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# Assessment of Leaf Fodder Quality of *Melia dubia* Genetic Resources for Proximate and Mineral Composition

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***Abstract*****:** The present investigation was carried out to evaluate the leaf fodder quality of thirty superior *Melia dubia* genetic resources. *Melia dubia* Cav. is a member of Meliaceae family and it's a multipurpose agroforestry tree used for pulpwood, timber, fuel wood, plywood and afforestation purposes. *Melia dubia* plantation was raised during January, 2010 under National Agriculture Innovation Project at Forest College and Research Institute, Mettupalayam, Tamil Nadu. Selection of superior genetic resources was carried out in the year 2016 by comparison tree method. Further screening has been done and thirty plus trees have been finally screened for leaf fodder quality estimation. In the current study among thirty genetic resources evaluated, the superiority of MTPMD 1 was evident due to higher crude protein (17.30%) coupled with increased dry matter production (37.95%). Among the thirty Melia genetic resources evaluated, high proportion of nutritional constitution viz. (N, P, K, Ca and Mg) was registered by the selection of MTPMD 1. This study is essential for successful breeding program and will help in development of varieties with superior fodder quality. This will help to meet the growing demand of fodder for livestock.

***Keywords*****:** *Melia dubia*, Leaf fodder quality, Animal feed, Proximate analysis, Mineral composition

Livestock rearing is one of the major occupations in India that provides dairy products, manure, draught power for agriculture and local transportation. It forms an important source of cash income to millions of households across various parts of the country. Significance of the livestock sector can be appreciated from the fact that it contributes about 8.5- 9% to the country's GDP. With world's largest livestock population, India faces problem in meeting its fodder requirement. Inadequate feed supply to ruminants during the dry season is the basis for poor performance of livestock. Cultivated fodders occupy only 4% of the entire cultivable land in the country. Presently, the country faces a net shortfall of 35.6% green fodder, 10.5% dry crop leftovers, and 44% concentrate feed ingredients (Singh et al. 2022). The option for increasing land area under fodder cultivation is very limited. Hence feed and fodder availability in India is not sufficient to meet the fast-growing ruminant population. There is an immediate need to explore new feed resources which do not compete with human food chain. Tree leaves are an alternative feed source for small ruminants and can help to minimize the wide gap between demand and supply of nutrients (Bakshi and Wadhwa 2007). The interest in search for alternative/additional feed ingredients is of great importance mainly because of the global demand for grains which has exceeded the production and stiff competition between man and the livestock industry for existing food and feed material. There is an urgent need to increase the productivity of cultivated fodder crops on the same piece of land in order to meet the fodder needs of rising number of cattle. In addition to vertical expansion from arable lands, utilization of non-arable land area for pastures is a viable option to balance the demand. There are a number of lesser-known and under-utilized plants that adapted to local, harsh conditions and have tremendous potential as livestock feed (Sukhadiya et al. 2022). Trees have greater adaptability to varied climatic condition and ability to produce biomass throughout the year. As trees require minimal post planting care, the cost of production will be low. In dry season, leaves as fodder is an important source of nutrients to cattle. Fodder trees are highly nutritious, easy to grow, improve soil fertility and are relatively easy to manage. Fodder trees do not compete with food crops, can be intercropped and once matured can be fed to live stock for up to 20 years. Utilization of protein rich fodder trees has been recognized to be one of the most effective means of improving both the supply and the quality of forage in tropical small holder livestock systems, especially during the dry season. In general, fodder tree leaves contain higher crude protein and calcium content compared to grasses and straws and can act as major feeding resources to the animals (Manoj et al 2017).

*Melia dubia* is one of the best trees that provides fodder to cattle during the off seasons. With its superior characteristics like fast growing nature, easy coppicing and high leaf biomass, it's a best alternative fodder resource. The processing and conservation of fodder trees is increasingly being recognized and explored, while the cultivation is minimal and insignificant. The role and importance of fodder trees for livestock production, their nutritional quality and factors that limit their use in livestock production are reviewed. The need for increased cultivation and integration of fodder trees into local farming systems through agroforestry is imperative in order to promote livestock production and also to support rural livelihoods. However, fodder quality studies in *Melia dubia* have not been evaluated. Hence the current investigation was to determine the fodder quality of *Melia dubia* genetic resources.

## MATERIAL AND METHODS

Leaves were obtained from the felled thirty genetic resource of *Melia dubia* from the 6-year-old existing plantation located at Forest College and Research Institute, Mettupalayam. These leaves were dried and powdered by using Willey mill passed through 60 mesh and analysis have been carried out. The leaves samples were subjected to analysis for proximate and mineral composition. All the analysis were carried out in the research laboratory present in the Agroforestry department, Forest College and Research Institute, Mettupalayam.

