AP 27 Nitrogen in beef cattle excreta as affected by the inclusion of high tannins legume on native grasslands

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Nitrógeno en excretas de ganado de carne afectados por la inclusión de leguminosas con alto contenido de taninos en NG

Introduction

The addition of legume species to native grasslands (NG) is one of the main strategies for intensification of extensive animal production systems, increasing both productivity and nutritive value, protein content in particular (Jaurena *et al.*, 2021). However, since cattle retains less than 20% of ingested nitrogen (N), higher legume content in animals diets can result in higher N excretion and thus increased emissions of N_2O from animal excreta, a powerful greenhouse gas, and risk of groundwater pollution by nitrate leaching.

Lower urinary N excretion mitigates such environmental impacts. Condensed tannins are phenolic compounds found in some herbaceous legumes. When included in ruminants' diet, they reduce ruminal degradation of plant protein and increase protein flow to the intestine which would reduce the proportion of N excreted *via* urine (Stewart *et al.*, 2019).

The objective of this study was to determine to what extent the inclusion of medium and high tannin content legumes in NG affects the excretion of N in feces and urine of beef heifers compared to NG without legumes.

Materials and Methods

The experiment was carried out at the Research and Experimental Center Dr. A. Gallinal (CIEDAG-SUL), Uruguay, from 20/10/21 to 22/11/21. A total of 21 one-year-old crossbred beef heifers (242±7 kg) were randomly assigned to paddocks with NG *vs.* NG plus legumes containing tannin, either *Lotus uliginosus* cv E-Tanin (NG+LE), or *L. subbiflorus* cv El Rincón (NG+LR).

Pasture samples collected before animals entered the paddocks served to characterize forage chemical composition and the proportion of legumes. Titanium dioxide (TiO_2) was used as a marker to estimate dry matter intake (DMI) and fecal output. Individual samples of feces and urine were collected during the last five days of the trial period to determine TiO_2 and N concentrations. The amount of N excreted in feces was calculated as feces output times N concentration in feces.

Data was analyzed using general linear models (R Core Team) to perform ANOVA for a completely random design with 7 replicates, using the Tukey-HSD test to compare treatments (alfa=5%).

Results and Discussion

About 20% of available herbage was legume in NG+LE and NG+LR, while there was no legume in NG (Table 1). Herbage in NG+LE and NG+LR both had higher protein content compared to NG (Table 1). Furthermore, fiber was lower and digestibility higher in herbage in NG+LE compared to NG and to NG+LR, indicating better nutritive value. However, DMI and feces output were similar in all treatments: 4.9 and 2.0 kg DM animal^{-1}d^{-1}, respectively, on average (Table 2).

N excretion in feces was almost 40% higher in NG+LE and NG+LR than in NG. Conversely, N concentration in urine was some 10% lower in NG+LR and NG+LE than in NG. This agrees with previous studies that have shown that tannin-protein complexes formed in the rumen increase fecal N loss and decrease urinary N loss in animals ingesting forages with significant tannins content (Stewart *et al.*, 2019).

Table 1. Forage chemical composition and proportion of legumes in the pastures used in this study on dry matter basis.

	NG	NG+LE	NG+LR	SE
Legume in forage (%)	-	20	21	-
Crude protein (%)	7.3	12	10	1
Nitrogen (%)	1.2	1.9	1.5	0.2
Nitrogen (kg ha^{-1})	12	44	32	-
NDF (%)	69	57	65	4
ADF (%)	39	34	38	1
Digestibility (%)	58	63	59	1
Condensed tannins (%)	-	4.0	6.2	0.6

NG=native grasslands; NG+LE= native grassland with *Lotus* E-Tanin; NG+LR= native grassland with *Lotus* Rincón; NDF (Neutral detergent fiber); ADF (Acid detergent fiber).

Table 2. Dry matter intake (DMI) and nitrogen (N) partitioning in crossbred beef heifers grazing native grasslands (NG), native grassland with *Lotus* E-Tanin (NG+LE) and native grassland with *Lotus* Rincón (NG+LR).

	NG	NG+LE	NG+LR	SE	P
DMI (kg animal^{-1}day^{-1})	4.5	5.1	5.1	0.3	ns
Fecal output (kgDM animal^{-1}day^{-1})	2.0	2.1	1.9	0.2	ns
Feces N conc. (%)	1.9 b	2.4 a	2.5 a	0.1	*
Urine N conc. (g L^{-1})	4.7 a	4.3 ab	4.1 b	0.3	*
N in feces (g animal^{-1}day^{-1})	32 b	45 a	48 a	2	*

SE (Standard error); NS.: Not significant (p>0.05). *: Significant difference (*P*<0.05). Different letters in rows indicate difference between treatments.

Conclusions

The addition of legumes with high tannin content into native grasslands have the potential to alter N partitioning and increase the excretion of N in the feces while reducing the concentration of N in urine. This may contribute to ensure the environmental sustainability of extensive systems since N present in urine is more susceptible to loss (ammonia volatilization, nitrate leaching, nitrous oxide emissions) than organic N present in the feces.

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Reference

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