NUTRITIVE VALUE OF GUINEA GRASS (*Panicum maximum* Jacq.) AND UREA SUPPLEMENTED RICE STRAW FOR CATTLE

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Summary

An experiment was conducted to study the comparative performance of cattle fed young or mature guinea grass (*Panicum maximum* Jacq. ecotype A) and urea supplemented rice straw. Evaluation was based on intake and digestibility parameters. Twelve crossbred bulls calves weighing 90 ± 15 kg were offered young (4 weeks regrowth) or mature (9 weeks regrowth) grass in the long or chopped (10 - 15 cm) form, and rice straw supplemented with urea. The diets were offered 30 - 60% in excess of voluntary intake, and the experiment consisted of two periods. The crude protein content of the young grass, mature grass and the straw offered were 12.2, 5.4 and 7.7%, respectively, and the refusal was 10.1, 3.9 and 7.0%, respectively. The organic matter digestibility of the young grass (69%) was significantly higher than the mature grass (62.5%) and straw (55.8%) diets. The organic matter intake (kg/100 kg LW/day) of the unchopped and chopped grass diets were 2.6 and 3.3 respectively, and these values were significantly higher ($p < 0.01$) than the young grass (2.3) and straw (2.1) diets. The digestible organic matter intake (DOMI) of the mature grass diet offered in the chopped form (2.1 kg/100 kg LW/day) was significantly higher ($p < 0.01$) than the other three diets. The DOMI of the young and mature grass offered in the long form was similar (1.6 kg/100 kg LW/day), but were significantly better ($p < 0.01$) than the urea supplemented straw diet.

(Key Words : Guinea Grass, Rice Straw, Cattle)

Introduction

Many of the forage species and cereal straws produced in tropical and arid regions fall below 70% apparent digestibility (Ulyatt, 1973). As in many regions in the tropics, in Sri Lanka small scale dairy farmers have to either depend on mature wayside grasses or on rice straw to feed their animals. *Panicum maximum* Jacq. ecotype A (guinea A) is the most abundantly available grass growing wild in the wet and semi-dry areas of Sri Lanka (Peiris and Ibrahim, 1986). With maturity the leaf : stem ratio in forage plants decreases (Oyenuga, 1960; Panditharatne et al., 1978; Omaliko, 1980), as a result the digestibility and intake of such forages also decreases (Gunawardana and Appadurai, 1972; Devendra, 1976). The latter is true when the forage in offered 10 - 15% in excess of the voluntary intake.

There is evidence to indicate that increased intake does not necessarily depress digestibility when it is associated with selective consumption (Hagger and Ahmed, 1970; Jeffrey, 1976; Schiere et al., 1990), but has a negative effect when high levels of feed for high performance are fed and no selection is allowed (Elkhidir and Vestergaard Thomsen, 1983). Even in instances where the digestibility is depressed due to increased intake, the benefits are higher when it is weighed against the intake of digestible material (Badurdeen et al., 1994). Roughage intake by ruminants is influeneced by a range of factors that are related to animal genotype, physiological state, environment, type and quantity of feed offered and factors related to processing of feed (Weston, 1984). It is also thought that the feed intake of low quality roughages which are below 60% digestibility is regulated by physical restrictions in the rumen (Conrad et al., 1964).

Since unfertilized grass whether young or mature is considered as a poor quality roughage, it is of interest to know whether its intake and digestibility could be

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Received April 30, 1994

Accepted September 26, 1994

improved by using liberal feeding levels. Secondly, whether the performance of animals fed mature grass could be improved by over coming the physical restrictions in the rumen by chopping. As rice straw is an alternative feed resource available at farm level, it is appropriate to include rice straw for comparative evaluation. Available information suggests that one of the primary limitations that restricts the utilization of rice straw by ruminants is low nitrogen content (Doyle et al., 1986). As such, the objective of the experiment reported in this paper was to assess the intake and digestibility of young and matured guinea grass and rice straw supplemented with urea. The chemical composition and *in vitro* digestibility data obtained from previous experiments (Peiris, 1985) aided to draw the line between young and mature grass.

