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Ahalya BN
College of Agriculture, Hagari, UAS, Raichur, Karnataka, India

Chikkalingaiah
University of Agricultural Sciences, GKVK, Bangalore, Karnataka, India

Sushmitha C
University of Agricultural Sciences, GKVK, Bangalore, Karnataka, India

Ravikumar A
College of Agriculture, Hagari, UAS, Raichur, Karnataka, India

Harish Menpadi
College of Agriculture, Hagari, UAS, Raichur, Karnataka, India

Manjunatha N
College of Agriculture, Hagari, UAS, Raichur, Karnataka, India

Corresponding Author:
Ahalya BN
College of Agriculture, Hagari, UAS, Raichur, Karnataka, India

Comparative assessment of biochemical constituents in tree mulberry genotypes

Ahalya BN, Chikkalingaiah, Sushmitha C, Ravikumar A, Harish Menpadi and Manjunatha N

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Abstract
Globally the most important utilization of mulberry is rearing of silkworm, which feeds exclusively on its leaves. Mulberry leaf quality plays a predominant role in healthy growth of silkworm and economic parameters which are highly influenced by the nutritional quality of leaves fed to silkworm. An experiment was undertaken to estimate the nutritional quantity of leaves from different mulberry genotypes *viz*., MI-012, MI-79, MI-21, MI-139, MI-516, ME-05 and two check varietiesV1 and M5 to select best performing mulberry genotypes for tree cultivation during at Department of Sericulture, UAS, GKVK, Bangalore-65. The genotypes were planted with the spacing (6 × 6 feet) single shoot was maintained. In the present investigation, the parameters *viz*., nitrogen, phosphorus, potassium, crude protein, crude fibre, ash content, chlorophyll, phenols, amino acid, carbohydrates, sugar and starch contents were estimated in leaves from different tree mulberry genotypes. The mean data of all the parameters were subjected to analysis of variance. The biochemical constituents of leaves of eight different tree mulberry genotypes were indicated that, V1 recorded highest nitrogen(3.62%), phosphorous (0.52%), potassium (1.38%), crude protein (22.67%), ash content (9.65%), crude fiber (9.33%), chlorophyll (2.41 mg/g), phenols (3.52 mg/100 g), amino acid (9.39mg/g), carbohydrate (22.39%), sugar (14.13%) and starch content (13.48%). The study indicated that, V-1 mulberry variety performed superior for all the characters studied, hence V1 found better and suits for tree mulberry cultivation with wider spacing. This nutrition content of leaves also increases quality cocoon production in sericulture industry.

Keywords: Chlorophyll, mulberry, nutrients, amino acid carbohydrate

Introduction
The present scenario of sericulture industry demands new cultivars suitable for varied agro climatic conditions. Mulberry crop improvement programmes mainly based on increasing the quality and quantity of leaf because of the entire activities and success completely depend on the nutritive value and yield of the mulberry leaves. Mulberry leaves with more moisture content and moisture retention capacity gives favorable effects in silkworm due to their high palatability and digestibility. These essential parameters must be considered during selection of parent genotype for breeding high yielding varieties.

Das and Krishnaswamy (1969) [4] described that sustainability and profitability of sericulture depend on the mulberry leaf productivity because mulberry is the only food source for the domesticated silkworm (*Bombyx mori* L.). Quality and quantity of mulberry leaves decide the success of superior cocoon production, it contributes 60% in total cost of production of cocoon (Ashiru, 2002) [1].

Hence, in recent years much emphasis has given for improvement of both in terms of quantity and quality. Appropriate selection of the tropical cultivars based on the plant nutrition and their effect on growth and silkworm cocoon yield parameters of *Bombyx mori* L. races for different agro-climatic conditions is essential to select and exploit promising varieties for better sericulture practices.

The studies related to the tree mulberry are scanty and it is an emerging concept in South India in view of scarce water resources, manpower and intensive cultivation. The study may help in advocating to the farmers to go for tree mulberry cultivation in the context of water scarcity. Keeping this in view, the present investigation was undertaken with an objective, to estimate the biochemical constituents of leaves from different tree mulberry genotypes

Materials and Methods

Estimation of biochemical constituents from mulberry leaves

The samples were analysed for nitrogen, phosphorus, potassium, ash, crude fibre, starch, total sugars, carbohydrates, amino acids, proteins, chlorophyll and phenol contents.

Collection and preparation of plant samples

Composite samples of thirty leaves were collected from each labelled tree and were air dried, then further dried in hot-air oven at 60 °C for 18 hours. These samples were then powdered and stored in polythene covers.

