Nutritional Value of two Native Shrub Species That Grow in the Tamaulipan Thornscrub from Mexico

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Introduction.

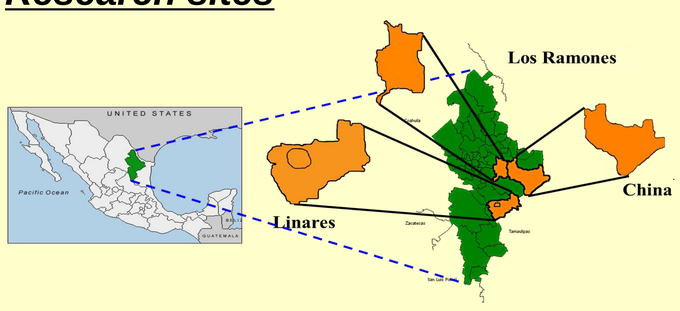
Rangeland owners use native foliage of trees and shrubs species during dry periods, for feeding livestock as green forage, fruits and litter fall. Shrub species of the Fabaceae family, particularly *A. amentacea* and *P. texana* are part of the dominant species at northeastern Mexico (Estrada-Castillón and Jurado, 2005). These species are characterized by having foliage throughout the year, with enough contents of CP and DM for facing the demands of small ruminants grazing in different physiological conditions (Ramirez and Gonzalez, 2010), but only sparse information exists on the nutritive value of these shrubby species.

Objetives.

The objectives of this paper were to estimate the chemical composition and fermentation kinetics of the two shrubby species and in what extent these species can meet the nutritional requirements of ruminants managed in extensive systems.

Materials and Methods.

Research sites



Sites	Altitude (masl)	Vegetation type
1. Los Ramones	200	Tamaulipan thornscrub
2. China	200	
3. Linares	370	

Sampling frequency. Seasonal collection (2009) of mature leaves was undertaken (800 g), at browsing height (1.0-1.5 m) from the 5 most representative individual plants randomly selected of the shrub species *A. amentacea* (a.a.) and *P. texana* (p.t.). Samples were collected from 3 experimental plots (50 m x 50 m) established in each site. Once the samples were dried, at room temperature, leaves were grounded using 1 mm x 1 mm mesh, and stored in labeled plastic containers.

Chemical composition procedures. The dry matter (DM; #934.01), crude protein (CP; #954.01), ether extract (EE; #929.29) and organic matter (OM; #942.05) contents were determined as described by AOAC (1997). The neutral detergent fiber (NDFom) was completed following Van Soest *et al*. (1991).

The condensed tannins. The CT were determined using butanol/HCl (95:5 v/v) and ferric ammonium sulfate (20 g/L 2N HCl) as reagents and leucocyanidin (1 mg/mL aqueous acetone, 700 mL/L) as standard. Absorbance was measured at 550 nm (Makkar, 2003).

Gas production procedure. 500 mg DM samples were incubated in glass syringes using ruminal fluid of three sheep fed alfalfa hay and commercial concentrate (75:25). Two, treatments: one with 1 g Polyethylene glycol (PEG 6000) and other without PEG were used. Gas volume was recorded at 0, 3, 6, 9, 12, 24, 48, 72, 96 h. Data were fitted to the equation $A = b \times (1-e^{-c(t-L)})$; where ***A*** is the total volume of GP (mL/g DM) at time t; ***b*** is the asymptotic GP (mL/g DM); ***c*** is the rate of GP (/h), and ***L*** (h) is the discrete lag time prior to gas production.

IVOMD Digestibility. 250 mg DM samples were processed in a DAISY^{II} digestor for 48 h, washed and refluxed with NDF solution. After that, the partitioning factor (PF) was calculated as the ratio between mg of OM truly degraded after 48h / ml of gas produced at 48h of incubation.

Synthesis of Microbial Protein. After 24 h of incubation, the residue from the syringes was centrifuged at 20,000 x g for 30 min. The recovered pellet was lyophilized and the content of purines was determined (Makkar, 2003).

Metabolizable Energy. was calculated from *in vitro* gas production in accordance with the equation: ME (Mcal/kg DM) = 2.20 + 0.136 GP_{24}h+0.057 CP+0.0029 EE^2; where GP_{24} h is the gas production after 24 h of incubation (mL gas/0.5 g DM); CP is the crude protein (g/kg DM); EE is the ether extract (g/kg DM) (Menke and Steingass, 1988).

Statistical analyses. Data were analyzed by ANOVA for a multifactorial completely randomized design using the Computer statistical software for Windows SPSS (2009, Version 17).

Results.