Materials and Methods

Experimental diets

The diets consisted of either unfertilised guinea A grass or rice straw. The grass was obtained from an area close to the Veterinary Research Institute farm, located in the mid-country wet zone of Sri lanka (elevation 550 metres above sea level, temperature range 22-27℃). The area was weeded and with the onset of the rains the grass was cut to a uniform height. Thereafter the grass was harvested either at 4 weekly or 9 weekly intervals.

The 4 weekly cut guinea grass was fed in the long form (diet 1), while the 9 weekly cut grass was fed in the long form (diet 2) or offered in the chopped (10-15 cm) form (diet 3). The straw in the long form was sprayed with 2% urea solution (2 kg urea dissolved in 100 litres water per 100 kg straw) and offered immediately to animals (diet 4).

Allotment of animals

Twelve growing crossbred bulls (Indigenous × Sindhi) weighing 90±15 kg were housed in individual pens for four weeks before commencement of the experiment. During this period they were offered *ad libitum* guinea grass and their daily intakes recorded. At the end of the four weeks the animals were weighed and allocated into 3 groups of 4 animals based on their liveweight (LW). The diets were randomly allocated to the four animals in each group.

The experiment consisted of two periods, each of 5 weeks duration. Each period consisted of an adaptation period of 10 days, preliminary period of 15 days and collection period of 10 days. At the end of the first period the animals were rerandomised into three groups, caution was taken to avoid repeating the same animals on the same feed.

Measurements and laboratory analyses

During the collection period, dry matter intake and faecal output were recorded daily. Dry matter content of the feed offered, feed refused and faeces were determined by drying subsamples at 100℃ for 36 hours. Representative subsamples of the daily feed offered and faecal output were stored at −4℃. At the end of the collection period the daily subsamples of feed and faeces were mixed well and dried at 70℃ for 30 hours, and ground to pass through a 1 mm screen. With the mature grass diets (D2 and D3), 500 g of the feed offered and feed refused were carefully separated into leaf and stem fractions and dried at 70℃ for 30 hours and the amount of these fractions consumed by the animals was estimated.

Feed offered and refused were analyzed for nitrogen and ash by the methods of AOAC (1980). *In vitro* digestibility measurements of the diets offered and refused were performed using cellulase enzyme and the procedure described by McLeod and Minson (1978).

Statistical analyses

Digestibility coefficients and the intake data were analyzed according to a factorial (4 × 3 × 2) design and the means separated using the Duncan multiple range test (Steel and Torrie, 1960).

Results and Discussion

The chemical composition and *in vitro* organic matter digestibility (IVOMD) of the diets offered and refused in period 1 and 2 are given in table 1. There were no contrasting differences between the two periods with any of the parameters studied. The ash contents of the grass diets (D1, D2 and D3) were from 10.5 to 11% as compared to the straw diet which was 13%. The crude protein (CP) content of the young grass offered was 12.0% followed by urea sprayed straw (7.7%) and mature grass (5.4%). The CP content of the feed refused was lower and the corresponding values for young grass, mature grass and straw diet were 10.1, 3.9 and 7.0%, respectively. Compared to the feed offered the IVOMD of the feed refused was 2.9-3.6 digestibility units lower for the grass diets (D1, D2 and D3) and 1.4 units lower for the straw diet.