**Proximate analysis:** Proximate analysis includes dry matter, ash, crude fat, crude protein, which are essential in determining the quality of the fodder. This analysis was carried out as per the guidelines of AOAC (1990).

**Moisture content:** Determination of moisture was done by; one gram of each sample was taken in a petri-dish and placed in an oven at 100 °C for four hours. It was then cooled in desiccators and weighed. The samples were heated again in the oven for another two hours and the process was repeated, till a constant weight obtained. The moisture content was calculated by using the following formula

$$\text{Moisture (\%)} = \frac{\text{Weight of fresh sample} - \text{Weight of dried sample}}{\text{Weight of the sample}} \times 100$$

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**Ash content:** Determination of ash was done by one-gram dried sample was taken in a crucible and charred over a low flame and kept in a muffle furnace set at 550 °C until white ash was obtained. The ash was moistened with water, dried on steam and then on hot plate. The crucible was again placed in the muffle furnace at 550°C, till a constant weight was obtained. The per cent ash was calculated as:

$$\text{Ash (\%)} = \frac{\text{Weight of sample of ter ash}}{\text{Weight of the sample}} \times 100$$

**Crude fat:** Determination of crude fat done by the dried sample was taken and crushed. Two gram of the sample was taken in a paper thimble and connected to a soxhlet extractor. Then 300 ml of petroleum ether was poured on the flask and refluxed for 12 hours with a heating mantle. Crude fat was extracted in a flask. The flask was cooled in a desiccator and the weight was taken. Crude fat was determined by using the formula:

$$\text{Crude fat (\%)} = \frac{\text{Weight of flash with fat} - \text{Weight of empty flask}}{\text{Weight of original sample}} \times 100$$

**Crude fiber:** Determination of crude fiber was done by one gram of the defatted plant material was taken in beakers and boiled in 200 ml of 1.25% sulphuric acid for 30 minutes. The content was then filtered and washed with distilled water to neutralize the content. The content was transferred again to the beaker and boiled in 200 ml of 1.25% sodium hydroxide for 30 minutes. They were again filtered and washed with distilled water for neutralization. A Gooch crucible was prepared with an asbestos mat and the contents of the beakers were placed on the mat and washed with 15 ml of ethyl alcohol. The crucible was dried in an oven at 110 °C to a constant weight. The crucible having crude fiber was cooled and weighed (W1). The content of the crucibles were ignited over a low flame until charred and then kept in a muffle furnace at 550 °C and weighed (W2). The Percentage fiber was determined by the following formula:

$$\text{Crude fibre (\%)} = \frac{W1 - W2}{\text{Weight of the sample}} \times 100$$

**Crude protein:** Determination of crude protein is done by micro Kjeldahl's method. It involves digestion, distillation and titration of the samples. Digestion is done by one gram of dried plant material of each species was taken in the digestion flask. To this, 10ml diacid was added. The solution was heated until it became clear and frothing ceased. It was then boiled gently for another 2 hours and then it was cooled down. This digested material was mixed with 30 ml of water with constant mixing. The digest was transferred to 100 ml volumetric flask and necessary amount of water was added up to the mark of the flask. Distillation is carried out in the Kjeloplus distillation unit. 25 ml of 2% boric acid was taken and double indicator was added, by which wine red colour could be observed. Then 10 ml of the digest was transferred to the distillation assembly and 10 ml of 40% sodium hydroxide solution was added on it. The distillation was completed in 10 minutes indicating the change of color of boric acid to blue due to the formation of ammonium borate. Titration is carried out by The boric acid having trapped ammonia was titrated with 0.02N sulphuric acid, the colour of boric acid having ammonia changed again to pink. The percent nitrogen was calculated by the formula

$$N (\%) = \frac{0.00028 \times X \times 100 \times 100 \times 100}{10 \times 1 \times 100 - x}$$

x – moisture content of the leaf,

From this crude protein was found by using the formula

CP (%) = 6.25 x nitrogen

**Mineral composition:** Mineral composition includes Nitrogen, Phosphorous, Potassium, Calcium, Magnesium and Carbohydrate content present in the sample, which is important constituent of nutritional feed. All this analysis were carried out as per the guidelines of AOAC (1990).

**Nitrogen:** Total nitrogen is estimated by micro Kjeldahl's method.

**Phosphorous:** Total phosphorous estimated by Vanadomolybdate yellow colour method. Pipette out 5ml of triacid extract into 25 ml volumetric flask, add 5ml Barton's reagent and make up volume. Allow 30 min. to develop yellow colour. Measured the intensity of colour in UV spectrophotometer (470nm).

