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DEGRADATION OF ORGANIC MATTER IN GROUNDNUT CAKE, *PANICUM MAXIMUM* AND RUMEN EPITHELIAL SCRAPING BASED DIETS BY WEST AFRICAN DWARF SHEEP

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ABSTRACT

Three West African dwarf rams fitted with rumen cannula, were used in a completely randomized design for the study of the degradation of organic matter (OM) of groundnut cake (GNC), *Panicum maximum* (Guinea grass), rumen epithelial scraping (RES), and diets containing increasing levels of RES. Concentrate diets were formulated such that 0% (A), 50% (B), and 100% (C) of groundnut cake were replaced with RES in a diet containing 20% GNC. The soluble fraction 'a' (86.81, 80.55, 68.83), insoluble fraction 'b' (4.8, 3.88, 4.62) and rumen undegradable organic matter (RUOM) (8.39, 15.57, 26.55) obtained for GNC, grass and RES respectively varied significantly ($p<0.05$). Significant variations ($p<0.05$) were also observed for a, b and RUOM of the test diets A, B and C. Effective degradability (ED) of OM in GNC, grass and RES (at the outflow rate of 0.02) were 77.34, 58.68 and 38.73 respectively, varied significantly ($p<0.05$). The ED of OM obtained for the diets decreased significantly ($p<0.05$) with increased inclusion of RES. The RES contained (26.55%) significantly higher ($p<0.05$) level of RUOM compared to either *Panicum maximum* (15.57%) or GNC (8.39).

Keywords: Rumen epithelial scraping, degradability, Organic matter, Cannulated sheep, Supplement.

INTRODUCTION

Ruminants are unable to meet their maintenance requirement by feeding on grasses alone (Adegbola, 1985). Adequacy of nutrition in terms of quality and quantity can confer a measure of immunity on the animals without succumbing to diseases Even, the so called grasses or legumes are not available all year round. This is because of seasonal effects, which minimizes forage production especially during the hot dry period that does not favor the growth of grasses and legumes.

Dietary supplementation therefore, remains the most obvious way of manipulating the supply of absorbed nutrients (Preston, 1995). Most supplements are expensive and their use in ruminant nutrition competes with monogastric animals and human nutrition.

Preston (1995) prescribed six nutritional attributes of a good supplement for ruminants. The fermentable energy, fermentable nitrogen, micronutrients and roughage ensures optimal rumen ecosystem while bypass nutrients (by pass energy and by pass protein) complement the need of

the animal as a whole. The choice of supplement must tilt towards the more available and less costly alternative. By pass nutrients sources such as oilseed cakes and fishmeal may be too expensive for use in the small scale farming system. The most sustainable solutions may therefore be the exploitation of a vast, cheap, available and underutilized slaughterhouse wastes from abattoirs and animal by products hitherto unused which also constitutes environmental pollutant.

Rumen epithelial scrapings of cattle are such major wastes from abattoirs. Available reports (Isah, 2001; Fajemisin, 2002; Ogunwole, 2004) indicated that an average of 0.6 Kg of properly dried scrapings could be obtained from slaughtered adult beef cattle when processed. The authors projected that more than 82 metric tons of the scrapings could be generated annually from Ibadan metropolis alone,

So far, the use of RES in goat production has been documented (Isah, 2001; Fajemisin, 2002).The chemical composition and degradability of dry matter (Ogunwole et al., 2009), crude protein (Ogunwole et al., 2011) in GNC, Guinea grass, RES and diets based on it in fistulated WAD rams have been reported. The present study was undertaken to investigate the degradation characteristics of organic matter in GNC, Guinea grass and RES and diets based on RES in WAD rams.

MATERIALS AND METHODS

Sources and Description of Rumen Epithelial Scraping.

Samples of RES for this study were collected at the main abattoir in Bodija market, Ibadan, Nigeria. Processing methods and preparation of RES have been outlined and documented (Ogunwole et al., 2009; 2011).

Concentrate supplements were formulated such that 0% (A), 50% (B), and 100% (C) of GNC were replaced weight for weight with RES in a concentrate diet containing 20% GNC. The formulated diets were then used for the experiment**.** The composition and nutrient content of experimental diets is shown in Tables 1 and 2.

Experimental Site, Animal Feeding and Management.

The study was carried out at the International livestock Research Institute (ILRI) Ibadan, Nigeria. The station is located between latitudes $6^0$10" and $9^0$10" North of the equator and longitudes 3^0 and 6^0 of the Greenwich.

