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Total phenolics, non-tannin phenolics and total tannin content of commonly available forages for ruminants in Tamil Nadu

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Abstract
The total phenolics, non tannin phenolics and total tannin content of sixteen commonly available forages in Tamil Nadu for feeding ruminants were analyzed. A highly significant ($p<0.01$) difference was observed between forages and shrubs/tree fodders (foliages). Among forages the highest total phenolics was present in *Sorghum vulgare* (4.63%) and lowest in *Cynodon dactylon* (0.72%). In tree fodders, the highest total phenolic was observed in *Acacia nilotica* (10.96%). In forages, the maximum non-tannin phenolics were recorded in *Brachiaria mutica* (2.25 %) and the minimum in *Stylosanthes scabra* (0.54%). Among tree fodders, *Moringa oleifera* had the highest (1.23 %) non-tannin phenolics and *Albezia lebback* had the lowest (0.41 %) level**.** Highest total tannin was present in *Sorghum vulgare* (3.18 %) and lowest in *Panicum maximum* (0.08 %) within forages. Among tree fodders, *Acacia nilotica* (10.12%) had highest tannin content.

Keywords: Forages, Non- tannin phenolics, Ruminants, Total phenolics, Total tannin

Introduction

Tannins are the secondary plant compounds which are not directly involved for the growth of the plant but act as natural defence mechanism against bacteria, insects, fungi and grazing animals and therefore assist in the survival of the plants (Kumar and Singh, 1984). They are complex polyphenolic compounds and have a variable effect in decreasing digestibility of proteins in rumen. Tannins reduce the palatability of the feed and subsequently decrease the feed intake and lower crude protein digestibility. There are also several cases of livestock death have been associated with high tannin content of some foliage. Tannins have strong affinity for enzyme and feed protein, which varies with plant species. *Prosopis cineraria* tannin has been observed to have a very high protein precipitating capacity when compared to other tree foliages (Patra and Saxena*,* 2011). Therefore, tannin content potentially alters the use and value of tree foliages andmay at times be responsible for the poor utilization of such forages by ruminant livestock. On the other hand, lack of tannins in *Gliricidia* is believed to leave the protein so unprotected as to be completely degraded in the rumen. Tannins from *Leucaena leucocephala* afford a good level of protection of the protein (Patra and Saxena*,* 2011), but tannins from *Lotus pedunculatus* appear to overprotect protein from rye grass fed to sheep (Waghorn *et al*., 1994) with subsequent increased faecal loss of protein. In general, shrub and tree foliages are likely to be higher in tannins than pasture plants. Leguminous forages from the tropics are generally higher in tannin than those from the temperate countries. The level of tannins within a species has been found to vary considerably depending on number of factors.

The present study was conducted to find out the total phenolics, non-tannin phenolics and total tannin content of the commonly available forages in Tamil Nadu for ruminants.

Materials and Methods

Six samples each of sixteen commonly available forages in Tamil Nadu used for feeding ruminants were collected (approximately 2 kg on each sample) as per the standard procedure. The collected forage samples were dried in a hot air oven at a temperature of 55 - 65^{o}C to constant weight and ground to pass through 1 mm sieve and stored in airtight containers for analysis. The plant extracts was prepared as per Makkar *et al*. (1993), in which one gram each of finely ground sample was weighed into 250 ml conical flasks and to it 10 ml of 70 % aqueous acetone was added and the flask was tightly sealed and kept in an orbital shaker at 120 rpm for 24 hr. The contents of the flasks were filtered through four layers of muslin cloth. The filtrate obtained was further filtered through whatman

no.1 filter paper and the resultant filtrate was used for total phenolics and non-tannin phenolics estimation.

