IN VITRO FERMENTATION CHARACTERISTICS OF PHYTOGENIC FORTIFIED DIETS FOR RUMINANT ANIMALS

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ABSTRACT

The study was carried out to estimate the chemical composition and in vitro rumen fermentation o ginger fortified diets. The diets consisted of four treatments A; Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) + Ginger (0g), B: Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) + ginger (200g), C: Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) + ginger (300g), D: Cassava peel (65%) + Moringa leaf (15%) + PKC (20%) ginger (400g). A completely randomized design (CRD) was adopted with three replicates per each treatment and samples were incubated for 24hrs. The chemical composition showed that dry matter ranged from 40.86% (diet B) to 54.68% (diet D). There was no significant (p>0.05) difference in the crude protein content (13.30 – 14.88%). The crude fibre content of the samples was significantly (p<0.05) different and it ranged from 14.67 – 22.15%. The in vitro potential gas production and effective degradability of dry matter (%) values were highest (39.03mL/36.14%) in diet D. The highest proportion of cumulative gas production at 24hr incubation was observed also in diet D. Based on this study, it seems fortifying ruminant feed with ginger could improve nutrient degradability.

Keywords: *Zingiber officinale*, gas production, effective degradability, ruminant, silage

INTRODUCTION

Growth and productivity of ruminants are mostly limited by the quality of feed available to the animals. The nutritive value of ruminant feed is determined by its chemical composition as well as rate and extent of digestion in the rumen (Songsak *et al.*, 2007). Moringa leaves are a valuable source of protein for ruminants. Its protein and organic matter are readily digestible in the rumen and/or in the intestine (Kakengi *et al.,* 2005). Ginger (Phytogenic) is in the family *Zingiberaceae*, it is reported to stimulate the appetite of animal and improve nutrients palatability (Tilgner,1999) and has favorable effects on digestion and absorption of lipids. *In vitro* gas production is a technique used in evaluating feed quality . It involves volumetric measurement of gas production in phosphate and bicarbonate buffered *in vitro* incubations in syringes (Abegunde, *et al.,* 2009). It is a rapid method used for predicting organic matter digestibility, short chain fatty acids and metabolizable energy content of ruminant feeds (Menke and Steingass, 1988). *In vitro* methods have the advantage of being less expensive and less time-consuming and accurate to predict feed intake, digestibility, microbial nitrogen supply, animal performance, short chain fatty acids, carbon dioxide and metabolizable energy of feed for ruminants (Getachew *et al.*,1999; Babayemi and Bamikole, 2006; Akinfemi, *et al.*,2009). Gas production reflect all fermented nutrients, soluble as well as insoluble and fractions that are not fermentable which do not contribute to gas production and from the total gas production, methane, individual volatile fatty acids can be predicted (Fievez *et al.*, 2005). This study was conducted to determine the *in vitro* gas production and effective dry matter degradability of ensiled cassava peel, moringa leaves, palm kernel cake diet fortified with ginger (*Zingiber officinale*) for ruminant feeding.

MATERIALS AND METHODS

The gross composition of the feed samples is shown below;

DietA: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (0g)

DietB: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (200g)

DietC: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (300g)

DietD: cassava peel (65kg) + palm kernel cake (15kg) + moringa leaves (20kg) + ginger (400g)

FERMENTATION KINETICS

The rate of gas production during 24h incubation was determined according to the procedure of Menke and Steingass (1988). Rumen fluid was collected using a stomach tube into a preheated thermos flask, strained through a sieve cloth and flushed with CO_2. The buffer containinig $NaHCO_3$+Na_2HPO_4+KCl+NaCl+$MgSO_4$.7H2O was used and kept in the incubator for warming prior to being mixed with rumen fluid. The experimental samples (200mg) were incubated in 100-mL calibrated glass syringes at 39^{o}C with the ruminal fluid and volume of gas production was recorded at 3hourly intervals for 24 hours. All samples were incubated with three syringes containing only rumen fluid -buffer mixture as blank. Gas production from the experimental sample was calculated by subtracting the volume of gas produced from the blank. At post incubation period, 4ml of 10M NaOH was introduced to estimate methane production per sample. Cumulative gas production data was obtained using the method of Ørskov and McDonald (1979). The effective degradability (ED) of dry matter was calculated according to the method of (Umunna *et al* 1995). Metabolizable Energy (ME) and Organic matter digestibility (OMD%) were calculated as ME=2.20+0.136GV+0.057CP+0.0029CF and 14.88+0.88GV+0.45CP+0.651XA respectively(MenkeandSteingass,1998), Short chain fatty acids (SCFA) as 0.0239Gv-0.0601(Getachew *et al*, 1991) was obtained where Gv, CP, CFand XA are total gas volume, crude protein, crude fibre and ash respectively. Data obtained were subjected to one-way analysis of variance, where significant differences occurred, the means were separated using Duncan multiple range F-test of SAS (2012)