Values for *A. amentacea* were higher for NDF (42%), CT (19 %), Purines (9 µ mol), PF (6.1) and GEL (6.7 %), whilst *P. texana* was higher in CP (18 %), IVTOMD (82 %), ME (2.1 Mcal/kg DM), A (183 ml), ***c*** fraction (0.071 /h) and L (0.868 h). Addition of PEG increased the ME values, ***A***, ***c*** and ***L***; on the contrary, values of purines and PF decreased. Gross energy losses (GEL) (2.9 to 6.7%), as methane production, was lower than the range reported as normal for feedstuffs. High concentrations of CT are one of the main factors of low nutritional value of forage legumes. However, for the studied species, the values of NDF, CP, IVTOMD, ME, PF and GEL, appear to be sufficient to satisfy the nutritional requirements of small ruminants.

Table 1. Chemical composition, *In Vitro* True Organic Matter Digestibility (IVTOM), Metabolizable Energy and Gross Energy Losses (GEL) of leaves of two native shrub species from northeastern Nuevo Leon, Mexico.

Sites	Species	OM	NDF	CT	CP	EE	IVTOMD	ME		GEL
								-PEG	+PEG	
1	a.a	81.2	47.3	19.0	14.6	1.1	52.4	1.6	1.9	6.5
2	a.a	80.1	49.2	19.6	14.9	1.0	47.7	1.8	1.9	6.8
3	a.a	85.0	50.3	18.3	15.0	1.0	50.9	1.7	1.9	6.7
Mean		82.1	48.9	19.0	14.8	1.0	50.3	1.7	1.9	6.7
SEM		1.48	0.88	0.38	0.12	0.03	1.39	0.06	0.03	0.09
1	p.t	82.1	31.2	10.0	20.3	1.6	83.3	2.1	2.2	2.5
2	p.t	82.3	32.9	9.6	22.0	1.7	82.5	2.1	2.1	2.7
3	p.t	83.7	34.2	9.5	20.1	1.6	79.9	2.1	2.2	3.3
Mean		82.7	32.8	9.7	20.8	1.6	81.9	2.1	2.2	2.8
SEM		0.51	0.87	0.15	0.60	0.03	1.03	0.01	0.06	0.22

a.a= *Acacia amentacea*; p.t= *Parkinsonia texana*; EE= Ether Extract (% DM); GEL= Gross Energy Losses (%, as methane production); SEM =Standard Error of Mean

Table 2. Fermentation characteristics, Purines and Partitioning Factor of leaves of two native shrub species from northeastern Nuevo Leon, Mexico.

Sites	Species	***A***		***c***		***L***		Purines		PF	
		- PEG	+ PEG	- PEG	+ PEG	- PEG	+ PEG	- PEG	+ PEG	- PEG	+ PEG
1	a.a	109	164	0.04	0.06	0.63	0.54	12.8	12.3	5.9	3.5
2	a.a	96	156	0.04	0.06	0.68	0.55	5.7	4.7	6.0	3.3
3	a.a	97	154	0.04	0.06	0.57	0.42	8.0	7.4	6.4	3.7
Mean		101	158	0.04	0.06	0.63	0.50	8.8	8.1	6.1	3.5
SEM		4.1	2.8	0.001	0.002	0.03	0.04	2.1	2.2	0.15	0.12
1	p.t	187	207	0.07	0.09	0.93	1.50	12.0	11.7	4.7	4.2
2	p.t	187	202	0.08	0.09	1.20	1.37	3.6	4.1	4.6	4.2
3	p.t	176	191	0.06	0.08	0.47	1.12	5.1	4.8	4.9	4.4
Mean		183	200	0.07	0.09	0.87	1.33	6.8	6.8	4.7	4.2
SEM		3.8	4.9	0.005	0.005	0.21	0.11	2.6	2.4	0.08	0.09

a.a= *Acacia amentacea*; p.t= *Parkinsonia texana*; SEM= Standard Error of Mean.

Table 3. *P*-values, from one-way ANOVA results for chemical composition and fermentation parameters.

Factors	Months (A)	Sites(B)	Species (C)	A*B	A*C	B*C	A*B*C
Probability	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Conclusions.

The chemical composition and fermentation parameters were affected by seasons and species. *Parkinsonia texana* seems to be better forage than *A. amentacea* because it has higher CP, IVTOMD, ME and it is more rapidly fermentable. Although CT and GEL content is higher in *A. amentacea*, their values of purines and PF lead to higher microbial protein synthesis. Results of this study suggest that both species could be a good combination to supply the nutritional requirements in autumn and winter seasons to adult Spanish goats, at the late gestation and at the beginning of lactation, and for wildlife when the mating and gestation occurs, in the Tamaulipan scrubland from northeastern Mexico.

Los Ramones

China

Linares

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