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CONDENSED TANNINS IN TROPICAL LEGUMES: CONCENTRATION, ASTRINGENCY AND EFFECTS ON THE NUTRITION OF RUMINANTS

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ABSTRACT
A feeding trial was carried out to determine the effect of extractable condensed tannins (ECT) concentration and tannin astringency in tropical legumes on nitrogen (N) digestion by sheep. Test legumes were *Desmodium ovalifolium* (Do) and *Flemingia macrophylla* (Fm) which had similar concentrations of Extractable CT (9% DM) but tannins with different degree of astringency (Do, 0.6 and Fm, 0.3 g protein bound/g of ECT). Chopped sun-dried forage of each legume was sprayed with either water (control) or polyethylene glycol (PEG, 3.5% DM) to reduce ECT and fed to 8 sheep with ruminal and duodenal canulas arranged in a replicated 4 x 4 Latin Square change-over design. Greater (P<0.05) N flow to duodenum, and fecal N were observed with Fm than with Do. Estimates of escape N were similar (58 to 61%) for both legumes. Reduction of ECT with PEG in both legumes (9.0-9.4 to 4.7-5.4%) resulted in lower (P<0.05) proportion of N reaching the duodenum. Results indicate that concentration of ECT had a greater effect on N digestion by sheep than tannin astringency.

KEYWORDS
Sheep, escape protein, duodenal flow, fecal N

INTRODUCTION
Results with tropical legumes suggest that nutritional benefits may be realized by reducing the concentration of extractable condensed tannins (ECT). Reduction of ECT in *Desmodium ovalifolium* from 5 to 2% resulted in 20% increase in voluntary feed intake and 2.5 fold increase in N retention by lambs (Carulla, 1994). The extent to which these results can be generalized to other tropical legumes is not known. Recent findings have shown large differences among tropical legumes in tannin astringency (i.e. affinity of tannins to protein) (Cano et al., 1994). These differences could affect nitrogen digestion by ruminants. Thus an experiment was carried out to study the influence of ECT and tannin astringency on N digestion by sheep fed tropical legumes.

METHODS
The feeding trial conducted in CIAT's research station in Quilichao, Colombia (N 3°6', W 76°3') involved two test legumes: the herbaceous *Desmodium ovalifolium* Wallick ex Ganep (CIAT 350) and the shrub *Flemingia macrophylla* Kuntze ex Merrill (CIAT 17403). Forage of the two legumes harvested at approximately the same age of regrowth (i.e. one year), was chopped and sun-dried for 4 days. Long-woody stems were hand-separated from the forage.

Eight growing African type whethers fitted with ruminal and duodenal canulas (BW 30 ±2.4 kg) were housed in metabolism crates and assigned by weight into two groups. Whethers within a group were allocated to one of four feeding treatments arranged in a 4 x 4 Latin Square change-over design with experimental periods of 15 days, of which 7 days were for adjustment and 8 days for measurements. Treatments were: (1) *D. ovalifolium*, (2) *D. ovalifolium* + PEG (3.5% DM), (3) *F. macrophylla*, and (4) *F. macrophylla* + PEG (3.5% DM). Animals offered the legume treatments (2.6% BW) were supplemented intraruminally with a starch-extracted cassava meal (0.4% BW). Measurements in the legumes fed, duodenal digesta and feces included Kjeldahl N (AOAC,1975) and indigestible acid detergent fiber as internal flow marker (Waller et al., 1980). Other analyses performed in the forage offered were ECT concentration (Terrill at al., 1992) and tannin astringency by a radial diffussion assay using BSA (bovine serum albumine) as protein source (Haggerman, 1987). Microbial N in ruminal and duodenal digesta was determined using purines as a marker (Zinn and Owens, 1986). Dietary escape N was calculated assuming that endogenous N was proportional to DM intake (2.2 g N/kg DM consumed) which was measured throughout the trial.

RESULTS AND DISCUSSION
As shown in Table 1, N intake was higher (P<0.05) with *F. macrophylla* than *D. ovalifolium*, which is consistent with its higher crude protein level (17% vs 23% DM). Higher N intake when *F. macrophylla* was fed was related to more N (P<0.05) reaching the duodenum, and more (P<0.05) fecal N when compared with *D. ovalifolium*. However, total N reaching the duodenum as a proportion of N intake was higher (P<0.05) in animals fed *D. ovalifolium*. This did not appear to be related to higher proportion of escape dietary N with *D. ovalifolium*, since duodenal NANMIc-N (non-ammonia non-microbial) as proportion of total duodenal N was higher (P<0.05) for *F. macrophylla* (73%) than for *D. ovalifolium* (64%). In addition, calculations showed slightly higher escape N as proportion of intake with *F. macrophilla* (61%) than with *D. ovalifolium (58%)*, but differences were not significant as had been expected on the basis of the astringency assay used.

Reduction of ECT in both legumes with PEG resulted in less (P<0.05) N reaching the duodenum as proportion of N intake. Consequently, N escaping from the rumen was lower in both legumes with reduced ETC concentration (Table 1).

Results suggest that differences between tropical legumes species in tannin astringency as measured in this study had no measurable effect on escape N as had been initially thought. In contrast, reduction of ECT concentration appeared to result in greater protein degradation in the rumen and consequently less escape N.

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Table 1
Nitrogen (N) digestion by sheep fed *Desmodium ovalifolium and Flemingia macrophylla withcontrasting concentrations of extractable condensed tannins (ECT) and tannin astringency.*

Item	*D. ovalifolium*		*F. macrophylla*		SEM
	Control	PEG	Control	PEG	
ECT in forage, % DM	9.4 a	5.4 b	9.0 a	4.7 b	0.4
Tannin astringency (g BSA protein bound/g ECT)	0.6 b	1.0 a	0.3 c	0.7 b	0.03
N intake, g/d	13.9 c	13.9 c	21.5 b	23.6 a	0.5
N duodenal flow, g/d	14.9 b	11.9 c	19.9 a	18.2 a	0.9
N duodenal, % N intake	107.6 a	85.5 c	91.8 b	77.2 d	5.1
NAMNMic-N, g/d	9.5 b	7.1 c	14.5 a	13.0 a	0.8
Fecal N, g/d	7.6 c	5.6 d	10.4 a	8.9 b	0.4
Escape N, % N intake	57.6 a	39.5 c	60.7 a	48.2 b	4.6