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CHEMICAL PROPERTIES OF ENSILED SUGARCANE WASTE TREATED WITH NON-PROTEIN NITROGEN SOURCES AND SOYBEAN RESIDUE

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ABSTRACT

An experiment was conducted to assess the chemical composition of ensiled sugarcane waste (ESCW) treated with non-protein nitrogen sources (urea and poultry litter) and soybean residue, in a completely randomized design. Sugarcane waste (SCW) was chopped and treated with different proportions of urea, poultry litter (PL) and soybean residue (SBR) as; A (100% SCW + urea), B (50% SCW + 50% SBR), C (75% SCW + urea + 25% SBR), D (25% SCW + 75% SBR), E (50% SCW + 25% PL + 25% SBR), F (75% SCW + urea + 25% PL) and G (50% SCW + 50% PL). The samples were ensiled for 7, 14 and 21 days in triplicate, at the end of each ensiling period, samples were analyzed. The results showed that the mean chemical composition of ESCW treated with different combinations of urea, PL and SBR varies significantly ($P < 0.05$) at 7, 14 and 21 days of ensiling. The CP obtained from the silages after 21 days of ensilage were improved and high enough to warrant the use of the silages. The result further revealed that urea, PL or SBR treatment and ensiling can confer nutritional benefit on poor quality sugarcane waste. Therefore, the treated sugarcane wastes have potential to benefit ruminants; it is recommended that silage of sugarcane wastes with urea, poultry litter and soybean residue be made especially during periods of feed scarcity for ruminant animals.

INTRODUCTION

Ruminants play an active role in converting feedstuffs of no human dietary value to meat and milk. Therefore, efforts to reduce the high cost of feeds and production have been concentrated on using such feeds. Several authors (Garba and Maigandi, 2008; Maigandi et al., 2008; Fawolu and Fajemisin, 2011; Olorunnisomo et al., 2011) have investigated the use of cheaper agro - industrial by - products and waste materials such as slaughter/abattoir wastes, poultry droppings and cassava peels at various levels of dietary inclusions for small ruminants to determine their efficiency of utilization in terms of growth and production with a view to

identifying the most suitable one in terms of nutritional value, cost effectiveness and all year round availability. Sugarcane (*Saccharum officinarum*) is one of the tropical crops which have the highest biomass production (Brown et al., 1987; Alexander, 1988). The problem associated with feeding ruminant livestock adequately in quantity and quality during the dry season calls for an alternative means of feeding bulky materials after ensiling. Sugarcane waste is one of such unconventional feedstuffs which are produced in large quantities in the country and could therefore be used to feed livestock after ensiling with urea, poultry litter and soybean residue.

The treatment will increase the nitrogen content of the diet and also improves digestibility and utilization of fibre by ruminant animals. However, information on the nutritional value of sugarcane waste treated with urea or poultry litter is limited in this ecological zone. In Nigeria, sugarcane is harvested mainly in the dry season which is a period of the year when there is lack of the roughage for ruminants. Sugarcane waste is obtained when the cane is being processed for chewing. It comprises of the tops, peels and baggase (obtained when the cane is chewed and the liquid swallowed). Small scale farmers cannot afford the investments required to establish improved pastures and feed concentrate supplements to alleviate dry season growth checks (Smith *et al.*, 1991). Therefore, it has become imperative for ruminant nutritionist to investigate ways of utilizing feedstuffs that are of no nutritional needs to man for feeding various classes of livestock. This study therefore aimed at determining the chemical properties and suitability of sugarcane waste ensiled with urea, poultry litter and/or soybean residue.

MATERIALS AND METHODS

Experimental Location

The experiment was conducted at the Animal Science Laboratory, Bayero University, Kano. Kano state lies on longitude 11°58.675 North and latitude 8°25.746 East on an elevation 468 metres. The area is characterized by tropical wet (May – September) and dry (October – April) seasons, (Olofin, 1985).

Collection and Preparation of Experimental Materials

Sugarcane waste (SCW) was collected within and around the University campus and was subsequently, samples were cleaned for extraneous materials like gravels, pieces of iron and polyethene. Soybean residue (SBR) was obtained from various soybean cake (*awara*) processing centers in the Kano metropolis. Inorganic granulated feed grade urea was obtained from market while poultry litter (PL) was obtained from a deep litter poultry house. The collected SCW, SBR and PL were sun dried for the period of 3 days during dry season by thinly spreading on a concrete floor.