**Potassium:** Potassium is estimated by pipette out 5ml of triacid extract into 25 ml volumetric flask, neutralize the acid with ammonium hydroxide, make up volume. Measured the concentration of K in the solution by using Flame photometer.

**Calcium and Magnesium:** Calcium and Magnesium get complexed by EDTA in order of Ca first followed by Mg. Ca is estimated first by using murexide indicator in the presence of sodium hydroxide at pH 12. The Ca + Mg is estimated using Erichrome block-T in the presence of ammonium chloride and ammonium hydroxide buffer solution at pH 10.

**Carbohydrate:** Carbohydrate is measured by weighed 0.1g sample in to boiling tube. Hydrolysed it with 5ml of 2.5 N HCl. Neutralize it with sodium carbonate. Made up the volume 100ml and centrifuge. Collect supernatant, prepare standards. Add 4ml anthrone to the samples, heat for eight min. and take reading in spectrophotometer (630nm).

## RESULTS AND DISCUSSION

Nutritive quality of leaves are very important for the fodder crops. Thirty *Melia dubia* genetic resources were subjected to the analysis for fodder quality. Both proximate as well as mineral content of the leaves were determined (Table 1 & 2). Dry matter is the actual amount of feed material leaving water and volatile acids and bases. Among the genetic resources the highest leaf moisture content was registered by MTPMD 6 (66.11%) and the lowest moisture content was registered by MTPMD 1 (62.01%). The highest dry matter was found in MTPMD 1 (37.95%) whereas the lowest was in MTPMD 6 (33.85%), highest ash content was registered by MTPMD 12, MTPMD 25 and MTPMD 42 (7.5%) and lowest was registered by MTPMD 6 (7.20 %). The results indicated that higher moisture content leads to lower dry matter yield and vice versa. Species containing more than 30% dry matter, 50% organic matter digestibility and less than 10% total ash in the dry matter generally considered as good fodder (Mandal and Gautam 2012). All the Melia genetic resources registered higher dry matter as well as lower ash content, which implies their suitability as a good fodder, among 30 genetic resources, the superiority of MTPMD 1 was very well witnessed. Similar work has been carried out Azim et al. (2011), Berhe and Tanga (2013), Haftay and Kebede (2014) and Awotoye et al (2016) in several tree species and found superiority of few species, which extent support to the current situation.

Crude protein (CP) content is the most important criterion for judging feed and fodder. Among the genetic resources, highest CP was registered by MTPMD 1 (17.30 %) and the lowest CP was registered by MTPMD 2 (16.80 %) which indicated that MTPMD 1 leaves as a good protein supplementn. This supports the findings of Onwuka (1980) who reported that main features of fodder are high crude protein and mineral content, and added that average trees and shrubs are richer in crude protein and lower ash than tropical grasses. The findings of this study were in line with those of Bakshi and Wadhwa (2004). They also reported high CP in the *Melia azedarach* and *Morus alba*. Srivastava et al. (2006) reported high CP contents of *Morus alba* (15.31-30.91%) on dry matter basis. Ayodele et al. (2014) and Amanulla et al. (2006) reported *Albizzia lebbeck* is very rich in crude protein with mean value of 20%.

Ether extract or fat is also a measure of energy levels of feedstuffs. Crude fat content was highest in MTPMD 42 (3.61 %) and lowest was in MTPMD 25 (2.81 %), carbohydrate content was maximum in MTPMD 30 (17.50 %) and minimum in MTPMD 14 and MTPMD 19 (15.00 %). This indicated that MTPMD 42 leaves could be a good source of energy that can be utilized by ruminants for body maintenance and production. Similar variations are also reported by other research group (Brandis et al. 1978, Malla 2004, Kayastha et al. 1998, Panday and Tiwari 2003).

Nitrogen is very essential for plant growth and serves as a source of supplementary energy for animal feeding, MTPMD 1 registered highest N content (2.77 %) and MTPMD 2 and MTPMD 11 registered lowest N content (2.69 %). Carew (1982) from his findings reported that *Gliricidia sepium* had a higher Nitrogen content with values ranging between 3.2% and 4.21%. Similar work was carried out in *Quercus serrata* (Migita et al 2007). Maximum phosphorus content was found in MTPMD 1 and MTPMD 30 (0.34 %), minimum was in

MTPMD 11 (0.28 %). Highest potassium content was registered by MTPMD 1 and MTPMD 30 (0.09 %) lowest was in MTPMD 11 and MTPMD 25 (0.06 %).

