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NUTRITIONAL EVALUATION OF FRESH LEAVES OF MULBERRY GENOTYPES

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ABSTRACT

Ten genotypes of mulberry leaves were evaluated for proximate principles, vitamins (ascorbic acid and beta-carotene) and minerals (iron, zinc, manganese, copper and calcium). Protein content of all the genotypes ranged from 6.38 to 10.73 %. Ascorbic acid and beta-carotene contents ranged from 142.99 to 370.08 and 3.91 to14.79 mg/100g, respectively in the fresh leaves of mulberry. Total iron, zinc, manganese, copper and calcium ranged from 3.81 to 6.80, 0.99 to 1.26, 0.68 to 1.30, 0.07 to 0.30, and 236.89 to 730.11 mg/100g, respectively.

Key words : Mulberry leaves, Nutritional quality, Genotypes.

Mulberry tree, a plant of the family of *Moraceae* and genus *Morus*, has been widely cultivated to feed silkworm. Sericulture based agro forestry system has great potential to generate larger income in India. It is a job oriented agro based industry, particularly for the farmers below poverty line. In addition to sericulture, mulberry has a wide and diverse potential to protect the environment in varying agro-climatic conditions. It is perennial, deep rooted, widely adaptable with fast growing and determinate type of plant. It produces high biomass and foliage with rich protein. Though it is medium sized tree but for intensive cultivation it is maintained as bushes of different sizes. Mulberry can be grown as a tree as well as in combination with agricultural crops (inter crop) to increase per unit area production (Kant *et al.,* 2004). Mulberry leaves contain all the essential nutrients required by mankind, they are considered as rich, nutritious and more palatable as compared to other leafy vegetables such as amaranth, spinach etc. (Suryanarayana, 2002 and Srivastava *et al.,* 2003). I.C.M.R. has recommended the use of 50g leafy vegetables per person per day for good nutrition. Zaheer (1965) reported that mulberry leaves are sometimes eaten as vegetables. Recent studies demonstrate use of mulberry leaves in different food preparations, *viz.* curry, saag, pakoda, paratha and dhokla for human consumption (Sreekumar *et al.*, 1994 and Srivastava *et al.*, 1997). The preparation of tea from mulberry leaves is commercialized in China, Japan and Thailand and is widely used as healthy beverage (Ramesh *et al.,* 2003).In Korea, Japan, and China mulberry fruit and leaves are used as functional foods especially for prevention and treatment of diabetes (Shivakumar *et al.*, 1995 and Andallu *et al.,* 2001).

Mulberry leaves contain appreciable amount of nutrients. Beyond silkworm feeding, mulberry leaves could be used for human nutrition. The present study was undertaken to determine the proximate principles, vitamins, and minerals, in fresh leaves of ten genotypes of mulberry.

Ten genotypes of mulberry are *viz.* K-2, S-41, CW, TR-8, CM, S-146, S-1531, L-2, L-5, and L-4 were randomly selected from the Mulberry Garden, Department of Entomology, G. B. Pant University of Agriculture and Technology, Pantnagar. All the

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genotypes were grown under similar agro climatic conditions. The leaves at 3rd and 4th position from the apex of plant were plucked. For chemical analysis mulberry leaves were analyzed in triplicate for moisture, crude protein, crude fat, crude fibre and total ash by AOAC (1975). Carbohydrates were estimated by difference. Ascorbic acid and beta carotene content in the fresh samples were determined using method given by AOAC (1995) with slight modification. The total ash obtained was used to prepare ash solution for the estimation of calcium (AOAC, 1995). Among minerals iron, zinc, manganese and copper were determined with the help of atomic absorption spectrophotometer according to the procedure given by AOAC (1995). Results were statistically tested using analysis of variance (Snedecor and Cochran, 1967).

Moisture content of these genotypes varied from 65.06 to 77.13 % with a mean value of 71.87 ± 0.05% (Table 1). Protein content ranged from 6.38 to 10.73% being minimum in genotype TR-8 and maximum in genotype S-1531 with mean value of 8.01±0.098%. Srivastava *et al.*, (2006) have reported a range of 4.72 to 9.96 % of protein in 6 genotypes of mulberry leaves and the present results are in accordance with these results. As compared to green leafy vegetables like spinach (2.0g/100g), fenugreek leaves (4.4g/100g), amaranth (4.0g/100g), bathua (3.7g/100g), mustard leaves (4.0g/100g) and bengal gram leaves (7.0g/100g), mulberry leaves have higher protein value. Thus, preparation from mulberry leaves is an excellent supplement to protein deficient diets. Fat ranged from 0.72 (genotype TR-8) to 1.30% (genotype S-1531) with mean value of 1.01±0.006%. The genotype CM was found to have minimum content of ash as 2.14 % whereas genotype K-2 was found to have 3.39% of ash. Carbohydrate content of the mulberry genotypes varied from 11.03 (genotype TR-8) to 16.27% (genotype S-1531). Mean value of carbohydrate for various genotypes was found to be 13.69 ± 0.114 %. Crude fibre content ranged from 2.24 (genotype CM) to 3.49 % (genotype S-41 and genotype S-1531) with mean value of 2.84 ± 0.023%. Physiological energy ranged from 76 (genotype TR-8) to 120 Kcal per 100g (genotype S-1531).

