

in other seasons. Moreover, lignin was significantly lower in summer than in other seasons. Effective degradability DM, EDCP and EDCW were also significantly higher in summer. In all seasons, L fraction resulted with higher nutrient digestion than S fraction. It is recommended that only during the summer season livestock can graze Llano buffelgrass because of its high nutritional quality.

**Key words:** Llano buffelgrass, nutrient content, *in situ* digestibility, Northeastern Mexico.

## **Introduction**

Llano buffelgrass is an apomitic F<sub>1</sub> hybrid developed by AR-SEA-USDA and Texas Agric. Exp. Stn. and released cooperatively with SCS-USDA in 1997. Adaptation of this cultivar is limited to arid areas with mild winters (Bashaw, 1980). Nutritional studies in this region have reported that common buffelgrass (Ramirez *et al.*, 2001a) and Nueces buffelgrass (Ramirez *et al.*, 2001b) have good nutritional quality during summer only for optimal livestock performance.

Even though, Llano buffelgrass has high productive potential, there is no scientific information about seasonal dynamics on nutrient digestion of this grass growing in northeastern Mexico. Moreover, the major factors limiting intake and digestibility are those associated with rate and extent of forage degradation. Thus, the objectives of this study were to estimate and compare seasonally the chemical composition and nutrient digestibility of total plant, leaves and stems of the hybrid Llano.

## **Materials and Methods**

The study area as well as the techniques used for sampling of plants, their chemical composition, nonlinear digestibility parameters and effective degradability of dry matter (DM), crude protein (CP) and cell wall (CW) of TP, L and S are described by Ramirez *et al.* (2001a). Chemical composition and digestion parameters were statistically analyzed using a completely randomized factorial model with four replications. Factor A was plant parts (TP, L, S) and Factor B was the seasons of the year. Moreover, Pearson correlation analysis was

Table 1  
Chemical composition (% DM of the total plant TP), leaves (L) and stems (S)

Table 1  
Chemical composition (% DM) of the total plant (TP), leaves (L) and stems (S)  
of Llano buffelgrass (*Cenchrus ciliaris* L.)

Seasons	Parts	Organic matter	Crude protein	NDF	ADF	Cellu-lose	Hemi-cellulose	Lignin	Insoluble ash
Autumn	TP	90.0	5.5	80.6	53.5	40.1	27.1	9.6	3.7
	L	84.0	8.5	72.3	43.7	34.8	28.6	4.4	4.6
	S	92.1	4.1	84.4	54.0	36.4	30.3	14.6	3.1
Winter	TP	93.2	4.4	87.8	49.7	38.4	38.1	7.8	3.5
	L	89.5	4.9	81.8	46.9	37.5	34.9	3.5	5.7
	S	95.3	3.1	88.5	52.6	39.3	35.9	11.3	2.2
Spring	TP	92.5	3.5	80.6	51.2	38.7	25.4	7.9	4.7
	L	88.6	5.4	72.3	50.7	38.6	21.5	5.6	6.9
	S	95.1	2.7	84.4	50.0	37.1	32.4	10.7	2.5
Summer	TP	81.9	12.3	77.0	40.2	33.3	36.8	4.7	2.7
	L	79.4	15.7	65.4	38.7	33.4	26.7	2.3	4.7
	S	85.1	9.6	74.4	41.3	32.1	32.1	7.2	2.2
Standard error		0.5	0.2	0.4	0.6	0.9	0.7	0.6	0.2
Significance		***	***	***	**	**	*	*	**

NDF=neutral detergent fiber; ADF=acid detergent fiber; \*\*(P<0.01); \*\*\*(P<0.001)

performed to estimate the influence of nutrient content over EDDM, EDCP and EDCW (Steel and Torrie, 1980).

## *Results and Discussion*

### *Nutrient content of Llano buffelgrass*

Protein in TP, L and S was significantly higher in summer and the lowest in spring (Table 1). The L fraction had higher CP than S fraction. Conversely, higher CW and lignin were in S than in L. The same pattern has been reported in common Nueces buffelgrass collected from the same area and harvested on the same dates as for this study (Ramirez *et al.*, 2001a;b).

Table 2

Digestion characteristics of the dry matter (DM) of total plant (T), leaves (L) and stems (S) of Llano buffelgrass (*Cenchrus ciliaris L.*)

Season	Parts	a, %	b, %	a+b, %	c, %/h	Lag time, h	EDDM, %
Autumn	TP	18.3	37.4	55.7	5.2	3.4	42.0
	L	26.2	53.1	79.2	4.8	3.7	60.9
	S	17.3	34.3	51.6	7.7	3.3	34.8
Winter	TP	14.9	23.6	38.5	5.2	3.7	30.5
	L	16.0	43.7	59.7	3.5	3.6	42.4
	S	13.9	16.9	30.8	6.3	3.5	22.2
Spring	TP	18.7	39.1	57.8	5.2	4.0	43.1
	L	26.6	52.8	79.4	3.4	4.7	62.4
	S	17.3	26.5	43.8	4.4	3.8	34.2
Summer	TP	26.1	48.0	74.1	5.5	3.6	50.6
	L	30.3	61.0	91.3	4.1	3.4	67.4
	S	19.2	41.3	60.5	7.9	3.3	43.5
Standard error		0.7	1.3	1.2	0.9	0.4	0.5
Significance		***	***	***	**	*	***

a=fraction of DM (%) lost during wash; b=Fraction of DM (%) degraded; a+b=fraction of DM (%) potentially degraded in the rumen of sheep; c=rate of degradation of DM (%h<sup>-1</sup>); EDDM=Effective degradability of DM, considering a rumen outflow rate of 5%h<sup>-1</sup>; \*(P<0.05); \*\*(P<0.01); \*\*\*(P<0.001).

### Digestibilities of dry matter, crude protein and cell wall

The highest EDDM was registered during summer and the lowest during winter (Table 2), similar to the findings of Ramirez *et al.* (2001a;b) for Common and Nueces buffelgrass. It seems that higher levels of lignin in S of Llano buffelgrass limited the EDDM compared to the L fraction, because L fraction was higher digested by microorganisms in the rumen of sheep than S fraction. Lovelance *et al.* (1972) in 15 lines of buffelgrass, Akin (1990) in warm season grasses and Ramirez *et al.* (2001a;b) in common Nueces buffelgrass also reported similar results.

Table 3

Digestion characteristics of the crude protein (CP) of total plant (TP), leaves (L) and stems (S) of Llano buffelgrass (*Cenchrus ciliaris L.*)

Season	Parts	a, %	b, %	a+b, %	c, %h <sup>-1</sup>	Lag time, h	EDDM, %
Autumn	TP	45.0	38.1	83.1	5.0	3.6	57.0
	L	50.9	44.1	95.0	4.3	3.5	64.1
	S	36.1	41.1	77.2	4.9	4.1	46.9
Winter	TP	35.6	19.1	54.7	3.1	3.5	43.6
	L	44.0	27.1	71.1	2.9	4.8	53.8
	S	26.4	21.7	48.1	4.4	4.3	34.6
Spring	TP	43.7	11.6	55.3	4.2	4.1	49.4
	L	51.3	31.5	82.8	4.7	4.4	65.3
	S	37.8	14.5	52.3	5.2	3.5	44.9
Summer	TP	44.2	42.1	86.3	8.6	4.2	59.5
	L	49.5	50.2	99.7	6.8	3.1	69.9
	S	41.2	40.2	81.4	9.1	4.0	48.2
<b>Standard error</b>		0.8	2.1	1.9	0.9	0.3	0.9
<b>Significance</b>		***	**	***	***	*	***

a=fraction of CP (%) lost during wash; b=Fraction of CP (%) degraded; a+b=fraction of CP (%) potentially degraded in the rumen of sheep; c=rate of degradation of CP (%h<sup>-1</sup>); EDCP=Effective degradability of CP, considering a rumen outflow rate of 5%h<sup>-1</sup>; \*(P<0.05); \*\*(P<0.01); \*\*\*(P<0.001).

The EDCP in TP, L and S of Llano was significantly higher during summer compared to other seasons (Table 3). Crude protein content in Llano buffelgrass may positively have influenced ( $r=0.51$ ;  $P>0.001$ ) EDCP. However, CW ( $r=0.70$ ;  $P<0.001$ ) and lignin ( $r=0.71$ ;  $P<0.001$ ) affected EDCP. Ramirez *et al.* (2001a;b) also found that CP (positively) and CW and lignin (negatively) influenced EDCP in forage from common and Nueces buffelgrass.

Like DM and CP, the EDCW was also higher during summer than in other seasons for this buffelgrass also (Table 4). Furthermore, the leaf fraction had higher EDCW than the stem fraction in all seasons. It seems that CP content in forages positively ( $r=0.64$ ;

Table 4

Digestion characteristics of the cell wall (CW) of total plant (TP), leaves (L) and stems (S) of Llano buffelgrass (*Cenchrus ciliaris* L.)

Season	Parts	a, %	b, %	a+b, %	c, %h <sup>-1</sup>	Lag time, h	EDDM, %
Autumn	TP	13.6	44.0	57.6	4.8	3.7	28.1
	L	16.7	59.8	76.5	5.0	3.6	41.9
	S	13.8	27.7	41.5	5.3	3.7	25.5
Winter	TP	15.2	23.7	38.9	4.9	4.1	25.2
	L	16.3	41.5	57.8	4.6	4.0	32.5
	S	12.5	14.5	26.9	5.4	3.5	21.0
Spring	TP	9.5	33.3	42.9	4.3	4.4	20.1
	L	21.0	42.2	63.2	4.6	3.7	39.1
	S	4.4	24.4	28.8	5.6	3.6	14.1
Summer	TP	36.8	48.4	85.2	4.3	3.8	41.6
	L	30.7	63.9	94.6	4.1	3.7	46.0
	S	24.9	37.1	62.0	5.6	3.6	37.1
Standard error		0.3	1.1	1.1	0.9	0.2	0.3
Significance		***	***	***	**	*	***

a=fraction of CW (%) lost during wash; b=Fraction of CW (%) degraded; a+b=fraction of CW (%) potentially degraded in the rumen of sheep; c=rate of degradation of CW (%h<sup>-1</sup>); EDCW=Effective degradability of CW, considering a rumen outflow rate of 5%h<sup>-1</sup>; \*( $P<0.05$ ); \*\*( $P<0.01$ ); \*\*\*( $P<0.001$ ).

$P<0.001$ ) influenced EDCW. Conversely, CW ( $r=-0.53$ ;  $P<0.001$ ), hemicellulose ( $r=-0.43$ ;  $P<0.001$ ) and lignin ( $r=-0.65$ ;  $P<0.001$ ) affected EDCW. It is concluded that during summer, in regions of northeastern Mexico, forage from Llano buffelgrass could make important contribution to the nutrition of grazing livestock.

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# RUMINAL DIGESTION AND CHEMICAL COMPOSITION OF NEW GENOTYPES OF BUFFELGRASS (*Cenchrus ciliaris* L.)

Guillermo Juan Garcia Dessommes, Roque Gonzalo Ramirez Lozano, Rahim Foroughbackhch P., Rocio Morales Rodriguez y Graciela Garcia Diaz

## SUMMARY

This study evaluates and compares the dry matter production (TDM), chemical composition and effective degradability of dry matter (EDDM), crude protein (EDCP) and neutral detergent fiber (EDNDF) of the Nueces hybrid and five new genotypes of buffelgrass growing in Northeastern Mexico. Potential intake of minerals by cattle consuming the new genotypes was also estimated. The experiments were established in a completely randomized design with three replicates in a rain fed experiment. Plants were hand harvested in Nov. 14, 2000 at Nuevo Leon, Mexico. TDM was not significantly different among genotypes. Crude protein content and cell wall and its components (cellulose, hemicellulose, and lignin) were significantly different

among grasses. Also, EDDM, EDCP, and EDNDF were significant different among the buffelgrass genotypes. The Nueces hybrid had the highest degradability values; in contrast, PI 2 had the lowest values. It seems that high lignin content in new genotypes may negatively influence nutrient digestion in the rumen of sheep. Only the K, Fe and Co contained in all grasses would be sufficient to meet the requirements of grazing cattle. Data of dry matter production and nutritional dynamics, suggest that the new genotypes PI-1 and PI-4 could be considered as good substitutes of the Nueces hybrid for grazing ruminants in the northeastern Mexico.