Methods used for estimation of nutrients and biochemical constituents in mulberry

1. **Total nitrogen (%):** Microkjeldahl method (Piper, 1966) [14].
2. **Phosphorus (%):** Outlined by Piper method (1966) [14].
3. **Potassium (%):** Di-acid extraction method.
4. **Crude protein (mg/g):** Micro-kjeldhal method.
5. **Amino acids (mg/g dry weight):** Nin hydin method (Spies,1955) [17].
6. **Starch (%):** Method of Mc cready *et al.*, 1960 [3].
7. **Sugar (%)**-Phenol sulphuric method.
8. **Total carbohydrates (mg/g):** Procedure of Dubois *et al*. (1956) [6].
9. **Total chlorophyll (mg/g):** Procedure of Hiscox and Israelstam (1979) [7].
10. **Crude fibre (%):** AOAC method (1955) [2].
11. **Ash content (%):** AOAC method (1955) [2].
12. **Phenol content (%):** Spectrophotometric method.

Results and Discussion

Nutritional quality of mulberry leaves plays an important role in growth and development of silkworm and commercial characters of the cocoons. All the nutrients in balanced proportion are necessary for growth of silkworm to produce superior quality of cocoons. In the present investigation, the parameters *viz*., nitrogen, phosphorus, potassium, crude protein, crude fibre, ash content, chlorophyll, phenols, amino acid, carbohydrates, sugar and starch contents were estimated in leaves from different tree mulberry genotypes and results are presented here under table 1-3.

Estimation of biochemical constituents of leaves from different tree mulberry genotypes

Nutritional quality of mulberry leaves plays an important role in growth and development of silkworm and commercial characters of the cocoons. All the nutrients in balanced proportion are necessary for growth of silkworm to produce superior quality of cocoons.

Nitrogen (%)

The highest nitrogen content of (3.62%) was recorded in V1 followed by M5 (3.54%) and MI-012 (3.43%). Whereas minimum nitrogen content of (3.22%) was recorded in MI-21 genotype. The present results are corroborating with the findings of earlier reports. Tewary *et al*. (2005) [19] reported leaves harvested from tree mulberry contained 3.90%. Narayanaswamy *et al*. (2003) [13] reported that tree mulberry leaves having highest nitrogen content of (2.21%) than the bush mulberry (2.11%). Waktole Sori and Wosene Gebreselassie, 2016 [22], observed highest nitrogen content of (4.29%) in Kumbi genotype. Vanitha 2018 [21], reported highest nitrogen content in tree mulberry (5.24± 0.28) compared to bush mulberry.

Phosphorous (%)

The mulberry variety V1 recorded highest phosphorous content (0.52%) followed by M5(0.51%) and MI-012(0.48%). Whereas lowest phosphorous content (0.42%) was registered by MI-516 genotype compared to others. The present results are in concurrence with the findings of earlier workers. Narayanaswamy *et al.* (2003) [13] reported leaves from tree mulberry contain maximum phosphorous (0.17%) than the leaves of bush mulberry (0.15%). Waktole Sori and Wosene Gebreselassie (2016) [22] observed highest phosphorous content (0.45%) in Kumbi genotype. Vanitha, 2018 [21], reported highest phosphorous content in tree mulberry (0.36±0.02) compared to bush mulberry. Lalfelpuii Ruth, 2019, also reported highest phosphorous content (1.672 ± 0.06) in Jorhat mulberry compared to other varieties.

Potassium (%)

The V1 mulberry recorded maximum potassium content of (1.38%) followed by MI-012 (1.36%). Whereas lowest potassium content (1.29%) was recorded by MI-139 genotype compared to other genotypes. The present results were corroborative with the findings of Narayanaswamy *et al*. (2003) [13] who reported higher potassium content in the leaves of tree mulberry leaves (2.05%) than the bush mulberry (1.80%). Similarly, Vanitha (2018) [21] reported highest phosphorous content was recorded by tree mulberry (1.33±0.01) compared to bush mulberry. Lalfelpuii Ruth, 2019, also reported highest potassium content (1.952 ± 0.072) in TR10 mulberry compared to other varieties.

