PLANT SECONDARY COMPOUNDS: A VIABLE OPTION FOR MITIGATING ENTERIC METHANE EMISSION IN NIGERIA

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ABSTRACT

This paper highlights the role of ruminants as important contributors to global warming through enteric methane emission with a focus on Africa and Nigeria in particular. It goes on to identify the dearth of research emanating from the country towards developing strategies for mitigating enteric methane emission despite the large ruminant population. The process of methane production by ruminants is briefly described along with the different strategies used for mitigating it. The paper proposes the use of plant secondary compounds as a good potential option of mitigating enteric methane for a country like Nigeria. The need for equipment for measuring enteric methane production in developing any effective strategy was raised. The paper was concluded by calling on scientists and researchers to conduct more research on developing strategies for mitigating enteric methane production; and on government on the need for a policy framework towards achieving this aim.

Keywords: ruminants, methane mitigation, plant secondary compounds, Nigeria.

INTRODUCTION

Ruminant production is very important in Nigeria which has the highest amount of cattle, sheep and goats in Africa with estimates totaling approximately 130 million in 2014 (FAO, 2016). Ruminant animals play numerous economic and social roles in the lives of rural farmers in Nigeria in terms of food, income, security and other festive and ceremonial activities However, ruminant production is said to contribute to the global green house gas emission which contributes to global warming (Moss *et al*., 2000). Ruminant animals produce large amount of methane which is the second most problematic green house gas. Over the years, much effort have been put into mitigating global methane emission but despite that little effort is seen in Africa towards mitigating methane emission. Developing methane mitigation strategies form one of important components of reducing methane emission. In Africa, particularly sub Saharan African very little effort is being put in terms of research towards developing strategies for mitigating enteric methane emission. This is especially true of Nigeria as evidenced by little research literature on the subject matter originating from the country. Nigeria has the highest estimated population of ruminants in Africa and this implies that she may also be the highest enteric methane producer in the continent. With the evident dangers of this on global warming, it becomes necessary for the country take responsible steps in lowering its enteric methane production especially that the country has signed the Paris climate change agreement on lowering methane production in 2017.

METHANE PRODUCTION BY RUMINANTS AND STRATEGIES FOR MITIGATING IT

Ruminant animals are able to utilize forage to obtain their energy requirement but in this natural process, methane is released as a bi-product into the atmosphere as a result of forage degradation in the rumen (Morgavi *et al*., 2011). The rumen is a large fermentation vat which habours millions of various species of bacteria, fungi, protozoa and archaea. Forage ingested by ruminants is broken down by enzymes produced by bacteria, fungi and protozoa into volatile fatty acids (VFAs), carbon dioxide (CO_2) and hydrogen (H_2) (Moss *et al*., 2000). Archaea in turn reduces the CO_2 produced into methane (CH_4) using H_2 in process known as methanogenesis (Morgavi *et al*., 2011). Apart from the negative environmental impact, enteric methane production represents a loss of energy for ruminants estimated up to about 2-12% of GE intake Johnson and Johnson (1995). Various approaches for mitigating

enteric methane production have been described by Hristov *et al*., (2013) to include dietary strategies, breeding, vaccination, and management.

Among the strategies for mitigating enteric methane emissions, dietary manipulation using plant secondary compounds (PSC) is one of the promising options that can be explored in Africa and Nigeria in particular. This is because they are contained in many forages which are widely abundant in the country making it a cheap option and one that can easily be accepted and adopted into the local ruminant production systems. Plant secondary compounds are several chemical compounds produced by plants which are not directly involved in their growth and other vital processes. Some of these compounds like tannins, saponins and essential oils have been found to reduce methane production in ruminants. Many tropical plants used as forage contain high quantities of these compounds thus providing an opportunity for developing dietary strategies for mitigating enteric methane production in the region.

Table 1 Nigerian forages containing PSC with anti methanogenic effect

Acacia tortilis, Moringa olifera, Leucaena lecocephala and *Zizifus mucronata*	Njidda and Nasiru, (2010)
Albezia rhizonse and *Albezia lebeck*	Babayemi *et al*., (2004)
groundnut shell	Akinfemi *et al*., (2012)
Flemingia macrophylla	Asaolu *et al*., (2014)
Syndrella nodiflora	Isah *et al*., (2012)
Essential oils from orange, tangerine, goat weed and African basil	Bamikole, (2015)
Gliricidia sepium and *Brachiaria ruziziensis*	Meale *et al*., (2012)
Acacia nilotica, Guiera senegalensis and *Lannea. acida*	Lawal *et al*., (2017 unpublished)

In developing any strategy for mitigating methane emission, a very important requirement is the ability to measure methane production. Several methods have been developed for measuring and estimating methane production from ruminants. These include:

Lab based in vitro incubation

Open circuit respiration chambers

Ventilated hood

SF6 tracer

Polyethylene tunnel

Open path laser

Greenfeed emission monitoring apparatus

Portable accumulation chambers

These methods have been extensively described by Makkar and Vercoe (2007), Goopy *et al*., (2016) and Hill *et al*., (2016). Lab based in vitro incubation methods like Hohenheim Gas Test, Pressure transducer systems and RUSITEC are relatively cheap, rapid and can be used to screen large amount of plant samples for anti-methanogenic properties. These equipments are available in few very universities in Nigeria. However, the open circuit respiration chambers have the greatest accuracy and are said to be the gold standard for measuring methane production from ruminants. To the best knowledge of the author, no such equipment is available in any of Nigeria's universities or research institutes.

CONCLUSION AND RECOMMENDATIONS

Methane is the second most important green house gas which contributes to global warming. Ruminant animals contribute significantly to global methane emission. Nigeria which has the highest estimated population of ruminants is likely to be the highest emitter of enteric methane in Africa. Very little effort is being done to curb enteric methane emission in the country in terms of developing strategies. More research is needed to develop strategies for cutting enteric methane emission. Plant secondary compounds are a promising option for developing strategies for cutting enteric methane emission in Nigeria. The ability to measure enteric methane emission is very necessary in developing effective strategies for cutting methane emissions. Equipment necessary for measuring enteric methane emission should be provided in universities and research institutes in various regions in the country. This paper is call on fellow scientists and researchers to conduct more researches in this area with a view to developing strategies of cutting enteric methane emission that is appropriate to our local conditions. For this to be successful, government support is needed in terms of developing a policy framework towards curbing enteric methane emission in the country.

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