Three matured rams with a mean live weight of 26.53 ± 3.32kg each one fitted with a permanent ruminal cannula, were used for the degradability studies. The sheep were housed in individual pens on a smooth concrete floor with wood shavings as bedding. The wood shavings were replaced on alternate days.

The animals were allowed to graze on Guinea grass (Panicum maximum) from 08.30h and 16.30h after which they were driven back to their pens. Each of them was offered a supplement of wheat bran at 17.00h daily at 3% of their live weight. They also had free access to fresh clean water and salt lick ad libitum. The animals were sprayed with Asuntol to remove external parasites and were also administered Banmith $F^{(R)}$, a dewormer by oral drenching as prophylactic treatments.

Determination of the dry matter (OM) degradability was by measuring loss of OM from 2g samples suspended in nylon bags in the rumen for different length of time (Mehrez et al., 1980). Samples were incubated for 12, 24, 48, 72 and 96h. After

withdrawal, the samples were washed in cold water until rinsing water became colourless. Duplicate lots from each treatment were used to determine washing losses of soaking them in lukewarm water for about one hour before washing. The bags were dried at 60 ^{0}C for 48h; OM loss from the incubated samples was described by the exponential equation;

$P = a + b (1 - e^{-ct})$ (Mehrez et al., 1980), where P = degradation at time t, a = water soluble fraction, b = insoluble but degradable fraction, c = rate of degradation of b at time t and PD (Potential degradability) = extent of degradation (a + b) after time t. The effective degradability values (ED) at rumen outflow rates of 0.02 and 0.05 were estimated electronically (Ørskov & Mac Donald, 1979) using the equation:

$$ED = a + \frac{b \times c}{c + k}$$

where a = water soluble fraction, b = insoluble but degradable fraction, c = rate of degradation, k = rumen out flow rate. Undegradable OM was also calculated according to the formula of AFRC (1992).

Chemical Analysis

Proximate composition of RES, RES based diets and grass was determined using the AOAC (1984) methods. Gross energy was determined with ballistic bomb calorimeter using thermo chemical benzoic acid as standard.

Statistical Analysis

Data were analyzed for variance (Gomez and Gomez, 1985) to determine the significant differences in the mean values obtained for different parameters while the means were separated by Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Table 1: Composition and nutrient content of rumen epithelial scrapings based-diets

INGREDIENTS (g/100g)	A	B	C
Groundnut Cake	20.00	10.0	-
Rumen epithelial scrapings	-	10.00	20.00
Cassava Peel	30.00	30.00	30.00
Wheat Offal	34.00	34.00	34.00
Palm kernel cake	10.00	10.00	10.00
Oyster Shell	2.00	2.00	2.00
Bone meal	3.25	3.25	3.25
*Vitamin- Mineral premix	0.25	0.25	0.25
Common salt	0.50	0.50	0.50

**Composition of the Vitamin – Mineral premix*
0.2% Vitamin/ Mineral Premix for Sheep and Goat (Vitadiz SG) Each 2.5kg contains;

Vitamin A	*10, 000, 000 i.u*	*Manganese*	*50g*
Vitamin D3	*1, 000, 000 i.u.*	*Zinc*	*100g*
Vitamin E	*15,000 i.u.*	*Iron*	*100g*
Calcium	*600mg*	*Iodine*	*1g*
Phosphorus	*400mg*	*Selenium*	*0.2g*
Anti-Oxidant	*15g*	*Cobalt*	*0.5g*

Table 2: Chemical composition of rumen epithelial scrapings-based diets and grass (*Panicum maximum*)

COMPOSITION (g/100g) (Air-dried Sample)	A	B	C	GRASS	GNC
Dry matter	91.90	92.53	91.69	93.76	96.80
Other components on % Dry matter basis					
Crude protein	20.25	19.87	19.65	6.23	44.75
Crude fibre	5.32	5.76	6.12	41.12	3.81
Ether Extract	4.38	4.27	3.51	2.34	9.20
Ash	17.67	11.85	16.34	11.13	4.89
Nitrogen free extracts	52.38	58.25	54.38	39.28	37.35
Calcium (%)	1.00	1.06	1.05	0.32	0.2
Phosphorous (%)	0.76	0.87	0.80	0.42	0.5
Gross energy (KCal/g)	2.77	2.74	2.75	3.56	-
Gross energy (KJ/g)	11.59	11.46	11.51	14.90	-

GNC= Groundnut cake

The Soluble Fraction '*a*'

The degradation characteristics of organic matter obtained for GNC, RES, grass and the diets are shown in Table 3. There were significant variations in the '*a*' values for all samples. The highest 'a' value of organic matter was obtained for GNC (86.81%) and the least value of organic matter was observed for RES (68.83%). Grass had intermediate 'a' value (80.55%). This shows that significant higher amount of organic matter from GNC was available for immediate microbial utilization than either RES or grass. Conversely there was an increasing trend in the 'a' value of the diets ($P<0.05$) as the level of GNC inclusion decreases.

