FEEDING VALUE OF *Calliandra calothyrsus* PROVENANCES INTRODUCED TO SRI LANKA AND THE POTENTIAL FOR SUBSTITUTION FOR COCONUT OIL CAKE IN RUMINANT RATIONS

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ABSTRACT

Six *Calliandra calothyrsus* provenance introduced to Sri Lanka were established in the mid country region of Sri Lanka and evaluated for their feeding value and polyphenolic contents. Samples were harvested from a regrowth after 24 weeks of pruning. The average dry matter (DM), organic matter (OM), crude protein (CP), acid detergent fibre (ADF), cellulose, acid detergent lignin (ADL) and in vitro dry matter (IVDMD) and organic matter digestibility (IVOMD) were 451"18, 947"5, 201"16, 447"53, 326 "49, 154"49, 258"38 and 367"35 g/kg, respectively. The tannin content was 40 g/kg and total extractable proanthocynadins (TEPA) and total proanthocynadins (TOPA) were 13"4 and 26"3 absorbance per 100mg dry matter, respectively. In nylon bag degradation study, the readily soluble fraction (a) od DM was between 28.9 - 34 %, and the insoluble but potentially soluble fractions (b) were lower than other common tree fodders (11.1 - 33.4%). Initial nitrogen disappearance from nylon bags in the rumen was highly variable (a = 1.9 - 16.2%), but the potential fraction was low in all provenance (b = 2.5 - 48.6%). Another experiment suggested that coconut oil cake can be successfully replaced by dried Calliandra leaf meal (CLM) up to 30%. Further increase of CLM in the concentrate ration reduced feed intake and total volatile fatty acid production, and beyond 20% level, both blood urea nitrogen and rumen ammonia contents were reduced. However, rumen pH was not effected by any level of substitution.

Key words: *Calliandra calothyrsus*, Provenance, Feeding value, Rumen degradation, Polyphenolics

INTRODUCTION

Calliandra calothyrsus was first introduced to Sri Lanka from Indonesia. The specifications of this provenance is not well documented and generally referred as Indonesian provenance. However this provenance adapted to many environmental conditions and gained popularity very soon. Another reason for its high acceptability by the farmers was that they have observed Calliandra as the best alternate for the gradually disappearing Leucaena. The Leucaena was found to be limited in supply due to its high intolerance to acid soils and the recent severe infestation caused by the *pshyllid bug* (*Heteropsylla cubana*). Compared to many other tree fodder species such as Gliricidia, Erythrina, Tithonia and Artocarpus, the use of Calliandra is limited by its high content of tannin. Practically Calliandra is not much preferred by the cattle and buffalo but relished by the goats. This may be due to their ability to neutralize or bind dietary tannin with the help of the proline present in their saliva. Due to the high protein content in Calliandra, it can be used as a protein supplement for ruminants. If this is successful large amounts of money spent on expensive coconut oil cake can be saved and thus the cost of production can be reduced. To expand the genetic diversity the Oxford Forestry Institute, UK, has introduced new provenance to Sri Lanka. Since this provenance are new to Sri Lanka their potential for feeding for ruminants needs to be evaluated.

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MATERIALS AND METHODS

The edible portion (leaves and twigs) of six *Calliandra calothyrsus* provenance (9/89, 9/91, 10/91,12/91, 18/91 and 20/91) introduced to Sri Lanka from OFI - UK, were collected from an establishment in the mid country (Annual rainfall, 1500 - 1800; elevation, 750 m; lateritic soil with a pH of 6.0 - 6.5; flat terrain) of Sri Lanka. The sampling was done from a two-year-old establishment, six weeks after the last pruning. After harvesting the edible portions were separated, weighed and transported to the laboratory in polythene bags in a ice box.

The edible samples were dried in an oven for laboratory analysis. Dry matter, ash, crude protein were analyzed according to standard methods (A.O.A.C., 1990). Detergent fibre was determined by the method suggested by Goering and Van Soest (1970). In vitro dry matter and organic matter digestibility were done according to Tilley and Terry (1963). Tannin, total extractable proanthocyanadins and total proanthocyanadins were determined by vanillin - HCL and Butanol - HCl methods.

Rumen degradation study was conducted with four ruminnaly cannulated male buffaloes fed on medium quality *Panicum maximum* (Guinea "A") grass *ad libitum*. Fodder samples were incubated in nylon bags (17 X 10 cm.; pore size 41 mm.) For 0, 8, 16, 24, 48 and 72 hours. Once the bags were withdrawn from the rumen after respective incubation time intervals, they were thoroughly washed and dried at 60 c^{o} for dry matter and nitrogen determination. Residues were ashed at 550 °C to determine the organic matter disappearance. The dry matter and organic matter disappearance values were fitted into the exponential equation $p = a + b (1 - e^{-ct})$; where p = disappearance rate (%), a = readily soluble fraction (%), b = insoluble but potentially degradable fraction (%), c = rate constant (%/hr), t = incubation time (hrs); (Mehrez and Ørskov, 1977).

