

Contributions to the study of the leaf protein value in different mulberry varieties

**Alexandra Matei¹, Doina Brailoiu Tanase¹, Cristina Diaconescu²,
Marilena Constantinescu¹, M. Dolis³²**

¹*SERICAROM SA- Research Department Bucharest, Romania*

²*University of Agricultural Sciences and Veterinary Medicine Bucharest, Romania*

³*University of Agricultural Sciences and Veterinary Medicine Iasi, Romania*

ABSTRACT

Mulberry leaf exclusively assures the growth and development of the silkworm larvae, being considered a complete value nutrient, so that the knowledge of its nutritional status is of great interest. The experiment was made in order to study the mulberry leaf protein value of the mulberry varieties: China 32, Eforie, Ichinose, Ucraina 107 and Kayrio Nezumigaeshi. The commercial silkworm hybrid "Triumf" was also utilized in experiment. The content of the protein substances in mulberry leaves, considered as the first step in the study of nutritive value, varied according to the mulberry variety and age of the leaves, being in average 7.93%. The total dry matter has increased together with the leaf age and was in average 30%, ranging from 28.08% to 31.53%. Concerning the protein content, the mulberry leaf reaffirms as a valuable nutrigenous source. The mulberry variety Ichinose showed the highest protein content (23.99%), followed by variety Kayrio Nezumigaeshi (23.53%). The total amino acids content in mulberry leaves changed in accordance with age of the leaves, providing the nourishing needs of the larvae. So, among of the four main amino acids: glycine, alanine, serine and tyrosine which form 90% of silk proteins, about 32% is glycine, 31% is alanine, 16% is serine and 11% is tyrosine. The most efficient mulberry varieties, estimated on the base of the quantitative and qualitative production, are Ichinose and Kayrio Nezumigaeshi.

Key words: mulberry leaf, protein value, dry matter, amino acids

INTRODUCTION

Thanks to the fact that the mulberry leaf exclusively assures the growth and development of silkworm larvae, being in the group of fodder with complete value (as milk or egg), the knowledge of its nutritive value presents a special interest.

The biochemical composition of mulberry leaf was the object of study for many researches which have expressed the nutritive value especially by dry matter and raw protein. Recent researches studied also the digestibility and the

content in amino acids (Matei, A., 1995, 2002; Marghitas, L., 1995; Dolis, M., 2006). The quality of mulberry leaf depends on many factors, such as: species, variety, type of the field, leaf age, time of harvesting, fertilizers, mode of food administration, etc.

MATERIAL AND METHOD

For the present investigation five mulberry varieties: China 32, Eforie, Ichinose, Ucraina 107, Kayrio Nezumigaeshi and the simple silkworm hybrid were used.

The studied varieties were taken from the mulberry collection of Commercial Society SERICAROM – Research Department Bucharest, cultivated in the same pedoclimatic conditions and characterized by production within 11-21 to leaf/ha.

From each mulberry variety were analyzed two average leaf samples: one sample was collected from the leaf utilized in the food of the young larvae (I-III age) and other sample from the leaf utilized in the food of grown larvae (IV-V age). Leaf samples were used for estimation of the raw protein and amino acids content.

The biochemical analysis – the first work stage in the study of nutritive value was effectuated on average samples of leaf, harvested in accordance with the usual technique and analyzed on groups of substances after the Weende scheme.

The content in amino acids was determined by acid hydrolysis separated on chromatographic column.

RESULTS AND DISCUSSIONS

The total leaf yield obtained from one hectare of intensive mulberry plantation is in average 16328 kg (from which 10686 kg leaf used in the spring silkworm rearing), with limits depending on the mulberry variety, from 11848 kg in Eforie variety to 21344 kg in Ichinose variety.

Table 1 Leaf yield / ha mulberry field in accordance with the mulberry variety

Mulberry variety	kg leaf / ha	kg DS / ha	Total yield	
			Of which – spring rearing	
			kg leaf / ha	kg DM / ha
China 32	14448	4840.08	9024.80	3023.31
Eforie	11848	4028.32	8312.96	2826.41
Ichinose	21344	7150.02	16205.44	5752.93
Ucraina 107	16000	5680.00	11700.00	3978.00
Kayrio Nezumigaeshi	18000	5670.00	8188.40	2579.35
Average	16328	5473.68	10686.32	3632.00

The total average dry matter (DM) obtained from 1 ha mulberry plantation is 5473 kg, from which 3632 kg obtained in the spring silkworm rearing.

