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Research Application Summary

Intensification of pastures in the tropics should consider Enteric Methane Emission to the environment to save the climate: An *in vitro* CH_4 analysis from common intensified range pastures in Kenya

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Abstract

Livestock production in the tropics contributes significantly to climate change through enteric emissions compared to in the developed continents. This is mostly attributed to the feed quality, extensive production systems, and the husbandry practices employed in Africa. Efforts to reduce these emissions have been the call in the recent parts, with prospects in finding environmentally friendly feeding systems. The need to explore available feed resource with potential for reduced emissions and increased production is paramount in Africa. This study evaluated local intensified range grasses in Kenya in comparison to temperate feeds with regards to *in vitro* CH4 emissions. Varying emission levels were noted from the test grass species. Breeding could help reduced emissions as observed in Bracharia hybrid. A few local grasses species have great potential like *Panicum maximum* and *Cecnchrus celiaris* which showed lower CH_4 emission, and higher digestibility compared to Bracharia and rye grass. Future breeding efforts should consider local species and select for low enteric emission potential for the benefit of our environment.

Key words: Africa, climate change, greenhouse gas emissions, livestock, pastures

Résumé

La production du bétail sous les tropiques contribue de manière significative au changement climatique, et bien-sûr à travers les émissions entériques comparativement aux régions développées. Ceci est principalement dû à la qualité des aliments, aux systèmes extensifs de production et aux pratiques d'élevage utilisées en Afrique. Récemment, des efforts en faveur de la réduction de ces émissions ont fait l'objet d'appel, avec comme perspectives l'identification des systèmes d'alimentation respectueux de l'environnement. La nécessité d'explorer les ressources alimentaires disponibles ayant un potentiel de réduction des émissions et de production accrue est primordiale en Afrique. La présente étude a évalué les émissions de CH_4 in vitro des graminées locales intensifiées au Kenya en comparaison

avec les aliments tempérés. Des niveaux d'émission variables ont été notés chez les graminées testées. La sélection pourrait aider à réduire les émissions, comme cela a été révélé chez l'hybride de Bracharia. Certaines espèces de graminées locales possèdent un grand potentiel comme le *Panicum maximum* et *Cecnchrus celiaris* qui ont montré des émissions plus faibles de CH_4, et une digestibilité plus élevée que celle du Bracharia et du seigle herbe. Les prochains travaux sur la sélection devraient tenir compte des espèces locales ayant un faible potentiel d'émission entérique pour le bien être de notre environnement.

Mots clés: Afrique, bétail, changement climatique, émissions de gaz à effet de serre, pâturages

Introduction

Livestock production in the tropics contributes immensely to food security and livelihoods especially in the arid and semi-arid rangelands (ASARLs) of eastern Africa. Ruminants are known to be major contributors to climate change and global warming from methane emissions (CH_4). Enteric emissions from livestock are estimated at 17 and 3.1 % of global CH_4 and other greenhouse gas (GHG) emissions, respectively (Knapp *et al*., 2014). There is an increasing environmental conservation concern from livestock production perspective, which calls for urgent need to develop strategies that increase production efficiency while reducing CH_4 and other GHGs.This study evaluated the CH_4 emission levels of ruminants fed on seven range grasses selected mainly on the basis of biomass yields and soil conservation potential. We hypothesized that variations in CH_4 emission levels by ruminants due to feeding on the different grasses. Ultimately, this would aid in the selection of target species for intensification. The grass species evaluated were *Chloris roxburghiana, Eragrostis superba, Enteropogon macrostachyus, Cenchrus ciliaris, Bracharia hybrid* cv. Mulati II) and *Pennisetum purpureum*. The study was conducted in Kenya. *Bracharia hybrid* and *Cenchrus ciliaris* have high potential for reducing methane emission.

Research methodology

The experiment was done in Aberystwyth University, Institute of Biological, Environmental and Rural sciences, UK. The study sample materials were obtained from Kenya. Samples were freeze dried and ground though 1mm hummer mill sieve. In vitro methane gas production techniques (GPT) was used (Theodorou *et al*., 1994). Grass samples were incubated with rumen fluid and buffer solution at 39^0C; followed by measurements of CH4 produced at intervals of 3 hours for a period of 120 hours. A gas analyser (ADC 5000 series, ADC Gas Analysis Ltd., Hoddesdon, UK) was used to determine proportions while apparent digestibility was determined using vacuum filtration method. Data were subjected to the general linear model (GLM) procedures where multiple comparisons among means were carried out by procedures of Tukey at 5% confidence level.

Results

The highest total CH_4 production was observed in rye grass silage and *Panicum maximum* at 32.9 and 31.3mls, respectively. These volumes were significantly higher ($p<0.05$) than gas produced from the rest of the grasses (Fig. 1). Interestingly, the volume of CH_4

