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Chemical Composition and *In Vitro* Gas Fermentation Evaluation of Selected Cereal Stovers Hay

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Abstract
The study investigated the chemical composition and *In vitro* gas fermentation evaluation of selected cereal stovers hay. Thus, the study was carried out to determine the nutritive value of these selected cereal stovers processed to hay using proximate analysis to x-ray the nutrient composition and *in vitro* gas fermentation technique. The dry matter (DM), crude protein (CP), crude fibre (CF), nitrogen-free extract (NFE), ether extract (EE), Ash, non-fibre carbohydrate (NFC) organic matter (OM), carbohydrate (CHO) and fibre fractions (neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL), cellulose and hemicellulose of selected cereal stovers hay were significantly ($P < 0.05$) different except for ether extract (EE) that was similar across the treatments. The *in vitro* gas fermentation parameters such as methane (CH_4), total gas volume (TGV), fermentation efficiency (FE), organic matter digestibility (OMD), dry matter degradability (DMD), short chain fatty acid (SCFA) and metabolisable energy (ME) varied significantly ($P < 0.05$) across the treatments. Furthermore, *in vitro* gas fermentation characteristics such as zero time which idealy reflects the fermentation of soluble fraction (a), extent of gas production from insoluble but degradable fraction (b), potential extent of gas production (a+b) and rate of gas production at time (c) were similar across the treatments, however, incubation time (t) and (mlh^{-1}), volume of gas produce at time (Y) varied significantly ($P<0.05$). The results of chemical composition and *in vitro* gas fermentation evaluation obtained in this study indicate that ruminant livestock farmers can utilise these unconventional feed resources as basal diet with concentrates supplement when fed out to ruminant animals.

Keywords: Cereal stovers, chemical composition, hay, in vitro fermentation, ruminant

Introduction
In livestock feeding, the purpose is to provide the animals with a balanced ration throughout the year with sufficient nutrients to meet the animal's requirements for maintenance and production. The major challenges in livestock production are nutrition and feed supplies. In Nigeria, forage and fodder availability in dry season and drought periods is a very important factor limiting livestock productivity. Inadequate feed resources often impose major constraints on the development of animal production in the tropics and sub-tropics. Large quantities of crop residues are produced every year in most developing countries in the tropics and sub-tropics which are suitable for feeding livestock. However, because of a lack of technical knowledge, they are lost or under-utilised. An intensive feeding system based on locally available agro-industrial by-products and crop residues is an alternative promising feeding system to rear ruminants economically. Ruminants because of their rumen physiological adaptation can utilise agro-industrial by-products and crop residues to meet their feed requirements for maintenance, growth and production. Crop residues and agro industrial by-products in the diets of ruminants enhance growth, lactation and result in the production of human edible food. Though, most of these feedstuffs have low nitrogen content, high fibre and low nutrient density, however, effective processing can raise their nutritive value (Areghore, 1994). Little information is available on the extent to which smallholder farmers in Nigeria utilise crop residues as livestock feed. It is very likely, however, that these resources are under-utilised. Even when they are utilised, farmers may not be able to incorporate them efficiently into their year-round livestock feeding programme because they lack suitable storage facilities and technical knowledge on treatments, processing methods and formulating feed ration. The selected cereal stovers hay (maize, sorghum, pearl millet, finger millet, rice and acha) are major food crops cultivated in north-east Nigeria. Most of these

cereal stovers are left on the field to waste after harvesting the main crops. Consequently, there is need to examine their potential feed value for ruminant production, therefore, a study was carried out to x-ray the chemical composition and *in vitro* gas fermentation assessment of selected cereal stovers hay.

Materials and Methods

Experimental Site

The study was carried out at Teaching and Research Farm of Federal University Wukari Taraba State, North–East Nigeria. Wukari is located on Latitude 7^0 51^1 North and Longitude $9^0 47^1$ East. Wukari is situated 189 metres above sea level and has a mean annual rainfall of 1300mm. The maximum annual temperature ranges between 30^0C and 39.4^0C while the minimum annual temperature is between 15^0 and 23^0C (Reuben and Mshelia, 2011).