Ensiling Procedures

The dried sugarcane waste used for silage was chopped into about 2-3 cm length for better compaction (Ogunlolu *et al.*, 2010). Sugarcane waste was ensiled with urea, PL and SBR in proportions as presented in Table 1. Sixty three (63) bottles of 946ml were used as laboratory silos. The procedure of Roy and Rangnekar (2006) was followed in which 1kg urea was dissolved in 15 litres of water and sprinkled on 25 kg SCW. For the silages without urea, 15 litres of water was used for each 25kg sugarcane waste. The samples were ensiled for 7, 14 and 21 days in triplicate. Masking tape was used to further seal the bottles after filling with weighed materials and compressed. At the end of each ensiling period, the silos were opened and the top most (5 cm) material was scooped off to avoid contamination with partially ensiled materials. The samples were taken using forceps from each ensiled bottle and sub samples were taken, oven dried at 60°C for 48 h for analyses (Jagdish, 2015).

Experimental Design and Treatments

A complete randomized design (CRD) was used as outlined by Steel and Torrie (1980). There were seven treatment combinations designated as; A (100% SCW + urea), B (50% SCW + 50% SBR), C (75% SCW + urea + 25% SBR), D (25% SCW + 75% SBR), E (50% SCW + 25% PL + 25% SBR), F (75% SCW + urea + 25% PL) and G (50% SCW + 50% PL).

Analytical Techniques

Representative samples of the ESCW (treatments A to G), were chemically analyzed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE) according to AOAC (2005) procedures. Metabolisable energy (ME) was calculated mathematically according to Ponzenga (1985) while organic matter (OM) was obtained by the difference between dry matter and ash. Fibre fractions viz., neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were analyzed by the procedures of Van Soest *et al.* (1991). Hemicellulose and cellulose were derived mathematically according to Rinne *et al.* (1997).

Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) using SAS Statistical package (SAS, 1989) and significant differences between the means were tested by Duncan multiple range test (Duncan, 1955). Differences between the means were considered significant at 5% probability level ($P < 0.05$).

RESULTS

The mean chemical composition of ESCW with different combinations of urea, PL and SBR varies significantly ($P < 0.05$) at 7 days of ensilage (Table 2). Mean DM value in treatment A was significantly ($P < 0.05$) higher than the rest of the other treatments. Mean CP was significantly ($P < 0.05$) highest in treatment B (20.78%) whereas CF was significantly ($P < 0.05$) higher in treatment C (24.33%). Mean EE values varied between 4.10% in treatment F to 5.93% in treatment C while ash varied from 4.07% to 5.31%. value of NFE was significantly ($P < 0.05$) higher in treatment F (95.90%) while OM was significantly ($P < 0.05$) lowest in treatment E (85.47%). Mean NDF in treatments B and G were significantly ($P < 0.05$) higher than the means of all the other treatments. Acid detergent fibre was significantly ($P < 0.05$) higher in treatments A and G while lignin was significantly ($P < 0.05$) highest in treatment G and lowest in treatment A. Percent cellulose was significantly ($P < 0.05$) highest in treatments A, B and G. Percent hemicellulose and ME kcal/kg were significantly ($P < 0.05$) highest in treatment B.

Table 3 showed the mean chemical composition of ESCW treated with different combinations of urea, PL and SBR at 14 days of ensilage. Significant ($P < 0.05$) variations were observed in all the parameters evaluated. Dry matter content was significantly ($P < 0.05$) highest in treatment F. Treatment G had the highest percent CP while treatment C had the lowest. Highest CF value was recorded in treatment C, while treatment F been the lowest. The percentage EE and ash were significantly ($P < 0.05$) higher in treatment A and lowest in treatment E however, differences amongst other treatments were observed ($P < 0.05$). Treatment E had the highest NFE (95.57%) and OM (89.06%) values.

The values obtained for NDF, ADF and lignin were significantly ($P > 0.05$) lowest in treatment C. Percent cellulose contents were significantly ($P < 0.05$) highest in treatment E, while percent hemicellulose was significantly ($P < 0.05$) highest in treatment B. Metabolisable energy was significantly ($P < 0.05$) highest in treatment B and lowest in treatment C.