Highest calcium content was found in MTPMD 30 (2.30 %) and lowest was in MTPMD 11 (2.16 %); maximum magnesium content was found in MTPMD 1, MTPMD 13, MTPMD 22, MTPMD 30, MTPMD 42 (0.33 %) and minimum was in MTPMD 12 & MTPMD 26 (0.29 %). The Melia genetic resource in the current study registered relatively higher calcium level, which appreceable to the results of Abdulrazak et al (2000) and Aganga et al. (2000). The leaves of *Melia* examined in the present study exceeded the recommended level of calcium for lactating ewes (11g/Kg DM) suggested by NRC (1985). However concentration of phosphorous was extremely low in the leaves of genetic resources studied. Potassium is also an essential element for growth and development of animals. Deficiencies in K in cattle can result in reduced intake, weight lose and stiff joints. Cattle stressed owing to long transport

**Table 1.** Proximate analysis of *Melia dubia* genetic resources for leaf fodder

| Genetic resource no. | Moisture content %) | Dry matter (%) | Ash (%) | Crude fat (%) | Crude protein (%) | Carbohydrate (%) |
|---|---|---|---|---|---|---|
| MTPMD 1 | 62.01 | 37.95* | 7.35 | 3.21* | 17.30* | 17.10* |
| MTPMD 2 | 65.31* | 34.65 | 7.25 | 2.96 | 16.80 | 16.30 |
| MTPMD 3 | 62.65 | 37.31 | 7.40 | 3.01 | 16.95 | 16.00 |
| MTPMD 4 | 62.41 | 37.55* | 7.45* | 2.76 | 17.10 | 16.50* |
| MTPMD 5 | 63.11 | 36.85* | 7.21 | 3.11 | 17.00 | 15.50 |
| MTPMD 6 | 66.11* | 33.85 | 7.20 | 2.81 | 17.20 | 16.00 |
| MTPMD 7 | 63.21 | 36.75* | 7.26 | 3.01 | 16.85 | 16.8* |
| MTPMD 11 | 62.91 | 37.05 | 7.25 | 2.86 | 16.82 | 16.85* |
| MTPMD 12 | 64.26* | 35.70 | 7.50* | 2.96 | 17.10 | 16.90* |
| MTPMD 13 | 63.71 | 36.25 | 7.25 | 2.91 | 17.20 | 16.00 |
| MTPMD 14 | 62.56 | 37.40* | 7.46* | 3.01 | 17.15 | 15.00 |
| MTPMD 15 | 62.91 | 37.05* | 7.35 | 3.06 | 17.15 | 16.50* |
| MTPMD 17 | 63.63 | 36.33* | 7.26 | 3.16 | 17.20 | 17.30* |
| MTPMD 19 | 64.36* | 35.60 | 7.30 | 2.96 | 17.02 | 15.00 |
| MTPMD 21 | 64.26* | 35.70 | 7.35 | 2.91 | 17.18 | 16.00 |
| MTPMD 22 | 64.71* | 35.25 | 7.39 | 3.01 | 17.05 | 17.00* |
| MTPMD 23 | 65.41* | 34.55 | 7.30 | 3.26* | 16.97 | 17.30* |
| MTPMD 24 | 65.56* | 34.40 | 7.25 | 2.86 | 16.98 | 16.90* |
| MTPMD 25 | 65.91* | 34.05 | 7.50* | 2.81 | 17.05 | 15.90 |
| MTPMD 26 | 62.41 | 37.55* | 7.40 | 2.96 | 16.95 | 16.00 |
| MTPMD 29 | 64.85* | 35.11 | 7.38 | 3.01 | 17.12 | 16.00 |
| MTPMD 30 | 65.11* | 34.85 | 7.26 | 2.91 | 17.25 | 17.50* |
| MTPMD 32 | 63.31 | 36.65* | 7.40 | 3.11 | 16.85 | 16.00 |
| MTPMD 34 | 62.91 | 37.05* | 7.37 | 3.06 | 16.89 | 15.40 |
| MTPMD 39 | 63.45 | 36.51* | 7.25 | 3.01 | 17.20 | 15.20 |
| MTPMD 40 | 64.36* | 35.60 | 7.35 | 2.96 | 16.99 | 15.80 |
| MTPMD 42 | 64.40* | 35.56 | 7.50* | 3.61* | 17.05 | 17.00* |
| MTPMD 43 | 65.11* | 34.85 | 7.28 | 2.86 | 17.10 | 15.40 |
| MTPMD 44 | 64.59* | 35.37 | 7.39 | 2.91 | 17.11 | 16.10 |
| MTPMD 46 | 63.21 | 36.75* | 7.36 | 3.21* | 17.20 | 16.20 |
| Mean | 63.95 | 36.00 | 7.34 | 3.01 | 17.06 | 16.25 |
| Sed | 0.08 | 0.11 | 0.04 | 0.09 | 0.11 | 0.12 |
| CD (p=0.05) | 0.15 | 0.22 | 0.08 | 0.18 | 0.21 | 0.25 |