Harvesting and Hay Making

Freshly harvested green cereal stovers (maize, sorghum, pearl millet, finger millet, rice and acha) were collected at Crop Production unit of the Teaching and Research Farm of Federal University Wukari and processed into hay. The harvesting was done in October and November 2018 and the samples were collected in batches. Harvested cereal stovers were chopped with cutlass into 3–5cm size (for easy drying). Thereafter, the chopped materials were air-dried under well-ventilated shed for two weeks on the floor. The chopped cereal stovers were constantly turned to ensure uniform drying and prevent mouldness and loss of nutrients. The low relative humidity (RH) with harmattan, facilitates the dryness of prepared hay. The chopped cereal stovers were then weighed and divided into equal portions (1kg) and each of cereal stover serves as experimental treatment making six treatments. $T_{1:}$ Rice Stover (RS), T_2: Finger Millet Stover (FMS), T_3: Sorghum Stover (SS), $T_{4:}$ Maize Stover (MS), T_5: Pearl Millet Stover (PMS) and T_6: Acha Stover (AS). All were replicated three times in a completely randomized design. However, samples for chemical analysis were oven dried at 65^0C and milled by 'MG 123' grinder.

Chemical Analysis

Each weighed sample of cereal stover was oven dried at 65^0C to a constant weight for dry matter determination (DM). The ground samples were analysed for organic matter (OM), crude protein (CP), crude fibre (CF) and nitrogen free extract (NFE) as described by AOAC (2002). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were assayed by the methods of Van Soest *et al*., (1991). Hemicellulose was calculated as the difference between NDF and ADF and cellulose as the difference between ADL and ADF ADF (Rinne *et al*., 1997) while non-fibre carbohydrate (NFC) was determined according to NRC (2001). Data obtained were analysed using one-way analysis of variance (ANOVA) using SPSS (Version 23.0.2018). The means were compared using Duncan Multiple Range Test (Duncan, 1955).

In vitro gas fermentation study

The rumen fluid was collected through the suction method from three West African Dwarf (WAD) goats under the same feeding regime. The animals were fed with 40% concentrate feed (40% corn, 10% wheat offal, 10% palm kernel cake, 20% groundnut cake, 5% soybean meal, 10% brewers dried grain, 1% common salt, 3.75% oyster shell and 0.25% fish meal) and 60% guinea grass. The rumen fluid was collected into a thermos flask that had been pre-warmed to a temperature of 39^0C before morning feeding and taken to the laboratory. Rumen liquor was filtered through a four-layered cheese cloth into a warm flask kept at 39^0C±1. The liquor was kept under continuous flushing with carbon dioxide (CO_2) gas. Glass syringes (100ml) fitted with plungers were used. 200mgDM of each cereal stover hay sample was inserted into syringes and thereafter the syringes were filled with inoculums containing strained rumen liquor and buffer solution (9.8g $NaHCO_3$ + 2.77g $NaHPO_4$ + 0.57g KCl + 0.47 NaCl +0.12g $MgSO_4.7H_2O$ +0.16/litre $CaCl_2.H_2O$) at ratio (1: 4 v/v). Incubation was done as reported by Babayemi (2004). The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24hr. At post incubation period 4ml of NaOH (10 M) was introduced to estimate methane production as reported by Fievez *et al*., (2005). At the end of incubation, the content of the syringes were transferred into centrifuge tubes and placed immediately in cold water at 4^0C to stop fermentation. The tubes were centrifuged at 15,000rpm x g for 25 minutes. The supernatant was discarded and the residues were oven dried at 55^0C for 48hrs to estimate *in vitro* dry matter digestibility (IVDMD %), Organic matter digestibility (OMD %), Metabolisable energy (ME MJ/KgDM), which were determined (Tilley and Terry, 1963) and Short chain fatty acids, (SCFA μml) was calculated as described by (Getachew *et al.,* 1999).The volume of gas produced every 3hours interval of the 3 replicates of each sample was plotted against the incubation time and from the graph, the gas production characteristics were estimated using the equation Y = a + b ($1\text{-}e^{ct}$) as described by Ørskov and McDonald, (1979), where Y = volume gas produced at time (t), a = intercept (gas produced from the soluble fraction), b = gas produced from insoluble but degradable fraction, c = gas production rate constant for the insoluble fraction (b), t = incubation time.

$$\text{IVDMD\%} = \frac{\text{Initial dry matter input} - \text{Dry matter residues}}{\text{Initial dry matter input}} \text{x100} \ldots (1)$$

$$\text{Fermentation efficiency (FE)} = \frac{\text{DMD /Kg}}{\text{IGVmlKg of DM}} \ldots. (2)$$

Metabolisable energy (ME) was calculated as: 2.20 + 0.136 GV + 0.057CP + 0.0029CF (Menke and Steingass, 1988). Organic matter digestibility (OMD) = 14.88 + 0.889 GV + 0.45 CP + 0.651 XA. Short chain fatty acids (SCFA) as: 0.0239GV – 0.0601(Getachew *et al*., 1998) was also obtained, where GV, CP, CF and XA are total gas volume (ml/200mg DM), crude protein, crude fibre and ash, respectively. Data obtained were subjected to Analysis of Variance (ANOVA) using statistical package for social sciences (SPSS) version 23 and significant means were separated by Duncan Multiple Range Test (1955).