The chemical composition of ESCW treated with different combinations of urea, PL and SBR at 21 days of ensilage are shown in Table 4. Significant ($P < 0.05$) differences were noted in all the parameters measured. The DM (%) content was significantly ($P < 0.05$) highest in treatment D. Significantly ($P < 0.05$) higher CP (27.34%) was recorded in treatment G, treatment C had a significantly ($P < 0.05$) higher CF value of 25.62% compared to the other treatment means. Treatment A had the highest EE (6.54%) while percent ash (7.48%) was significantly ($P < 0.05$) highest in treatment F. The mean NFE (96.32%) and OM (92.42%) values were significantly ($P < 0.05$) highest in treatments C and D, respectively. The NDF values were significantly ($P > 0.05$) similar for treatments A, D and E. Percent ADF was significantly ($P < 0.05$) highest in treatment G. Lignin was significantly ($P < 0.05$) highest in treatment B while Treatment G had significantly ($P < 0.05$) highest mean cellulose value. Percent hemicelluloses was significantly ($P < 0.05$) highest in treatments B. Treatment G had the significantly ($P < 0.05$) highest energy (4753.59 kcal/kg) value.

DISCUSSION

The DM values of the treatments evaluated in this study were high and had no trend due to either addition of urea, PL and SBR or ensiling days. While some treatments decrease with increasing days of ensiling, others increase as the days of ensiling increases. Eniolorunda *et al.* (2010) observed a decrease in DM values as days of ensiling increases and concluded that the reduction in DM may be associated with changes in carbon metabolism and hydrolysis of non – fermentable starch into simple sugars by microorganisms. This high DM implies that the silages might be good sources of energy and roughage that could enhance rumination and prevent digestive upset in the rumen (Van Soest, 1982). Fresh materials are generally

characterised by high moisture content hence There were considerable changes in CP content during ensiling. The decreases in CP from 7 to 14 days might probably be due to proteolysis (McDonald *et al.*, 1988). Fasina (2012) observed a decrease in CP contents of cassava forages with increasing days of ensiling and attributed that to the use of nutrients by the microbes in the ensiled materials. Several authors (Obua 2005; Inyang *et al.*, 2012 and Amadi *et al.*, 2012) had similar observation and relate it to proteolysis. An increase in the CP content of the silages from 14 to 21 days of ensiling was observed in the present study and could be due to addition of urea, PL and soybean residue which are good sources of protein. This is in agreement with earlier report of Nguyen *et al.* (2009) that an increase in CP content of rice straw treated with poultry litter lead to loss of some volatile substances during ensiling process. The increased CP in most of the silages with days of ensiling observed in this study were similar with the results obtained by Ngele *et al.* (2006) and Eniolorunda *et al.* (2010). Increase in the CP content is thought to be associated with the proliferation of microbial bodies in the silage material. The mean CP content of all the silages were higher than the value of 8% defined as the CP requirement by ruminants (Norton, 2003) and as the dietary threshold level providing adequate ammonia concentration for microbial activities within the rumen.

There was increase in CF content of the silages at 21 days of ensilage except in treatments A and F which were reduced. This reduction in CF content of these two silages might be as a result of the breakdown of fibres by the microorganisms present in the ensiled mass and this corroborate the report of Obua (2005) who had similar observation. The CF range after 21 days of ensiling was lower than 23.39 – 36.34% CF reported for untreated rice straw by Ngele *et al.* (2006) and 25.12 – 39.44% by Ajayi *et al.* (2011) when various crop residues were ensiled with urea. However, this implies that the treatment used on SCW (urea, PL and SBR) can effectively lower the CF content thereby making energy more available to the animals.

low DM content.

Ether extract in the diet indicates fat content which subsequently contributes to volatile fatty acids and therefore high energy value of the diet. The ether extract contents of the silages in the present study after 21 days of ensiling were moderate because high levels of EE (fats) may depress fibre digestion. Earlier reports suggested that there would be a depression in fibre digestion when fat levels exceed 5 – 6% in ruminant ration Maithison *et al.* (1997).

More so, the ash contents of the silages in the present study after 21 days of ensiling were lower than 10.08 – 12.67% reported by Maigandi *et al.* (2004) for ensiled fore stomach digesta. This could be probably due to the differences in ensiling material used. Lower ash content may mean that the silages might be low in minerals as McDonald *et al.* (1998) stated that total ash decrease as plants matures.