Table 1: Nutritional constituents in leaves of eight tree mulberry genotypes

Sl. No.	Genotypes	Nitrogen (%)	Phosphorous (%)	Potassium (%)
1	MI-012	3.43	0.48	1.36
2	MI-21	3.22	0.43	1.30
3	MI-139	3.32	0.44	1.29
4	MI-516	3.28	0.42	1.34
5	ME-05	3.34	0.47	1.35
6	MI-79	3.37	0.45	1.33
7	V1	3.62	0.52	1.38
8	M5	3.54	0.51	1.35
	C.D. (5%)	0.180	0.037	0.023
	C.V.%	3.075	4.553	0.989
	S.Em±	0.060	0.012	0.008

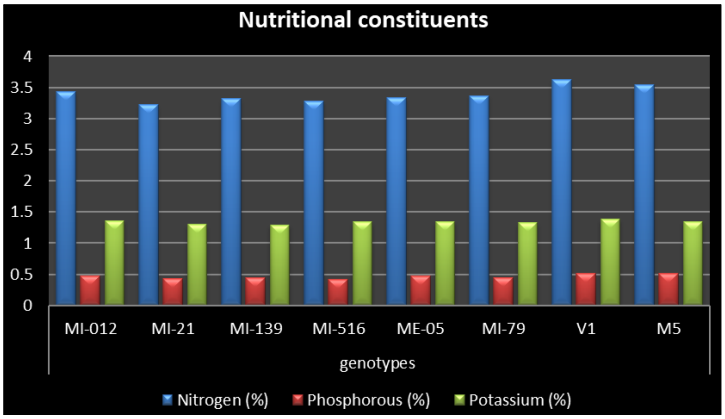

Fig 1: Nutritional constituents in leaves of eight tree mulberry genotypes

Crude Protein (%)

The V1 mulberry leaves registered higher crude protein content (22.67%) followed by M5 (22.14%) and ME-05 (21.37%). Whereas least protein content was recorded by MI-21(20.16%) compared to others.

These results are in corroboration with those of Narayanaswamy *et al.*, (2003) [13] who reported highest crude protein content of (13.55%). Qader *et al.* 1991 [15] reported (17.91 mg/100 g) crude protein. Maribashetty *et al.*, 1999 [12] recorded highest protein content of (18.64%). Tewary *et al.*, 2005 [19], reported higher crude protein content of (24.38%) in tree mulberry when compared to bush mulberry.

Crude fibre (%)

The leaves harvested from V1 recorded highest crude fibre (9.33%) followed by MI-012 (8.75%) and MI-79 (8.60%). Whereas genotype MI-21 recorded lesser crude fibre (8.31%) compared to other genotypes. Similar findings were obtained by Maribashetty *et al.* (1999) [12] who reported tree mulberry leaves showed higher crude fibre content (9.22%) in tree mulberry compared to bush mulberry. Manjunatha and Krishnamurthy (2006) [11] reported crude fibre content of (12.50%) in V1 bush mulberry.

Ash content (%)

The V1 mulberry leaves recorded significantly highest ash content of (9.65%) followed by MI-79 (9.31%) and ME-05 (9.28%). Whereas genotype MI-516 recorded less ash content (8.80%) compared to other genotypes. Mangammal, 2012 reported ash content was significantly highest in bush mulberry leaves of TB-21 (12.65%) followed by MI-79 (12.57%).

Table 2: Nutritional constituents in leaves of eight tree mulberry genotypes

Sl. No.	Genotypes	Crude Protein (%)	Crude fibre (%)	Ash (%)	Chlorophyll (mg/g)	Phenols (mg/100g)
1	MI-012	21.28	8.75	8.98	1.84	3.22
2	MI-21	20.16	8.31	8.84	1.70	2.35
3	MI-139	20.36	8.58	8.86	1.72	2.63
4	MI-516	21.17	8.32	8.80	1.72	2.61
5	ME-05	21.37	8.58	9.28	1.92	3.36
6	MI-79	21.07	8.60	9.31	1.86	3.24
7	V1	22.67	9.33	9.65	2.41	3.52
8	M5	22.14	8.72	8.87	1.85	3.21
	C.D. (5%)	1.566	0.385	0.195	0.120	0.245
	C.V.%	0.522	2.575	1.239	3.703	4.685
	S.Em.±	4.251	0.129	0.065	0.040	0.082