Total phenolics were estimated (Makkar *et al*., 1993) by adding to 0.1 ml of plant extract, the following *viz.* 0.9 ml of distilled water, 0.5 ml of 1N Folin-Ciocalteu reagent and 2.5 ml of 20 % sodium carbonate solution. The contents were mixed and incubated for 40 minutes at room temperature. The optical density was measured at 725 nm in a UV spectrophotometer (Perkin Elmer model Lambda 25). The concentration was calculated with tannic acid equivalent standard curve. The standard curve was drawn from different concentrations of standard tannic acid solution (0.1mg/ml) ranging from 0 to 0.3 ml by adopting the same procedure as that for plant extracts. For non-tannin phenolics estimation (Makkar *et al*., 1993), 100 mg of poly vinyl poly pyrrolidone was taken in test tube and to it one ml of distilled water along with 1 ml of plant extract was added, centrifuged at 3000 rpm for 10 minutes and the supernatant was collected. The supernatant contained non tannin phenolics other than tannins. Total tannin was calculated by subtracting non tannin phenolics from the total phenolics. The data were analysed through the procedure of statistical analysis system (IBM SPSS® Version 20.0 for Windows®) as per the Snedecor and Cochran (1989).

Results and Discussion

A highly significant ($p<0.01$) difference was observed between forages and shrubs/ tree fodders with regard to total phenolics, non-tannin phenolics and total tannin content (Table 1). Among forages, the highest total phenolics were present in *Sorghum vulgare* (4.63%) and lowest in *Cynodon dactylon* (0.72%). Other forages like *Brachiaria mutica, Stylosanthes scabra. Vigna unguiculata, Panicum maximum* and *Pennisetum typhoides x Pennisetum purpureum* had 2.39, 1.92, 1.64, 1.22 and 1.03 % of total phenolics respectively. In shrubs/ tree fodders the highest total phenolics was observed in *Acacia nilotica* (10.96%) followed by *Moringa oleifera* (4.5%), *Sesbania grandiflora* (2.25 %), *Leucaena leucocephala* (1.97 %) and *Azadirachta indica* (1.66%). *Gliricidia sepium* had lowest level of (0.67%) of total phenolics.

In forages, the maximum content of non-tannin phenolics was present in *Brachiaria mutica* (2.25 %) and the minimum content of non-tannin phenolics was present in *Stylosanthes scabra* (0.54%). The other forages had values ranging between 0.55 - 1.45 % for non-tannin phenolics. Among shrubs/tree fodders, *Moringa oleifera* had the highest (1.23 %) non-tannin phenolics followed by *Azadirachta indica* (1.02%), *Leucaena leucocephala* (0.69 %) and *Albezia lebback* (0.41 %)**.** Other shrubs/tree fodders had 0.52 to 0.84 % of non-tannin phenolics.

The observed value for total phenolics in the present study across forages and shrubs/ tree fodders fell within the range of values reported in earlier studies. The earlier reported values of total phenolics and non-tannin phenolics in shrubs/tree fodders were in the range of 1.35-33.9 % and 0.24 -3.6 % respectively (Alexander *et al*., 2008). The total phenolics and non-tannin phenolics content of *Moringa oleifera* was lower than the reported values (Alexander *et al*., 2008).

Highest total tannin was present in *Sorghum vulgare* (3.18 %) and lowest was present in *Panicum maximum* (0.08 %) among the forages. Other forages had total tannin values between 0.13 % to 1.38 % *viz., Stylosanthes scabra* (1.38 %), *Vigna unguiculata* (1.01 %), *Medicago sativa* (0.31 %), *Cynodon dactylon* (0.17 %), *Pennisetum typhoides x Pennisetum purpureum* (0.16 %), *Brachiaria mutica* (0.14 %) and *Saccharum officinarum* (0.13 %). Among shrubs/tree fodders *Acacia nilotica* (10.12 %) had highest tannin content followed by *Moringa oleifera* (3.27%), *Sesbania grandiflora* (1.64%), *Leucaena leucocephala* (1.28 %) and *Albezia lebback* (1.16%). *Azadirachta indica* (0.64 %) and *Gliricidia sepium* (0.15 %) had lowest content of total tannin.