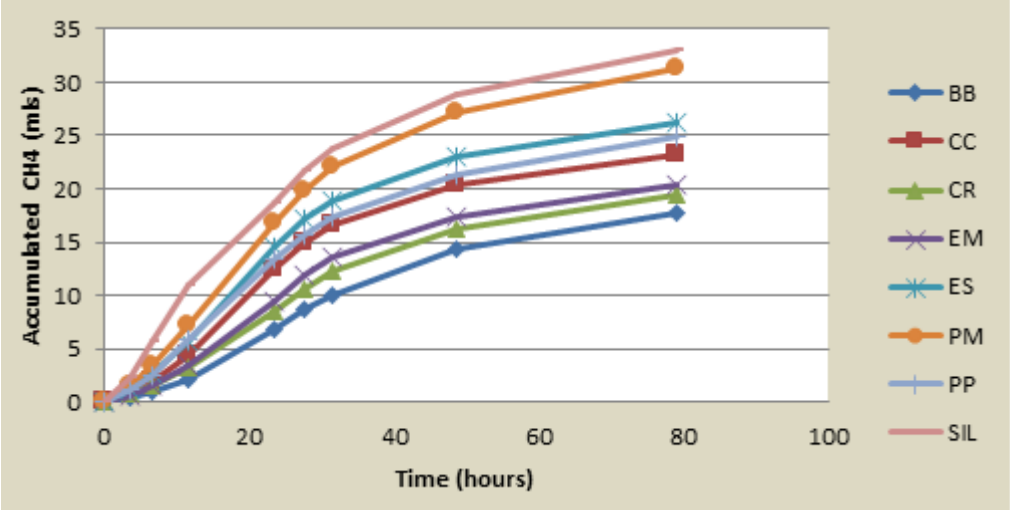

Figure 1. Accumulated CH_4 gas produced during the in-vitro gas produced measurements period for the eight grass species. Key: BH (mulatoII) = Bracharia hybrid Cv. Mulato II), CC = Cenchrus ciliaris, CR = *Chloris roxburghiana*, EM= *Enteropogon macrostachyus,* ES = *Eragrostis superba,* PM=*Panicum maximum,* PP = *Pennisetum purpureum,* SIL-PRye= Silage from *Lolium perenne (Perennial ryegrass)*

produced per gram of DM digested from rye grass silage and *Panicum maximum* was not significantly different ($p>0.05$) from CH_4 produced per g DM digested from *Chloris roxburghiana, Enteropogon macrostachyus, Eragrostis superba,* and *Pennisetum purpureum* despite them having higher % DMD (Fig. 2). Bracharia hybrid and *Cenchrus ciliaris* had significantly ($p<0.05$) lower CH_4 production of 36.2 and 46.0 mls, respectively, per g of DM digested compared to the rest of the grasses. Rye grass silage and Panicum maximum had significant higher percent dry matter digestibility (% DMD) of 69.3 and 66.7%, respectively compared to the other grass species. This was followed by *Bracharia hybrid* and *Cenchrus ciliaris* with 57.6 and 56.4% DMD and were significantly different ($p<0.05$) from the latter two species.

Discussion

The study demonstrates varying CH_4 emissions from different grass species and that there are benefits in terms of reducing emissions by breeding as shown by the *Bracharia* hybrid. There is great potential on existing local grasses species like *Panicum maximum* and *Cecnchrus celiaris* with respect to lower CH_4 emissions and higher digestibility, respectively. Breeding programmes to improve these species is recommended. Notably, the highly promoted *Eragrostis superba,* and *Pennisetum purpureum* (Mganga *et al*., 2015), contributed more to CH_4 production. From the study results, *Bracharia* hybrid and *C. ciliaris* have demonstrated their importance in the tropics due to their lower CH_4 production per g of DM digested followed *P. maximum*.

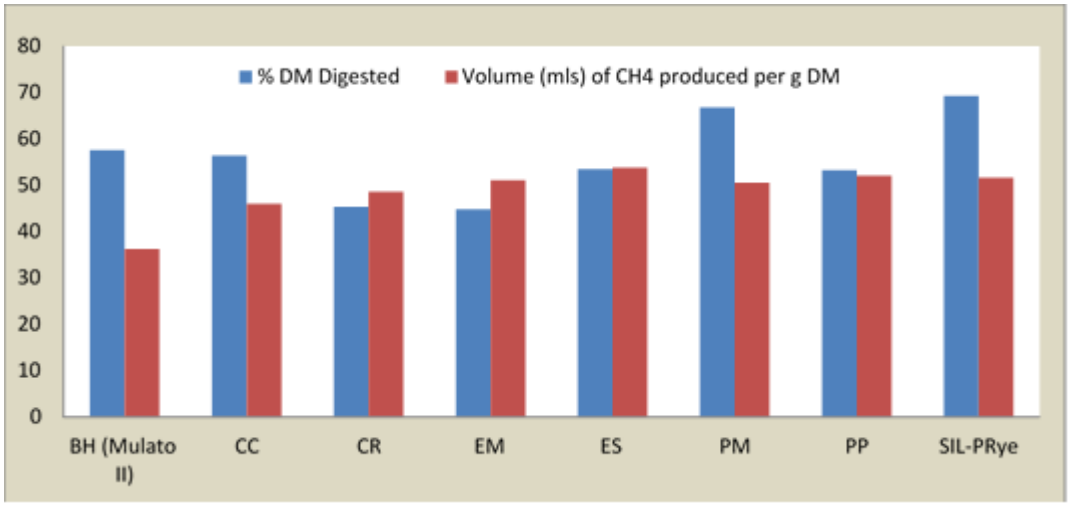

Figure 2. Volume (mls) of CH_4 gas produced per gram of DM digested in relation to % DM digested for the eight grass species. Key: BH (Mulato II) = *Bracharia* hybrid Cv. Mulato II), CC= *Cenchrus ciliaris,* CR = *Chloris roxburghiana,* EM = *Enteropogon macrostachyus,* ES = *Eragrostis superba,* PM = *Panicum* maximum, PP= *Pennisetum Purpureum,* SIL-PRye = Silage from *Lolium perenne (Perennial ryegrass)*

The findings suggest that future agricultural intensification programmes should consider species with potential to reduce enteric CH_4 for sustainable development of livestock-crop intensification.

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