Results and Discussion

Chemical composition of selected cereal stovers hay

Table 1 showed the chemical composition of selected cereal stovers hay (Rice, Finger millet, Sorghum, Maize, Pearl millet and Acha). The Dry matter (DM),crude protein (CP), crude fibre (CF), nitrogen free extract (NFE), Ash, ether extract (EE), non-fibre carbohydrates (NFC) organic matter (OM) and carbohydrate (CHO) ranged from 91.69 – 92.69, 8.90 –11.78, 31.05–34.00, 38.86 – 48.42, 8.35 – 14.40, 1.15 – 1.25, 9.36 – 17.04, 76.94 – 91.65 and 72.81–80.73, respectively. All the parameters were significantly (P<0.05) different except ether extract that was similar across the treatments. The crude protein contents which was major nutrient of selected cereal stovers hay range (8.90 –11.78%) was relatively low compare to legume stovers. This agreed with report of Adegbola (1998), who observed that cereal stovers and straws, which form the bulk of crop residues, are inherently low in crude protein. The crude protein content of samples was higher than critical value of 7.70% recommended by National Research Council (NRC 1981) and also higher than the minimum CP level of 7% required for optimum rumen function (Van Soest, 1994). However, feeding out these cereal stovers hay directly to ruminants' animal, need to be supplemented with protein concentrates for optimum performance. The crude fibre ranged value (31.05– 34.00) suggest that ruminants can utilise it effectively owing to their stomach structure with the aid of rumen microbes. The values (8.35 – 14.20) of ash obtained in this study is an indication that the hay is rich in minerals. Furthermore, NFE is fermentable carbohydrates portion of hay samples that serve as energy source when fermented in the rumen to produce volatile fatty acids (VFA) of about 75-80% source of energy to ruminants is relatively low. Similarly, the range value (9.36-17.04%) of non-fibre carbohydrate (NFC) which serves as balancing factor to fibre fractions to optimize energy intake and rumen health is very low compared to the range value (38-44%) reported by NRC (2001) for dairy cattle needed to be supplemented when feeding out the stovers hay to ruminants.

Fibre fractions of selected cereal stovers hay

Presented in Table 2 is the fibre fractions (neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), cellulose and hemicellulose) of selected cereal stovers hay. There were significant (P<0.05) differences across the treatments such that T_5 (Millet stover) hay had the highest value in NDF (66.52%), ADF (47.51%), ADL (23.05%), cellulose (24.46%) but lowest in hemicellulose (19.01%) while T_4 (Maize stover) hay had the lowest in NDF (63.21%), ADF (44.16%) and ADL (21.41). However, T_6 (Acha stover) hay had the highest value (21.92%) of hemicellulose and the lowest in cellulose (22.71%). The significant differences that occurred in fibre fractions of cereal stovers hay could be adduced to leave to stem ratio, age and different species of cereal stovers processed to hay. The fibre fractions (NDF, ADF, and ADL) influence digestibility of feedstuff in ruminant nutrition. The neutral detergent fibre (NDF), is a measure of plant's cell wall contents that determines the rate of feed digestion, and is inversely related to the plant's digestibility (McDonald *et al*., 1995, Gillespie, 1998). High NDF content lowers the plant's digestible energy and the level of intake. Sing and Oosting (1992) cited by Amuda *et al.* (2020) reported that roughage feeds that contained 45% NDF could be classified as high quality, those with values ranged from 45-65% as medium and those with values higher than 65% as low quality. In this study, T_3 and T_4 could be classified as medium while T_1, T_2, T_5 and T_6 as low quality. Low level of ADF content of any feed produces high energy content and digestibility of such feed (Joe, 2013). High NDF could result in low intake while high ADF may engender low digestibility (Babayemi *et al*., 2010). According to Van Soest (1994), forage digestibility in ruminants is limited by the extent of cell wall (NDF) digestion. The Acid Detergent Fibre (ADF) consist mainly lignin and cellulose. Acid Detergent Fibre (ADF) is correlated with the digestibility. Acid detergent lignin (ADL) of a plant is the most indigestible component of the fibre fraction (Gillespie, 1998), and its amount will also influence the plant digestibility. ADL fraction was relatively low in all the cereal stovers hay therefore, ruminants can utilise about 76.95-78.59% of it, if feed out. Lignin is generally accepted as the primary component responsible for limiting the digestion of forages (Van Soest, 1994; Traxler *et al*., 1998; Agbagla-Dohnani., 2001). Furthermore, it is the most important factor affecting the total diet organic matter digestibility (Nousiainen *et al*., 2004) and it has influence on animal performance (Oba and Allen, 1999). The high level of fibre fractions observed in this study may be attributed to the age or maturity at harvest and leaf to stem-ratio of cereal stovers hay.