## RESUMEN

Este trabajo evalúa y comprueba el contenido nutrimental y degradabilidad efectiva de la materia seca (DEMS), proteína cruda (DEPC) y pared celular (DEFDN) de la planta completa de cinco nuevas líneas y un híbrido de pasto buffel en el noreste de México. El consumo potencial de minerales contenidos en los nuevos genotipos por bovinos también fue estimado. Todos los pastos se establecieron bajo condiciones de temporal usando un diseño completamente al azar con tres repeticiones. La colección manual de plantas fue llevada a cabo el 14 nov. 2000, en Nuevo Leon, México. La producción de materia seca no fue significativamente diferente entre zacates. Sin embargo, la proteína cruda, pared celular y sus componentes (celulosa, hemicelulosa y lignina) fueron significativamente diferentes entre

los pastos evaluados. Asimismo, DEMS, DEPC y DEF DN fueron significativamente diferentes entre pastos. El híbrido Nueces tuvo los valores más altos para DEMS, DEPC y DEF DN, mientras la línea PI 2 tuvo los valores más bajos. Al parecer el alto contenido de lignina en los nuevos genotipos pudo haber influido en la baja degradación de los nutrientes en el rumen de los borregos. Solo K, Fe, Mn y Co, en todos los zacates, tuvieron concentraciones suficientes para satisfacer los requerimientos de ganado de carne. Los resultados de producción de materia seca y dinámica nutricional sugieren que las nuevas líneas PI 1 y PI 4 pueden ser consideradas como buenos substitutos del híbrido Nueces para rumiantes en pastoreo en el noreste de México.

## Introduction

Common buffelgrass (T-4464) was introduced into Texas in the late 1940s and is currently grown on 8 to 10

millions acres in Southern Texas, USA, and the North of Mexico. Since introduction, buffelgrass has had a marked impact on the livestock industry of these regions since, as

a range grass, it is highly productive and has allowed an increase in cattle stocking rates from one animal unit (AU) for every 12ha to 1 AU for 4ha (Hanselka, 1985).

Buffelgrass reproduces by obligate apomixis, in which seeds are formed without sexual fertilization. Consequently, the progeny are genetically identical to the ma-

## KEYWORDS / Buffelgrass / Grass Genotypes / Nutrient Digestibility / Northeastern Mexico / Ruminants /

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## RESUMO

Este trabajo evalúa y comprueba el contenido nutrimental y degradabilidad efectiva de la materia seca (DEMS), proteína cruda (DEPC) y pared celular (DEFDN) de la planta completa de cinco nuevas líneas y un híbrido de pasto buffel en el noreste de México. El consumo potencial de minerales contenidos en los nuevos genotipos por bovinos también fue estimado. Todos los pastos se establecieron bajo condiciones de temporal usando un diseño completamente al azar con tres repeticiones. La colección manual de plantas fue llevada a cabo el 14 nov., 2000, en Nuevo León, México. La producción de materia seca no fue significativamente diferente entre zacates. Sin embargo, la proteína cruda, pared celular y sus componentes (celulosa, hemicelulosa y lignina) fueron significativamente diferentes entre

los pastos evaluados. Asimismo, DEMS, DEPC y DEDFN fueron significativamente diferentes entre pastos. El híbrido Nueces tuvo los valores más altos para DEMS, DEPC y DEDFN, mientras la línea PI 2 tuvo los valores más bajos. Al parecer el alto contenido de lignina en los nuevos genotipos pudo haber influido en la baja degradación de los nutrientes en el rumen de los borregos. Solo K, Fe, Mn y Co, en todos los zacates, tuvieron concentraciones suficientes para satisfacer los requerimientos de ganado de carne. Los resultados de producción de materia seca y dinámica nutricional sugieren que las nuevas líneas PI 1 y PI 4 pueden ser consideradas como buenos substitutos del híbrido Nueces para rumiantes en pastoreo en el noreste de México.

temal parent. The monoculture of this grass with its unique type of reproduction encompasses millions of ha with genetically identical plants, and represents a high risk due to the susceptibility to diseases or pests. Recently, a blight of epidemic proportions on common buffelgrass has been reported in Mexico and South Texas. The causal agent has been identified as *Pyricularia grisea* (Cook) Sacc. (Rodriguez *et al.*, 1999). Because of this and other potential problems, new strains, cultivars, and hybrids of buffelgrass have been tested in order to increase the genetic pool of this grass in the region.

Because of its wide adaptation to semiarid regions and relatively good nutritional quality, buffelgrass is considered as a South Texas and Northeastern Mexico wonder grass (Hanselka, 1988). However, seasonality of rainfall and temperature are major influences on nutritional quality of buffelgrass (White and Wolfe, 1984). Silva and Faria (2001) reported significant differences in the nutritional value among new cultivars and hybrids of buffelgrass; moreover, the rate and extent of ruminal digestion of the nutrients contained in forage of new genotypes has not been reported in the scientific literature. Thus, effective degradability and the rate of digestion are important characteristics of forage that may be used to predict the nutritive value more accurately and

compare the utility of this kind of forages in the diets for ruminants (Ørskov, 1991). Grasses are important sources of organic and inorganic nutrients for ruminants; however, in some circumstances, they are deficient in one or more of these nutrients. Minerals are required to meet the animal needs for optimum development and health (Spears, 1994), as they are essential nutrients and influence animal performance (McDowell, 1997). The object of this study was to evaluate and compare the nutrient content and ruminal fermentation of forage of five strains and one hybrid of buffelgrass under rain feed conditions in Northeastern Mexico.

### Materials and Methods

Research was carried out at the Experimental Station "General Teran", Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) and the Universidad Autónoma de Nuevo León (UANL). General Teran, N.L., Mexico, is located at 25°18'N and 99°35'W, with an altitude of 332masl. The climate is typically semitropical and semiarid with warm summers. The predominant type of vegetation is known as the Tamaulipan Thorn scrub or subtropical Thorn scrub woodlands. The dominant soils are deep, dark-gray, lime-clay Vertisoles resulting from alluvial processes. These soils are characterized by high Ca carbonate (pH 7.5-

0.5) and relatively low organic matter content. Annual mean temperature is 22.4°C, average yearly rainfall 784 mm and evaporation 1622mm.

Under rain fed conditions, five strains of buffelgrass (*Cenchrus ciliaris* L.) identified as PI-307622 (PI 1), PI-409252 (PI 2), PI-409375 (PI 3), PI-409443 (PI 4), PI-409460 (PI 5), and the hybrid Nueces were established in experimental plots, using a completely randomized design with three replicates. The plots consisted of 5m long rows, with 0.8m between rows. With the purpose to achieve a uniform grass growth, all grasses were cut prior to the experiment, in March 2000. The first significant rainfall of that year occurred on Sept. 14 (66mm) and provided the conditions to sustain grass growth. In Sept. and Oct., 452mm of rainfall were recorded, which allowed the grasses to reach full blossom by Nov. 14, when all grasses were hand harvested to a height of 0.15m above ground. Partial dry matter was determined after drying in an oven at 55°C for 72 h. Blades and stems were split and weighted individually, and the proportion of blades (H%) for each sample was obtained. Then, samples were ground in a Wiley mill (1mm screen) and stored in plastic containers.

Samples were analyzed for dry matter (DM), organic matter (OM), crude protein (CP; AOAC, 1990), neutral detergent fiber (NDF), acid

detergent fiber (ADF; Goering and Van Soest, 1970) and acid detergent lignin (ADL; AOAC, 1990). Hemicellulose (NDF-ADF) and cellulose (ADF-ADL) were estimated by difference. Estimation of insoluble N<sub>2</sub> in NDF (INNDF) and insoluble N<sub>2</sub> in acid detergent fiber (INADF), which corresponds to the non-degraded N<sub>2</sub>, was performed according to Van Soest *et al.* (1991), and the slowly degraded N<sub>2</sub> associated to the cell wall components was calculated as INNDF minus INADF (Goering and Van Soest 1970; Krishnamoorthy *et al.*, 1982).

Mineral content was estimated by incinerating the samples in a muffle oven at 550°C, during 4h. Ashes were digested in a solution containing HCl and HNO<sub>3</sub>, using the wet digestion technique (Diaz-Romeau and Hunter, 1978). Concentrations of Ca, Na, K, Mg, Cu, Fe, Zn, Mn, Co, and Mo were obtained using an atomic absorption spectrophotometer, and the P content was determined in a colorimeter (AOAC, 1990).

The rate and extent of DM, CP and NDF digestibility in gasses were measured using the nylon bag technique. Four rumen fistulated Pelibuey x Rambouillet sheep (weighing 45.2 ± 2.3kg, BW) were used to incubate bags (5 x 10cm, 53 1/4 mm pore size) containing ground samples (4g) of each grass replication and suspended in the ventral part of the rumen of each sheep. Throughout the experiment,

sheep were fed alfalfa hay *ad libitum*. For each grass replication six bags were incubated for 4, 8, 12, 24, 36, and 48h. Upon removal from the rumen, bags were washed in running cold water. Zero time disappearance was obtained by washing non-incubated bags (0h bag) washed in a similar fashion. All bags were dried at 60°C in an oven during 48h. Weight loss of DM, CP and NDF was recorded. Disappearance of DM, CP, or NDF for each incubation time was calculated as

$$\text{Disappearance (\%)} = \left( \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \right) \times 100$$

The disappearance of DM, CP, or NDF for each incubation time was used to estimate the digestion characteristics of DM, CP and NDF, using the equation of Ørskov and McDonald (1979)

$$p = a + b (1 - e^{-ct})$$

where p: disappearance rate at time t; a: an intercept representing the soluble portion of DM, CP or NDF at the beginning of incubation (time 0); b: portion that is slowly degraded in the rumen; c: rate constant of disappearance of fraction b; and t: time of incubation.

The nonlinear parameters a, b, and c and effective degradability of DM (EDDM), CP (EDCP) or NDF (EDNDF) =  $(a+b)c/(c+k)(e^{kt})$ , were calculated using the Neway computer program (McDonald, 1981); k is the estimated rate of outflow from the rumen and LT is the lag time. The EDDM, EDCP and EDNDF values were estimated assuming a rumen outflow rate of 2.0%/h. Digestible dry matter was calculated as TDM x EDDM and DCP as TDM x EDCP.

Data of chemical composition, a, b, c, EDDM, EDCP, EDNDF, DDM and DCP were statistically analyzed using a one-way analysis of variance. Means were separated using the Least Signifi-

cant Difference technique. Simple linear correlation analyses were performed between TDP, %H, chemical composition and EDDM, EDCP and EDNDF (Snedecor and Cochran, 1980).

## Results and Discussion

The total dry matter (TDM) production was not significantly different among the evaluated genotypes (Table I). However, PI 4 and PI 2 yielded more dry matter than other grasses including the

hybrids Nueces (Ramirez *et al.*, 2001b) and Llano (Foughbackch *et al.*, 2001) growing in the same regions but in different soil types.

The cell wall (NDF) content and its components (ADF, ADL, cellulose, and hemicellulose) were significantly different among grasses (Table I). Nueces resulted with the highest cell wall contents and PI 5 with the lowest. Moreover, PI 5 had the largest fully digestible portion of the NDF (100-NDF= 34.1%), and Nueces the lowest (28.2%). Also, Nueces contained less lignin (Table I). Lignification of the cell wall has been related to low degradability of nutrients contained in plants (Van Soest, 1994). The INNDF was not significantly different among grasses. Conversely, INADF

and INNDF-INADF were significantly different. The N<sub>2</sub> non-available for ruminants, estimated by the fraction INADF, was high (29.8%; mean value of all grasses) as compared with previous reports (3 to 15%; Van Soest, 1994).

Fraction a (lost during washing of bags) of DM, CP, and NDF was significantly different among the grasses. Conversely, fraction b (slowly degraded in the rumen of sheep) was not different ( $P>.05$ ). The degradation rate (c, %/h) in DM and FC were different ( $P<0.05$ ), but was not different ( $P>0.05$ ) in NDF. The EDDM, EDNDF, and EDCP were significantly different among grasses (Table II). The hybrid Nueces had the highest value of EDDM, EDNDF, and EDCP while the strain PI 2 had the lowest values. Higher lignin content in the new genotypes might have decreased rumen fermentation of nutrients in the rumen of sheep. The EDCP overall mean was estimated to be 64.2% and, the potential available CP (100-INADF) was 70.2%. The difference of 6% between these two values might be the amount of INNDF-INADF

TABLE I  
DRY MATTER PRODUCTION (ton/ha), CRUDE PROTEIN, CELL WALL COMPONENTS AND NITROGEN ASSOCIATED TO CELL WALL (%) IN THE FORAGE OF THE HYBRID NUECES AND FIVE NEW GENOTYPES OF BUFFELGRASS

Concept	Genotype						Mean±SE
	Nueces	PI 1	PI 2	PI 3	PI 4	PI 5	
TDM	4.8*	5.2*	3.8*	3.5*	5.6*	4.1*	4.5 ± 0.4
%H, g	0.71*	0.66**	0.49*	0.63*	0.71*	0.66**	0.65 ± 0.02
Organic matter	88.5*	85.9*	87.7*	87.0*	86.4*	86.6*	87.0 ± 0.2
Crude Protein	8.4*	7.8**	8.1**	7.5*	8.8*	9.2*	8.3 ± 0.1
NDF	71.8*	69.7*	70.4*	69.7*	70.4*	65.9*	69.6 ± 0.5
ADF	47.9*	51.6*	49.8*	50.8*	48.8*	50.6*	49.9 ± 0.3
Hemicellulose	23.9*	18.1*	20.6*	18.9*	21.6*	15.2*	19.7 ± 0.7
Cellulose	38.3*	33.2*	40.2*	37.7*	36.3*	40.3*	37.6 ± 0.6
ADL	5.3*	8.5*	6.9*	7.5*	8.1*	6.6*	6.7 ± 0.7
INNDF	48.7*	46.6*	48.5*	45.9*	36.0*	45.8*	45.2 ± 1.2
INADF	27.3*	32.8*	30.7*	35.0*	21.7*	31.2*	29.8 ± 1.2
INNDF-INADF	21.5*	13.8**	17.7*	10.9*	14.3*	14.6*	15.5 ± 1.1

\*\* Indicate difference ( $P<.05$ ) among values in a row.

