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CONTINUOUS DIGESTIBILITY ASSESSMENT OF TROPICAL GRASSES

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Abstract

The feed value for cattle of three tropical grasses, Gatton (*Panicum maximum* cv. Gatton), Estrella (*Cynodon plectostachyus*) and Tifton-85 (*Cynodon sp.* cv. Tifton-85) was investigated during the growing period, using the method of "continuous digestibility estimation". Results indicate that feed value is hardly influenced by the growth stage from the 90th day on. Common European in-vitro feed evaluation procedures are not to be recommended for tropical grasses as they presented consistently lower values than did in-vivo measurements.

Keywords: Feed value, metabolizable energy, net energy lactation, Chaco

Introduction

Available biomass, nutrient composition and digestibility, as well as intake of forages by grazing animals, vary considerably during the vegetation cycle. This variability is particularly pronounced in tropical and subtropical grasses as they grow fast at the beginning of the rainy season while digestibility is rapidly decreasing (Minson, 1981). This has to be taken into account for any effective grazing management and forage production in the tropics.

The objective of this study was to follow up feed value and nutrient availability in pastures of three tropical grasses, Gatton (*Panicum maximum* cv. Gatton), Estrella (*Cynodon plectostachyus*) and the newly bred cultivar Tifton-85 (*Cynodon* cv. Tifton-85; Hill et al., 1993), as dependent on their growth stage, under the conditions of the Paraguayan Chaco (Schmidt, 1997), using the in-vivo-method of continuous digestibility assessment in cattle (Nehring, 1961; Schiemann, 1981). Moreover, this method was to be compared with common European in-vitro-methods for feed value prediction.

Material and Methods

The principle of the in-vivo-method of continuous digestibility assessment is to feed animals continuously with daily cut fresh fodder during the vegetation cycle, collecting the faeces daily for subsequent analysis. The experiment was carried out in the Central Chaco Research Station (22º40'S, 59º50'W), Paraguay. Three Braham steers (453 ±11,7, 445±13,1 and 420±5,3 kg LW), housed individually in feeding cages, were fed three times a day on maintenance level (≈500 kJ ME*LW [$kg^{0,75}$]*d^{-1}) exclusively with the aforementioned grasses, the plots of which had been cut in September 1995 to standardize growth. Measurements started in October 1995 and finished in April 1996. Daily dry matter intake was estimated.

From every cut 5-8 sub-samples were taken at random, united, dried and milled for analyses. Dry matter (DM), crude ash (CA), crude protein (CP), crude fibre (CF), NDF, ADF were analysed using standard procedures. Additionally, enzyme (cellulase) degradable organic matter (digestible OM [g*kg DM^{-1}] = 940 - CA - 0,678*RE (RE = insoluble rest); Weißbach et al., 1996) and in-vitro digestibility (Hohenheim gas test; Menke et al., 1979) were determined to predict feed value. The daily collected faeces were aliquot pooled to 5-daysamples. Dry matter, crude ash, nitrogen contents, crude fibre and ADF were determined in the faeces (only for Gatton and Tifton-85).

Since only one animal was available for each grass, the steers had been tested beforehand on no significant differences in feed digestion. Negative influences were caused by the late onset of the rainy season and a grasshopper attack, particularly of Estrella and Tifton-85.

Results and Discussion

Dry matter yield and dry matter content increased, as the growth cycle went on. Gatton, Estrella and Tifton-85 reached a maximum standing biomass of 13.7, 4.4 and 4.8 $t*ha^{-1}$ at the longest growth period measured (Zierenberg, 1996).

Feed quality characteristics are summarized in table 1. Generally, the feed values remained below expectation. In-vivo digestibility of organic matter averaged 60% in Tifton-85 and 65% in both Gatton and Estrella. The low contents of crude protein (53-96 g $CP*kg\ DM^{-1}$), combined with a relatively low CP-digestibility (means of 62±4, 68±4 and 52±5 %), results in very low contents of digestible protein (44±8, 52±10 and 30±5 $g*kg\ DM^{-1}$) for Gatton, Estrella and Tifton-85 respectively.

The increase of the fibre fractions during the growth period was less pronounced than expected. Moreover, the average digestibility of crude fibre was comparatively high (66±4% for Gatton and 61±4% for Estrella and Tifton-85). Hence, in this experiment only a limited influence of the growth stage and time of harvest on feed value could be detected.