The hemicellulose and cellulose are cell wall constituents and polysaccharides. They are very indigestible in monogastrics but digestible in ruminants through fermentation by rumen microbes. Hemicellulose values obtained for hays ranged from 19.01 – 21.92% while cellulose ranged from 22.71 – 24.46%. These values are not too high for ruminants due to the nature of their stomach and the presence of cellulolytic bacteria and fibrolytic fungi in the rumen. According to McDonald *et al*. (1995), ruminants can be fed sole on feed that contained 40% cellulose and 20% hemicellulose. McDonald *et al*. (1995), further stated that in mature herbage, and in hay and straw, the proportion of cellulose and hemicellulose is much higher and that of water soluble carbohydrates is much lower, and that all the carbohydrates but not lignin are attacked by the rumen microorganisms. This indicates that ruminants can cope with feed that contains high level of cellulose and hemicellulose with the aid of rumen microbes. Fibre fractions, cellulose and hemicellulose of selected cereal stovers hay are relatively low, therefore ruminants can digest them.

***In vitro* gas fermentation characteristics of selected cereal stovers hay at 24 hours incubation period**

Presented in Table 3 is the summary of *in vitro* gas fermentation characteristics result (a, b, a+b, c, t and Y). The intercept value 'a' at 24hrs ranged from 1.67 to 2.67ml200mg/DM. The value 'a' used ideally to reflects the fermentation of soluble fraction of samples and this were similar across the treatments. The soluble fraction makes the attachment by rumen microbes to be done easily and this results to increase in gas production. Doano *et al.* (1997) reported that gas produced is directly proportional to the rate at which substrate is degraded. Getachew *et al.* (1998) also reported that gas production could be attributed to the nature of carbohydrate fractions contained in the substrates. The potential degradability' a+b' of a diet indicates the level at which the diet could be degraded if it were in the actual rumen of the animal (*in vivo*). This mostly depends on how much of the fibre fractions (NDF and ADF) have been broken down for easy access of microbes to nutrients available in the diet. Low level of carbohydrate and high fibre fractions of the cereal stovers used in hay production might be responsible for low gas volume produced in estimating the values of *in vitro gas* fermentation characteristics (a, a+b, b, c, and y). Cell wall components have been observed to have negative correlation with gas production (Sallam *et al*., 2007). Furthermore, Moncao *et al*. (2014) reported that the structural arrangement influence the extent of degradation which implies that increase or decrease in gas production depends on chemical composition of the forage. *In vitro* gas methods primarily measure digestion of soluble and insoluble carbohydrates (Menke and Steingass, 1988). The values of 'a+b', 'b' and 'c' obtained in this study were consistent with the values reported for some crop residues (Babayemi *et al*., 2009). The extent of gas production 'b' describe the fermentation of insoluble but degradable fraction of the samples, result obtained in this study ranged from 14.67 to 22.00 ml200gm/DM. Blummel and Ørskov (1993) found that value could account for 88% for voluntary feed intake. There are many factors that may determine the amount of gas produced during fermentation, depending on the nature and level of fibre, the presence of secondary metabolites (Babayemi *et al*., 2004b) and potency of the rumen liquor for incubation.