TDM: total dry matter production; \*%H: ratio between leaf blades and plant total weight; NDF: neutral detergent fiber, ADF: acid detergent fiber; ADL: acid detergent lignin, INNDF: insoluble N<sub>2</sub> in NDF as % of the total crude protein; INADF: insoluble N<sub>2</sub> in ADF as % of the total crude protein; INNDF-INADF: slowly degraded N<sub>2</sub> associated to the cell wall components, as % of the total crude protein.

which is slowly available in the rumen of the animal, but could be fully digested in the abomasum (Van Soest, 1994; Van Soest, *et al.*, 1991). Moreover, it seems that INADF negatively affected EDCP ( $r = -0.47$ ,  $P < 0.05$ ).

The degradability values found in Nueces were higher than reported by Ramirez *et al.* (2001b), who evaluated Nueces growing in these regions but harvested in different dates. High degradability values reported in the present study may be associated to positive effects of high precipitation (Foroughbackch *et al.*, 2001; Ramirez *et al.*, 2001a). In this experiment, more than 400mm fell during the growing season. The %H also influenced the effective degradability of nutrients in the grasses, since it correlated with EDDM ( $r = 0.63$ ,  $P < 0.05$ ), and EDCP ( $r = 0.53$ ,  $P < 0.05$ ). The EDCP was also positively correlated to CP content ( $r = 0.50$ ,  $P < 0.05$ ), and negatively to INADF. This means that when CP increased, EDCP may also increase.

There were no differences ( $P > 0.05$ ) in DDM (calculated as TDM x EDDM) among the grasses tested (Table II). The differences found in EDDM were overridden by the non-significant differences in forage production (TDM) among the genotypes. In contrast there were significant ( $P < 0.05$ ) differences in DCP among the genotypes evaluated. The strain PI 4 had the highest value and PI 2 the lowest (Table II).

With exception of Ca, Fe, Mn, and Co, all minerals evaluated were significantly ( $P < 0.05$ ) different among genotypes (Table III). In general, most minerals had concentrations that are deemed low for the needs of adult grazing cattle. It appears that soil characteristics did influence forage concentration of specific minerals. Forages growing in soils with high values of Ca carbonates and pH, and low organic matter content, such as the ones used

TABLE II  
DIGESTION CHARACTERISTICS AND EFFECTIVE DEGRADABILITY OF DRY MATTER, CRUDE PROTEIN AND NEUTRAL DETERGENT FIBER IN THE FORAGE OF THE HYBRID NUECES AND FIVE NEW GENOTYPES OF BUFFELGRASS

Concept	Genotype						Mean $\pm$ SE
	Nueces	PI 1	PI 2	PI 3	PI 4	PI 5	
EDDM, %	66.3 <sup>a</sup>	62.6 <sup>b</sup>	55.0 <sup>d</sup>	61.5 <sup>b</sup>	62.2 <sup>b</sup>	57.9 <sup>c</sup>	60.9 $\pm$ 0.9
a, %	43.3 <sup>a</sup>	37.7 <sup>b</sup>	30.3 <sup>d</sup>	38.8 <sup>b</sup>	38.8 <sup>b</sup>	35.3 <sup>c</sup>	37.4 $\pm$ 0.1
b, %	40.7 <sup>a</sup>	42.9 <sup>b</sup>	43.2 <sup>a</sup>	37.4 <sup>a</sup>	38.1 <sup>b</sup>	38.6 <sup>b</sup>	40.2 $\pm$ 0.8
c, %/h	3.4 <sup>c</sup>	3.7 <sup>bcd</sup>	3.4 <sup>bcd</sup>	4.1 <sup>ab</sup>	4.3 <sup>a</sup>	3.8 <sup>bcd</sup>	3.8 $\pm$ 0.1
DDM, ton/ha	3.2 <sup>a</sup>	3.2 <sup>a</sup>	2.1 <sup>a</sup>	2.2 <sup>a</sup>	3.5 <sup>a</sup>	2.4 <sup>a</sup>	2.7 $\pm$ 0.2
EDCP, %	70.8 <sup>a</sup>	68.6 <sup>a</sup>	55.3 <sup>c</sup>	59.4 <sup>bcd</sup>	67.2 <sup>ab</sup>	63.9 <sup>ab</sup>	64.2 $\pm$ 1.6
a, %	49.7 <sup>a</sup>	46.7 <sup>b</sup>	30.2 <sup>c</sup>	34.6 <sup>bcd</sup>	46.1 <sup>ab</sup>	43.0 <sup>bcd</sup>	41.7 $\pm$ 2.2
b, %	37.1 <sup>a</sup>	37.1 <sup>a</sup>	43.6 <sup>a</sup>	40.4 <sup>a</sup>	34.1 <sup>a</sup>	34.2 <sup>a</sup>	37.8 $\pm$ 1.1
c, %/h	3.4 <sup>c</sup>	3.8 <sup>bcd</sup>	3.5 <sup>bcd</sup>	4.2 <sup>ab</sup>	4.4 <sup>a</sup>	4.1 <sup>ab</sup>	3.2 $\pm$ 0.12
DCP, kg/ha	0.28 <sup>ab</sup>	0.28 <sup>ab</sup>	0.17 <sup>b</sup>	0.16 <sup>b</sup>	0.33 <sup>a</sup>	0.24 <sup>ab</sup>	0.24 $\pm$ 0.01
EDNDF, %	69.6 <sup>a</sup>	64.5 <sup>c</sup>	58.2 <sup>d</sup>	63.8 <sup>c</sup>	66.4 <sup>b</sup>	55.4 <sup>e</sup>	63.0 $\pm$ 1.18
a, %	48.8 <sup>a</sup>	39.5 <sup>c</sup>	37.0 <sup>c</sup>	44.0 <sup>b</sup>	43.8 <sup>b</sup>	31.0 <sup>d</sup>	40.7 $\pm$ 1.42
b, %	34.2 <sup>a</sup>	41.0 <sup>a</sup>	37.6 <sup>a</sup>	32.8 <sup>a</sup>	42.8 <sup>a</sup>	39.6 <sup>a</sup>	38.0 $\pm$ 1.20
c, %/h	4.1 <sup>a</sup>	4.2 <sup>a</sup>	3.3 <sup>a</sup>	4.0 <sup>a</sup>	3.4 <sup>a</sup>	4.3 <sup>a</sup>	3.9 $\pm$ 0.18

<sup>a,b,c,d</sup> Indicate difference ( $P < .05$ ) among values in a row.

EDDM: effective degradability of the dry matter; EDCP: effective degradability of crude protein; EDNDF: effective degradability of neutral detergent fiber, calculated using a rumen outflow rate of 2.0%/h; a: fraction of DM or CP or NDF (%) lost during washing; b: fraction of DM or CP or NDF (%) slowly degraded in the rumen of sheep; c: degradation rate of DM or CP or NDF (%/h); DDM: digestible dry matter (TDM x EDDM); DCP: digestible crude protein (TDM x EDCP); SE: standard error.

TABLE III  
MACRO AND TRACE MINERAL CONTENT IN THE FORAGE OF THE HYBRID NUECES AND FIVE NEW GENOTYPES OF BUFFELGRASS

Concept <sup>1</sup>	Genotype						Mean $\pm$ SE
	Nueces	PI 1	PI 2	PI 3	PI 4	PI 5	
Ca, g/kg	0.38 <sup>a</sup>	0.38 <sup>a</sup>	0.37 <sup>a</sup>	0.38 <sup>a</sup>	0.37 <sup>a</sup>	0.37 <sup>a</sup>	0.38 $\pm$ 0.002
P, g/kg	0.11 <sup>ab</sup>	0.12 <sup>a</sup>	0.10 <sup>ab</sup>	0.10 <sup>ab</sup>	0.10 <sup>ab</sup>	0.09 <sup>b</sup>	0.10 $\pm$ 0.003
Na, g/kg	0.12 <sup>a</sup>	0.17 <sup>b</sup>	0.12 <sup>c</sup>	0.12 <sup>c</sup>	0.24 <sup>a</sup>	0.11 <sup>c</sup>	0.15 $\pm$ 0.01
K, g/kg	24.3 <sup>a</sup>	28.7 <sup>a</sup>	23.7 <sup>a</sup>	21.4 <sup>a</sup>	25.1 <sup>a</sup>	23.9 <sup>a</sup>	24.5 $\pm$ 1.1
Mg, g/kg	0.46 <sup>ab</sup>	0.40 <sup>a</sup>	0.44 <sup>bcd</sup>	0.42 <sup>bcd</sup>	0.43 <sup>bcd</sup>	0.48 <sup>a</sup>	0.44 $\pm$ 0.01
Cu, mg/kg	2.50 <sup>bcd</sup>	3.27 <sup>ab</sup>	2.60 <sup>a</sup>	1.49 <sup>c</sup>	4.26 <sup>a</sup>	2.65 <sup>b</sup>	2.8 $\pm$ 0.2
Fe, mg/kg	137.6 <sup>a</sup>	172.4 <sup>a</sup>	76.4 <sup>a</sup>	135.0 <sup>a</sup>	131.7 <sup>a</sup>	115.3 <sup>a</sup>	128.1 $\pm$ 9.9
Zn, mg/kg	12.3 <sup>d</sup>	18.7 <sup>c</sup>	26.4 <sup>a</sup>	27.9 <sup>a</sup>	20.7 <sup>bcd</sup>	17.9 <sup>cd</sup>	20.6 $\pm$ 1.5
Mn, mg/kg	28.9 <sup>a</sup>	29.9 <sup>a</sup>	29.8 <sup>a</sup>	28.7 <sup>a</sup>	42.2 <sup>a</sup>	26.3 <sup>a</sup>	31.0 $\pm$ 1.8
Co, mg/kg	6.8 <sup>a</sup>	6.7 <sup>a</sup>	6.8 <sup>a</sup>	6.8 <sup>a</sup>	7.0 <sup>a</sup>	6.6 <sup>a</sup>	6.8 $\pm$ 0.1
Mo, mg/kg	1.9 <sup>a</sup>	1.5 <sup>ab</sup>	1.0 <sup>b</sup>	1.1 <sup>b</sup>	1.3 <sup>b</sup>	1.07 <sup>b</sup>	1.3 $\pm$ 0.1

<sup>a,b,c,d</sup> Indicate difference ( $P < .05$ ) among values in a row.

<sup>1</sup> dry matter basis.

in this experiment, tend to have lower content of most essential minerals (INIFAP, 1991). White and Wolfe (1985) also reported low values for P (0.23%) and Ca (0.30%), K (1.6%) and Mg (0.18%) in common buffelgrass harvested during the autumn season in Cotulla, Texas, USA.

