Reducing enteric methane emissions from ruminants

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Development of methane mitigation strategies for ruminant production systems in the tropical and sub-tropical regions of South Africa.

Heartwater is caused by the organism Ehrlichia ruminantium which is transmitted by ticks of the Amblyomma species. It affects mainly domestic and wild ruminants and it is controlled by use of a live blood vaccine. Alternative vaccines are required due to the limitations associated with the current vaccine. At ARC-OVI research towards alternative vaccines has been ongoing and one example is the use of DNA vaccines. Previous studies have shown that the DNA vaccines could offer protection in the laboratory but failed in the field where the disease is transmitted by ticks. In the project we investigated the use of a multi-epitope DNA vaccine which is made up of short sequences from different antigens that were shown to be immunogenic. After three inoculations with the multi-epitope DNA vaccine delivered by i.m. injection and the gene gun, none of the sheep survived challenge with E. ruminantium infected ticks. However, when the same multi-epitope DNA vaccine was formulated with an adjuvant, it protected three of the five sheep against tick transmitted E. ruminantium infection. From the project we learnt that when using subunit vaccines like DNA vaccines, it is very important to include appropriate adjuvants in the vaccine formulation in order to improve the immunogenicity of the DNA vaccineQuantifying methane emissions from South African rangelands will enable researchers to develop decision support models which can form part of greenhouse gas mitigation strategies. South Africa is required by the Kyoto protocol to reduce national greenhouse gas emissions. If the methane production potential of South African forages can be accurately predicted it would be possible to manage methane emissions in animal production systems through the choice of pasture species and strategic supplementation and thus increase productivity and profitability. The loss of methane not only contributes to our changing climate, but also presents an opportunity to better efficiency gains in South African agricultural production systems.

The overall objective of the project was to employ the in vitro gas production technique to identify practical methods to mitigate enteric methane emissions appropriate to South African pasture-based production systems.

The aims of the project were to (i) determine the methane production from a range of South African pasture species that represent those utilised in rural and commercial ruminant production systems and (ii) to investigate the extent to which specific pasture components affect enteric methane emissions and (iii) to quantify the in vivo enteric methane production from sheep fed tropical pastures using respiration chambers.

The chemical composition and in vitro CH_4 emission potential of the selected grass species harvested during the project indicated variation between grass species. This presents an opportunity to select grass species that have high nutritional quality and lower CH_4 emissions potential. Physiological maturity had a negative effect on grass quality, with cellulose and lignin content (ADF) peaking during the early bloom stage of both tropical and temperate grass species. The application of nitrogen fertiliser increased grass quality with the CP concentration in temperate grass species showing the highest response to nitrogen fertilisation. The low level of crude protein at maturity beyond the vegetative stage of tropical grasses would make it essential to supplement ruminants grazing these grasses with protein for improved rumen fermentation. The results of this study are only based on one season and further research is needed to describe the changes in chemical composition, feeding values and methane production potential between seasons. Improved grazing management, cultivation of improved grass species and pasture fertilization are possible options to reduce methane emissions from ruminants grazing tropical grasses