The Insoluble but Degradable fraction 'b'

Table 1 showed the insoluble but fermentable organic matter component of GNC, RES, Grass and diets A, B and C. Of the test ingredients, grass recorded the lowest value of 'b' (3.88%), which varied significantly ($P<0.05$) compared with higher 'b' value obtained for organic matter (4.62%) in RES. The value observed for diets A B and C were 3.60%, 5.54% and 4.59% respectively, highest for diet B. The trend varied significantly ($P<0.05$) with the inclusion of RES in the diet.

The Potentially Degradable Fraction (a + b) or 'p'

Values obtained for potentially degradable portion of the samples are shown in Table 3. The GNC recorded the highest 'p' value (91.61%) of organic matter and RES had the lowest value (73.45%). Generally, there were significant variations ($P<0.05$) in the observed 'p' value for all samples. The 'p' value for the diets increased significantly ($P<0.05$) with increasing inclusion of RES in the diets.

The 'p' value is an indication of the extent of potential digestibility of the organic matter component. Therefore, GNC and grass are more digestible. This indicated that the fibre content of both is more digestible whereas the 'p' value of organic matter obtained for RES is lower.

Lag Phase

The organic matter of GNC had significantly higher ($P<0.05$) lag phase action (11.5) compared with grass (10.70) and RES (8.80hours). It therefore shows that OM of RES, which though less soluble, had faster, and higher microbial colonization, which might be as a result of

relatively higher crude protein 'a' value as indicated by Preston and Leng (1987).

Table 3: Degradation characteristics and estimated effective degradability of organic matter from groundnut cake, rumen epithelial scrapings, grass and rumen epithelial scrapings-based diets

Parameters ↓	GNC 44.75% CP	RES 44.19% CP	GRASS 6.23% CP	DIET A 20.25% CP	DIET B 19.87% CP	DIET C 19.65% CP
a%	86.81_a	68.83_d	80.55_c	80.71_c	82.57_b	82.58_b
b%	$4.80b_a$	4.62_{bc}	3.88_{de}	3.60_d	5.54_a	4.59_b
c^{h-1}	0.11_a	0.02_d	0.05_b	0.04_c	0.02_d	0.01_e
p%	91.61_a	73.45_e	84.43_d	84.43_d	88.11_b	87.17_e
Lag Time	11.5_a	8.80_b	10.70_a	7.67_b	7.97_b	5.63_c
U%	8.39_e	26.55_a	15.57_b	15.69_b	11.87_d	12.83_e
ED O.O2	77.34_a	38.73_e	58.68_b	53.79_b	43.18_e	27.62_d
ED 0.05	62.67_a	22.77_d	40.28_b	35.05_c	24.48_d	13.54_e
RSD	0.13	0.43	0.39	0.10	0.18	0.32

Means along the same row with identical subscripts are not significant (P>0.05)

Footnote:

a= water soluble fraction; b= insoluble but degradable fraction; ch-^{1}= rate of degradation; LT= Lag time; U= Undegradable Fraction; ED= Effective degradability at 0.02 and 0.05 outflow rates.
RSD= Relative Standard Deviation P=Potential degradability CP=Crude protein

The Rate of Degradation per Hour C^{h-1}

The rate of degradation of organic matter was higher for GNC (0.11) and grass (0.05) and the lowest for RES (0.02). This perhaps reflected in significant decrease (P<0.05) in the rate of degradation of the diets with increasing inclusion of RES.

The relative lower value observed for diet C (0.01) compared with B (0.02) and A (0.04) could be due to lower inclusion of GNC which is also more fibrous. Thus, GNC OM is more degradable relative to the organic matter in RES, which is relative more resistant to microbial degradation in the rumen.

The Undegradable Organic Matter U%

RES recorded significantly (P<0.05) higher level of 'U' organic matter (26.55%). There was however a significant (P<0.05) decreasing trend in 'U' value with increasing inclusion of RES in the diets. The relative higher 'U' value of OM obtained for RES indicated the RES could contain higher 'by pass' organic matter.