The total tannin content of *Panicum maximum* (0.08 %) was similar to that reported by Tona (2011). The total tannin in *Medicago sativa* was lower than reported by Vieira and Borba (2011). In case of *Vigna unguiculata* (1.8%) and *Stylosanthes scabra* (2.21%), higher values were reported earlier (Baloyi *et al*., 2001). For *Sorghum vulgare* also higher values (11.7%) were reported when compared to estimated values in the present study. The total tannin content of *Pennisetum typhoides x Pennisetum purpureum* was very low (0.16 %) than observed in *Pennisetum purpureum* (28.64%) by Okaraonye and Ikewuchi (2009). Among the shrubs/ tree fodders, the present estimation of total tannin content of *Gliricidia sepium* and *Albezia lebback* were comparable with the earlier findings (Hess *et al.,* 2006; Wankhede and Jain, 2011). But the total tannin content of *Acacia nilotica* and *Azadirachta indica* were lower than that reported by Harvey *et al*. (2007) and Sirohi *et al*. (2009). *Leucaena leucocephala* and *Moringa oleifera* had higher total tannin values than that reported by Belewu *et al*. (2008) and Alexander *et al*. (2008).

Table 1. Percentage of total phenolics, non-tannin phenolics and total tannin content of commonly available forages for ruminants on DM basis (Mean# ± S.E)

Forages		Total phenolics	Non-tannin phenolics	Total tannin
Botanical Name	**Common Name**			
Forages				
Panicum maximum	Guinea grass	1.22 ± 0.03	1.14 ± 0.03	0.08 ± 0.02
Cyanodon dactylon	Hariali grass	0.72 ± 0.09	0.55 ± 0.02	0.17 ± 0.10
Pennisetum typhoides x *Pennisetum purpureum*	Cumbu Napier grass	1.03 ± 0.03	0.87 ± 0.07	0.16 ± 0.06
Brachiaria mutica	Paragrass	2.39 ± 0.10	2.25 ± 0.03	0.14 ± 0.08
Sorghum vulgare	Sorghum	4.63 ± 0.15	1.45 ± 0.09	3.18 ± 0.20
Medicago sativa	Lucerne	0.85 ± 0.02	0.54 ± 0.02	0.31 ± 0.02
Vigna unguiculata	Cowpea	1.64 ± 0.11	0.63 ± 0.02	1.01 ± 0.13
Stylosanthes scabra	Shrubb stylo/Muyalmasal	1.92 ± 0.09	0.54 ± 0.05	1.38 ± 0.13
Saccharum officinarum	Sugarcane tops	0.86 ± 0.04	0.73 ± 0.02	0.13 ± 0.04
Shrubs/Tree fodders				
Gliricidia sepium	Khillari	0.67 ± 0.07	0.52 ± 0.03	0.15 ± 0.04
Leucaena leucocephala	Subabul	1.97 ± 0.06	0.69 ± 0.03	1.28 ± 0.08
Sesbania grandiflora	Agathi	2.25 ± 0.06	0.61 ± 0.03	1.64 ± 0.06
Acacia nilotica	Karuvel	10.96 ± 1.45	0.84 ± 0.11	10.12 ± 0.57
Albezia lebback	Vagai	1.57 ± 0.09	0.41 ± 0.05	1.16 ± 0.04
Azadirachta indica	Neem	1.66 ± 0.04	1.02 ± 0.07	0.64 ± 0.08
Moringa oleifera	*Murungai*	4.50 ± 0.28	1.23 ± 0.09	3.27 ± 0.22
Statistical Analysis				
Forages (Mean ± S.E)*		1.77 ± 0.16[a]	0.94 ± 0.07[b]	0.77 ± 0.14[a]
Shrubs/Tree fodders (Mean ± S.E)*		3.22 ± 0.50[b]	0.69 ± 0.04[a]	2.49 ± 0.47[b]
Test of significance		P<0.01	P<0.01	P<0.01

Mean of six observations

***** Means bearing different superscripts in the same column differ significantly

On screening of the forages in the present study, the shrubs/ tree fodders had higher level of tannin with the range of 0.015 ï 10.12 % than forages that had range of 0.08 - 3.8 %.

The variation in the values may be due to the changes in environmental factors like the soil, harvest stage, irrigation interval and time *etc*. Among the shrubs/tree fodders, *Acacia nilotica* had the highest level of tannin (10.12 %) which is common browsing top fodder for goats and cattle. The study inferred that the forages/top fodders which contained higher level of tannins should be used judiciously for feeding ruminants.

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