The components that most disposes a feed resource as an energy source is the fibre fraction. The NDF and ADF were found to increase with days of ensiling contrary to the studies of Oduguwa *et al.* (2011) and Fajemisin *et al.* (2012). The authors observed a decrease in NDF and ADF values with increased days of ensiling and related the decrease to delignification of lignocelluloses complex and its utilization by microbes during fermentation. These differences observed might be probably due to the differences in the ensiling materials in terms of maturity/age and moisture level. However values recorded in the present study at 21 days of ensiling for NDF and ADF were lower than (68.67 – 72.75% and 62.94 – 69.30%) ADF and NDF respectively, reported by Oduguwa *et al.* (2011). Interestingly, the entire fibre fractions recorded in this study were similar to those of Guinea grass cherished by ruminant animals (Olorunnisomo and Dada, 2011), this may also implies that the silages might be cherished by the ruminants. The recorded ME values all improved with days of ensiling and this might be due to the positive influence of fermentation on nutrients availability and utilization as reported by Akanji *et al.* (2003).

CONCLUSION AND RECOMMENDATIONS

The CP obtained from the silages after 21 days of ensilage were improved and high enough to warrant the use of the silages. The values for fibre fractions recorded suggested the suitability of the silages to ruminant animals that feed on them.

The results further revealed that urea, PL or SBR treatment and ensiling can confer nutritional benefit on poor quality SCW. Therefore, the ESCW have potential to benefit ruminants, especially during periods of feed scarcity. It is recommended that silages of SCW with urea, poultry litter and soybean residues be made because the treatments

confer nutritional benefit on the poor quality sugarcane waste. It is also recommended that further feeding trials be conducted in order to reveal the actual nutritional potential of ESCW for feeding ruminants.

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Table 1: Proportion (%) of sugarcane waste (SCW) ensiled with urea, poultry litter (PL) and soybean residue (SBR)

| Treatments | SCW | Urea | PL | SBR |
|------------|-----|---------|----|-----|
| A | 100 | + urea* | – | – |
| B | 50 | – | – | 50 |
| C | 75 | + urea* | – | 25 |
| D | 25 | – | – | 75 |
| E | 50 | – | 25 | 25 |
| F | 75 | + urea* | 25 | – |
| G | 50 | – | 50 | – |

*Urea treatment at 25kg sugarcane waste to 1kg of urea

A (100% SCW + urea), **B** (50% SCW + 50% SBR), **C** (75% SCW + urea + 25% SBR), **D** (25% SCW + 75% SBR), **E** (50% SCW + 25% PL + 25% SBR), **F** (75% SCW + urea + 25% PL) and **G** (50% SCW + 50% PL).

Table 2: Chemical composition (%) of ESCW at 7 days

| Parameters | Treatments | | | | | | | LSD |
|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------|
| | A | B | C | D | E | F | G | |
| DM | 94.40 ^a | 90.80 ^f | 91.51 ^e | 92.27 ^d | 89.72 ^g | 92.81 ^c | 94.29 ^b | 0.016 |
| CP | 14.22 ^d | 20.78 ^a | 12.03 ^f | 16.41 ^c | 14.22 ^d | 13.13 ^e | 19.69 ^b | 0.015 |
| CF | 20.60 ^d | 20.52 ^e | 24.33 ^a | 19.28 ^g | 19.67 ^f | 21.25 ^c | 21.74 ^b | 0.04 7 |
| EE | 4.90 ^d | 5.26 ^b | 5.93 ^a | 4.80 ^e | 4.62 ^f | 4.10 ^g | 5.05 ^c | 0.015 |
| Ash | 4.07 ^f | 3.55 ^g | 4.67 ^c | 4.77 ^b | 4.25 ^e | 4.56 ^d | 5.31 ^a | 0.016 |
| NFE | 95.10 ^d | 94.74 ^f | 94.07 ^g | 95.20 ^c | 95.38 ^b | 95.90 ^a | 94.74 ^e | 0.018 |
| OM | 90.33 ^a | 87.25 ^e | 86.84 ^f | 87.50 ^d | 85.47 ^g | 88.25 ^c | 88.98 ^b | 0.025 |
| ME kcal/kg | 4299.09 ^d | 4558.19 ^a | 4266.05 ^f | 4375.57 ^c | 4286.35 ^e | 4222.49 ^g | 4508.31 ^b | 1.038 |
| NDF | 62.00 ^b | 67.00 ^a | 59.00 ^c | 57.00 ^d | 59.00 ^c | 60.00 ^c | 67.00 ^a | 1.621 |
| ADF | 29.00 ^b | 31.67 ^a | 29.00 ^b | 27.00 ^c | 29.00 ^b | 27.00 ^c | 33.00 ^a | 1.666 |
| Lignin | 6.78 ^g | 9.87 ^b | 7.94 ^e | 8.31 ^d | 8.77 ^c | 7.87 ^f | 11.01 ^a | 0.018 |
| Cellulose | 22.22 ^a | 22.13 ^a | 21.06 ^{ab} | 18.69 ^c | 20.23 ^{bc} | 19.13 ^c | 21.99 ^a | 1.753 |
| Hemicellulos | 33.00 ^b | 35.00 ^a | 30.00 ^c | 30.00 ^c | 30.00 ^c | 33.00 ^b | 34.00 ^{ab} | 1.986 |

