Peer Community In
Animal Science

Ruminal microbial degradation of tannin-rich tropical plants and methane production

Antonio Faciola *based on peer reviews by* ***Todd Callaway*** *and* ***Srinivasan Mahalingam***

Moufida Rira, Diego P Morgavi, Milka Popova, Gaelle Maxin, Michel Doreau (2022) Microbial colonization of tannin-rich tropical plants: interplay between degradability, methane production and tannin disappearance in the rumen. Missing preprint_server, ver. Missing article_version, peer-reviewed and recommended by Peer Community in Animal Science. https://doi.org/10.1101/2021.08.12.456105

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Rira et al. (2022) evaluated ruminal degradation of tropical tannins-rich plants and the relationship between condensed tannins disappearance and microbial communities. I found this study relevant because a major limitation for tropical plants utilization by ruminants is their potential reduced nutrient digestion. In this study, authors used leaves from *Calliandra calothyrsus*, *Gliricidia sepium*, and *Leucaena leucocephala*, pods from *Acacia nilotica* and the leaves of *Manihot esculenta* and *Musa* spp., which were incubated in situ in the rumen of dairy cows. An *in vitro* approach was also used to assess the effects of these plants on ruminal fermentation. They observed that hydrolysable and free condensed tannins from all plants completely disappeared after 24 h incubation in the rumen. Disappearance of protein-bound condensed tannins was variable with values ranging from 93% for *Gliricidia sepium* to 21% for *Acacia nilolitica*. This demonstrated some potential for selection and improvements in protein digestion. In contrast, fibre-bound condensed tannins disappearance averaged ~82% and did not vary between plants, which was remarkable. The authors noted that disappearance of bound fractions of condensed tannins was not associated with degradability of plant fractions and that the presence of tannins interfered with the microbial colonisation of plants. Each plant had distinct bacterial and archaeal communities after 3 and 12 h of incubation in the rumen and distinct protozoal communities at 3 h. This suggests a great deal of specificity for microbial-plant interactions, which warrants further evaluation to consider also animal contributions to such specificity. Adherent communities in tannin-rich plants had a lower relative abundance of fibrolytic microbes, notably *Fibrobacter* spp. Whereas, archaea diversity was reduced in

high tannin-containing *Calliandra calothyrsus* and *Acacia nilotica* at 12 h of incubation. Concurrently, *in vitro* methane production was lower for *Calliandra calothyrsus*, *Acacia nilotica* and *Leucaena leucocephala* although for the latter total volatile fatty acids production was not affected and was similar to control. Finally, the study demonstrated that the total amount of hydrolysable and condensed tannins contained in a plant play a role governing the interaction with rumen microbes affecting degradability and fermentation. The effect of protein- and fibre-bound condensed tannins on degradability is less important. The major limitation of the study is the lack of animal validation at this stage; therefore, further studies are warranted, especially studies evaluating these plants in vivo. Furthermore, mechanisms associated with plant-microbial specificity, the role played by the host, and more data on nutrient utilization and gas production should be investigated. Nonetheless, this work show interesting microbial colonization and specific plant-microbial relationships that are novel in the ruminal environment.

References:

Rira M, Morgavi DP, Popova M, Maxin G, Doreau M (2022). Microbial colonization of tannin-rich tropical plants: interplay between degradability, methane production and tannin disappearance in the rumen. bioRxiv, 2021.08.12.456105, ver. 3 peer-reviewed and recommended by Peer Community in Animal Science. https://doi.org/10.1101/2021.08.12.456105

Reviews

Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.1101/2021.08.12.456105

Authors' reply, 20 December 2021

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Decision by Antonio Faciola, posted 29 December 2021

recommendation

Two reputable reviewers have reviewed this manuscript and have recommended publication based on the quality of the work, novelty, and value to the scientific community. I agree with them. They have also pointed out a few items that must be addressed before moving forward, I recommend authors to address these issues and the point by point comments as well. Sincerely,

Reviewed by Srinivasan Mahalingam, 21 October 2021

This is a fascinating study with some interesting findings. I would like to thank the authors for their unique contributions.

Initially, two controls were used for the dry matter analysis remaining experiments carry only one control? Explain it.

Is there any result available about the relative abundance of microbiome in respective of bacteria, archaea and protozoa for better understanding of microbiome influence on methane mitigation? Example relative

abundance of microbiome (bacteria (%), archaea (%) and protozoa (%).because not only individual microbes influence the methane production it depends on the composition of bacteria, archaea and protozoa.

It is necessary to determine the effect of Hydrolysable and protein- and fibre-bound condensed tannins interaction with rumen microbiome similarities or dissimilarities (perhaps by MANOVA or PCoA, = Multidimensional scaling, MDS).

The time variation indicates variances between 3 and 12, but what about 24h?

Need to include estimates of error for all measures of alpha diversity. Box plots with error bars would better represent your data.

Overall, data representation in the form of figures would be preferred for comprehension.

Reviewed by Todd Callaway, 18 November 2021

Rumen disappearance of tannins

The title really might be better to focus more on the attachment part, because that's what is really novel here.

This is a neat study looking at ruminal disappearance and impacts on the microbial populations on tropical tannin containing plants in ruminal fermentations. It is a small scale study that is fairly well focused other than an extraneous bit that needs more attachment to the rest of the study. This is a well written study, and it is solid and novel work. It's not groundbreaking but it's on the cutting edge of what we are doing today. The work adds to the body of knowledge and is good science.

Abstract runs a bit long and could be trimmed significantly

L	Comment
85	Font size changes randomly
105	Materials and methods

Figure 1 Make sure to label this as part of the in situ portion.

There really needs to be a stronger connection between why the In vitro is attached to the in situ, it's kind of like an appendix here, that argument needs to be set up. The logic is not clear here, I see why, but it takes a lot of effort from the reader.

I would like to see Supplementary Figure 3 included, this is some neat work to see this kind of correlation that really needs to be out there.