Table IV shows the potential mineral intake, calculated for each mineral appearing in Table III, by a cow of 400kgBW, with a daily intake of 10.2kgDM of the evaluated grasses. The potential intake of K, Fe, Co, Mn (only in PI 4), and Mo (only in Nueces), would be sufficient to meet the requirements of these

minerals for a growing cow of 400kg grazing any of the genotypes tested in these soils. However, Ca, P, Na, Mg, Cu, and Zn, were lower than required. Deficiencies of P and Na have been reported and they occur in many grass species that grow in warm climates (McDowell, 1997). Thus, to obtain an optimal

**TABLE IV**  
**POTENTIAL MINERAL INTAKE OF GROWING CATTLE CONSUMING FORAGE OF THE HYBRID NUECES AND FIVE NEW GENOTYPES OF BUFFELGRASS**

Concept	Potential mineral intake <sup>1</sup> Genotypes						Requirements	
	Nueces	PI 1	PI 2	PI 3	PI 4	PI 5	Required in the diet <sup>2</sup>	Mineral daily Requirements <sup>3</sup>
Ca, g/kg	3.9	3.9	3.8	3.8	3.8	3.8	1.8	18.3
P, g/kg	1.1	1.3	0.98	1.0	1.0	0.9	1.8	18.3
Na, g/kg	1.3	1.8	1.2	1.3	2.4	1.1	1.0	10.2
K, g/kg	247.5	292.9	242.2	218.2	255.5	243.9	6.0	61.2
Mg, g/kg	4.7	4.1	4.5	4.3	4.4	4.9	0.7	7.1
Cu, mg/kg	25.6	33.3	26.5	15.2	43.5	27.0	7.0	71.4
Fe, mg/kg	1403.1	1758.1	779.1	1377.1	1343.4	1176.5	30.0	306.0
Zn, mg/kg	125.2	190.6	260.5	284.7	211.0	192.0	50.0	510.0
Mn, mg/kg	295.2	305.3	303.7	292.8	430.2	267.8	30.0	306.0
Co, mg/kg	69.5	68.0	68.9	69.2	71.8	67.3	1.8	18.3
Mo, mg/kg	19.3	15.0	10.6	11.6	13.9	10.9	1.8	18.3

<sup>1</sup>Asuming a cow of 400kg with a dry matter intake of 10.2kg (NRC, 1984), times the concentration of each mineral in the plant of buffel grass, reported in Table III.

<sup>2</sup>Daily requirement (McDowell, 1997) in the dry matter of the diet of a cow weighing 400kg with a daily mineral intake of 10.2 kg (NRC, 1996).

productivity of cattle grazing these grasses growing in this type of soil, the animals have to be supplemented with Ca, P, Na, Mg, Cu, Zn, Mn (except for PI 4), and Mo (except for Nueces).

#### Conclusions

Forage dry matter production and total digestible dry matter were not significantly different among evaluated grasses. However, there were significant differences for most of the chemical components and digestion parameters. The hybrid Nueces had higher values of EDDM, EDNDF, and EDCP than other grasses. High lignin content in the forage of new genotypes may decrease the amount of nutrients degraded in the rumen of sheep. In general, the mineral content in all grasses was low for the needs of grazing ruminant, an effect probably caused by the low mineral content in the soil. Only K, Fe, and Co would be sufficient to fulfill the requirements of a mature cow grazing the evaluated grasses, while other minerals have to be supplemented for an optimal cattle growth. As new genotypes had very simi-

lar dry matter production and nutritional dynamics, it is suggested that they could be used as forage substitutes of Nueces buffelgrass growing in the region.

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#### NOTA PARA LOS AUTORES:

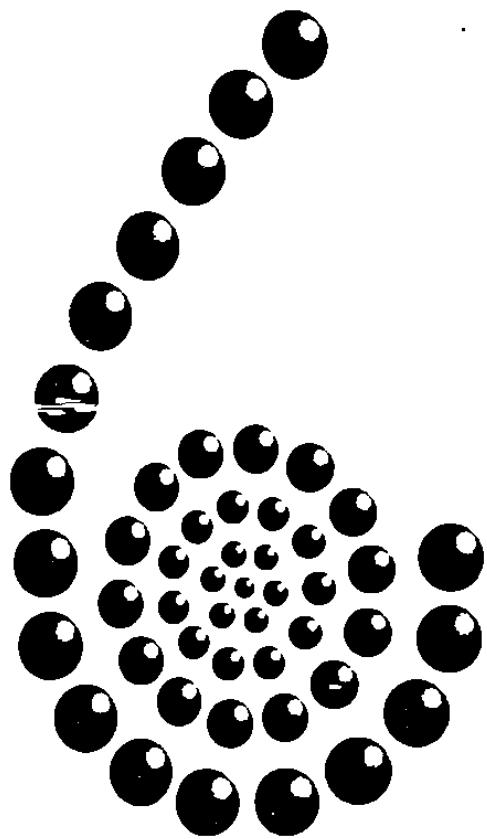
1) Completar datos faltantes en nota curricular según estilo de la revista (grados académicos, institución donde los obtuvo, actual

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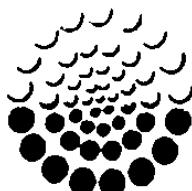
a) Cotejar que todos los autores citados estén en la lista de referencias y viceversa (IMPORTANTE!!)

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**SIMPOSIO  
DE CIENCIA Y TECNOLOGÍA**

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**SEP - CONACYT**

## **20 DETERMINACIÓN DE COMPUESTOS AROMÁTICOS POLINUCLEARES A BAJAS CONCENTRACIONES EN AGUA POTABLE POR CLAR**

Ramírez Villarreal Elsa Guadalupe<sup>1</sup>, Waksman de Torres Noemí<sup>1</sup>, Garza Ulloa Humberto<sup>2</sup>

<sup>1</sup> Depto. de Química Analítica, Facultad de Medicina, U.A.N.L. Monterrey, N.L. México.

C.P. 64460. [elsa49@hotmail.com](mailto:elsa49@hotmail.com) <sup>2</sup> Investigación y Desarrollo Químico, S.A. de C.V.

Monterrey, N.L. C.P. 64984 [hgarzaulloa@analitek.com](mailto:hgarzaulloa@analitek.com)

Los compuestos aromáticos polinucleares son moléculas orgánicas constituidas por dos ó más anillos aromáticos condensados, se encuentran en el medio ambiente, en aire, agua, suelos, son importantes para los seres vivos ya que se ha comprobado que algunos de ellos son carcinógenos. En la Ley Federal de Derechos en materia de agua, establece para el agua de consumo humano, los lineamientos de calidad, así los hidrocarburos aromáticos polinucleares totales tiene un valor límite de 0.0001 mg/L, y considera solamente tres individuales con valores entre 0.02 a 0.04 mg/L. Entre los métodos analíticos empleados para su cuantificación destacan los cromatográficos. Nos propusimos desarrollar una metodología analítica para la cuantificación de dichos compuestos en agua, logrando la separación cromatográfica de 16 de los mencionados compuestos en 15 minutos, obtuvimos valores de regresión lineal de 0.9954, así como el límite de detección en un intervalo de 4.5 – 0.09 mg/L, usando extracción en fase sólida concentrando 1000 veces mejorando la sensibilidad del método.

## **21 DETERMINACIÓN DE LA DEGRADABILIDAD EFECTIVA DE LA PROTEÍNA CRUDA DE LAS HOJAS DE OCHO ARBUSTIVAS NATIVAS DE LA FLORA DE NUEVO LEÓN**

Rocio Morales-Rodriguez, José G. Moya-Rodriguez, Roque G. Ramírez Lozano y R. Foroughbakhch P. Facultad de Ciencias Biológicas, Pedro de Alba y Manuel Barragán S/N, Cd. Universitaria, San Nicolás de los Garza, N.L., 66451

Las hojas de ocho especies arbustivas nativas del estado de Nuevo León, fueron evaluadas para determinar el valor nutritivo y degradabilidad efectiva de la proteína cruda (DEPC). Las especies colectadas fueron *Acacia wrightii*, *Bumelia celastrina*, *Castela texana*, *Forestiera angustifolia*, *Karwinskia humboldtiana*, *Larrea tridentata*, *Schaeferia cuneifolia*, *Zanthoxylum tagara* y como testigo la alfalfa (*Medicago sativa*). La colecta se llevó a cabo durante las 4 estaciones del año de 1999, en los municipios: El Carmen, Mina y Hualauises, N.L. Para la determinación de la DEPC se usaron cinco borregos fistulados del rúmen, los cuales fueron alimentados con heno de alfalfa a libre acceso. Las muestras de cada planta (4g) se incubaron en bolsas de nylon (5 x 10 cm y poro de 53 micras) a diferentes horas; 0, 4, 8, 12, 24, 36 y 48. La DEPC a una tasa de recambio ruminal del 2%/h fue diferente ( $P<0.001$ ) entre plantas. *Schaeferia cuneifolia* tuvo 82.5 %, *M. sativa* 75.1%, *C. texana* 73.1%, *Z. Fagara* 72.8%, *A. wrightii* 72.1%, *K. humboldtiana* 69.7%, *F. Angustifolia* 69.3%, *Larrea tridentata* 60.2% y *Bumelia celastrina* con 59.3%. Por su alto contenido de PC y DEPC *S. Cuneifolia*, *C. texana*, *Z. Fagara* y *A. wrightii* pueden ser consideradas como buenos complementos proteicos para el ganado en pastoreo, especialmente durante el invierno.

# III CONGRESO REGIONAL EN CIENCIA DE LOS ALIMENTOS.

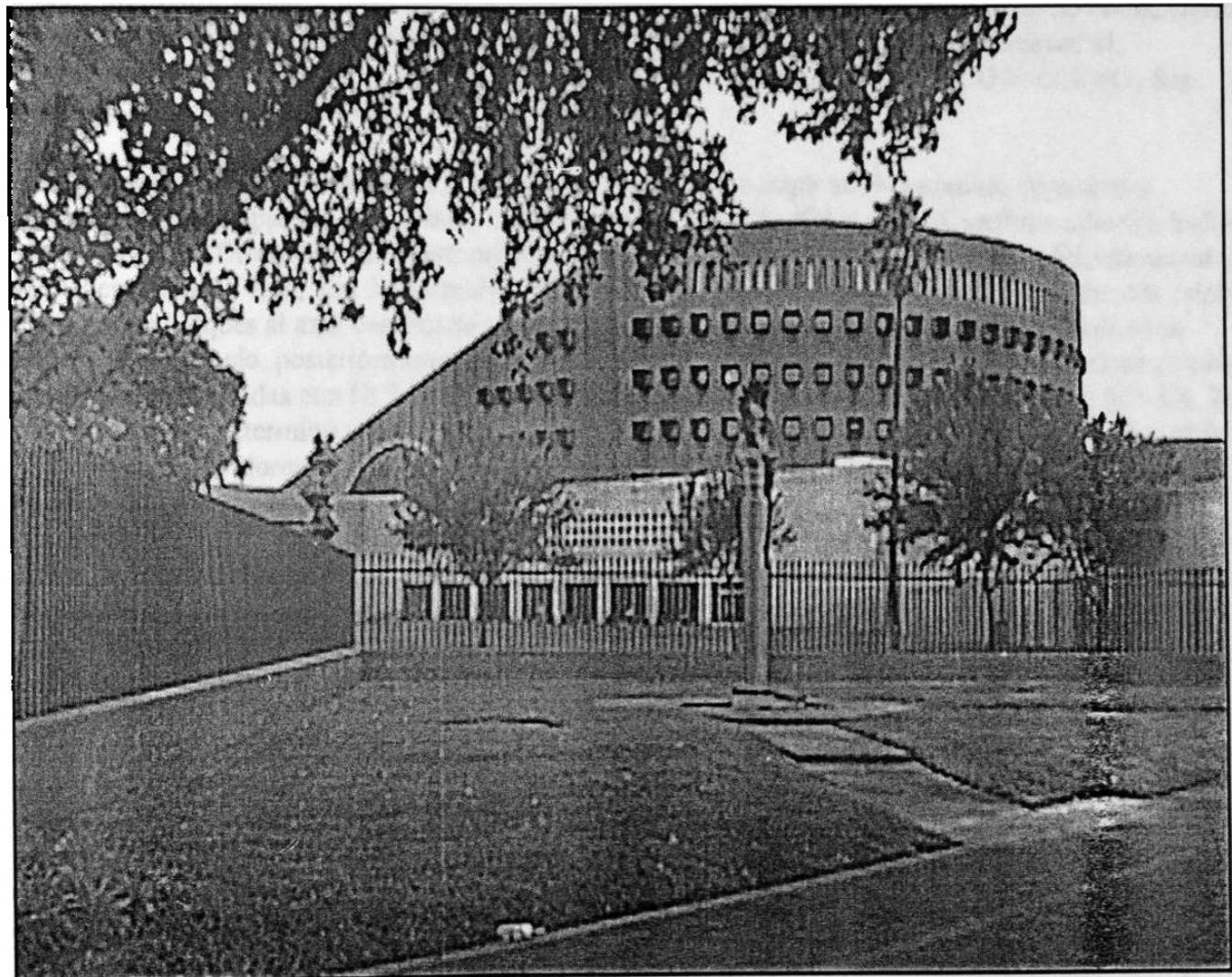
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ASOCIACION NACIONAL DE TECNOLOGOS EN  
ALIMENTOS DE MEXICO, A.C. DELEGACION  
NUEVO LEON



| Principales | Artículos |

## PERFIL MINERAL DE VARIOS TIPOS DEL ZACATE BUFFEL COMÚN Y DEL ZACATE PRETORIA.

Morales Rodríguez Rocio, Cortez Pérez Raquel, Vázquez Corpus, Juan E, Ortiz Llanas Jovanna, Garza Padrón Ruth A., Ramírez Lozano Roque G., García Desommess G. y Gonzalez Rodríguez H.  
Facultad de Ciencias Biológicas, UANL. Pedro de Alba y Manuel Barragán, Cd. Universitaria, San Nicolás de los Garza, N.L. 66451.