***In vitro* fermentation parameters of selected cereal stovers hay**

Table 4 shows the *in vitro* gas fermentation parameters of selected cereal stovers hay. The parameters differed significantly (P<0.05) across the treatments. The *in vitro* gas fermentation technique provided a useful basis from which metabolisable energy (ME), organic matter digestibility (OMD), short chain fatty acid (SCFA) and methane (CH_4) gas of feed samples are evaluated. The values of ME (5.14–6.23) obtained among the treatments were significant. Methane production is an energy loss to the animal since the portion of the animal's feed, that is converted to CH_4, is eructed as gas and when accumulates in the rumen, it results to bloat (Babayemi 2006). Methane (CH4ml) gas production of incubated samples are relatively low indicating that there would be reduction in energy loss through eructation and more energy would be available to the ruminant animals. The *in vitro* fermentation technique has been widely used to estimate the energy value of several classes of feed (Getachew *et al*., 1998). The value (2.86) of Fermentation Efficiency (FE) obtained from T_2 (Finger millet stover) and Total Gas Volume (TGV) value (24.67ml) suggest that the hay type contained soluble carbohydrates (soluble sugar) which favouring a higher gas production and rapid fermentation kinetics. The ME values obtained in this study (5.14-6.23MJ/KgDM) were within the range of 4.5 to15 MJkg^{-1}DM reported by Menke and Steingass (1988) and ME values of various kinds of European feeds. Metabolisable energy (ME) values are very useful and significant for purposes of ration formulation and to set the economic value of feeds for trading purposes. The OMD is a measure of degradability potentials of microbes on substrate in the presence of sufficient ammonia nitrogen (NH_3-N) that has influence on bacteria fermentation. The values (45.54–52.58%) obtained were higher than ranged values (35.45 – 46.0%) reported by Falola *et al*., (2015) for vetiver grass (*Chrysopogon zizanioides L., Roberty)* and 36.45 – 45.93%) reported by Alasa *et al*. (2010) for guinea grass intercropped with two cultivars of *Lablab purpureus.* Similarly, SCFA ranged value (0.36 – 0.53µml) obtained in this study were higher than the ranged values (0.31 – 0.36µml) reported by Alasa *et al*., (2010) but relatively inclined to range values (0.42 – 0.68µml) reported by Falola *et al*., (2015). The levels SCFA of selected cereal stover hay indicates that energy will be available for the animal.

Conclusion

In conclusion, this study revealed that chemical composition and *in vitro* gas fermentation evaluation indicated that nutritive values of the selected cereal stovers hay with concentrates supplement can sustain ruminant animals during dry the season period if it is well-prepared and stored in dry place.

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Table 1: Chemical composition (g/100g DM) of selected cereal stovers hay

	Treatments						
Parameters (%)	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**SEM**
Dry Matter	92.56^{ab}	91.69^{c}	92.69^{a}	92.10^{bc}	92.14^{bc}	91.91^{c}	0.30
Crude Protein	11.78^{a}	11.70^{a}	9.60^{b}	8.90^{bc}	9.35^{b}	9.05^{b}	0.92
Crude Fibre	31.62^{b}	32.00^{ab}	31.05^{b}	31.55^{b}	31.53^{b}	34.00^{a}	1.67
Nitrogen Free Extract	40.52^{c}	43.55^{b}	48.42^{a}	48.15^{a}	43.71^{bc}	44.95^{ab}	2.33
Ash	14.40^{a}	11.50^{b}	8.35^{c}	10.75^{b}	14.20^{a}	10.80^{b}	0.72
Ether Extract	1.15	1.25	1.20	1.15	1.20	1.20	0.11
NFC	10.56^{cd}	11.56^{bc}	17.04^{a}	16.41^{a}	9.36^{d}	12.69^{b}	0.33
Organic Matter	85.60^{b}	76.94^{c}	91.65^{a}	89.25^{b}	85.80^{b}	89.78^{b}	1.06
Carbohydrate	72.81^{c}	75.55^{b}	80.73^{a}	79.20^{a}	75.25^{b}	78.95^{a}	1.31

a,b,c= means on the same row with different superscripts are significantly (P<0.05) different.
T_1 = Rice stover, T_2 = Finger millet stover, T_3 = Sorghum stover, T_4 = Maize stover, T_5 = Millet stover, T_6 = Acha stover, NFC=Non-Fibre Carbohydrates, SEM = Standard Error of Mean

