental diets

Variables	[1]DIET 1	[2]DIET 2	[3]DIET 3	[4]DIET 4SEM
DM (%)	88.08a	81.71a	84.33a	79.92a8.94
OM (%)	70.41a	62.73b	67.04ab	67.06ab6.05
CP (%)	14.53a	14.00a	21.00b	16.98b 5.12
NDF (%)	51.00a	52.00a	61.00b	51.00a 3.38
ADF (%)	27.00a	40.00b	39.00b	33.00ab 10.12
Hemicellulose (%)	24.00a	12.00b	22.00a	18.00c2.98
ASH (%)	29.05	31.27	32.96	32.943.06
*ME(MJ/kg DM)	7.05a	3.91b	5.65c	5.99c 1.27

*ME (MJ/Kg DM) = 13.5 — 0.15 X ADF% ÷ 0.14 + CP% — 0.15× ASH% (MAFF, 1984)

DM - Dry matter, OM -Organic matter, CP - Crude protein

NDF - Neutral detergent fibre, ADF - Acid detergent fibre, ME – Metabolizable energy

SEM – Standard error of mean;

abc, – means along the rows with the same letters are not significantly different

[1]Diet 1(control) - 0% composite diet (waste).

[2]Diet 2- 5% Cattle Rumen Content, 15% Poultry Droppings, 25% Cassava Peels.

[3]Diet 3 - 15% Cattle Rumen Content, 25% Poultry Droppings, and 5% Cassava peels.

[4] Diet 4 - 25% Cattle Rumen Content, 5% Poultry Droppings, and 15% Cassava Peels.

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Table 4: Feed intake (g/day and g/kgw$^{0.75}$day respectively) of the West African Dwarf goats fed experimental diets

Variables	[1]DIET 1	[2]DIET 2	[3]DIET 3	[4]DIET 4	SEM
Intake g/day					
DMI(g/day)	320.7a	148.55b	120.77b	154.97b	22.02
OMI (g/day)	256.37a	114.04b	96.00b	130.03b	17.73
CPI (g/day)	52.90a	25.45c	30.08b	32.93b	3.62
NDFI(g/day)	185.69a	94.53b	87.36b	98.89b	13.37
ADFI (g/day)	98.13a	72.72b	55.85c	63.98c	8.02
ASH intake (g/day)	107.74a	67.76b	47.20c	63.87b	8.43
Intake (g/d//kgw$^{0.75}$)					
DMI (g/d//kgw$^{0.75}$)	60.71a	36.59b	28.75b	32.46b	8.70
OMI (g/d//kgw$^{0.75}$)	48.53a	28.10b	22.87b	27.24ab	6.95
CPI (g/d//kgw$^{0.75}$)	10.07a	6.18b	7.16b	6.90b	1.45
NDFI (g/d//kgw$^{0.75}$)	35.15a	23.29a	20.80a	20.71a	5.20
ADFI (g/d//kgw$^{0.75}$)	18.16a	17.92a	13.30b	13.23b	3.02
ASH intake (g/d//kgw$^{0.75}$)	20.40a	16.69b	11.24c	13.38c	3.13

DMI – Dry matter intake;OMI – Organic matterintake; NDFI– Neutral detergent fibreintake; ADFI – Acid detergent fibreintake; CPI - Crude protein intake; SEM - Standard error of mean.

abc, – means along the rows with the same letters are not significantly different

[1]Diet 1(control) - 0% composite diet (waste).

[2]Diet 2- 5% Cattle Rumen Content, 15% Poultry Droppings, 25% Cassava Peels.

[3]Diet 3 - 15% Cattle Rumen Content, 25% Poultry Droppings, and 5% Cassava peels.

[4] Diet 4 - 25% Cattle Rumen Content, 5% Poultry Droppings, and 15% Cassava Peels.

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Table 5: Growth Performance of WAD Goats fed experimental diets

Variables	[1]DIET 1	[2]DIET 2	[3]DIET 3	[4]DIET 4	SEM
Final LW (Kg)	10.40a	6.60b	7.17b	8.20a	1.41
Initial LW (Kg)	9.33	8.23	7.73	7.23	1.53
Total Weight change(Kg)	1.07a	-1.63b	-0.56c	0.97a	0.67
Average daily gain/loss (g/day)	12.70a	-19.41	-6.67	11.55a	8.02
Daily feed intake(g/day)	225.77a	83.09b	54.07b	93.51b	20.58
FCE	0.07a	-0.28b	-0.16b	0.14a	0.08

LW - Live weight (Kg); FCE - Feed conversion efficiency; SEM - Standard error of mean

abc – means along the rows with the same letters are not significantly different

[1]Diet 1(control) - 0% composite diet (waste).

[2]Diet 2- 5% Cattle Rumen Content, 15% Poultry Droppings, 25% Cassava Peels.

[3]Diet 3 - 15% Cattle Rumen Content, 25% Poultry Droppings, and 5% Cassava peels.

[4] Diet 4 - 25% Cattle Rumen Content, 5% Poultry Droppings, and 15% Cassava Peels.