^{a,b,c,d,e,f,g} Means with different superscripts within the same row are significantly different (P<0.05).

A (100% SCW + urea), **B** (50% SCW + 50% SBR), **C** (75% SCW + urea + 25% SBR), **D** (25% SCW + 75% SBR), **E** (50% SCW + 25% PL + 25% SBR), **F** (75% SCW + urea + 25% PL) and **G** (50% SCW + 50% PL).

DM = Dry matter; CP = Crude protein; CF = Crude fibre; EE = Ether extract; NFE = Nitrogen free extract; OM = Organic matter; ME = Metabolisable energy; NDF = Neutral detergent fibre; ADF = Acid detergent fibre.

Table 3: Chemical composition (%) of ESCW at 14 days

| Parameters | Treatments | | | | | | | LSD |
|--------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------|
| | A | B | C | D | E | F | G | |
| DM | 92.34 ^c | 91.89 ^e | 90.93 ^f | 92.57 ^b | 91.91 ^d | 94.13 ^a | 91.92 ^d | 0.018 |
| CP | 15.64 ^e | 21.88 ^b | 13.13 ^f | 17.50 ^c | 16.41 ^d | 16.41 ^d | 22.97 ^a | 0.018 |
| CF | 21.45 ^d | 18.31 ^f | 26.57 ^a | 21.15 ^e | 21.90 ^c | 18.13 ^g | 23.80 ^b | 0.018 |
| EE | 7.26 ^a | 6.07 ^c | 5.50 ^e | 6.09 ^b | 4.43 ^g | 5.89 ^d | 4.59 ^f | 0.018 |
| Ash | 7.86 ^a | 4.47 ^d | 3.77 ^e | 3.75 ^f | 2.85 ^g | 5.89 ^b | 4.59 ^c | 0.018 |
| NFE | 92.74 ^g | 93.93 ^e | 94.50 ^c | 93.91 ^f | 95.57 ^a | 94.11 ^d | 95.41 ^b | 0.018 |
| OM | 84.48 ^f | 87.42 ^c | 87.16 ^d | 88.82 ^b | 89.06 ^a | 85.48 ^e | 87.15 ^d | 0.02 |
| ME kcal/kg | 4459.01 _d | 4635.75 _a | 4286.06 _g | 4474.59 _c | 4358.74 _f | 4425.17 _e | 4608.74 _b | 1.534 |
| NDF | 65.67 ^b | 68.00 ^a | 60.00 ^e | 62.00 ^d | 62.00 ^d | 64.00 ^c | 63.00 ^{cd} | 1.666 |
| ADF | 31.00 ^{bc} | 31.00 ^{bc} | 30.00 ^c | 31.00 ^{bc} | 33.00 ^a | 31.00 ^{bc} | 32.00 ^{ab} | 1.621 |
| Lignin | 9.21 ^c | 8.88 ^d | 8.18 ^g | 9.98 ^b | 8.45 ^e | 8.29 ^f | 11.12 ^a | 0.018 |
| Cellulose | 21.79 ^{bc} | 22.12 ^{bc} | 21.82 ^{bc} | 21.02 ^c | 24.55 ^a | 22.71 ^b | 20.88 ^c | 1.634 |
| Hemicellulos | 34.67 ^b | 37.00 ^a | 30.00 ^d | 31.00 ^{cd} | 29.00 ^d | 33.00 ^{bc} | 31.00 ^{cd} | 2.228 |

^{a,b,c,d,e,f,g} Means with different superscripts within the same row are significantly different (P<0.05).

