

## STUDIES ON ANTI-NUTRITIONAL FACTORS AND MICRO NUTRIENT CONTENT OF LOCALLY AVAILABLE TREE FODDERS AND SHRUBS IN SOUTHERN KERALA

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### SUMMARY

The study was conducted in College of Agriculture, Vellayani, Thiruvananthapuram during January-September, 2020 to investigate the anti-nutritional factors and micro nutrient contents of different tree fodder and shrubs that are locally available in Southern Kerala. Ten different fodder trees and shrubs which are locally fed to the cattle viz., *Sesbania grandiflora*, *Erythrina indica*, *Moringa oleifera*, *Cocos nucifera*, *Glyricidia maculata*, *Terminalia elliptica*, *Leucaena leucocephala*, *Manihot esculenta*, *Musa acuminata* and *Mangifera indica* were selected and analysed for micro nutrient content (Fe, Zn, Mn and Cu) and anti-nutritional factors (oxalate and nitrate). The results revealed that mean values of iron, zinc, manganese and copper content were of the range 136.45±18.55, 20.59 ±3.62, 30.16±6.48 and 11.75±0.91 respectively. The study also revealed that, both *Sesbania grandiflora* and *Glyricidia maculata* have negligible amount of nitrate. Remaining all tree fodders have nitrate in the range of 2.72±1.02. Whereas oxalate content in all tree leaves ranged from 1.43 to 2.97 per cent, with a mean value of 2.93± 0.16 per cent.

**Key words :** Anti nutritional factors, micronutrients, nitrate, oxalate, tree fodder

Nutrition is the foundation of the livestock production system and proper nutrition is imperative for achieving high and sustained livestock productivity. The farmers are investing two third of the total cost of animal production for cattle feed alone, thus quality green forage availability is the only way to reduce the cost and to increase the returns from livestock. Fodder trees and shrubs are potential sources of various nutrients, but these feed resources are generally ignored from the feeding systems, mainly because of the lack of knowledge regarding the nutritional superiority of these fodder trees. Tree fodder can play a vital role in mitigating the fodder shortage in the country, as Over 60 per cent of the fodder requirements of goats are normally met from shrubs and tree leaves (Ally and Kunjikutty, 2000).

Tree fodders are rich source of various macro and micro nutrients which is essential for proper growth and development of cattle, but there are certain anti-nutritional factors like oxalate, nitrate, tannin etc. that interfere with feed utilization and may affect animal health and reproduction. The present study was therefore undertaken to investigate the micro nutrient and anti-nutrient contents of ten tree fodder and shrubs that are locally available in Southern Kerala. The experimental foliage species were selected because they are abundantly available and highly preferred by

ruminants in its natural habitat and also because farmers strongly believe that these foliage species are highly nutritious.

### MATERIALS AND METHODS

#### Location of the study

The experiment was conducted in College of Agriculture, Vellayani, Thiruvananthapuram during January-September, 2020 to investigate the micro nutrient and anti-nutrient contents of ten different tree fodder and shrubs that are locally available in Southern Kerala. The study area is located within 8.52° and 9.59° north latitudes and 76.93° and 76.52° east longitudes and average precipitation varies from 2250-2500 mm annually.

#### Sample collection

Samples were collected from southern districts of Kerala which include Thiruvananthapuram, Kollam, Pathanamthitta, Kottayam and Alappuzha. Ten different fodder trees and shrubs leaves are locally fed to the cattles were selected viz Agathi (*Sesbania grandiflora*), Erythrina (*Erythrina indica*), Drumstick (*Moringa oleifera*), Coconut (*Cocos nucifera*), *Glyricidia* (*Glyricidia maculata*), Matti (*Terminalia elliptica*), Subabul (*Leucaena leucocephala*), Cassava (*Manihot esculenta*), Banana (*Musa acuminata*) and

Mango (*Mangifera indica*) The green leaves were rinsed in distilled water to remove dust and stored in a refrigerator to be freeze dried as soon as possible after collection. All the foliages were cut into small pieces so as to facilitate easy handling and uniform sampling for analysis. Samples were initially sun dried followed by drying in the hot air oven at 65°C for 24 hrs. Samples were ground to pass through 0.5mm sieve, and stored in zip lock bags at room temperature.

### Chemical analysis

The content of micro nutrients viz., iron, zinc, manganese and copper in plant samples were estimated using Atomic absorption spectrophotometry (Jackson, 1973). The oxalate content of the samples were determined by standard method (AOAC, 2012) and nitrate content was determined calorimetrically by salicylic acid method (Cataldo *et al.*, 1975).

### Statistical analysis

Detailed statistical analysis was not carried out, but the average figure with their standard deviation has been given with the help of Microsoft Excel-2010. This gives an idea about nutritive value of predominant tree fodders in Southern part of Kerala. A minimum of three observations were taken for each species to calculate the average value.

