Pitangueira Leaves Effects on Enteric Methane Emission in Adult Sheep

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Introduction

On a global scale, the production of methane (CH_4) from ruminant animals is responsible for 8% of total anthropogenic greenhouse gas emissions (Beauchenin et al., 2008). This production is naturally generated in the ruminal digestion of ingested food. The development of feeding strategies to minimize the emission of enteric CH_4 is therefore desirable to mitigate, over time, emissions of greenhouse gases to the atmosphere and the economic benefits in the short term (Berndt and Tomkins, 2013). Currently, the use of foods with secondary compounds or other natural compounds to minimize methane are under study. Tannins may be found in the plant in soluble or insoluble form and can reduce enteric methane emissions when consumed in significant quantities (Saminathan et al., 2015).

The objective was to evaluate the effect of increasing levels of pitangueira leaves on the individual intake and methane emission adult sheep.

Material and Methods

The experiment was conducted at Embrapa South Livestock (CPPSUL), Bagé, RS, in the period from 08/20/2015 to 09/02/2015. Were used 20 adult sheep barrows, five animals per treatment, with an average initial weight of 40 $\pm$ 7 kg. The basic diet for all treatments was composed of chopped alfalfa hay plus 300 grams of a commercial concentrate with 14% crude protein (CP). The amount of feed was calculated to allow 10% of leftovers daily. The treatments consisted of four levels of inclusion of pitangueira leaves (*Eugenia uniflora*), which is a native fruit tree of the Pampa biome. It was included at 0, 50, 100 and 150 grams. The pitangueira leaves were collected manually in the experimental fields of CPPSUL and subsequently dried in an oven with forced ventilation at 40 °C, homogenized and milled to be offered in different treatments. Feed supply was made in the morning and pitangueira leaves were mixed with the concentrate. Every day the leftovers were weighed for subsequent calculation of individual intake. The animals were kept in metabolic cages. The adjustment period was eight days followed by five days of collection.

On the ninth day, the animals were prepared for methane studies. To measure methane, we used the technique described by Johnson et al., (1994) and adapted by Gere and Gratton (2010) employing sulfur hexafluoride (SF_6) tracer. It was used stainless steel tubes for storage of gases and remained the same for five consecutive days. We used control tubes (n=3) to control for ambient methane. Methane and SF_6 was measured with gas chromatography.

The leaves of pitangueira were analyzed for total phenolic content (TF) and total tannins (TT) expressed as equivalent gram acid tannic.kg of dry matter^{-1} (DM) and condensed tannins (CT) expressed in equivalent gram of leucocyanidin.kg of DM^{-1}.

Daily individual intake and the emission of enteric methane.animals^{-1}.day^{-1} was subjected to regression analysis by the statistical program JMP (JMP version 9.0.0, 2010).

Results and Conclusions

There was no significant difference between treatments for daily individual intake. The literature found divergent results on the influence of condensed tannins on individual intake. This is due mainly to the tannin content in the diet (%) and the different forms of ruminal activities of tannins, which may reduce the digestibility of DM and nitrogen and affect fiber digestion (Batta et al., 2002). While these effects are small, there is no influence on individual intake. Here, condensed tannins present in the pitangueira leaves did not affect the digestibility parameters.

There was no significant difference between treatments for the emission of enteric methane.animals^{-1}. day^{-1}. Vázquez et al. (2016) tested the in vitro effect of including leaves of four different trees and three inclusion levels. There were no significant differences in the type of tree or level of inclusion. The leaves of trees with greater presence of CT showed greater reduction in methane emissions.

The action of condensed tannins on the effect on mitigation of methane emissions, intake and digestibility of food is related to its composition—especially with respect to molecular weight and degree of polymerization. In this sense, Saminathan et al. (2015) tested the effect of five different CT molecular weights purified from the *Leucaena leucocephala* and concluded that the fractions TC that had higher molecular weight and higher degree of polymerization showed greater reduction in methane production, but did not affect the digestibility of dry matter.

Table 1. Daily individual intake and emission of enteric methane from sheep receiving increasing doses of pitangueira leaves.

Treatments	Individual intake (grams of the DM)	Grams of the methane.animals^{-1}. day^{-1}
0 grams of pitanga leaves	1296±95	37,3±4
50 grams of pitanga leaves	1209 ±250	31,9 ±12
100 grams of pitanga leaves	1190 ±224	31,5 ±3
150 grams of pitanga leaves	1158 ±380	28,6 ±13

Means presented are followed by standard deviation.

The pitangueira leaves had 135g/kg DM of total tannins (TT), 153.5 g/kg DM of total phenols and 7.8 g/kg DM condensed tannin (CT), however, the amounts of compounds in the leaves of pitangueira offered to animals were not enough to affect methane. These results may have been influenced by the chemical composition and molecular weight.

The inclusion of up to 150 grams of pitangueira leaves in the diet did not affect the daily individual dry matter intake nor the emission of methane in adult sheep.

References

Berndt, A. and Tomkins, N. W. 2013. Measurement and mitigation of methane emissions from beef cattle in tropical grazing systems: a perspective from Australia and Brazil. **Animal**, 7:363– 372

Bhatta, R., A. K. Shinde, S. Vaithiyanathan, S. K. Sankhyan, and D. L. Verma. 2002. Effect of polyethylene glycol-6000 on nutrient intake, digestion and growth of kids browsing *Prosopis cineraria*. **Anim. Feed Sci. Technol**. 101:45–54

Beauchemin, K.A., Kreuzer, M., O'mara, F., McAllister, T.A., 2008. Nutritional management for enteric methane abatement: a review. **Anim. Prod. Sci.** 48:21–27.

Gere, J.I., Gratton, R. 2010. Simple, low- cost flow controllers for time averaged atmospheric sampling and other applications. **Latin. Am. Appl. Res**., 40, 377-381.

Johnson, K. et al. 1994.Measurement of methane emissions from ruminant livestock using a SF_6 tracer technique. **Environ. Sci. Technol**., 28:359-362.

Vázquez, E.G.; Medina, L.H.; Benavides, L.M.; Caratachea, A.J. Razo, G.S.; Burgos, A.J.A.; Rodrígues, R.O. 2016. Effect of fodder tree species with condensed tannin contentes on in vitro methane production. **Asian-Australasian Journal Animal Science** 29:73-79.

Saminathan, M., Tan, H.Y., Sieo, C.C., Abdullah, N., Wong, C.M.V.L., Abdulmalek, E., Ho, Y.W., 2014. Polymerization degrees: molecular weights andprotein-binding affinities of condensed tannin fractions from a *Leucaena leucocephala* hybrid. **Molecules**. 19:7990–8010.

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