*Significant at 5% level

**Table 2.** Leaf mineral composition of *Melia dubia* genetic resources

| Genetic resource No. | Nitrogen % | Phosphorus % | Potassium % | Calcium % | Magnesium % |
|---|---|---|---|---|---|
| MTPMD 1 | 2.77* | 0.34* | 0.09* | 2.29* | 0.33 |
| MTPMD 2 | 2.69 | 0.29 | 0.07 | 2.21 | 0.31 |
| MTPMD 3 | 2.71 | 0.32 | 0.08 | 2.20 | 0.32 |
| MTPMD 4 | 2.74 | 0.30 | 0.08 | 2.24 | 0.30 |
| MTPMD 5 | 2.72 | 0.31 | 0.07 | 2.23 | 0.30 |
| MTPMD 6 | 2.75 | 0.30 | 0.08 | 2.20 | 0.32 |
| MTPMD 7 | 2.70 | 0.30 | 0.07 | 2.20 | 0.30 |
| MTPMD 11 | 2.69 | 0.28 | 0.06 | 2.16 | 0.28 |
| MTPMD 12 | 2.74 | 0.30 | 0.08 | 2.24 | 0.29 |
| MTPMD 13 | 2.75 | 0.31 | 0.08 | 2.23 | 0.33 |
| MTPMD 14 | 2.74 | 0.31 | 0.08 | 2.20 | 0.32 |
| MTPMD 15 | 2.74 | 0.29 | 0.08 | 2.20 | 0.30 |
| MTPMD 17 | 2.75 | 0.33* | 0.08 | 2.29* | 0.31 |
| MTPMD 19 | 2.72 | 0.31 | 0.07 | 2.20 | 0.30 |
| MTPMD 21 | 2.75 | 0.30 | 0.08 | 2.23 | 0.32 |
| MTPMD 22 | 2.73 | 0.30 | 0.07 | 2.24 | 0.33 |
| MTPMD 23 | 2.71 | 0.30 | 0.07 | 2.20 | 0.31 |
| MTPMD 24 | 2.72 | 0.32 | 0.08 | 2.26 | 0.31 |
| MTPMD 25 | 2.73 | 0.31 | 0.06 | 2.24 | 0.30 |
| MTPMD 26 | 2.71 | 0.33* | 0.08 | 2.19 | 0.29 |
| MTPMD 29 | 2.74 | 0.31 | 0.07 | 2.22 | 0.30 |
| MTPMD 30 | 2.76* | 0.34* | 0.09* | 2.30* | 0.33 |
| MTPMD 32 | 2.70 | 0.31 | 0.08 | 2.21 | 0.32 |
| MTPMD 34 | 2.70 | 0.31 | 0.08 | 2.19 | 0.30 |
| MTPMD 39 | 2.75 | 0.32 | 0.08 | 2.20 | 0.30 |
| MTPMD 40 | 2.72 | 0.30 | 0.07 | 2.27* | 0.31 |
| MTPMD 42 | 2.73 | 0.33* | 0.08 | 2.26 | 0.33 |
| MTPMD 43 | 2.74 | 0.30 | 0.08 | 2.25 | 0.32 |
| MTPMD 44 | 2.74 | 0.31 | 0.08 | 2.24 | 0.30 |
| MTPMD 46 | 2.75 | 0.29 | 0.07 | 2.20 | 0.30 |
| Mean | 2.73 | 0.31 | 0.08 | 2.23 | 0.31 |
| Sed | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 |
| CD (p=0.05) | 0.03 | 0.02 | 0.01 | 0.04 | 0.03 |

*Significant at 5% level

distance may require increased levels of K to replenish lost body reserves (NRC 1980). In the present study, potassium level was comaparatively low, which may be due to the age factors. Young tissue posses higher concentrations of N, P, K and Mg and lower calcium concentrations on dry matter basis.

## CONCLUSION

Among thirty *Melia dubia* genetic resource MTPMD 1 exhibited the better values for proximate analysis as well as mineral composition thus it proved to be superior genetic material with improved leaf fodder quality and extended scope for further breeding programme and immediate deployment in industrial agroforestry plantations.

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