Values of metabolizable energy (ME) and net energy lactation (NEL) respectively as predicted by common European laboratory procedures are clearly underestimated as compared to figures obtained by in-vivo-measurements (table 1). The Hohenheim gas test (columns b and d) produced consistently the lowest estimates of ME, in the average 22%, 26% and 18% less than the in-vivo values for Gatton, Estrella and Tifton-85 respectively. The levels of underestimation by the cellulase method (column a) were 6%, 8% and 1% for the three grass cultivars. Estimations of NEL-contents resulted in a similar trend as for ME. However, a different ranking of the grasses is obtained when the average contents of digestible OM are considered as determined by in-vivo assessments (593±33, 580±46 and 552±24 g*kg DM^{-1} for Estrella, Gatton and Tifton-85).

It is concluded that for an objective feed value evaluation of tropical grasses and forage crops in-vivo methods should be used. For this purpose the method of continuous digestibility estimation seems to be particularly suitable. The European in-vitro procedures, calibrated for temperate forages, are not to be recommended for tropical grasses under advanced maturity.

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Table 1 - Feed quality characteristics of Gatton, Estrella and Tifton-85: Maximum, minimum and average values, as determined with a variety of methodologies during the growing period

Grass cultivar	Min.-max. growth period (days)	Dry matter g*kg^{-1}	Crude ash g*kg DM^{-1}	Crude protein g*kg DM^{-1}	Crude fibre g*kg DM^{-1}	NDF g*kg DM^{-1}	ADF g*kg DM^{-1}
1. Chemical composition							
Gatton	96-168	154-350	118-88	90-49	380-421	730-802$^{1)}$	395-472$^{1)}$
Estrella	123-176	280-490	98-81	96-53	352-379	827-731$^{1)}$	435-376$^{1)}$
Tifton-85	131-188	317-436	97-76	54-74$^{1)}$	347-372$^{1)}$	747-815$^{1)}$	356-406$^{1)}$
2. Digestible nutrients		Feed intake kg DM*d^{-1}					
Gatton		7.7±1.0		44±8	266±17		282±17
				54-29	303-251		319-253
Estrella		8.3±0.6		52±10			
				67-40			
Tifton-85		5.8±0.2		30±5	219±16		228±20
				24-40$^{1)}$	240-183		256-185
3. In-vivo-digestibility (%)		Organic matter					
Gatton		65±5	49±7	62±4	66±4		65±3
		60.5-72.4	40.9-60.0	66.8-54.4	61.4-73.8		59.0-71.9
Estrella		65±4	43±7	68±4			
		63.2-64.8	48.2-34.9	73.5-62.4			
Tifton-85		60±3	33±6	52±5	61±4		59±4
		64.5-54.6	41.5-24.2	60.3-45.4	66.0-53.0		63.7-49.9

4. Energetic values

	Metabolizable energy (ME) MJ*kg DM^{-1}			**Net energy lactation (NEL)** MJ*kg DM^{-1}				
	in vivo	a)	b)	in vivo	c)	d)	e)	f)
Gatton	8.5	8.0	6.6	4.9	4.6	3.7	4.3	4.7
	6.9-9.6	8.3-7.6	7.9-4.4	5.7-3.9	4.8-4.3	4.5 – 2.3	4.5-4.2	4.8-4.5
Estrella	8.7	8.0	6.4	5.1	4.6	3.5	4.7	5.0
	7.8-9.6	8.5-7.5	7.1-5.8	5.6-4.4	4.9-4.2	4.0-3.1	4.8-4.5	5.1-4.8
Tifton-85	8.1	8.0	6.6	4.6	4.5	3.7	4.8	5.2
	7.3-8.6	8.2-7.8	7.1-5.4	5.0-4.1	4.7-4.4	4.0–2.9	4.9-4.6	5.3-5.0

$^{1)}$ not correlated with length of growth period

a) Cellulase degradable organic matter (de Boever et al., 1986)
(ME [MJ*kg DM^{-1}] = 13.96 - 0.0147*CA -0.0108*RE + 0.00234*CP) (Weißbach et al., 1996)

b) Hohenheim gas test (Close and Menke, 1986)

c) Cellulase degradable OM
(NEL [MJ*kg DM^{-1}] = 0.6 [1+0.004(q-57)]*ME[MJ*kg DM^{-1}])
(q =metabolizable energy*gross energy^{-1}[%]) (van ES, 1978)

d) Hohenheim gas test (Close and Menke, 1986)

e) Calculated on basis of crude fibre (NEL [MJ*kg DM^{-1}] = 8.69 - 0.110*CF) (Kirchgessner und Kellner, 1981)

f) Calculated on basis of ADF (NEL [MJ*kg DM^{-1}] = 9.23 - 0.105*ADF) (Kirchgessner, 1996)