## RESULTS AND DISCUSSION

### Micro nutrient status

Fodder trees and shrubs represent an enormous potential source of energy, fats, proteins,

minerals and vitamins for livestock. Among these sources, micronutrients play an important role in plant metabolism starting from cell formation, cell wall development, chlorophyll formation, respiration, photosynthesis, enzyme activity and nitrogen fixation. Micronutrients are otherwise known as trace elements as it is required in extremely small quantities to the crops and livestock, however, it is no way refers to role being minor. The deficiency of any of the micronutrient may cause problems in forage production and health disorders in livestock.

The mineral status including micro nutrient content of feeds and fodder varied based on the climatic condition prevalent in that area, cropping pattern, soil type and feeding system of that particular region of the country (Bhandari *et al.*, 2014). In India, mineral status may also vary with agro-climatic zones. Thus, deficiency and surplus of a particular mineral is area specific (Garg *et al.*, 2005). The micro nutrient content (Fe, Zn, Mn and Cu) of ten different fodder tree leaves that are prevalent in southern Kerala are mentioned in the Table 1.

Among presently investigated fodder trees, it was registered that, iron (Fe) status of the tree fodders varied from 58.11 ppm to 222.14 ppm with a mean value of 136.45±18.55 ppm. The highest content was found in *Leucaena leucocephala* (222.14 ppm) followed by *Musa acuminata* (202.98 ppm), *Manihot esculenta* (185.97 ppm) and *Mangifera indica* (184.27 ppm). These results were in general agreement with those reported by Fasuyi, (2005) and Pugalenthi *et al.* (2004). The lowest Fe content was noticed in *Moringa oleifera* (58.11 ppm). This finding was in line with the reports of Singh and Banu (2014), who reported

TABLE 1  
Anti-nutritional factors and micro nutrient content of locally available tree fodders and shrubs in southern Kerala

Tree fodder	Anti-nutritional factors		Micro nutrient contents (ppm)			
	Oxalate (% DM basis)	Nitrate (ppm)	Fe	Mn	Zn	Cu
T <sub>1</sub> : Agase ( <i>Sesbania grandiflora</i> )	1.43	0.00	76.02	9.10	35.34	15.6
T <sub>2</sub> : Erythrina ( <i>Erythrina indica</i> )	2.07	2.49	85.97	8.60	12.64	11.9
T <sub>3</sub> : Drumstick ( <i>Moringa oleifera</i> )	2.35	0.69	58.11	14.60	22.84	12.1
T <sub>4</sub> : Coconut ( <i>Cocos nucifera</i> )	2.97	4.46	126.96	31.90	10.14	9.4
T <sub>5</sub> : Glyricidia ( <i>Glyricidia maculata</i> )	2.13	0.00	130.09	13.29	15.44	14.7
T <sub>6</sub> : Matti ( <i>Terminalia elliptica</i> )	2.78	9.26	91.94	23.10	7.64	6.9
T <sub>7</sub> : Subabul ( <i>Leucaena leucocephala</i> )	2.13	3.74	222.14	35.10	18.84	10.1
T <sub>8</sub> : Cassava ( <i>Manihot esculenta</i> )	2.81	0.08	185.97	48.60	31.04	10.3
T <sub>9</sub> : Banana ( <i>Musa acuminata</i> )	2.97	0.21	202.98	71.0	40.44	15.7
T <sub>10</sub> : Mango ( <i>Mangifera indica</i> )	2.21	6.44	184.27	46.30	11.54	10.8
Mean	2.39	2.72	136.45	30.16	20.59	11.75
SEm±	0.16	1.02	18.55	6.48	3.62	0.91

that Fe content in drumstick, comes under three categories *viz.*, low, medium and high. Among these three categories, low Fe content was observed in India (3-57 ppm).

Zinc (Zn) plays an active role in various metabolic activities including the synthesis of certain proteins, carbohydrate and chlorophyll. Apart from these functions, the presence of Zn in plant tissue will help to withstand cold temperature and has an essential role in the formation of auxin, which helps in growth regulation and stem elongation. Present study revealed that zinc content of the selected tree leaves varied from 7.64 ppm to 40.44 ppm with a mean value of  $20.59 \pm 3.62$  ppm (Table 1). The highest Zn content was observed in *Musa acuminata* (40.44 ppm) followed by in *Sesbania grandiflora* (35.34 ppm). Among all the ten different tree leaves, lowest Zn content was noticed in *Terminalia elliptica* (7.64 ppm). However these values seem to be lower as compared to an earlier report in the same crop (Pugalenthi *et al.*, 2004).

Manganese (Mn) is used in plants as a major contributor to various biological systems nitrogen assimilation, photosynthesis and respiration. Manganese is also involved in pest and disease resistance, pollen germination and pollen tube growth and root cell elongation. The present study reported that, the Mn content of all the top feeds comes under the range of 8.6 ppm to 71.0 ppm with a mean value of  $30.16 \pm 6.48$  ppm. The highest value was noticed for *Musa acuminata* (71.0) and the lowest value for *Erythrina indica* (8.6 ppm).