Another experiment was conducted to evaluate the substitution level of dried Calliandra leaf meal for coconut oil meal in ruminant rations. Mature male goats were used as the test animals. They were kept in metabolism cages and fed with dried rice straw *ad libitum* as the basal feed. Coconut oil cake was used as the concentrate (control) and in the other test concentrates diets the coconut oil meal was replaced by dried Calliandra leaf meal at the rate of 10, 20, 30, 40 and 50%. All test diets including the control were offered at the rate of 30 g / kg body weight. These test diets were offered twice daily in equal portions. The experiment consisted a 10 days transition period followed by a 15 days adaptation period. The total collection period was 10 days in which period both feces and urine were collected twice daily. At the last day of the collection, blood from jugular vein and rumen fluid through a mouth tube was drawn. Rumen pH (electrometrically), rumen ammonia nitrogen (Conway, 1975), total volatile fatty acid (Erwing *et al.*, 1942) and blood urea nitrogen (IAEA standard kits) were determined. The results were analyzed by analysis of variance (SAS, 1980) and means were separated by Duncan's multiple range test (Snedcor and Cochran, 1967).

RESULTS AND DISCUSSION

The proximate compositions of different Calliandra provenance are given in Table 1. The average dry matter content of this provenance was 451" 18 g/kg. The differences between provenance were not very significant (range 421 - 472 g/kg). This in agreement with the values reported for many other tree fodder species (Perera, 1992). This high dry matter in Calliandra is attributed to the presence of large proportions of petioles and tender twigs in the edible portion. The organic matter content of Calliandra was higher than (average 947"5 g/kg) the values reported for many other tree fodder species (Rajaguru, 1990). The average CP was 201"16 g/kg (range 178 - 226 g/kg) which is similar to the commonly used protein supplement for ruminants, coconut oil meal. This level of CP is sufficient to maintain an optimum rumen ammonia nitrogen level for efficient microbial activity (Perera *et al*, 1992). However the availability of nitrogen in the rumen is depend on the solubility of dietary nitrogen. The cell wall

constituents were in agreement with the values reported for other tree fodder species by Perera (1992) and Rajaguru (1990). However, the ADL values were somewhat higher than the value of other common tree fodders such as Gliricidia, Erythrina and Leucaena. This may be again due to the presence of large proportion of petioles and tender twigs in the edible portion. This high ADL may interfere with the intake and digestibility.

The in vitro dry matter and organic matter digestibility were 258"38 and 367"35 g/kg, respectively (Table 2). For leguminous tree fodder, this is a very low figure. The reported values for other local tree fodders are about 480 g/kg (Perera, 1995). The tannin content in all provenance were similar with an average value of 40"9 g/kg. This is in agreement with the values reported in other experiments on Calliandra (Perera, 1993). The average TEPA and TOAP were 13.0"4 and 26.0"3 Abs. per 100mg, respectively. Presence of Tannin and polyphenolic compounds restricts intake and digestibility of fodder. The estimation of tannin and other polyphenolic compounds are highly variable. In comparison of four methods of tannin analysis by Velario (1994), the best correlation found to be Folin Denis vs gravimetry methods using Yt. These two methods gave the best correlation with IVDMD.

The degradation characteristics studied using nylon bag technique are given in Table 3. Nearly 30% of the Calliandra dry matter is readily soluble (a) in the rumen. However the readily soluble nitrogen* was low (range 1.9 to 6.8%) in all provenance except in provenance 10/91 (16.2 %). The low nitrogen solubility may be associated with the presence of high contents of tannin. The average total degradable fraction of both dry matter and nitrogen were 52.8"6.9 and 28.7"14.3 % respectively. In total nitrogen degradation, provenance 20/91 had the highest value (54.7%) and provenance 10/91 and 18/91 the lowest (18.7 and 18.4%, respectively). The nitrogen degradation in the rumen of all Calliandra provenance was lower than other tree fodder species (Perera *et al* 1992). This low degradability of Calliandra nitrogen in the rumen may be due to the presence of polyphenolic compounds in higher proportions than in other tree fodder species (Kaitho *et al*, 1993). This has a practical importance, since the leguminous tree fodder have a shorter retention time in the rumen (Thronton and Minson, 1973) and therefore, considerable amount of undegradable proteins escape rumen to enter small intestine and undergo enzymatic digestion (Kaitho *et al*, 1993). There is also a marked difference in the feeding values of tree fodder when analyzed dry and fresh samples. This marked difference is very prominent in Calliandra. Therefore, Palmer and Schlink (1992) suggested using fresh samples when analyzing for feeding value to obtain better estimate. In contrast Perera *et al*, (1992) found no difference in the feeding value of different tree fodder species whether used in dry or fresh form.

The effect of substitution of Calliandra leaf meal (CLM) to coconut oil meal (COM) was investigated. The results are given in Table 4. Straw dry matter intake was significantly reduced after 40% substitution level of CLM. This may be due to the reduced rumen activity caused by low availability of rumen ammonia nitrogen at this level (114 mg/l). Similarly total nitrogen intake also significantly reduced above the substitution level of 40% CLM. Both these factors may have contributed to low rumen activity to results low dry matter intake. The digestibility of dry matter and organic matter were reduced at 30% level of substitution of CLM and thereafter. Rumen pH was lower up to 30% level of substitution of CLM. All these information suggest that in ruminant concentrate rations COM can be successfully replaced by CLM up to 30% level.

In conclusion the Calliandra provenance introduced to Sri Lanka can be successfully used in ruminant feeding and CLM can be successfully substituted up to 30% level.

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