Effect of Tannins on Nitrogen Cycling In Pasture Soils

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Introduction
Ruminants and pastures contribute significant amounts of nitrous oxide (N₂O), and carbon dioxide (CO₂) to the atmosphere and nitrogen (N) to waterways. Finishing beef cattle on tannin-containing legumes such as birdsfoot trefoil (Lotus corniculatus) and sainfoin (Onobrychis vicifolia) may reduce soil N mineralization, thus increasing overall N retention. Tannins are secondary compounds produced by plants which bind proteins and alkaloids (Waghorn et al. 2008). Here, we observe how tannin and non-tannin containing fecal additions affect soil N cycling processes.

Methods
We performed an 84-day incubation study. Feces from cattle feeding on tannin containing (birdsfoot trefoil (BFT) and sainfoin (SFN)) and non-tannin containing (alfalfa (ALF), cicer milkvetch (CMV), meadow brome grass (MBG), and small burnet (SBN)) hay were added to a pasture soil. A subset of samples were periodically watered to mimic irrigation practices.

Nitrates (NO₃⁻) and ammonium (NH₄⁺) concentrations and N₂O and CO₂ production rates were measured throughout the study.

Figures 1 & 2: Preparing soil samples for incubation

Preliminary Results and Discussion

Panel 1. N₂O and CO₂ production and NO₃⁻ concentration: Tannins and other secondary compounds may inhibit CO₂ production. High N₂O production in sainfoin and birdsfoot trefoil may be due to higher fecal N content. Nitrate decreases corresponded to increases in N₂O production.

Panel 2. Irrigated N₂O production and NO₃⁻ concentrations: N₂O production increased after irrigation on days 0 and 21. N₂O was both produced and consumed on days 42 and 84. Nitrate concentrations were highest after irrigation on day 84, corresponding to higher average non-irrigated soil nitrate.

Conclusions:
Preliminary results suggest that tannins and other secondary compounds may inhibit soil microbial activity and limit nitrate concentrations. Increased fecal N content of tannin treatments may cause slightly higher N₂O production in feces, but divert N from urine hotspots to feces.

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References