Copper (Cu) acts an important role in lignin synthesis and an essential part of several enzyme systems and also assist in plant metabolism of carbohydrates and protein. Among presently investigated fodder trees and shrubs, the Cu content in all leaf samples comes under a range of 6.9 ppm to 15.7 ppm with a mean value of  $11.75 \pm 0.91$  ppm. The higher content of Cu was noticed in *Musa acuminata* (15.7 ppm) followed by *Sesbania grandiflora* (15.6 ppm), whereas lowest value was noticed in *Terminalia elliptica* (6.9 ppm). These results were in agreement with the findings of Pugalenthi *et al.* (2004).

### Anti-nutritional factors

The utility of the leaves, twigs and pods of trees and shrubs as an animal feed is sometimes limited by the presence of certain substances which are produced in plants by different mechanisms and it adversely affects the optimum nutrition. Such substances are known as antinutritional factors. These

factors either directly or indirectly interfere with the feed utilization or adversely affect the normal health and development of animals. It may negatively affect the nutrient intake, digestion, absorption and utilization. The major anti-nutritional factors are nitrate, oxalate, mimosine tannin and saponins and sinogen. The consumption of fodder containing above critical limit of anti-nutritional factors are fatal, and its regular use even below critical limit may reduce the growth and quality of animals. The present investigation mainly focused on the presence of two anti-nutrients in fodder trees and shrubs. *viz.*, nitrate and oxalates.

### Nitrates

Nitrogen can be taken up by the plants in the form of nitrate from the soil and transported into the leaves. Under stressed condition, there is a chance of nitrate accumulation in plants. The major nitrate accumulating fodders are sudan grass, pearl millet and oats (Singh *et al.*, 2000). Under normal condition, plant nitrate will be converted into amino acid and protein, but higher accumulation of nitrates in animal body may lead to direct absorption through rumen wall to the blood streams, which converts the haemoglobin in the blood to methamoglobin, which cannot carry oxygen and blood turns to chocolate brown colour (Kumar *et al.*, 2017). Nitrate poisoning is more prevalently found in sheep and cattle (Neale, 2006).

The present investigation on nitrate content in ten different fodder leaves revealed that, both *Sesbania grandiflora* and *Glyricidia maculata* have negligible amount of nitrate. Remaining all tree fodders have nitrate at a range of 0.08 ppm (*Manihot esculenta*) to 9.26 ppm (*Terminalia elliptica*) with an average of  $2.72 \pm 1.02$  ppm. The nitrate content in fodder at a range of 0-1000 ppm is considered as safe to feed cattle under all conditions (John Andrae, 2008). The present study was in agreement with the findings of Kumar *et al.* (2017), Where he observed that the nitrate accumulation is more likely found in annual forages than in perennial fodder. Hence the entire tree fodders taken up for the study were safe in terms of nitrate content.

### Oxalate

Oxalate is an important anti-nutrient that is found sufficiently in large quantities in several fodder crops which may negatively affect the normal growth and development of animals. Soluble oxalate can easily

bind with blood calcium to form insoluble calcium oxalate, reducing calcium absorption. This further cause an imbalance in absorbed calcium: phosphorus ratio, resulting in mobilization of bone minerals to alleviate hypocalcaemia. This prolonged mobilization may further lead to osteodystrophy fibrosa (Rahman and Kawamura, 2011). The present investigation showed that the oxalate content in tree leaves ranged from 1.43 per cent to 2.97 per cent, with a mean value of  $2.93 \pm 0.16$  per cent (Table 1). The least oxalate content was observed in *Sesbania grandiflora* (1.43%) whereas both *Musa acuminata* and *Cocos nucifera* have recorded highest oxalate content of 2.97 per cent. Rahman *et al.* (2013) suggested that more than 2 per cent of soluble oxalate in fodder crops may harmful to the ruminants and fodder with 7-16.6 per cent of oxalate may cause acute poison and death (El-Khodery *et al.*, 2008). In the present study all the fodder trees except *Sesbania grandiflora* have oxalate content more than 2 per cent, consequently feeding ruminants solely with these top feeds might produce hypocalcaemia (Rahman *et al.*, 2013).

### CONCLUSION

The present investigation on anti-nutritional factors and micro nutrient content in predominant tree fodders and shrubs that locally available in southern Kerala have revealed that Banana (*Musa acuminata*) is nutritionally superior with respect to micro nutrients such as iron, zinc, manganese and copper. But the high content of oxalate may limit its utility as a fodder. Whereas agathi (*Sesbania grandiflora*) can be recommended as the best top feed due to negligible content of anti-nutritional factor, viz., oxalate and nitrates. Nevertheless, all the ten different top feed are very good source of micronutrient and can be used for livestock feeding in scarcity zones of Kerala.

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