The quantity of feed offered, the quantity refused, intakes and the mean digestibility coefficients are presented in table 2. Both the dry matter digestibility (DMD) and organic matter digestibility (OMD) of the 4

TABLE 1. CHEMICAL COMPOSITION AND *IN VITRO* ORGANIC MATTER DIGESTIBILITY (IVOMD) OF THE DIETS OFFERED AND REFUSED

	Dry matter (%) (as offered)	Ash (% DM)	Crude protein (% DM)		IVOMD (%)	
			Feed offered	Feed refused	Feed offered	Feed refused
Period 1						
D1	23.2	11.0	12.1	10.2	57.5	54.2
D2	35.8	10.5	5.6	3.9	50.9	47.3
D3	46.7	10.5	5.6	4.0	50.9	48.0
D4	53.6	13.0	7.8	7.0	47.1	45.8
Period 2						
D1	22.6	10.9	11.9	10.0	56.9	53.9
D2	34.2	11.0	5.2	3.8	49.5	46.0
D3	44.9	11.0	5.2	4.0	50.0	47.2
D4	52.8	13.1	7.6	7.0	46.9	45.4

TABLE 2. INTAKE AND MEAN DIGESTIBILITY COEFFICIENT OF GUINEA GRASS AND UREA SUPPLEMENTED RICE STRAW WHEN FED TO CATTLE (MEAN OF 6 ANIMALS)

	Young grass (D1)	Mature grass		Rice straw (D4)
		Unchopped (D2)	Chopped (D3)	
Feed offered (kg, fresh)	18	25	16	9.0
Feed refused (kg, fresh)	4.9	14.4	7.0	3.3
% Feed refused	27.2	57.6	43.8	36.7
Intake (kg/100 kg LW/day)				
– Dry matter	2.89[a] (0.21)	3.05[b] (0.34)	3.93[c] (0.49)	2.78[d] (0.37)
– Organic matter	2.26[a] (0.18)	2.57[b] (0.28)	3.26[c] (0.42)	2.12[d] (0.29)
– Digestible organic matter	1.55[a] (0.14)	1.59[a] (0.13)	2.05[b] (0.20)	1.18[c] (0.16)
Digestibility coefficient (%)				
– Dry matter	63.9[a] (2.47)	55.9[b] (1.75)	57.9[c] (2.83)	50.1[d] (3.15)
– Organic matter	68.7[a] (2.71)	62.1[b] (2.07)	62.8[c] (3.08)	55.8[d] (3.23)

Figures in parentheses are standard errors
Within rows means with dissimilar superscripts are significantly different ($p < 0.01$)

week old guinea grass (D1) was significantly higher ($p < 0.01$) than the mature guinea grass (D2 and D3) and the straw diet (D4). The DMD of the 4 week and 9 week regrowth of guinea grass were 64 and 57%, respectively. These values are similar to the values reported by Devendra (1976) working with *Panicum maximum* ecotypes Serdang and Coloniao. With sheep, Devendra reported DMD values of 69 and 59% for 3-4 week and 6-7 week defoliated Coloniao grass. In another study (Aguilu-Arroyo and Oporta, 1980), the DMD of 12-13 week old guinea grass (chopped) measured using cattle, goat and sheep was 53, 48 and 50%, respectively. Comparing the cattle data from the above study with our study (53 vs 58%), the difference in DMD could be due to difference in stage of maturity and also the level of selection allowed.

The crude protein content of mature grass was around 5.6% compared to 7.7% for urea sprayed straw. The OMD of urea sprayed straw was 56% (table 2), and there is evidence to show that the response achieved in supplementing straw with urea depends to a great extent on the initial quality of straw (Zemmelink et al., 1987). In spite of the moderately high OMD value, the organic matter intake (OMI) was comparatively low (2.12 kg/

100 kg LW) resulting in low digestible organic matter intake (1.18 kg/100 kg LW). The dry matter intake (DMI) of the chopped grass diet (D3) was significantly higher ($p < 0.01$) than the other three diets. Also, the DMI of the unchopped grass diet (D2) was significantly higher ($p < 0.01$) than the young grass (D1) and straw diet. The OMI for the unchopped (D2) and chopped (D3) mature grass diets were 2.6 and 3.3 kg/100 kg LW/day, and these values were significantly higher than those for the young grass and straw diets. The OMI for the diets consisting of mature grass were higher than the young grass diet. The OMI from young and mature grass fed in the long form was 2.3 and 2.6 kg/100 kg LW/day, respectively. Possible explanations for the higher intake could be; (a) the animals selectively consumed about 70-80% leaves, and in the mature grass the animals could easily distinguish between stems and leaves, and (b) the rate of degradation of leaves being high were therefore cleared faster from the rumen.