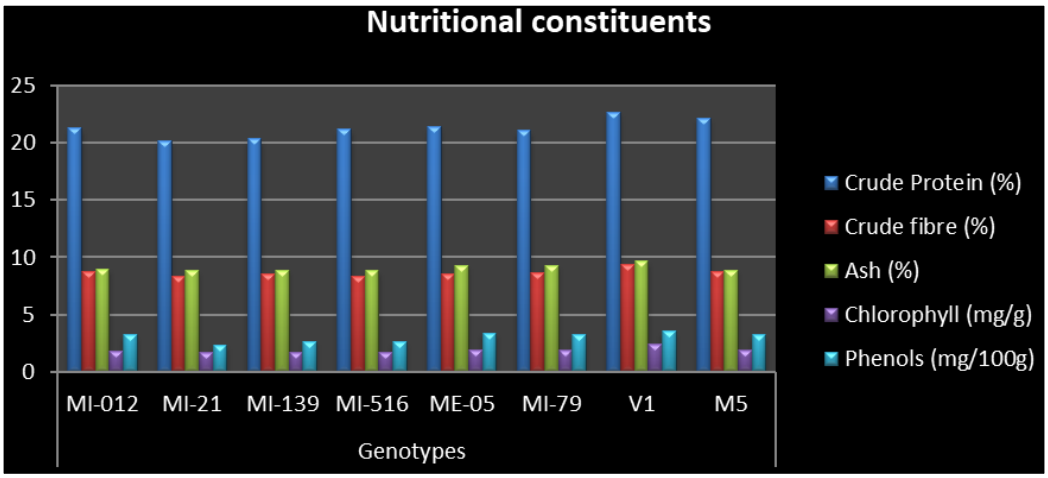

Fig 2: Nutritional constituents in leaves of eight tree mulberry genotypes

Chlorophyll (mg/g)

The leaves harvested from V1 recorded highest chlorophyll content of (2.41mg/g) followed by ME-05 (1.92mg/g) and MI-79(1.86mg/g). Whereas, genotype MI-21 recorded lowest chlorophyll content of (1.70 mg/g) compared to other genotypes. The present results are corroborating with the studies of Doss *et al.* (2007) [5] who found higher chlorophyll content of (2.45 mg/g). Manjunatha and Krishnamurthy (2006) [11] recorded highest chlorophyll content of (2.96 mg/g) in V1 bush mulberry. Sudhakar *et al*., 2018 [18] reported highest chlorophyll content 3.35 ppm/gm was recorded in tree mulberry.

Phenols (mg/100g)

Leaves harvested from V1 recorded highest phenol content 3.52mg followed by ME-05 (3.36mg) and MI-79(3.24mg). Whereas lowest phenol content was recorded by MI-21 (2.35 mg) compared to other genotypes. The present results are in concurrence with the findings of earlier workers. Tewary *et al*. (2005) [19] reported highest phenol content of 3.18% was recorded in tree mulberry than 2.90% bush mulberry. Vanitha, 2018 [21], reported highest phenol content of 3.22±0.03 mg in tree mulberry compared to bush mulberry.

Amino acid (mg/g)

The variety V1 recorded highest amino acid content of 9.39 mg/g followed by MI-012 (9.25 mg/g) and M5 (9.16 mg/g). Whereas genotype MI-21recorded lowest amino acid content of 8.69 mg/g compared to other genotypes. The present results are agreement with the findings of Jyothi, *et al*., 2014 who reported V1 recorded highest amino acid (9.88µg/g) compared to others.

Table 3: Nutritional constituents in leaves of eight tree mulberry genotypes

Sl. No.	Genotypes	Amino acid (mg/g)	Carbohydrates (%)	Sugar content (%)	Starch content (%)
1	MI-012	9.25	21.61	12.23	13.36
2	MI-21	8.69	20.06	11.89	11.88
3	MI-139	9.06	20.28	13.91	12.91
4	MI-516	8.45	20.91	12.37	12.09
5	ME-05	8.85	21.30	10.55	12.44
6	MI-79	9.15	19.72	12.02	12.15
7	V1	9.39	22.39	14.13	13.48
8	M5	9.16	21.18	12.62	12.34
	C.D. (5%)	0.249	1.196	0.540	0.987
	C.V.%	1.598	3.302	2.501	4.532
	S.Em. ±	0.083	0.399	0.180	0.329