A (100% SCW + urea), B (50% SCW + 50% SBR), C (75% SCW + urea + 25% SBR), D (25% SCW + 75% SBR), E (50% SCW + 25% PL + 25% SBR), F (75% SCW + urea + 25% PL) and G (50% SCW + 50% PL).

DM = Dry matter; CP = Crude protein; CF = Crude fibre; EE = Ether extract; NFE = Nitrogen free extract; OM = Organic matter; ME = Metabolisable energy; NDF = Neutral detergent fibre; ADF = Acid detergent fibre.

Table 4: Chemical composition (%) of ESCW at 21 days

| Parameters | Treatments | | | | | | | LSD |
|--------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------|
| | A | B | C | D | E | F | G | |
| DM | 93.29 ^e | 91.76 ^f | 93.37 ^d | 95.96 ^a | 95.17 ^b | 94.55 ^c | 90.49 ^g | 0.018 |
| CP | 17.50 ^e | 24.06 ^b | 15.31 ^f | 18.59 ^d | 18.59 ^d | 19.69 ^c | 27.34 ^a | 0.017 |
| CF | 19.71 ^f | 21.85 ^d | 25.62 ^a | 22.89 ^c | 21.56 ^f | 17.42 ^g | 23.79 ^b | 0.018 |
| EE | 6.54 ^a | 4.67 ^c | 3.70 ^g | 3.93 ^f | 4.03 ^e | 4.85 ^b | 4.22 ^d | 0.016 |
| Ash | 6.73 ^b | 4.38 ^d | 4.12 ^e | 3.49 ^f | 2.79 ^g | 7.48 ^a | 4.41 ^c | 0.015 |
| NFE | 93.46 ^g | 95.33 ^e | 96.32 ^a | 96.07 ^b | 95.97 ^c | 95.15 ^f | 95.78 ^d | 0.017 |
| OM | 86.56 ^f | 87.38 ^d | 89.25 ^c | 92.47 ^a | 92.38 ^b | 87.07 ^e | 86.08 ^g | 0.02 |
| ME kcal/kg | 4495.07 _d | 4652.71 _b | 4285.53 _g | 4416.65 _f | 4421.20 _e | 4499.21 _c | 4753.59 _a | 1.661 |
| NDF | 65.00 ^c | 70.00 ^a | 61.00 ^d | 64.00 ^c | 64.00 ^c | 62.00 ^d | 67.00 ^b | 1.751 |
| ADF | 31.00 ^c | 34.00 ^b | 27.00 ^d | 31.00 ^c | 32.00 ^c | 31.00 ^c | 36.00 ^a | 1.751 |
| Lignin | 10.02 ^d | 11.32 ^a | 9.04 ^f | 10.02 ^d | 10.21 ^b | 9.07 ^e | 10.14 ^c | 0.018 |
| Cellulose | 20.98 ^b | 22.68 ^b | 17.96 ^c | 20.98 ^b | 21.79 ^b | 21.93 ^b | 25.86 ^a | 1.746 |
| Hemicellulos | 34.00 ^{ab} | 36.00 ^a | 34.00 ^{ab} | 33.00 ^{bc} | 32.00 ^{bc} | 31.00 ^c | 31.00 ^c | 2.093 |

^{a,b,c,d,e,f,g} Means with different superscripts within the same row are significantly different (P<0.05).

A (100% SCW + urea), B (50% SCW + 50% SBR), C (75% SCW + urea + 25% SBR), D (25% SCW + 75% SBR), E (50% SCW + 25% PL + 25% SBR), F (75% SCW + urea + 25% PL) and G (50% SCW + 50% PL).

DM = Dry matter; CP = Crude protein; CF = Crude fibre; EE = Ether extract; NFE = Nitrogen free extract; OM = Organic matter; ME = Metabolisable energy; NDF = Neutral detergent fibre; ADF = Acid detergent fibre.