El presente estudio fue realizado con el objetivo de evaluar y comparar el contenido de macro y microminerales en la planta completa de cinco líneas de zacate buffel común (*Cenchrus ciliaris*), buffel nueces y pretoria (*Dicanthium annulatum*). Los zacates fueron colectados en el Campo Experimental del INIFAP en general Terán, Km 30 carretera Montemorelos-China en agosto de 1999. Los zacates estaban sembrados en bloques al azar con tres repeticiones. Las plantas se cortaron, en la parte útil de cada bloque, a ras del suelo, posteriormente se secaron a 55°C y se incineraron a 500°C. Las cenizas de cada muestra fueron digeridas con HCl al 25%. La concentración del Ca, Mg, K, Na Cu, Fe, Zn, Mn, Co, Mo en las muestras se determinó usando un espectrofotómetro de plasma. El P se estimó usando la técnica calorimétrica. Los valores de minerales presentaron diferencias significativas entre zacates. Aunque el contenido de Ca entre zacates fue diferente ( $P<0.001$ ), las diferencias fueron marginales y todos tuvieron Ca en cantidades muy similares al buffel nueces, que en este estudio se usó como un zacate de referencia. El contenido de P fue más bajo ( $P<0.001$ ) en el pretoria comparado con los otros zacates. El Mg tuvo un comportamiento muy parecido al Ca. El contenido de K fue más elevado ( $P<0.001$ ) en las líneas 307622 y 443 que los otros y, éstas tuvieron K comparable al buffel nueces. Las líneas 307622 y 409375 igualaron a nueces en Na, mientras que 409252 y 443 superaron a éste. El Cu en el pretoria fue más bajo que los demás zacates. En cambio, las líneas 409375, 443 y 409252 superaron en Mn al buffel nueces. El buffel común y la línea 409375 obtuvieron contenidos de Fe comparables al buffel nueces. El resto de los zacates fueron más bajos en Fe. En general, todos los zacates evaluados tuvieron más ( $P<0.001$ ) Zn que el buffel nueces. El Co y Mo tuvieron concentraciones que aunque variaron significativamente, las diferencias entre zacates fueron marginales. Con excepción del Mn, Fe, Co y Mo todos los minerales evaluados resultaron en concentraciones por debajo de los requerimientos para bovinos de carne en crecimiento.

# **SÉPTIMO SIMPOSIO DE CIENCIA Y TECNOLOGÍA**

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**DRA. MA. JULIA VERDE STAR  
M.C. MA. EUFEMIA MORALES RUBIO  
M.C. MARCELA GONZÁLEZ ÁLVAREZ  
M.C. JAIME FCO. TREVINO NEÁVEZ**

**MAYO 2002**

## **25. PERFIL MINERAL DE VARIOS TIPOS DEL ZACATE BUFFEL COMÚN Y DEL ZACATE PRETORIA.**

Morales Rodríguez R., Cortez Pérez R., Vázquez Corpus, J. E., Ortiz Llanas J., Garza Padrón R. A., Ramírez Lozano R. G., García Desommess G. y González Rodríguez H. Facultad de Ciencias Biológicas, UANL. Pedro de Alba y Manuel Barragán, CD. Universitaria, San Nicolás de los Garza, N.L. 66451.

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## **26. DIGESTIBILIDAD *IN SITU* DE 86 GENOTIPOS DEL PASTO BUFFEL COMÚN (*Cenchrus ciliaris L.*).**

Morales-Rodríguez, Rocio, Ramírez Lozano R. G., García Dessommes, G. y Foroughbakhch, R. Facultad de Ciencias Biológicas, Pedro de Alba y Manuel Barragán S/N, Cd. Universitaria, San Nicolás de los Garza, N.L., 66451

El propósito de este estudio fue comparar la producción (PMS) y digestibilidad *in situ* de la materia seca (DISMS) de 86 genotipos del zacate buffel común (*Cenchrus ciliaris L.*). Existen colectados y clasificados más de 600 genotipos de esta especie en el Banco Mundial de buffel en la Universidad de Texas A & M, de este banco se realizó la introducción a México de 100 genotipos con el propósito de medir su capacidad forrajera y calidad nutricional. Dichos genotipos se establecieron en el Campo Experimental del INIFAP, en General, Teran Nuevo León. Para determinar la DMS se utilizaron 4 borregos fistulados del rumen, los cuales fueron alimentados con heno de alfalfa a libre acceso. Posteriormente se incubaron las muestras (4g) en bolsas de nylon por 48 horas. Para la PMS el genotipo 409529 obtuvo el valor mas alto (5.6%), junto con 443 (5.5%), 307622 (5.2%), 409155 (5.1%) y Nueces (4.8%). El valor mas bajo fue para 409223 (0.8%). El porcentaje de DISMS mas alto fue de 73.1% para Nueces, seguido de 307622 (70.2%), 443 (69.6%) y 409151 (62.2%); 409197 (44.7%), 414467 (44.6%) y 414532 (43.2%) presentaron los porcentajes mas bajos. Por lo tanto los genotipos Nueces, 443, 307622 y 409155 por su alta digestibilidad y producción de materia seca pueden ser considerados buena alternativa para la producción de ganado bovino en pastoreo.

# **1. ESTIMACIÓN DEL VALOR NUTRICIONAL Y DIGESTIÓN RUMINAL DE CINCO LÍNEAS APOMÍTICAS Y UN HÍBRIDO DE PASTO BUFFEL (*Cenchrus ciliaris* L.) EN DOS EPOCAS DEL AÑO.**

Guillermo J. García Dessommes<sup>1</sup>, Roque G. Ramírez Lozano<sup>2</sup>, Rahim Foroughbakhch<sup>2</sup>, Rocio Morales Rodríguez<sup>2</sup>, Graciela García Díaz<sup>2</sup>. <sup>1</sup> Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias, Campo Experimental de General Terán, Apartado Postal No 3 General Terán, N. L: C. P. 67400, <sup>2</sup>Facultad de Ciencias Biológicas, Subdirección de Postgrado, Universidad Autónoma de Nuevo León. Apartado Postal 105-F, Cd. Universitaria, San Nicolás de los Garza, N. L., México. C. P. 66450.

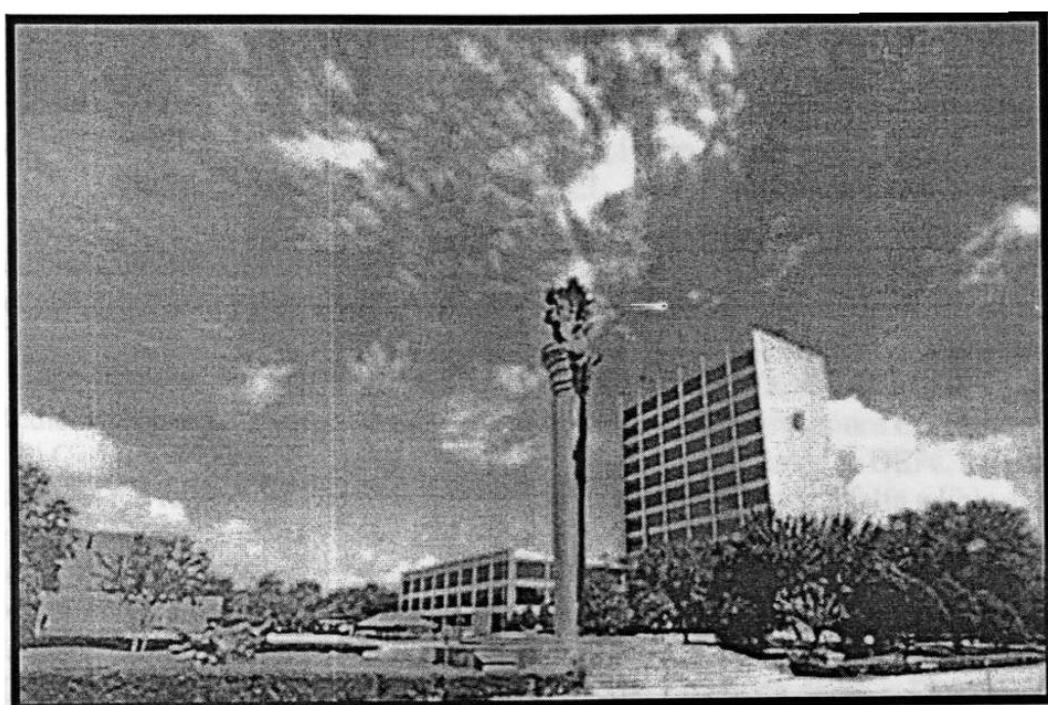
Con el objetivo de comparar el efecto del genotípo y época de corte sobre la producción de materia seca y su calidad nutricional, se evaluaron cinco líneas de zacate buffel y el híbrido nueces bajo condiciones de temporal en el Campo Experimental de General Terán. La colecta de pastos se llevó a cabo en agosto y noviembre de 1999. Se estimó la producción de MS ha<sup>-1</sup> (MST), porcentaje de hojas (%H), el contenido de materia orgánica (MO), proteína cruda (PC), nitrógeno insoluble en detergente neutro (NIFDN), nitrógeno insoluble en detergente ácido (NIFDA), fibra detergente neutro (FDN), fibra detergente ácido (FDA), hemicelulosa (HEM), celulosa (C), lignina (LDA). El contenido de Ca, P, Na, K, Mg, Cu, Fe, Zn, Mn, Co, y Mo en los pastos, así como su consumo potencial, también se estimaron. La degradabilidad efectiva de la MS (DEMS), PC (DEPC) y FDN (DEFDN), la producción de materia seca digestible (MSDT) y la producción de proteína digestible ha<sup>-1</sup> (PCDT) para cada pasto y época del año fueron calculadas. Se encontraron diferencias significativas para MST, %H, MO, FDA, HEM, LDA, PC, NIFDN, NIFDA, DEMS, DEF DN, DEPC, MSDT y PCDT entre zacates y para %H, FDN, FDA, CEL, PC, NIFDN, NIFDA, DEMS Y DEF DN entre épocas. El contenido de los minerales en los pastos fue bajo para satisfacer las necesidades de rumiantes en pastoreo.

# IV CONGRESO REGIONAL EN CIENCIA DE LOS ALIMENTOS.

MONTERREY, N.L. 10 Y 11 DE JUNIO DEL 2002.

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## UNIVERSIDAD AUTONOMA DE NUEVO LEON



# FACULTAD DE CIENCIAS BIOLOGICAS DE LA U.A.N.L.



ASOCIACION NACIONAL DE  
TECNOLOGOS EN ALIMENTOS DE  
MEXICO, A.C. DELEGACION  
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## DETERMINACIÓN DE LA DEGRADABILIDAD EFECTIVA DE LA PROTEÍNA CRUDA DE LAS HOJAS DE OCHO ARBUSTIVAS NATIVAS DE LA FLORA DE NUEVO LEÓN

MVZ. Rocio Morales-Rodríguez, MC. José G. Moya-Rodríguez, PhD. Roque G. Ramírez Lozano y Dr. R. Foroughbakhch P. Facultad de Ciencias Biológicas, Pedro de Alba y Manuel Barragán S/N, Cd. Universitaria, San Nicolás de los Garza, N.L., 66451. rociomrdz@hotmail.com

Las hojas de ocho especies arbustivas nativas del estado de Nuevo León, fueron evaluadas para determinar el valor nutritivo y degradabilidad efectiva de la proteína cruda (DEPC). Las especies colectadas fueron *Acacia wrightii*, *Bumelia celastrina*, *Castela texana*, *Forestiera angustifolia*, *Karwinskyia humboldtiana*, *Larrea tridentata*, *Schaefferia cuneifolia*, *Zanthoxylum fagara* y como testigo la alfalfa (*Medicago sativa*). La colecta se llevó a cabo durante las 4 estaciones del año de 1999, en los municipios: El Carmen, Mina y Hualauises, N.L. Para la determinación de la DEPC se usaron cinco borregos fistulados del rumen, los cuales fueron alimentados con heno de alfalfa a libre acceso. Las muestras de cada planta (4g) se incubaron en bolsas de nylon (5 x 10 cm y poro de 53 micras) a diferentes horas; 0, 4, 8, 12, 24, 36 y 48. La DEPC a una tasa de recambio ruminal del 2%/h fue diferente ( $P<0.001$ ) entre plantas. *Schaefferia cuneifolia* tuvo 82.5 %, *M. sativa* 75.1%, *C. texana* 73.1%, *Z. Fagara* 72.8%, *A. wrightii* 72.1%, *K. humboldtiana* 69.7%, *F. Angustifolia* 69.3%, *Larrea tridentata* 60.2% y *Bumelia celastrina* con 59.3%. Por su alto contenido de PC y DEPC *S. Cuneifolia*, *C. texana*, *Z. Fagara* y *A. wrightii* pueden ser consideradas como buenos complementos proteicos para el ganado en pastoreo, especialmente durante el invierno.