From the data presented in table 2 results that the nutritive substances varied quantitatively, in accordance with both variety and maturity degree of leaf.

Table 2 Protein content of the mulberry leaf

Mulberry variety	Larval age	Total dry matter	Crude protein	
			% leaf	% dry matter
China 32	I – III	27.12	7.50	20.85
	IV – V	32.93	7.71	25.03
	Average	30.03	7.61	22.94
Eforie	I – III	25.51	6.99	23.57
	IV – V	34.97	9.29	24.11
	Average	30.24	8.14	23.84
Ichinose	I – III	29.31	8.72	21.56
	IV – V	33.75	8.19	26.41
	Average	31.53	8.46	23.99
Ucraina 107	I – III	25.73	7.66	20.32
	IV – V	34.57	7.92	26.42
	Average	30.15	7.79	23.37
Kayrio	I – III	23.96	6.74	23.81
Nezumigaeshi	IV – V	32.20	8.57	23.25
	Average	28.08	7.65	23.53
Average		30.01	7.93	23.53

The leaf utilized by the larvae in the Vth age is characterized by a high degree of maturity, due to the increased content of dry matter and raw cellulose. The total dry matter, with an average of 30% ranges within 28.08 and 31.53%, the raw protein from fresh leaf is 7.93%, with limits within 7.61 - 8.46% and from dry matter is 23.53%, with limits within 22.94 – 23.99%. These values compare with those established by the other authors (Pop, E., 1966, 1967; Prakash N., 1987; Suzuki, T., 1982; Petkov, N., 1980; Tzenov, P., 1993).

Regarding the protein content, the mulberry leaves were proved as a valuable nitrogenous source. The variety with the highest content in protein is Ichinose (23.99%), followed by Kayrio Nezumigaeshi (23.53%).

Generally, the protein decreases with the increasing of the leaf maturity degree, while the cellulose content increases.

Seventeen amino acids were found in our experiment, but only four of them, namely serine, glycine, alanine, tyrosine are presented, because their frequency in fibroine has a higher importance.

As shown in the table 3, the varieties Ichinose, with a content in amino acids of 46.48 – 93.67 kg/ha and Kayrio Nezumigaeshi with 40.82 – 64.64

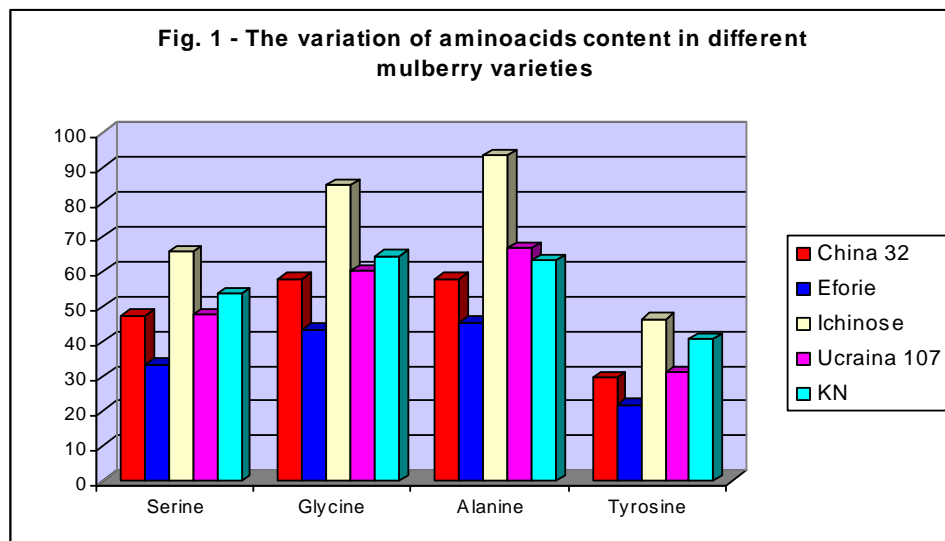
kg/ha expressed their superiority. The results are correlated with high leaf yield/ha and high protein content.

