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IN SITU DRY MATTER RUMINAL DEGRADATION KINETICS OF PRAIRIE GRASS AND ANNUAL RYEGRASS FORAGE

J. R. Carrete[1] and I. Ceconi[1]

[1]INTA EEA Pergamino, CC 31 (2700) Pergamino, Buenos Aires, Argentina

jcarrete@pergamino.inta.gov.ar

Abstract

The objective of this study was to evaluate dry matter ruminal degradation kinetics, of prairie grass (*Bromus catharticus* Vahl.) and annual ryegrass (*Lolium multiflorum*), by using *in sacco* technique, on seven different harvesting dates. The forage was incubated in nylon bags, suspended in the rumen of four Hereford steers with a rumen fistula. The dry matter ruminal degradation was calculated through the exponential model P=a+b(1-exp(-ct)). Potential degradabilities (PD) were high and reduced accross a temporal trend, ranging between 92,31 and 81,79g 100g $^{-1}$ of dry matter (DM) for prairie grass (PG) and 95,06 and 77,44g 100g $^{-1}$ DM for annual ryegrass (AR). Effective degradabilities (ED) had the same tendency as PD, ranging between 75,85 and 53,80g 100g $^{-1}$ DM for PG and 79,68 and 53,60g 100g $^{-1}$ DM for AR. For both parameters and most of the harvesting dates, AR was superior to PG. Except on two harvesting dates, both species presented similar degradation rates, ranging between 16,30% h^{-1} and 5,35% h^{-1}. It was concluded that, during its main period of utilization, AR showed more ED and PD than PG, though, except on October, differences were of scarce magnitude. However, PD and ED decay accross a temporal trend were more pronounced in RG. On the last harvest dates PG tended to stabilize its degradabilities.

Keywords: prairie grass, annual ryegrass, ruminal degradation kinetics

Introduction

Prairie grass is an important native grass in the pampas of Argentina. It has a high production with relative good forage quality and palatability (Harpster et al, 1990; Hume, 1991 and Hall et al, 1996). Traditionally, PG has been planted with others species such as lucerne. However, it can be used as small grain pasture or preserved as hay or silage. Additionally, few studies of *in situ* degradation kinetics that directly compare forage of PG with other grass species have been conducted. The purpose of this study was to evaluate dry matter ruminal degradation kinetics of PG (*Bromus catharticus* Vahl) and AR (*Lolium multiflorum* L) on different harvesting dates using *in sacco* technique.

Material and Methods

The experiment was conducted at Pergamino Experimental Station (Instituto Nacional de Tecnología Agropecuaria) in the north of Buenos Aires province. The utilized materials were Martín Fierro M.A.G. prairie grass and Comet annual ryegrass. These were planted into plots at 500 seed $m^{2\ -1}$ seeding rate on fall. 100 kg ha^{-1} of P_2O_5 and 11 kg. ha^{-1} of N were applied at sowing. Nitrogen was applied at 125 kg. ha^{-1} yr^{-1}. The determinations were carried trough on seven harvesting dates (10August, 10 September, 8 October, 30 October, 24 November, 5 January and 8 February). The plots were harvested at 8 cm residual stubble high when the plans were 20-30 cm high or early head stage. Except on the first harvest date (23 and 33 days for RG and PG) both species had the same forage accumulation period. Both species were evaluated on the six first dates and only prairie grass on the last one. The forage was dried and milled (1 mm) and a portion was remitted to laboratory to characterize the forage in terms of *in vitro* dry matter digestibility (IVDMD), neutral-detergent fiber (NDF), acid-detergent fiber (ADF) and crude protein (CP). The remainder was incubated in nylon bags, suspended in the rumen of four Hereford steers with a rumen fistula and fed on *ad libitum* with alfalfa hay and water. The incubation times were 2, 4, 8, 16, 24, 48 and 72 hours. Dry matter ruminal degradation was calculated through the exponential model P=a+b(1-exp(-ct)) (Ørskov y Mc Donald, 1979), where P was degradation at (t) incubation time and a, b and c were constants that indicated: a, the soluble fraction; b, the insoluble but potentially degradable fraction; a+b, the potential degradability and c, the fractional degradation rate. The non-degradable fraction was calculated as A=100-a-b. ED was calculated considering a 6% h^{-1} outflow rate. ADF and NDF were determined according to the Van Soest and Wine method (1970); CP was calculated as Kjeldhal N * 6,25 and IVDMD by Tilley and Terry method (1963). Data were analyzed through ANOVA (SAS system), using a split-plot design, where the main plot was the specie, the subplot was the harvest date and the animals were the blocks. Treatment means were separated using Duncan´s test (P<0,05). PD and ED rates of change were calculated through a linear regression analysis.

Results and Discussion

Most of harvesting dates AR had greater IVDMD and lower ADF and NDF than PG (Table 1). For both species the IVDMD decreased and ADF and NDF increased across a temporal trend. Concerning CP contents, both PG and AR showed high but reduced values across a temporal trend.