## IV CONGRESO EN CIENCIA DE LOS ALIMENTOS



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TECNOLOGOS EN ALIMENTOS DE  
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NUEVO LEON

## DIGESTIÓN RUMINAL DE LA MATERIA SECA Y PARED CELULAR DEL FORRAJE DE LÍNEAS DEL ZACATE BUFFEL (*Cenchrus ciliaris L.*)

Biol. Claudia Cobio Nagao, Biol. Dafne Aline Morales Murillo, MVZ. Rocio Morales Rodríguez y PhD. Roque G. Ramírez Lozano. Facultad de Ciencias Biológicas, Pedro de Alba y Manuel Barragán S/N, Cd. Universitaria, San Nicolás de los Garza, N.L., 66451. cobio01@hotmail.com

El propósito de este estudio fue el de comparar las características de la digestión ruminal y el valor nutritivo del zacate buffel nueces (*Cenchrus ciliaris*), contra las de las líneas del buffel: 409252, 409460, 409375, 443 y 307622. Los zacates se colectaron en el Campo experimental de Terán, N.L., de la INIFAP. La técnica de la bolsa nylon fue usada para estimar la degradabilidad efectiva de la pared celular, para lo cual se usaron cuatro borregos fistulados del rumen, a los cuales se les incubaron las bolsas de nylon contenido 0.4 g de muestra de cada zacate. Los resultados de la degradabilidad efectiva de la materia seca (DEMS) muestran que la línea 409375 resultó con el mayor porcentaje (48.4%), seguido de las líneas 409460 y 443 (47.8%) y finalmente la línea 307622 (47.2%) comparado con nueces que obtuvo (46.5%). El bajo contenido de lignina en la línea 409375 (4.7%), comparado con la línea 307622 (6.2%) y 409460 (5.7%) pudo haber influido en que resultara con valores de DEMS mayores que los otros zacates evaluados. La Línea 409460 tuvo el más bajo valor de proteína cruda (6.1%), comparado con la línea 409375 (7.7%) y nueces (7.8%). Los resultados de la degradabilidad efectiva de la pared celular (DEPC) muestran que el buffel nueces resultó con el mayor valor (46.8%), seguido de la línea 409460 (41.8%) y finalmente la línea 307622 (41.7%). El bajo contenido de lignina en el buffel nueces (5.5%), seguido de la línea 409460 (5.7%) o la línea 307622 (6.2%) pudo haber influido en que el nueces resultara con valores de DEPC mayores que los otros zacates evaluados.

## IV CONGRESO EN CIENCIA DE LOS ALIMENTOS



# THE SIXTH INTERNATIONAL SYMPOSIUM ON THE NUTRITION OF HERBIVORES



UNIVERSITY OF YUCATAN

30 April, 2003

Dear Colleague,

On behalf of the Local Organizing Committee of The Sixth International Symposium on the Nutrition of Herbivores, it is my pleasure to inform you that your work "*Nutritive value and in situ digestibility of the cell wall of 86 genotypes of buffelgrass (Cenchrus ciliaris L.)*" by R. Morales-Rodríguez, R. G. Ramírez-Lozano, G. García-Dessommes, C. Cobio-Nagao, D. A. Morales-Murillo and R. Foroughbakhch, has been accepted to be presented as a poster at this scientific event.

I will really appreciate if you could register at your earliest convenience for attendance to the symposium by checking instructions at the website <http://isnh6mexico.org>

Sincerely

**Dr. Juan Carlos Ku-Vera**  
Local Organizing Committee  
The Sixth International Symposium on the Nutrition of Herbivores

# **Nutritive value and *in situ* digestibility of the cell wall of 86 genotypes of buffelgrass (*Cenchrus ciliaris* L.)**

R. Morales-Rodríguez, R. G. Ramírez-Lozano, G. García-Dessommes, C. Cobio-Nagao, D. A. Morales-Murillo and R. Foroughbakhch

Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León. Pedro de Alba y Manuel Barragán S/N, Cd. Universitaria, San Nicolás, CP 66450, México, e-mail: roqramir@scb.uanl.mx

## **Summary**

The objectives of this study were to evaluate the nutritive value, the *in situ* digestibility of neutral detergent fiber (IDNDF) and dry matter production of 86 genotypes of buffelgrass (*Cenchrus ciliaris* L.) growing in the Experimental Station of the Instituto de Investigaciones Forestales Agrícolas y Pecuarias (INIFAP) at General Terán, N.L., México. Under rain fed conditions the genotypes were established. In November 2000 all genotypes were hard harvested. To estimate the NDF disappearance four rumen cannulated Pelibuey sheep ( $45 \pm 2.5$  kg LW) were used to incubate nylon bags (5 x 10 cm 53  $\mu\text{m}$  of pore size) containing 4 g of ground material. In this study the hybrid Nueces and Llano buffelgrass were used as controls. The IDNDF varied ( $P < 0.001$ ) from 46 to 76% (mean of 55%). The dry matter production also varied ( $P < 0.001$ ) from 1 to 6 ton/ha. Genotypes such as 443 and 307622 resulted with nutritive and IDNDF values that were comparable to Nueces buffelgrass.

## **Introduction**

Actually, in Mexico there are about four million of ha of buffelgrass of the cultivar T-4464 called common buffelgrass and in northeastern Mexico there are about 500,000 ha (Alcalá, 1995). The buffel is well adapted to the arid and semi-arid regions of the world, because it can be established easily and due to its capacity to support long periods of drought (Humphrey, 1976). The hay of *C. ciliaris* has been used as an alternative to alleviate the overgrazing. In Mexico it also has been used to increase productivity of grazing cattle, due to his relative high dry matter production and nutritive quality (Cajal et al., 1984). However, it is susceptible to cold. Thus, new genotypes of buffelgrass have to be evaluated and the objectives of this study were to evaluated the nutritive value and digestibility of 86 genotypes of buffelgrass. The highly productive hybrids Nueces and Llano were used as controls.

## **Materials and Methods**

This research was carried out at the Experimental Station of the Instituto Nacional de Investigaciones, Agrícolas y Pecuarias (INIFAP) at General Terán, Nuevo Leon, México, located in the km 30,5 of the highway Montemorelos-China and Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo Leon. Eighty six genotypes of buffelgrass that were produced under rain fed conditions were collected during November of 2000. Plants were harvested 15 cm above of the to floor. To determine partial dry matter, samples were dried in an oven at 55 °C, during 72 hours. After drying, samples were ground in a Wiley mill (1mm screen) and they were stored in plastics containers for further analyses. Dry matter (DM), ash and crude protein (CP) were determined (AOAC, 1996). Neutral detergent fiber (cell wall), cellulose, hemicellulose, lignin and insoluble ash (IA) were determined by methodology described by Goering and Van Soest (1970) and Van Soest et al. (1991).

The nylon bag technique (Ørskov, et al., 1980) was used to estimate the *in situ* digestibility of the cell wall of grasses. Nylon bags (5 x 10 cm and 53  $\mu\text{m}$  of pore size) with 4 g of ground samples were incubated, during 48 hours, in the ventral part of the rumen of fistulated Pelibuey lambs with a live weight of  $45 \pm 2.5$  kg. After the incubation time bags were taken out of the rumen and washed in tap water until the water was crystalline. Later the bags were dried in an oven at 60 °C, during 48 hours and, weighed. *In situ* cell wall disappearance

from the nylon bags was calculated by difference of initial cell wall weight minus final cell wall weight divided into initial cell wall weight and then multiply by 100 (Ash 1990).

## Results and Discussion

Data of Table 1 shows that the nutritive value, IDNDF and, dry matter production (DMP) were different ( $P<0.001$ ) among genotypes. The range of crude protein (CP) content in grasses varied from 6 to 9%, with a mean value of 8%. Cell wall content also varied from 67% to 79% with a mean value of 73%. Cellulose content was in a range of 36 to 44%, with a mean of 40%. The hemicellulose in grasses also varied from 15 to 31% with a mean of 25%. The lignin concentration ranged widely from 1 to 9%, with a mean value of 4%. The IDNDF also varied from 46 to 76% with a mean value of 55%. Finally, the DMP in grasses also varied within a range of 1 to 6 ton/ha, with a mean value of 3 ton/ha.

The IDNDF in all genotypes was correlated to cellulose content ( $r = -0.16$ ;  $P<0.01$ ). This means that when cellulose increased, IDNDF decreased. In this study, the hybrids Nueces and Llano were used as controls; thus, genotypes such as 443 (73%) and 307622 (71%) had IDNDF values that were comparable to Nueces (76%). The genotypes 443 and 409527 had the highest DMP (6 ton/ha). Genotypes such as 365713, 409154, 409155, 409165, 409373, 409377, 409459 and 409672 produced the same amount of DM than Nueces.

## Conclusions

In this study, some new genotypes had similar responses in DMP and nutrient content than the hybrid Nueces, that was used as a control. It has been proved that Nueces produced more dry matter and had better nutritional quality than common buffelgrass. Thus, genotypes such as 443, 409527, 365713, 409154, 409155, 409165, 409373, 409377, 409459 and 409672 are considered as good substitutes of Nueces when are growing in northeastern Mexico.

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Table 1. Chemical composition (% DM), *in situ* digestibility of NDF (%DM) and dry matter production (ton/ha) of 86 genotypes of buffelgrass (*Cenchrus ciliaris* L.) collected in November 2000 at Teran, N. L., Mexico

Genotypes	CP	OM	NDF	Cellulose	Hemi	Lignin	IDNDF	DMP
NUECES (control)	8	87	72	38	24	5	76	5
LLANO	7	87	70	40	24	3	49	4
202513	7	88	73	38	29	3	55	4
253261	8	88	72	38	27	4	49	4
307622	8	86	73	40	25	4	71	5
364428	8	86	69	38	22	4	49	3
364439	7	88	76	42	23	6	50	4
364445	6	87	73	40	22	7	51	2
365654	7	87	72	41	23	4	55	3
365702	7	86	72	41	27	1	61	3
365704	8	84	71	42	21	3	61	3
365713	8	87	75	40	27	5	60	5
365728	8	83	76	41	25	5	59	3
365731	8	84	77	41	27	5	62	4
409142	7	88	75	40	27	3	61	3
409151	7	87	72	42	26	3	59	3
409154	7	87	70	41	19	6	56	5
409155	8	87	71	42	26	1	60	5
409157	7	88	71	42	23	4	58	3
409162	8	88	69	41	22	2	55	4
409164	7	85	74	40	22	8	51	4
409165	7	87	69	39	22	6	49	5
409168	8	87	70	40	24	3	57	4
409185	8	88	72	40	24	4	50	3
409197	8	87	70	43	25	1	52	2
409200	8	88	79	39	29	8	58	3
409219	8	88	68	39	24	3	46	4
409220	9	87	71	42	26	2	58	2
409222	8	86	76	41	31	2	55	2
409223	8	87	75	41	27	2	56	1
409225	8	89	77	42	29	3	55	4
409227	8	87	75	39	29	4	58	3
409228	8	85	71	41	26	1	62	3
409229	8	86	68	38	27	2	58	2
409230	8	87	71	40	23	3	56	4
409232	8	86	70	41	26	1	52	2
409234	8	86	70	40	24	2	55	2
409235	7	88	70	41	27	1	54	3
409238	8	86	68	38	26	1	57	3
409240	8	87	70	40	24	2	57	2
409242	8	88	76	44	28	2	55	3
409252	8	86	72	38	26	3	53	3
409252	8	88	70	40	21	5	62	4
409254	7	87	75	41	28	1	57	3
409258	7	87	73	41	24	2	53	4
409263	8	88	67	39	21	5	50	3

**Table 1. Continuation.-**

409264	7	87	70	40	27	2	55	2
409266	8	86	73	41	27	2	56	2
409270	7	87	74	41	31	1	58	1
409278	7	87	73	41	29	2	57	2
409280	8	88	71	43	25	1	50	2
409300	8	87	70	42	26	1	57	2
409342	8	87	75	41	23	9	54	4
409359	8	87	70	40	25	4	47	3
409363	8	85	73	43	23	4	58	3
409369	7	86	68	40	25	1	53	4
409373	8	86	70	41	23	2	51	5
409375	7	87	69	37	19	7	69	4
409377	7	86	72	41	24	4	49	5
409381	8	86	71	40	24	4	53	4
409391	8	87	71	40	27	2	53	4
409400	8	86	75	40	24	7	53	2
409410	8	86	75	40	24	8	57	2
409424	8	88	74	40	25	6	49	3
409448	7	82	70	41	21	5	53	3
409449	8	88	76	41	30	1	58	4
409459	8	86	73	40	25	2	57	5
409460	9	87	67	41	15	5	63	4
409465	8	87	72	41	24	2	54	3
409466	7	86	75	42	27	5	57	4
409472	8	87	76	41	28	3	55	5
409480	8	86	72	41	28	1	51	4
409529	8	86	76	41	26	4	55	6
409691	8	88	76	42	30	1	53	2
409711	7	87	74	39	29	4	57	4
414447	7	88	76	39	29	4	52	4
414451	8	86	76	42	27	2	51	4
414454	8	86	75	41	26	5	50	4
414460	7	86	75	39	28	2	53	2
414467	8	87	75	41	23	6	50	3
414499	8	86	75	42	25	4	53	3
414511	8	84	78	42	26	6	56	4
414512	8	84	76	42	26	5	55	3
414520	8	84	74	42	25	4	54	4
414532	8	86	76	41	26	3	50	3
443	8	86	71	36	22	8	73	6
Mean	8	86	73	40	25	4	55	3
Standard error, n = 4	0.2	0.2	0.4	0.7	0.8	0.4	1.1	0.2
Probability level	***	***	***	***	***	***	***	***

CP = crude protein, OM = organic matter, NDF = neutral detergent fiber, Hemi = hemicellulose, IDNDF = *in situ* digestibility of neutral detergent fiber; DMP = dry matter production.