The amino acids content from mulberry leaf changes in accordance with the age of the leaf and provides the nutritional needs of the larva. So, from the four main amino acids – glycine, alanine, serine and tyrosine – which represent about 90% of the silk fibroin, approximately 32% is glycine, 31% is alanine, 16% is serine and 11% is tyrosine.

The quantities of the main amino acids with major implications in the silk production vary in accordance with the mulberry variety and the leaf yield / ha (table 3 and fig. 1).

Table 3 Variation of protein and amino acids levels in different mulberry varieties (for 1 ha plantation)

Mulberry variety	Crude protein (kg/ha)	Serine (kg/ha)	Glycine (kg/ha)	Alanine (kg/ha)	Tyrosine (kg/ha)
China 32	1110	47.43	58.08	58.08	29.52
Eforie	1081	33.44	43.51	45.52	21.75
Ichinose	1715	65.78	85.09	93.67	46.48
Ucraina 107	1362	47.71	60.21	67.02	31.24
Kayrio Nezumigaeshi	1306	53.87	64.64	63.50	40.82
Average	1315	49.65	62.30	65.56	33.96



CONCLUSIONS

The level of protein substances from mulberry leaf, determined as first stage in the study of total nutritive value, varies in accordance with the mulberry

variety and the leaf maturity degree and presents an average of 7.93% fresh leaf and 23.53% dry matter.

The total dry matter increases with the leaf maturity degree and has a mean of 30%, with limits within 28.08% and 31.53%.

The raw protein from leaf dry matter decreases with its maturity degree, corresponding to high ages and varies from a variety to other. The average is 23.53%, with minimum value of 22.94% in China 32 variety and maximum of 23.99% in Ichinose.

The quantity of crude protein at hectare varies within 1.08 – 1.71 tones.

Regarding the amino acids content, on the first place is situated Ichinose variety, due to its high protein level and leaf yield / ha.

The most efficient mulberry varieties, estimated on the base of their quantitative and qualitative production are Ichinose and Kayrio Nezumigaeshi.

REFERENCES

- Dolis M. (2005) – Cercetari referitoare la valoarea nutritiva a frunzei de dud, Teza de doctorat, USAMVC, 101-122.
- Marghitas L.A. (1995) – Cresterea viermilor de matase, Ed. Ceres
- Matei A. (1995) – Determinarea valorii nutritive a principalelor soiuri si hibrizi de dud cu utilizare in cresterea industrială a lui *Bombyx mori*, Teza de doctorat, Universitatea de Stiinte Agronomice Bucuresti.
- Matei A., Tanase D., Pau E., Brasla A. (2002) – Ghidul practic al sericultorului, Ed. Carol Davila, 23 – 41.
- Pop E.C., Floca L. (1966) – Contributii la studiul compozitiei amino-acizilor din frunzele de dud congelate, *Sericicultura*, 3, 12-15.
- Pop E.C. (1967) – Compozitia chimica a frunzelor de dud in diferite perioade si consumabilitatea ei, *Sericicultura*, 4, 12-18.
- Prakash Naik R., Delvi M.R. (1987) – Food utilization in different races of silkworm *Bombyx mori* (Lepidoptera Bombycidae), *Sericologia*, 27, 3, 391 – 397.
- Suzuki T. (1982) – Changes in total nitrogen and free amino acids in stem cuttings of mulberry (*Morus alba* L.), *Sericologia*, 22, 2-3, 123.
- Petkov N. (1980) – Studies on the utilization of mulberry leaves of some varieties at different norms and seasons of silkworm feeding. II. Expenditure of mulberry leaves per unit of production and their repayment by spring feeding of silkworms, *Sericologia*, 20, 1-2, 32.
- Tzenov P., Petkov N. (1993) – Study on the productivity of differential feeding amount in sex limited strains of the silkworm, *Bombyx mori* L., for egg and larval traits, *Sericologia*, 33,2, 235-241.