Effective Degradation of Organic Matter at 0.02 and 0.05 Outflow Rates

There were significant variations (p<0.05) in the ED values of all samples. The ED value was highest for GNC (77.34%, 62.72%) at different outflow rates (0.02 and 0.05) respectively.

The ED values of organic matter for the diets decreased significantly (P<0.05) with the inclusion of RES. The relative low degradability of organic matter of RES therefore contributed to the variation observed in the ED of the diets.

Organic Matter Disappearance

The disappearance of organic matter components of feedstuffs and feeds incubated are shown in Figure 1. At 0 hour of incubations, 86.81%, 80.70% and 68.83% of OM in GNC, grass and RES respectively had disappeared. For all samples most of the organic matter component disappeared at a higher rate within the first 48 hours of incubation. The organic matter of GNC disappeared more extensively (up to 91.60 at 72 hours) than OM in RES (72.76 at 96 hours of incubation), which was at a more constant rate from 0-72 hours. Disappearance of OM in GNC, diet B and grass was most rapid between 12 and 24 hours of incubation.

At the end of 96-hour incubation period, diet B had disappeared (87.09) more than diet C (85.08) and A (84.13). This could be attributed to the equal inclusion of both GNC and RES in the sample which could have interacted to bring about this apparent increase in disappearance above other diets. The organic matter content of GNC was probably more highly degraded than the OM content of RES and this might be that OM in RES was more resistant to microbial degradation and the OM of GNC and grass-though fibrous were more susceptible to microbial degradation.

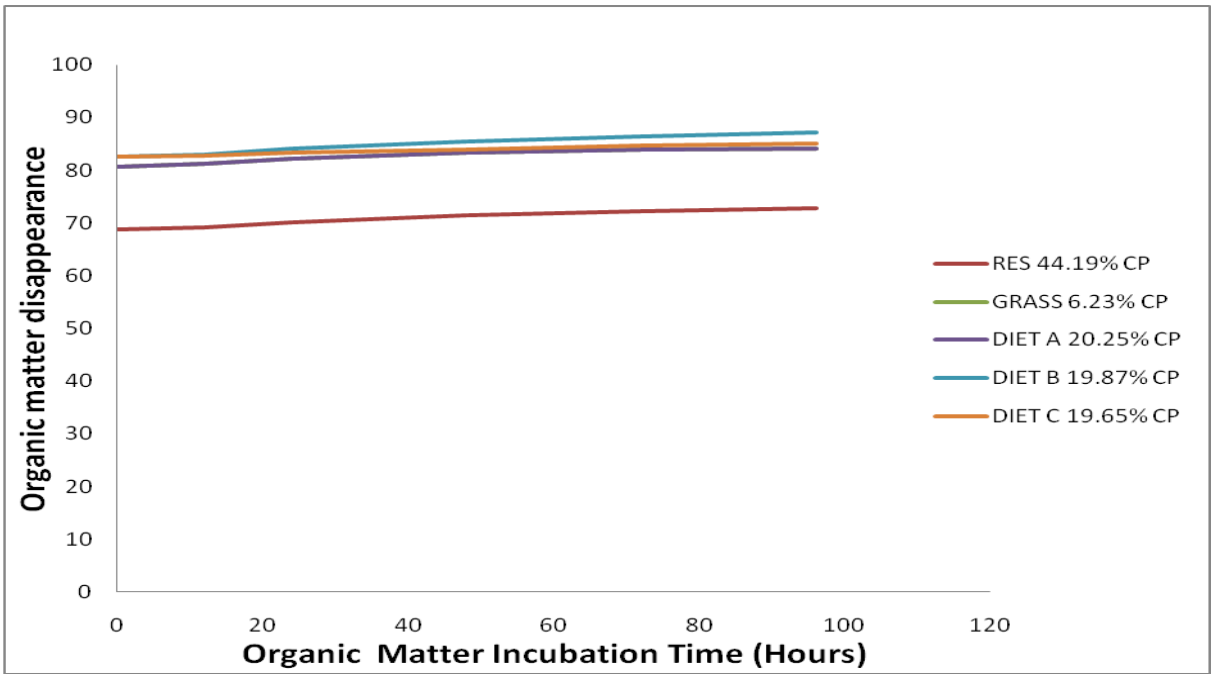

Figure 1: Mean organic matter disappearance of feeds and feedstuffs incubated in the rumen of West African dwarf sheep

CONCLUSION

Empirical evidence from this study revealed that rumen epithelial scrapings compared with groundnut cake and grass contained prime substantial slowly degradable, higher rumen undegradable by-pass or escape (nutrients) organic matter that could be of subsequent post ruminal digestion and use by the animals.

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