RESULTS AND DISCUSSION

Dry matter ranged from 40.86-54.68%, however there was no significant (p>0.05) difference in the crude protein content (13.30 – 14.88%). The CP values are above the critical 8% crude protein requirement by ruminants for optimum microbial activities in the rumen (Norton, 2003). The crude fibre content of the samples which ranged from 14.67 – 22.15% suggests that many of the soluble nutrients were not degraded and would be adequate to support rumination. The values were within the requirement of 8-33% crude fibre suggested by Castrillo, (2001). Gas production reflects the degradation of dietary organic matter and more gas production, more degradation of Organic matter (Groot *et al*., 1996). Differences in potential gas production (***a*** + ***b***) and effective degradation of dry matter (ED) among the samples could also be due to the extent of lignification of NDF (Al-Masri, 2017). Lower NDF and lignin concentrations mean greater amounts of soluble cell walls which are available for fermentation (Al-Masri, 2017). Getachew *et al*. (2004) reported a negative relationship between gas production and cell wall content of diet. Samples with ginger produced relatively higher gas production. This corroborates the reports of Kim *et al*. (2012) who reported that ginger extract increased total gas production. Cumulative gas production at 24h as presented in Figure 1 showed significance at 400g of ginger inclusion. The level of SCFA indicates that the samples have potential to make energy available to animals. Although not significantly (p>0.05) different, samples with ginger had better organic matter digestibility denoting that ginger could improve digestibility.

Table 1: Chemical composition of ensiled experimental diets

Parameters	A(0g)	B(200g)	C(300g)	D(400g)
Dry Matter (%)	47.35±0.00^{b}	40.86±0.00^{d}	44.70±0.00^{c}	54.68±0.00^{a}
Crude protein (%)	13.30±0.70	13.50±14.00	14.59±0.84	14.88±0.88
Crude fibre (%)	14.67±0.82^{c}	17.53±0.49^{cb}	22.14±1.91^{a}	19.10±0.25^{ab}
Ether extract (%)	17.17±0.48	19.02±2.55	19.08±0.49	16.42±3.32
Ash (%)	5.29±1.39^{b}	5.94±0.37^{b}	3.30±2.71^{c}	7.27±0.43^{a}
NFE (%)	49.57±1.03^{a}	40.01±11.56^{c}	40.89±0.43^{c}	42.32±4.02^{b}
NDF (%)	36.64±3.68^{b}	22.72±21.52^{cd}	23.82±21.52^{c}	41.39±4.57^{a}
ADF (%)	29.29±0.05^{ab}	23.77±4.45^{b}	31.82±1.41^{ab}	37.89±5.14^{a}
ME(kcal/kg)	3396.42	3644.54	3552.26	3656.22

Table 2: *In vitro* gas production and estimated fermentation on Metabolizable energy, Short chain Fatty acids, Organic matter digestibility and Effective degradability of samples incubated for 24hrs

Samples	Parameters							
	A	B	a+b	C	ME	SCFA	OMD	ED
A	3.27±0.05	33.94±2.74	37.21	0.25±0.03^{ab}	7.99±0.37	0.75±0.02	57.9±2043	33.09±2.60
B	2.35±0.03	36.72±0.25	38.07	0.25±0.02^{ab}	7.75±0.04	0.85±0.07	60.40±0.23	35.73±0.20
C	1.84±0.07	34.95±1.76	36.79	0.32±0.04^{a}	8.13±0.02	0.78±0.04	58.82±1.57	34.29±1.166
D	1.86±0.07	37.17±0.12	39. 03	0.20±0.00^{b}	8.13±0.02	0.83±0.01	60.80±0.10	36.14±0.10

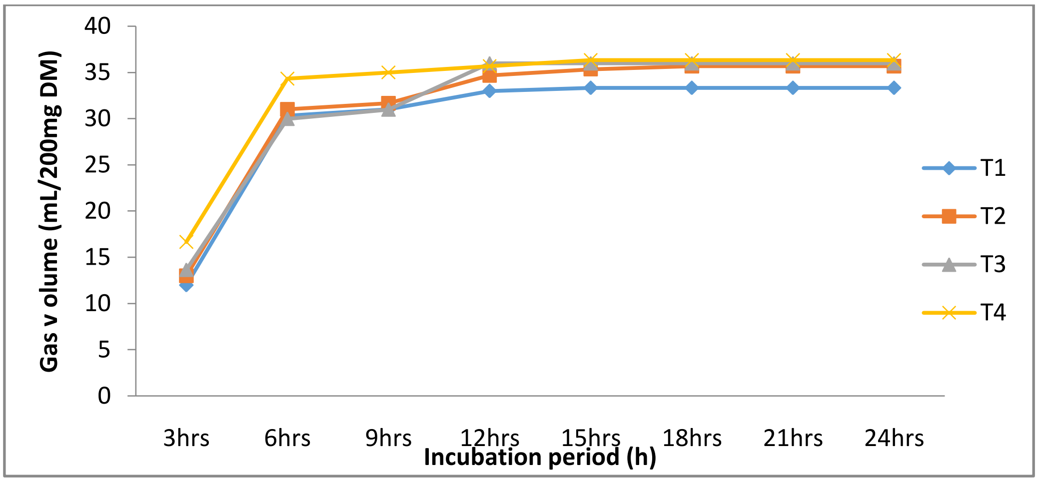

Figure 1:Cummulative gas prodution (*invitro*) of incubated samples at 24hrs

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