The leaf:stem ratios and the mean intake of leaf and stem fractions of the mature grass diets (D2 and D3) are presented in table 3. The leaf:stem ratio of the mature grass offered in the unchopped and chopped form were 1:0.4 and 1:0.6, respectively. In the dry matter consumed by the animals the leaf:stem ratio for diets 2 and 3 was 1:0.3 and 1:0.5, respectively. The leaf:stem ratio in the refusal dry matter of both these diets was 1:1. The grass and the straw diets were offered 30-60% in excess of daily intakes (table 2), this allowed the animals to select between the different components of the plant.

Whether the mature grass was offered unchopped or chopped the animals tend to consume more leaves which are higher in digestibility than stems. Voluntary intake of forage depends on the quantity of feed offered (Butterworth, 1965; Zemmelink, 1980), and the increased intake does not depress digestibility when it is associated with selective consumption (Jeffrey, 1976; Schiere et al., 1990). The higher intake observed in our study could be due the increased opportunity given to the animal to select the more desirable and usually less fibrous parts of the forage when excess feed is made available. With several grasses and tropical legumes it has been demonstrated (Butterworth, 1965; Zemmelink et al., 1972; Zemmelink, 1980), that the leaf fraction was preferred and the diet selected was very different from that offered. Butterworth (1965) studied the nutritive value of chopped *Pennisetum purpureum* defoliated at 30, 50 and 70 day intervals. He reported that residues up to a third of the material offered were necessary to attain maximum intake, and the sheep were able to select a diet of similar composition from these contrasting forages and hence intake was unaffected.

Compared to the unchopped mature grass the organic matter intake from chopped grass was high (2.6 vs 3.3 kg/100 kg LW). According to Conrad et al. (1964), the intake and digestibility of low quality herbage could be improved by physical means such as chopping. This could be due to the increased rate of passage through the rumen. Feed intake by ruminants is controlled by a complex of factors which are not yet fully understood. However, it is generally accepted that deficiencies of specific nutrients, in particular protein may considerably modify intake, and intake of diets of low digestibility is primarily limited by physical factors related to capacity of the reticulo-rumen and the rate of disappearance of digesta. From the results presented in table 3, it is evident that even when the mature grass was chopped (10-15 cm), the animals were still capable of selectively consuming more leaves. It would be of interest to examine the changes in intake and digestibility if the mature grass was chopped finer.

TABLE 3. LEAF : STEM RATIO OF THE MATURE GRASS DIETS OFFERED AND REFUSED AND THE MEAN DAILY INTAKE OF LEAVES AND STEMS

	Leaf : stem ratio of feed offered	Intake (kg DM /day)			Refusal (kg DM /day)		
		Leaf	Stem	Leaf : stem ratio	Leaf	Stem	Leaf : stem ratio
Unchopped (D2)	1 : 0.6	2.19 (0.15)	0.58 (0.05)	1 : 0.3	0.47 (0.03)	0.46 (0.04)	1 : 0.9
Chopped (D3)	1 : 0.7	2.44 (0.44)	1.18 (0.16)	1 : 0.5	0.81 (0.12)	0.81 (0.12)	1 : 1

Figures in parentheses are standard errors

Conclusions

As animal performance depends on the amount of digestible organic matter (DOM) consumed, rice straw even after supplementation with urea is inferior to guinea grass at various stages of maturity. Furthermore, the marked difference in organic matter intakes between the young and mature grass are narrowed when DOM intakes are considered. The results might be different if the animals were offered only 10% excess feed when selectivity would be reduced. As such we should be very cautious in reporting intake results especially when working with mature grasses. However, availability of feed and economic analysis will decide whether it pays to allow for high refusals at farmer's level.

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