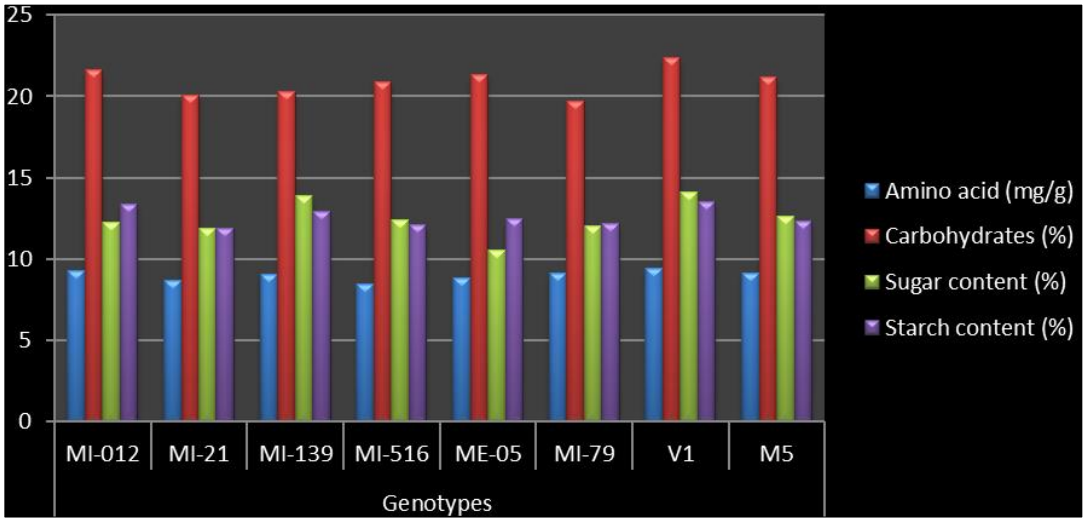

Fig 3: Nutritional constituents in leaves of eight tree mulberry genotypes

Carbohydrates (%)

The V1 variety leaves recorded highest carbohydrate content of (21.30%) followed by MI-012 (21.61%) and ME-05 (21.30%). Whereas least carbohydrate content was recorded in MI-21 (20.06%) compared to other genotypes. The present results are are in concurrence with the findings of Shakhawat, 2016 [16], who reported tree mulberry leaves recorded highest carobhdrate content of 17.85±0.78% compared to bush and low-cut system of cultivation. Vanitha, 2018 [21], also reported the leaves of tree mulberry had significantly higher carbohydrate content (17.89±0.33 mg/100g). Narayanaswamy *et al*., 2003 [13] who reported that leaves from tree mulberry contain more carbohydrate (32.33%) than the bush mulberry (30.16%). Maribashetty *et al*., 1999 [12] who reported highest carbohydrate content of (17.69g/100g). Tewary, *et al*., 2005 [19] who also reported highest carbohydrate content (12.01 g/100g) in tree mulberry than the bush mulberry.

Sugar content (%)

Among the different genotypes studied, V1 recorded highest sugar content of (14.13%) followed by MI-139 (13.91%) and M5 (12.62%). Whereas least sugar content (10.55%) was recorded in ME-05 compared to other genotypes. The present results are agreement with the findings of earlier reports. Tewary *et al*. (2005) [19] reported highest sugar

content of 11.17% in tree mulberry. Manjunatha and Krishnamurthy (2006) [11] recorded soluble sugars (18.90%) in V1 bush mulberry.

Starch content (%)

The leaves harvested from V1 mulberry recorded highest starch content of (13.48%) followed by MI-012 (13.36%) and M5 (13.34%). Whereas least starch content was recorded in MI-21 (11.88%) compared to other genotypes. The present results are agreement with the findings of earlier workers, Shakhawat *et al*., 2016 [16], reported that highest starch content of 13.44±0.64% was recorded in tree mulberry compared to low cut and bush mulberry system. Qader *et al.* (1991) [15] reported that highest starch content of (14.55%) in tree mulberry than low cut and bush mulberry. Maribashetty *et al*. (1999) [12] also reported that tree mulberry leaves showed a higher starch (14.77 g/100g) compared to low cut and bush mulberry.

Summary

Based on the present investigation, it was observed that the V1 exhibited the highest levels of various biochemical constituents of leaves including nitrogen content (3.62%), phosphorous (0.52%), potassium (1.38%), crude protein (22.67%), ash content (9.65%), crude fibre (9.33%), chlorophyll (2.41 mg/g), phenols (3.52 mg/100g), amino acid (9.39 mg/g), carbohydrate (22.39%), sugar (14.13%) and starch content (13.48%), followed by M5 for nitrogen content (3.54%), phosphorous (0.51%), crude protein (22.17%) and sugar content (12.62%). Whereas, among the genotypes MI-012 recorded highest potassium (1.36%), crude fibre (8.75%), amino acid (9.25 mg/g), carbohydrate (21.61%) and starch content (13.36%).

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