EXTENDED ABSTRACT

ASSESSING THE CONTRIBUTION ON METHANE PRODUCTION OF THREE FODDERS DURING THE *MAHA* SEASON IN SRI LANKA

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Abstract

The present study was conducted to evaluate CH_4 emission and *in-vitro* rumen characteristics of two hybrid Napier (*Pennisetum perpureum* x *P. americanum*) varieties (CO-3 and CO-4) and a fodder sorghum variety (*Sorghum bicolor* var. Sugargraze). Fodder samples were collected at three harvesting intervals as 4, 6 and 8 weeks during *Maha* season in low country wet zone, Sri Lanka. They were analyzed for Metabolizable energy (ME), Organic matter digestibility (OMD) and CH_4 production by *in-vitro* gas production technique. The data were analyzed using General Linear Model procedure. ME content and OMD gradually declined ($p<0.05$) while methane production increased ($p<0.05$) with increasing harvesting interval for all three varieties. Compared with Hybrid Napier varieties, sugargraze recorded the greatest ME content (9.13, 8.65, 8.08 MJ/kg DM) and OMD (62.58, 59.05, 54.88 %) and lowest ($p<0.05$) methane production (10.05, 12.13, 14.33 mg/g digested DM) at 4, 6 and 8 weeks harvesting interval, respectively. Sugargraze is superior to CO-3 and CO-4 in terms of higher ME content and OMD and lower CH_4 production.

Keywords: Sugargraze, hybrid Napier, methane, organic matter digestibility, metabolizable energy

1. Introduction

Methane (CH_4) is the most publicized greenhouse gas (GHG). According to the Environmental Protection Agency (2010), CH_4 is 21-25 times effective as a GHG compared to carbon dioxide (CO_2). Cattle produced approximately 24.8% of global enteric CH_4 production (Chase, 2014) and thus greatly contribute to the climate change. Methane is produced during the microbial fermentation of amino acids in ruminants by methanogenic microorganisms. About 8% gross energy in ruminant feed is estimated to be lost due to enteric CH_4 production. Thus, besides the effect on climate change, CH_4 emission has a direct impact on reducing the production potential of ruminants. Reduction of enteric CH_4 production could avail partitioned of more energy to increase milk production and body weight and by contributing less to the global warming.

Forage quality has a direct impact on the yield of ruminants and enteric methane emissions and that improving forage quality is one of the best feed manipulation methods (Boadi et al., 2004). According to Bruinenberg et al. (2002) and Nkrumah et al. (2006), milk production and body

weight gain of cattle could be increased by 1L/d and 75g/d, respectively, by reduction of 25% enteric CH_4 production. Several improved fodder varieties have been recently introduced to the country to improve nutritional status of dairy cattle. Hybrid Napier varieties CO-3, CO-4 and fodder sorghum variety sugargraze are among them. These perennial Napier fodder varieties are superior to other fodder varieties grown in Sri Lanka in terms of tillering and regeneration ability, green forage yield, leaf to stem ratio, crude protein and dry matter content, palatability, resistant to pests and diseases and free from adverse factors (Premaratne and Premalal, 2006). Sugargraze is a newly introduced hybrid sorghum variety for green chop and hay (Thomas and Cobill, 2008). This study was conducted to assess the impact of harvesting interval (i.e. 4, 6 and 8 weeks) on organic matter digestibility (OMD), metabolizable energy (ME) and CH_4 emission of CO-3, CO-4 and sugergraze in ruminants during the *Maha* season in Sri Lanka.

2. Materials and method

Forages (CO-3, CO-4 and sugargraze) varieties grown at Agriculture Research Farm - Kamburupitiya, University of Ruhuna were harvested at 4, 6 and 8 weeks interval during the *Maha* season (October - February) 2018. The experimental design was a Randomized Complete Block Design (RCBD) in a factorial arrangement with 3 replicates. Forage samples were assessed for *in-vitro* OMD, ME and CH_4 production at 24 hours fermentation (Menke and Steingass, 1988) at Veterinary Research Institute (VRI), Gannoruwa, Peradeniya. The pressure inside the *in-vitro* syringes at 24 hours fermentation was measured using a manometer. Then the *in-vitro* syringe was connected to an empty syringe at atmosphere using a valve and the gas was pulled into the empty syringe. When all the gas was collected the gas was diluted with atmospheric air up to 100 mL. Using a gas analyzer the diluted CH_4 in the syringe was measured as a percentage. Finally, the amount of CH_4 was calculated as mg CH_4/g forage sample digested (Chaves et al., 2006).