Table 2: Fibre fractions (g/100g DM) of selected cereal stovers hay

	Treatments						
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**SEM**
NDF	65.05^{abc}	65.41^{ab}	63.81^{bc}	63.21^{c}	66.52^{a}	66.26^{a}	1.20
ADF	45.32^{b}	45.66^{b}	45.01^{b}	44.16^{b}	47.51^{a}	44.34^{b}	1.11
ADL	22.03^{b}	21.49^{b}	21.61^{b}	21.41^{b}	23.05^{a}	21.64^{b}	0.58
Cellulose	23.28^{b}	23.17^{b}	23.40^{b}	22.75^{b}	24.46^{a}	22.71^{b}	0.58
Hemicellulose	19.69^{ab}	20.75^{ab}	19.13^{b}	19.05^{b}	19.01^{b}	21.92^{a}	1.63

a,b,c = means on the same row with different superscripts are significantly (P<0.05) different.
T_1 = Rice stover (RS), T_2 = Finger millet stover (FMS), T_3 = Sorghum stover (SS), T_4 = Maize stover (MS), T_5 = Pearl Millet stover (PMS), T_6 = Acha stover (AS), NDF = Neutral Detergent Fibre, ADF = Acid Detergent Fibre, ADL = Acid Detergent Lignin, and SEM = Standard Error of Means

Table 3: *In vitro* gas characteristics (200mg/DM) of selected cereal stovers hay at 24hour incubation period

	TRMTS						
PRMTS	T_1	T_2	T_3	T_4	T_5	T_6	SEM
a (ml^3)	1.67	2.67	1.67	2.67	2.00	2.67	0.18
b (ml^3)	17.00	22.00	20.33	18.67	16.67	14.67	1.36
a+b (ml^3)	18.67	24.67	22.00	21.33	18.67	17.33	1.41
c (hrs)	0.037	0.057	0.043	0.080	0.048	0.051	0.00
t (hrs)	10.00^{b}	15.00^{ab}	14.00^{ab}	10.00^{ab}	13.00^{ab}	18.00^{a}	1.11
Y (mlh-3)	6.67^{b}	15.33^{a}	10.33^{ab}	11.33^{ab}	9.33^{b}	11.33^{ab}	0.55

a,b,c = means on the same row with different superscripts are significantly (P<0.05) different.
T_1: Rice stover (RS), T_2:Finger millet stover (FMS), T_3 : Sorghum stover (SS), T_4: Maize stover (MS), T_5: Pearl Millet stover (PMS), T_6:Acha stover (AS), SEM :Standard Error of Mean, a: zero time which idealy reflects the fermentation of soluble fraction (ml^3), b : extent of gas production from insoluble but degradable fraction (ml^3), a+b: potential extent of gas production (ml^3), t : incubation time (hrs), c : rate of gas production at time (mlh^{-1}) and Y: volume of gas produce at time (ml^3)

Table 4: *In vitro gas* fermentation parameters of selected cereal stovers hay at 24hours incubation period

	Treatments						
Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
TGV (ml)	18.67^{b}	24.67^{a}	16.67^{b}	18.00^{b}	18.67^{b}	17.33^{b}	5.94
CH_4 (ml)	13.33^{b}	17.33^{a}	9.33^{c}	10.67^{c}	11.33^{c}	12.00^{b}	5.14
FE (g/GVml)	4.07^{ab}	2.86^{c}	5.62^{a}	3.62^{b}	3.84^{b}	3.59^{b}	2.17
OMD (%)	47.30^{ab}	52.58^{a}	45.54^{b}	49.64^{ab}	47.30^{ab}	46.12^{b}	5.75
DMD (%)	74.67^{a}	69.80^{ab}	66.77^{ab}	69.67^{ab}	70.93^{a}	61.40^{b}	7.60
ME (MJ/Kg DM)	5.42^{ab}	6.23^{a}	5.14^{ab}	5.78^{a}	5.42^{ab}	5.24^{ab}	0.89
SCFA (µml)	0.39^{b}	0.53^{a}	0.34^{c}	0.45^{ab}	0.39^{b}	0.36^{b}	0.16

a,b,c= means on the same row with different superscripts are significantly ($P<0.05$) different.

T_1: Rice stover, T_2: Finger millet stover, T_3: Sorghum stover, T_4: Maize stover, T_5: Pearl millet stover, T_6: Acha stover, SEM: Standard Error of Mean CH4: Methane, TGV: Total Gas Volume, ME: Metabolisable Energy, SCFA: Short Chain Fatty Acid, DMD: Dry Matter Degradability, OMD: Organic Matter Digestibility and FE: Fermentation Efficiency