# THE SIXTH INTERNATIONAL SYMPOSIUM ON THE NUTRITION OF HERBIVORES



UNIVERSITY OF YUCATAN

30 April, 2003

Dear Colleague,

On behalf of the Local Organizing Committee of The Sixth International Symposium on the Nutrition of Herbivores, it is my pleasure to inform you that your work "*Ruminal Digestion and Chemical Composition of New Genotypes of Buffelgrass (Cenchrus ciliaris L.)*" by Guillermo J. García-Dessommes, Roque G. Ramírez-Lozano, Rahim Foroughbackch P., Rocío Morales-Rodríguez, Graciela García-Díaz, has been accepted to be presented as a poster at this scientific event.

I will really appreciate if you could register at your earliest convenience for attendance to the symposium by checking instructions at the website <http://isnh6mexico.org>

Sincerely

**Dr. Juan Carlos Ku-Vera**  
Local Organizing Committee  
The Sixth International Symposium on the Nutrition of Herbivores

# Ruminal Digestion and Chemical Composition of New Genotypes of Buffelgrass (*Cenchrus ciliaris* L.)

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## Summary

The aim of the study was to evaluate and compare the dry matter production (TDM), chemical composition and effective degradability of dry matter (EDDM), crude protein (EDCP) and neutral detergent fiber (EDNDF) of the hybrid Nueces and five genotypes (PI 1, PI 2, PI 3, PI 4, PI 5) of buffelgrass growing in northeastern Mexico. All grasses were established in a completely randomized design with three replicates in a rain fed experiment. Plants were hand harvested in November 14, 2000 at Nuevo Leon, Mexico. TDM was not significantly different among genotypes. Crude protein content and cell wall and its components (cellulose, hemicellulose and lignin) were significantly different among grasses. Also the EDDM, EDCP, and EDNDF were significant different among the buffelgrass genotypes. The hybrid Nueces had the highest degradability values; however, PI 2 had the lowest values. It seems that high lignin content in new genotypes may negatively influenced nutrient digestion in the rumen of sheep. Data of dry matter production and nutritional dynamics, suggest that the new genotypes PI-1 and PI-4 could be considered as good substitutes of the hybrid Nueces for grazing ruminants in the northeastern Mexico.

**Key words:** Nueces buffelgrass, new genotypes of buffelgrass, chemical composition, effective degradability.

## Introduction

Common buffelgrass (T-4464) was introduced into Texas in the late 1940s and actually is currently growth on 8 to 10 millions acres in South Texas and north of Mexico. Since then, buffelgrass had a tremendous impact on the livestock industry in these regions, because of as a range grass it is highly productive and has allowed an increase in cattle stocking rates from one animal unit (AU) for each 12 ha to one AU for each 4 ha (Hanselka, 1985). Because of its wide adaptation to semiarid regions and relatively good nutritional quality, buffelgrass is considered as a South Texas and northeastern Mexico wonder grass (Hanselka, 1988). However, seasonality of rainfall and temperature are the major influences on nutritional quality of buffelgrass (White and Wolfe, 1984). Silva and Faria, (2001) had reported significant differences in the nutritional value among new cultivars and hybrids of buffelgrass; however, the rate and extent of ruminal digestion of the nutrients contained in forage of new genotypes has not been reported in the scientific literature yet. Thus, effective degradability and the rate of digestion are important characteristics of forage that may be used to predict the nutritive value more accurate and compare the utility of this kind of forages in the diets for ruminants (Ørskov, 1991). The objectives of the study were to evaluate and compare the nutrient content and ruminal fermentation of forage of five strains and one hybrid of buffelgrass under rain feed conditions in northeastern, Mexico.

## Materials y Methods

Research was carried out at the Experimental Station "General Teran" by the Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias (INIFAP) and the Universidad Autónoma de Nuevo Leon. General Teran, N.L., Mexico, is located at 25° 18' N and 99° 35' W, with an altitude of 332 m. The climate is typically semitropical and semi-arid with a warm summer. The main and most common type of vegetation is known as the Tamaulipan thornscrub or subtropical thornscrub woodlands. The dominant soils are deep, dark-gray, lime-clay Vertisoles, which are the result of alluvial process. These types of soils are characterized by high calcium carbonate (pH = 7.5 to 8.5) and relatively low organic matter content. The annual mean temperature is 22.4°C, the rainfall average 784 mm, and the evaporation 1622 mm.

Under rain fed conditions, five strains of buffelgrass identified as PI-307622 (PI 1), PI-409252 (PI 2), PI-409375 (PI 3), PI-409443 (PI 4), PI-409460 (PI 5), and the hybrid Nueces of buffelgrass were established in an experiment using a completely randomized design with three replicates. The experimental plots consisted of rows 5.0 m long with 0.8 m between rows. With the purpose to uniform the grass growth, a previous cut was given to all grasses in March of this year. The first significant rainfall of the year 2000 occurred in September 14 (66 mm), and gave the conditions to sustain grass growth. In September and October 452 mm were recorded. This amount of rainfall allowed the grasses to reach full blossom by November when all grasses were hand harvested to a height of 0.15 m above the ground. Partial dry matter was determined in an oven at 55° C for 72 h. Then samples were ground in a Wiley mill (1 mm screen) and stored in plastic containers.

Samples were analyzed for dry matter (DM), organic matter (OM), crude protein (CP; AOAC, 1990), neutral detergent fiber (NDF), acid detergent fiber (ADF; Goering and Van Soest, 1970) and acid detergent lignin (ADL; AOAC, 1990). Hemicellulose (NDF-ADF) and cellulose (ADF-ADL) were estimated by difference. Estimation of insoluble nitrogen in NDF (INNDF) and insoluble nitrogen in acid detergent fiber (INADF), which corresponds to the non-degraded nitrogen, was performed by procedures of Van Soest et al. (1991) and the slowly degraded nitrogen associated to the cell wall components was calculated as INNDF minus INADF (Goering and Van Soest, 1970; Krishnamoorthy et al., 1982).

The rate and extent of DM, CP and NDF digestibility in gasses were measured using the nylon bag technique. Four rumen fistulated Pelibuey x Rambouillet sheep (weighing 45.2±2.3 kg, BW) were used to incubate bags (5 x 10 cm, 53 µm of pore size) that contained ground (4 g) samples of each grass replication and suspended in the ventral part of the rumen of each sheep. Throughout the experiment, sheep were fed alfalfa hay *ad libitum*. For each grass replication six bags were incubated at 4, 8, 12, 24, 36, and 48 h. Upon removal, from the rumen; bags were washed in running cold water. Zero time disappearance was obtained by washing non-incubated bags (0 h bag) washed in a similar fashion. All bags were dried at 60 C in an oven during 48 hours. Weight loss of DM, CP and NDF was recorded.

Data of the non linear parameters a, b and c of DM, CP and NDF were calculated by an iterative process called Neway (McDonald, 1981) that considers the following equation:  $p = a+b(1-e^{-ct})$ , where p= the velocity of disappearance at a time t, a = is the intercept that represents the portion of DM or CP or NDF solubilized at the beginning of incubation (time 0); b = is the portion of the DM or CP or NDF potentially degraded in the rumen of sheep and c = the rate of degradation of DM or CP or NDF (Ørskov y McDonald, 1979) and, effective degradability of DM (EDDM), CP (EDCP) and NDF (EDNDF) was estimated by the following equation: ED = a + (bc/c+k) e<sup>-ct+kT</sup>, at a rumen outflow rate of 2%/hour.

Data of chemical composition, a, b, c, EDDM, EDCP, EDNDF, DDM and DCP were statistically analyzed using a one-way analysis of variance. Means were separated using the Least Significant Difference technique. Simple linear correlation analyses were performed between TDP, %H, chemical composition and EDDM, EDCP and EDNDF (Snedecor and Cochran, 1980).

## Results and Discussion

The total dry matter production (TDM) was no significantly different among the evaluated genotypes (Table 1). However, numerically PI 4 and PI 2 yielded more dry matter than other grasses including the Nueces buffelgrass which is recognized as a highly producing grass with good nutritional quality. The %H was significantly different among grasses, being Nueces and PI 4 the leafier grasses evaluated.

The CP content was significantly different among genotypes. PI 5 had the highest value and PI 3 the lowest. The mean value of CP in all genotype was 8.3% (Table 1). This value is about one percent above the minimum (7%) required to sustain rumen functionality (NRC, 1996). It appears that low N content in the forage is related with the available N in the soil (Ramos and McDowell, 1994). The soil, where this experiment was located, has been characterized for its low N availability (INIFAP, 1991). However, higher CP values, only at the end of summer and the beginning of autumn, were reported for the total plant in Common buffelgrass (Ramirez et al., 2001a) and the hybrids Nueces buffelgrass (Ramirez et al., 2001b) and Llano buffelgrass (Foroughbackch et al., 2001) growing in the same regions but, in different type of soils.

The cell wall (NDF) content and its components (ADF, ADL, cellulose and hemicellulose) were significantly different among grasses (Table 1). Nueces resulted with the highest cell wall and PI 5 with the lowest. Moreover, PI 5 had the largest fully digestible portion of the NDF (100-NDF = 34.1%), and Nueces was lowest (28.2 %). Moreover, Nueces resulted with lower lignin content (Table 1). Lignification of cell wall has been related to low degradability of nutrients contained in plants (Van Soest, 1994). The INNDF was not significantly different among grasses. Conversely, INADF and INNDF-INADF were significantly different. The N non-available for ruminants estimated by the fraction INADF was high (29.8%; mean value of all grasses) compared with previous reports (3 to 15%; Van Soest, 1994).

The EDDM, EDNDF, and EDCP were significantly different among grasses (Table 2). The hybrid Nueces had the highest value of EDDM, EDNDF, and EDCP, and the strain PI 2 had the lowest values. Higher lignin content in the new genotypes might have decreased rumen fermentation of nutrients in the rumen of sheep. The EDCP overall mean was estimated to be 64.2 % and, the potential available CP (100-INADF) was 70.2%. The difference between these two values (6%) might be the amount of INNDF-INADF which is slowly available in the rumen of the animal, but could be fully digested in the abomasum (Van Soest, 1994; Robertson, and Lewis, 1991). Moreover, it seems that INADF negatively affected EDCP ( $r = -0.47$ ;  $P < 0.05$ ).

The degradability values found in Nueces were higher than previous studies reported by Ramirez et al. (2001b) who evaluated Nueces growing in these regions, but harvested in other dates (1998). High degradability values reported in this study may be associated to the positively effects caused by high precipitation (Ramirez et al., 2001ab; Foroughbackhch et al., 2001). In this experiment more than 400 mm were precipitated in the growing season of the genotypes evaluated. The %H also influenced the effective degradability of nutrients in the grasses, because of it was correlated with EDDM ( $r = 0.63$ ;  $P < 0.05$ ), and EDCP ( $r = 0.53$ ;  $P < 0.05$ ). The EDCP was also positively correlated to CP content ( $r = 0.50$ ;  $P < 0.05$ ), and negatively to INADF. It means that when CP increased, EDCP may also increase.

## Conclusions

Forage dry matter production was not significantly different among evaluated grasses. However, there were significant differences for most of chemical components and degradability values. The hybrid Nueces had higher values of EDDM, EDNDF, and EDCP than other grasses. Higher lignin content in the forage of new genotypes may decrease the amount of nutrients degraded in the rumen of sheep. Because of new genotypes PI 1 and PI 4 had very similar dry matter production and nutritional dynamics, it is suggested that they could be used as forage substitutes of Nueces buffelgrass growing in the region.