3. Results and Discussion

3.1 Metabolizable energy and Organic Matter digestibility

The ME content and OMD were declined ($p<0.05$) with increasing harvesting interval in all forage varieties. Compared with Hybrid Napier varieties, sugargraze recorded the highest ($p<0.05$) ME content and OMD at three harvesting intervals indicating the highest potential to provide energy for maintenance and production of ruminants. The lowest ($p<0.05$) ME content and OMD were recorded in CO-3 at 4 and 6 weeks harvesting intervals whilst there was no difference ($p>0.05$) between CO-3 and CO-4 at 8 weeks. Present ME contents were comparable with those of Garg et al., (2012) for variety CO-4 (7.90–8.87MJ/kg DM) and variety CO-3 (6.72–7.45MJ/kg DM). The reduction of OMD along with the increasing harvesting interval in present results may be due to the high fiber content with the maturity of forage. As the dearth of information on researches on ME content and OMD of fodder species in Sri Lanka, present results were incapable to compare in Sri Lankan conditions.

3.2 Methane production

The CH_4 production from all forage varieties was increased with the increasing harvesting interval. There was no difference ($p>0.05$) in CH_4 production among the three varieties at the 4 weeks harvesting interval. The greater ($p<0.05$) CH_4 production was recorded in CO-3 at 6 weeks while no difference ($p>0.05$) between CO-4 and sugargraze. Methane production was lowest ($p<0.05$) in sugargraze at 8 weeks while it was not different ($p>0.05$) between CO-3 and CO-4 varieties. Present CH_4 production from CO-4 harvested at 4 weeks (11.7 mg/g digested DM) was comparable with Meale et al., (2012) as 11.6 mg/g digested DM whereas, CH_4 production from forage harvested at 6 and 8 weeks were higher than the reported values.

According to Shibata and Terada, (2010) CH_4 production tends to increase as the fiber content of feed increases. In this study accretion of CH_4 production with increasing harvesting interval may be due to the increase of fiber content. Increasing fiber content leads to reduce forage intake and fermentability, resulting in enhancement of CH_4 production per unit organic matter digested (Wilson and Mertens, 1995). The lowest fiber content and highest crude protein content of sugargraze may account for lowest methane productions (Shibata and Terada, 2010) in the present study. Although, the extent of plant secondary metabolites such as condensed tannin and saponins was not examined in the present study, they may also account for lower CH_4 production of sugargraze. Tiemann et al., (2008) described that presence of tannins can reduce CH_4 production by binding with proteins, thereby deduct degradation of plant protein in the rumen resulting low fiber digestion as well. In addition, Van Kessel and Russell (1996) indicated the ability to promote the production of propionate in the rumen by feeding forages with high soluble carbohydrates. Thus, reduction of CH_4 production per unit organic matter digested by lowering of ruminal pH and inhibition of methanogens could be ensured.

Production of CH_4 has a negative influence on animal productivity. Thus, reduction of CH_4 production is an essential strategy to improve the production performance of ruminants. Chaves et al., (2006) investigated that diet quality has an impact on CH_4 production when low concentrations of non-fibrous carbohydrates are in legumes and grass. In addition, Boadi and Wittenberg (2002) stated that 25% of higher CH_4 production in low-quality diets when compared with medium or high nutritional quality diets.

4. Conclusion

It can be concluded that sugargraze is superior to CO-3 and CO-4 in terms of higher ME and OMD and lower CH_4 production. Further, sugargraze should be harvested between 6-8 weeks and CO-3 and CO-4 can be recommended to harvest at 6 weeks intervals.

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