Ascorbic acid ranged from 142.99 to 370.08 mg/100g among mulberry genotypes (Table 2). The genotype L-4 contained minimum amount while genotype L-5 had the maximum content. Mean value of ascorbic acid of all the genotypes analyzed was 272.86 ±7.56 mg/100g.The value of ascorbic acid is comparable to the value (200-300 mg/100g) reported by Suryanarayana (2002). The value of ascorbic acid of spinach, fenugreek leaves, amaranth, bathua and mustard leaves are 28, 52, 99, 35, and 33mg/100g, respectively (Gopalan *et al.*, 1995). Hence, the content of ascorbic acid is more in fresh mulberry leaves as compared to other edible green leaves. Beta- carotene content of mulberry leaves

Table 1. Proximate composition of fresh mulberry leaves

Genotype	Moisture (%)	Crude protein (%)	Crude fat (%)	Total ash (%)	Crude fibre (%)	Carbohydrate (%)	Physiological energy (Kcal/100 g)
K-2	68.17	8.47	1.24	3.39	2.63	16.10	109
S-41	67.54	9.01	1.16	3.05	3.49	15.75	109
CW	72.61	8.70	1.06	2.25	2.44	12.94	96
TR-8	77.13	6.38	0.72	2.18	2.56	11.03	76
CM	76.68	6.59	0.73	2.14	2.24	11.62	79
S-146	71.40	7.26	0.99	2.53	3.17	14.65	97
S-1531	65.06	10.73	1.30	3.15	3.49	16.27	120
L-2	76.00	6.52	0.84	2.26	2.61	11.77	81
L-5	68.93	9.02	1.14	2.67	3.21	15.03	107
L-4	75.18	7.40	0.94	2.26	2.51	11.71	85
Mean	71.87	8.01	1.01	2.59	2.84	13.69	96
SEM ±	0.050	0.098	0.006	0.024	0.023	0.114	0.271
CD at 5%	0.148	0.288	0.018	0.069	0.069	0.336	0.801

Table 2. Ascorbic acid and beta carotene content of fresh leaves of mulberry genotypes.

Genotype	Ascorbic acid (mg/100 g)	Beta- carotene (mg/100 g)
K-2	313.92	10.66
S -41	203.31	12.15
CW	179.91	5.60
TR-8	320.16	6.74
CM	320.83	3.91
S-146	282.72	10.99
S-1531	334.35	14.79
L-2	260.36	12.30
L-5	370.08	10.89
L-4	142.99	8.39
Mean	272.86	9.64
SEM±	7.560	0.099
CD at 5%	22.302	0.292

Calcium content was 372.97±32.403 mg/100g with a range of 236.89 to 730.11 mg/100g (Table 3). Results are in accordance with those reported by Srivastava *et al.* (2006) who observed a range of 380 to 786 mg/100g in leaves of six mulberry genotypes. Calcium content of all genotypes was found to be higher as compared to other common edible leaves like spinach 73mg/100g), fenugreek leaves (395mg/100g), amaranth (397mg/100g), bathua (150mg/100g) and mustard leaves (155mg/100g). Iron content of leaves of mulberry genotypes ranged from 3.81 to 6.80 mg/100g being minimum in genotype S-146 and maximum in genotype L-2 with a mean value of 5.06 ± 0.021 mg/100g. Srivastava *et al.* (2006) have reported a range of 4.70 to 10.36 mg/100g of iron in leaves of six mulberry genotypes. A range of 0.99 (genotype CW) to 1.26 (genotype S-1531) mg/100g of zinc was observed in various genotypes. The values (0.22 to 1.12 mg/100g) are in accordance with those reported by Srivastava *et al. (*2006). Manganese content of the genotypes varied from 0.68 (genotype L-2) to 1.30 (genotype S-41) mg/100g with a mean value of 0.97 ± 0.006 mg/100g. Copper content ranged from 0.07 to 0.30 mg/100g being minimum in genotype S-146 and maximum in genotype S-41 with mean value of 0.14 ±0.002 mg/100g.

Table 3. Mineral content of fresh mulberry leaves.

Genotype	Calcium (mg/100 g)	Iron (mg/100 g)	Zinc (mg/100 g)	Manganese (mg/100 g)	Copper (mg/100 g)
K-2	730.11	5.35	1.22	0.79	0.16
S -41	553.79	4.03	1.20	1.30	0.30
CW	471.24	4.79	0.99	0.97	0.16
TR-8	430.43	4.79	1.07	0.83	0.13
CM	267.05	5.27	1.05	0.82	0.08
S-146	264.00	3.81	1.08	1.10	0.07
S-1531	247.74	5.14	1.26	1.14	0.12
L-2	236.89	6.80	1.00	0.68	0.13
L-5	271.57	4.78	1.20	1.13	0.13
L-4	256.87	5.83	1.12	0.97	0.09
Mean	372.97	5.06	1.12	0.97	0.14
SEM ±	32.403	0.021	0.001	0.006	0.002
CD at 5%	95.590	0.062	0.004	0.019	0.007

varied from 3.91 to 14.79mg/100g being minimum in genotype CM and maximum in genotype S-1531. Average value of beta- carotene content was found to be 9.64±0.099mg/100g. Srivastava *et al.* (2006) reported it in the range of 10.00 to 14.69 mg /100g in leaves of six mulberry genotypes. The beta-carotene content of spinach, fenugreek leaves, amaranth, bathua and mustard leaves have been reported to be 5.58, 2.34, 5.52, 1.74 and 2.62mg/100g, respectively (Gopalan *et al.*, 1995). Hence, the leaves of mulberry can be considered an excellent source of vitamin A.

Thus, it can be concluded that the nutritional quality of fresh mulberry leaves is better compared

to other commonly consumed green leaves with high protein, vitamin C, beta- carotene, and calcium content. It can be easily grown in different parts of India hence can help to meet the recommended dietary allowance of various micronutrients and improve the health status of vulnerable groups.

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