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Table 1. Dry matter production (ton/ha), crude protein, cell wall components and nitrogen associated to cell wall (%) in the forage of the hybrid Nueces and five new genotypes of buffelgrass (*Cenchrus ciliaris* L)

Concept	Genotypes						Mean±SE
	Nueces	PI 1	PI 2	PI 3	PI 4	PI 5	
TDM	4.8 <sup>a</sup>	5.2 <sup>a</sup>	3.8 <sup>a</sup>	3.5 <sup>a</sup>	5.6 <sup>a</sup>	4.1 <sup>a</sup>	4.5±0.4
%H, g	0.71 <sup>a</sup>	0.66 <sup>ab</sup>	0.49 <sup>c</sup>	0.63 <sup>b</sup>	0.71 <sup>a</sup>	0.66 <sup>ab</sup>	0.65±0.02
Organic matter	88.5 <sup>a</sup>	85.9 <sup>c</sup>	87.7 <sup>b</sup>	87.0 <sup>b</sup>	86.4 <sup>c</sup>	86.6 <sup>c</sup>	87.0±0.2
Crude Protein	8.4 <sup>c</sup>	7.8 <sup>dc</sup>	8.1 <sup>cd</sup>	7.5 <sup>c</sup>	8.8 <sup>b</sup>	9.2 <sup>a</sup>	8.3±0.1
NDF	71.8 <sup>a</sup>	69.7 <sup>b</sup>	70.4 <sup>b</sup>	69.7 <sup>b</sup>	70.4 <sup>b</sup>	65.9 <sup>c</sup>	69.6±0.5
ADF	47.9 <sup>c</sup>	51.6 <sup>a</sup>	49.8 <sup>b</sup>	50.8 <sup>ab</sup>	48.8 <sup>bc</sup>	50.6 <sup>ab</sup>	49.9±0.3
Hemicellulose	23.9 <sup>a</sup>	18.1 <sup>c</sup>	20.6 <sup>b</sup>	18.9 <sup>c</sup>	21.6 <sup>b</sup>	15.2 <sup>d</sup>	19.7±0.7
Cellulose	38.3 <sup>b</sup>	33.2 <sup>d</sup>	40.2 <sup>a</sup>	37.7 <sup>bc</sup>	36.3 <sup>c</sup>	40.3 <sup>a</sup>	37.6±0.6
ADL	5.3 <sup>d</sup>	8.5 <sup>a</sup>	6.9 <sup>c</sup>	7.5 <sup>b</sup>	8.1 <sup>a</sup>	6.6 <sup>c</sup>	6.7±0.7
INNDF	48.7 <sup>a</sup>	46.6 <sup>b</sup>	48.5 <sup>a</sup>	45.9 <sup>a</sup>	36.0 <sup>a</sup>	45.8 <sup>a</sup>	45.2±1.2
INADF	27.3 <sup>b</sup>	32.8 <sup>a</sup>	30.7 <sup>b</sup>	35.0 <sup>a</sup>	21.7 <sup>c</sup>	31.2 <sup>ab</sup>	29.8±1.2
INNDF-INADF	21.5 <sup>a</sup>	13.8 <sup>bc</sup>	17.7 <sup>ab</sup>	10.9 <sup>c</sup>	14.3 <sup>bc</sup>	14.6 <sup>bc</sup>	15.5±1.1

<sup>abcd</sup>Means in a row with different letter superscripts are different (P<0,05); TDM = total dry matter production; %H = ratio between leaf blades and plant total weight; NDF = neutral detergent fiber; ADF = Acid detergent fiber; ADL = acid detergent lignin; INNDF = insoluble nitrogen in NDF as a % of the total crude protein; INADF = insoluble nitrogen in ADF as a % of the total crude protein; INNDF-INADF = slowly degraded nitrogen associated to the cell wall components, as a % of the total crude protein; SE = standard error.

Table 2. Digestion characteristics and effective degradability of the dry matter, crude protein and neutral detergent fiber in the forage of the hybrid Nueces and five new genotypes of buffelgrass (*Cenchrus ciliaris* L)

Concept	Genotypes						Mean±SE
	Nueces	PI 1	PI 2	PI 3	PI 4	PI 5	
EDDM, %	66.3 <sup>a</sup>	62.6 <sup>b</sup>	55.0 <sup>d</sup>	61.5 <sup>b</sup>	62.2 <sup>b</sup>	57.9 <sup>c</sup>	60.9±0.9
a, %	43.3 <sup>a</sup>	37.7 <sup>b</sup>	30.3 <sup>d</sup>	38.8 <sup>b</sup>	38.8 <sup>b</sup>	35.3 <sup>c</sup>	37.4±0.1
b, %	40.7 <sup>a</sup>	42.9 <sup>a</sup>	43.2 <sup>a</sup>	37.4 <sup>a</sup>	38.1 <sup>a</sup>	38.6 <sup>a</sup>	40.2±0.8
c, %/h	3.4 <sup>c</sup>	3.7 <sup>abc</sup>	3.4 <sup>bc</sup>	4.1 <sup>ab</sup>	4.3 <sup>a</sup>	3.8 <sup>abc</sup>	3.8±0.1
EDCP, %	70.8 <sup>a</sup>	68.6 <sup>a</sup>	55.3 <sup>c</sup>	59.4 <sup>bc</sup>	67.2 <sup>ab</sup>	63.9 <sup>ab</sup>	64.2±1.6
a, %	49.7 <sup>a</sup>	46.7 <sup>ab</sup>	30.2 <sup>c</sup>	34.6 <sup>bc</sup>	46.1 <sup>ab</sup>	43.0 <sup>abc</sup>	41.7±2.2
b, %	37.4 <sup>a</sup>	37.1 <sup>a</sup>	43.6 <sup>a</sup>	40.4 <sup>a</sup>	34.1 <sup>a</sup>	34.2 <sup>a</sup>	37.8±1.2
c, %/h	3.4 <sup>c</sup>	3.8 <sup>abc</sup>	3.5 <sup>bc</sup>	4.2 <sup>ab</sup>	4.4 <sup>a</sup>	4.1 <sup>ab</sup>	3.2±0.12
EDNDF, %	69.6 <sup>a</sup>	64.5 <sup>c</sup>	58.2 <sup>d</sup>	63.8 <sup>c</sup>	66.4 <sup>b</sup>	55.4 <sup>c</sup>	63.0±1.18
a, %	48.8 <sup>a</sup>	39.5 <sup>c</sup>	37.0 <sup>c</sup>	44.0 <sup>b</sup>	43.8 <sup>b</sup>	31.0 <sup>d</sup>	40.7±1.42
b, %	34.2 <sup>a</sup>	41.0 <sup>a</sup>	37.6 <sup>a</sup>	32.8 <sup>a</sup>	42.8 <sup>a</sup>	39.6 <sup>a</sup>	38.0±1.20
c, %/h	4.1 <sup>a</sup>	4.2 <sup>a</sup>	3.3 <sup>a</sup>	4.0 <sup>a</sup>	3.4 <sup>a</sup>	4.3 <sup>a</sup>	3.9±0.18

<sup>abcd</sup>Means in a row with different letter superscripts are different (P<0,05); EDDM = effective degradability of the dry matter; EDCP = effective degradability of crude protein; EDNDF = effective degradability of neutral detergent fiber, calculated using a rumen outflow rate of 3,0 %/hour; a= fraction of DM or CP or NDF (%) lost during washing; b= fraction of DM or CP or NDF (%) slowly degraded in the rumen of sheep; c= degradation rate of DM or CP or NDF (%/h); SE = standard error.

## DIGESTIBILIDAD *IN SITU* DE 86 GENOTIPOS DEL PASTO *Cenchrus ciliaris* L.

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Aun cuando el pasto buffel comun se ha naturalizado en el noreste de México, su productividad se ve limitada por problemas fitopatológicos y de susceptibilidad a las bajas temperaturas. Lo anterior ha generado la necesidad de probar nuevos genotipos, además del híbrido buffel nueces, que produzcan más con igual o mejor calidad nutritiva y que sean resistentes. Por lo tanto el objetivo de este estudio, fue comparar la producción de materia seca (PMS), valor nutrimental y digestibilidad *in situ* de la materia seca (DISMS) de 85 nuevos genotipos del pasto buffel (*Cenchrus ciliaris* L.) y el híbrido buffel nueces, el cual fue usado como un pasto de referencia, más tolerante a las bajas temperaturas, mejor calidad nutritiva y PMS que el buffel común. Bajo condiciones de temporal, con un diseño en bloques al azar con tres repeticiones, en 1995 se sembraron los pastos en el Campo Experimental del Instituto de Investigaciones Forestales, Agrícolas y Pecuarias, de General Terán, Nuevo León, México. El corte de los pastos para este estudio se llevó a cabo en noviembre del 2000. Las plantas se cortaron a ras del suelo en la parte útil de cada bloque. La técnica de la bolsa nylon fue usada para determinar la DISMS, para lo cual se utilizaron 4 borregos (42 kg±2,5 kg de peso vivo) fistulados del rumen. Bolsas nylon (5 x 10 cm y 53 µm de tamaño de poro) conteniendo 4 g de cada pasto fueron incubadas en la parte ventral del rumen por un período de 48 horas. Los borregos, durante la adaptación (15 días) y periodo experimental, fueron alimentados con heno de alfalfa a libre acceso. Los genotipos PI409529 (5.6 ton/ha), PI443 (5.5 ton/ha), PI307622 (5.2 ton/ha), PI409155 (5.1 ton/ha) y buffel nueces (4.8 ton/ha) tuvieron la más alta ( $P<0.05$ ) PMS; sin embargo, PI409223 (0.8%) fue el más bajo. La DISMS fue más elevada ( $P<0.05$ ) en el buffel nueces (73.1%) seguido de PI307622 (70.2%), PI443 (69.6%) y PI409151 (62.2%), pero PI409197 (44.7%), PI414467 (44.6%) y PI414532 (43.2%) resultaron con los valores más bajos. Por lo tanto, los nuevos genotipos PI443, PI307622 y PI409151 por ser superiores en PMS y comparables en DISMS al híbrido buffel nueces y, aparentemente más resistentes a las enfermedades y a las bajas temperaturas, pueden ser considerados como una buena alternativa para la productividad de ganado bovino en pastoreo en estas regiones.

**DIGESTIÓN RUMINAL DE LA MATERIA SECA Y PARED CELULAR DEL FORRAJE DE  
VARIOS GENOTIPOS DE PASTO *Cenchrus ciliaris***

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En el noreste de México, bajo condiciones de temporal, se ha evaluado, durante cinco años consecutivos, la producción de materia seca de 95 nuevos genotipos introducidos del la Universidad de Texas A y M, EUA, de los cuales PI-443, PI-409375, PI-409460, PI-307622 y PI-409252 fueron las más sobresalientes; sin embargo no se les ha determinado su calidad nutrimental. Por lo tanto, los objetivos de este estudio fueron evaluar y comparar su valor nutrimental y el grado de digestión ruminal. El híbrido buffel nueces (*Cenchrus ciliaris*), fue usado como un pasto de referencia con alta calidad nutritiva. Bajo condiciones de temporal, con un diseño en bloques al azar con tres repeticiones, en 1995 se sembraron los pastos en el Campo Experimental del Instituto de Investigaciones Forestales, Agrícolas y Pecuarias, de General Terán, Nuevo León, México. El corte de los pastos para este estudio se llevó a cabo en agosto de 1999. La técnica de la bolsa nylon fue usada para determinar la DISMS y DEPC, para lo cual se utilizaron 4 borregos ( $42 \text{ kg} \pm 2,5 \text{ kg}$  de peso vivo) fistulados del rumen. Bolsas nylon ( $5 \times 10 \text{ cm}$  y  $53 \mu\text{m}$  de tamaño de poro) conteniendo 4 g de cada pasto fueron incubadas (0, 4, 8, 12, 24, 36 y 48 horas) en la parte ventral del rumen. Los borregos, durante la adaptación (15 días) y período experimental, fueron alimentados con heno de alfalfa a libre acceso. Aun cuando las diferencias entre pastos en su contenido de proteína cruda, pared celular y sus componentes (celulosa, hemicelulosa y lignina) y proteína cruda en la pared celular, fueron significativamente diferentes, éstas fueron marginales. La misma tendencia se obtuvo en la DEMS y DEPC. Los resultados de este estudio sugieren que debido a que la calidad nutritiva del buffel nueces, es comparable con la de los nuevos genotipos, éstos representan una buena alternativa como alimento del ganado alimentado con estos pastos, sembrados en el noreste de México.