Ruminal degradation parameters are presented on Table 2. Significant differences were found between species and between harvesting dates, where the interaction species*date was also significant. PD were high and reduced across a temporal trend, ranging between 92,31 and 81,79g $100g^{-1}$ DM for PG and 95,06 and 77,44g $100g^{-1}$ DM for AR. The linear regression equations for PD were PD= 90,801424-0,056437 X for PG (R2= 0,6664; P < 0,0001) and PD= 96,137598-0,114466 X, for AR (R2= 0,8648; P < 0,0001), where X meant the days since 10 August. ED had the same tendency as PD, ranging between 75,85 and 53,80g 100g $^{-1}$ DM for PG and 79,68 and 53,60g 100g $^{-1}$ DM for AR. The linear regression equations for ED were ED=80,011945-0,167580 X, for AR (R^2=0,7418; $P < 0,0001$) and ED=73,975132-0,120718 X, for PG (R^2=0,8286; $P < 0,0001$). For both parameters and most of harvesting dates, AR was superior to PG. These differences were more noticeable on October and the reason would have been that in this month and unlike PG, AR was not on head stage. Except on two harvesting dates, both species presented similar degradation rates, ranging between 16,30 % h^{-1} and 5,35 % h^{-1}.

It was concluded that during its main period of utilization, AR showed higher ED and PD than PG. Differences were of scarce magnitude, except in October. However, PD and ED decay across a temporal trend was more pronounced in AR. On the last harvesting dates PG tended to stabilize its degradabilities.

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Table 1 - *In vitro* dry matter digestibility (IVDMD), neutral-detergent fiber (NDF), acid-detergent fiber (ADF) and crude protein (CP) contents in Martin Fierro MAG prairie grass and Comet annual ryegrass on different harvesting dates.

Harvesting date	Species	IVDMD ($g\ 100g^{-1}$)	NDF ($g\ 100g^{-1}$)	ADF ($g\ 100g^{-1}$)	CP ($g\ 100g^{-1}$)
10 August	Prairie grass	70.3	57.3	26.4	22.2
	Annual ryegrass	69.5	58.0	24.6	24.5
10 September	Prairie grass	67.0	45.6	26.0	20.3
	Annual ryegrass	63.5	40.7	23.4	17.1
8 October	Prairie grass	59.4	62.0	33.0	18.7
	Annual ryegrass	62.0	49.9	-	17.4
30 October	Prairie grass	53.0	62.3	34.1	18.8
	Annual ryegrass	64.1	54.8	25.6	19.0
24 November	Prairie grass	51.4	68.0	38.0	14.7
	Annual ryegrass	54.1	57.6	29.4	17.7
5 January	Prairie grass	49.9	65.7	39.4	12.2
	Annual ryegrass	50.3	63.7	36.9	11.3
8 February	Prairie grass	50.5	67.8	40.4	11.6

Table 2 - Comparison of means for *in situ* degradation parameters and effective dry matter degradability of prairie grass and annual ryegrass

	Sp.	Harvesting dates							CV
		8/10	9/10	10/8	10/30	11/24	1/5	2/8	
a†	PG	23.65 a D	33.26 b A	32.31 b AB	29.26 a BC	24.6 a D	26.44 b CD	24.10 D	4.60
	AR	20.51 b D	44.41 a A	39.64 a B	29.97 a C	23.6 a D	32.49 a C	-	5.10
	cv	2.93	1.23	5.16	3.39	1.81	1.75	-	
b†	PG	68.66 b A	58.46 a B	52.37 a D	54.26 b CD	58.74 a B	57.55 a BC	57.7 BC	2.97
	AR	74.55 a A	48.81 b C	47.78 a C	60.29 a B	61.15 a B	44.95 b C	-	2.91
	cv	1.05	1.34	3.57	2.73	1.88	1.34	-	
a+b†	PG	92.31 b A	91.72 b A	84.68 b B	83.52 b BC	83.33 a BC	83.99 a B	81.79 C	1.36
	AR	95.06 a A	93.22 a B	87.42 a D	90.26 a C	84.78 a E	77.44 b F	-	1.95
	cv	0.64	0.97	0.89	1.48	1.85	0.91	-	
A†	PG	7.69 a C	8.28 a C	15.32 a B	16.48 a AB	16.67 a AB	16.01 b B	18.21 A	4.25
	AR	4.94 b F	6.78 b E	12.58 b C	9.74 b D	15.22 a B	22.56 a A	-	5.79
	cv	3.33	4.51	2.78	4.84	5.23	2.23	-	
c	PG	15.47 a A	16.30 a A	9.71 a B	7.63 b B	7.31 a C	6.98 a C	6.38 C	7.11
	AR	15.23 a A	15.60 a A	11.89 a B	15.15 a A	7.44 a C	5.35 b C	-	8.43
	cv	2.86	7.35	10.53	3.26	2.94	3.15	-	
ED†	PG	73.00 b B	75.85 a A	64.60 b C	63.23 b C	56.70 a D	57.40 a D	53.80 E	1.35
	AR	73.95 a B	79.68 a A	71.08 a C	73.08 a B	57.50 a D	53.60 b E	-	1.37
	cv	0.20	2.25	1.02	0.50	1.56	0.21	-	

a: soluble fraction; b: degradable fraction; a+b: potential degradability; A: non-degradable fraction; c: fractional degradation rate (% hour $^{-1}$); ED: effective degradability; cv: variation coefficient.

† g 100g $^{-1}$ DM

Within each harvest date. means followed by the same small letter are not different at the 0.05 probability level.

Within each species. means followed by the same capital letter are not different at the 0.05 probability level.