EVALUATION OF THE NUTRITIONAL QUALITY OF NATURALLY DRIED MULBERRY LEAVES

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Abstract

Nowadays, in addition to silk production, sericulture has acquired new values. Thus, it should be emphasized the important purpose that larvae or pupae have as sources of proteins for some animal species (fish, birds, and mammals). On the other hand, the nutritional qualities of the mulberry leaves make them increasingly used in feeding different species of farms animals (sheep, goats, cattle, pigs, rabbits, gallus type fowl, quail, fish, etc.). In turn, the quality of leaves is also influenced by several factors related to soil and climate conditions, to season, to mulberry variety, to harvesting and storage, etc.

Key words: *mulberry, fodder, analyses, chemical composition*

INTRODUCTION

Nowadays, in addition to silk production, sericulture has acquired new values. It now serves as a significant protein source for a diverse range of animal species, including fish, birds, mammals, and even humans [1-5].

On the other hand, the nutritional quality of mulberry leaves has led to their increased use in feeding various farm animals, such as sheep, goats, cattle, pigs, rabbits, chicken, quail, and fish.

These leaves can reduce dependence on other feed sources, such as soybean meal, for laying hens. For example, in an experiment involving Leghorn hens, the inclusion of silkworm meal demonstrated beneficial effects on both health and production performance, establishing it as a viable alternative protein source to soybean meal [6].

The age of mulberry trees has been observed to impact digestibility, as evidenced in goat farming [7-9]. Additionally, mulberry leaves have been shown to positively influence protein intake in swine when they constitute up to 0.3% of a sow's diet [10,11].

Similarly, research on sheep has indicated favorable limits in mulberry digestibility [12], as they exhibit a preference for these leaves due to their palatability [13].

Irrespective of the intended purpose of sericultural activities-whether for silk production or other benefits-the primary focus of research in this field centers on assessing the nutritional value of mulberry leaves and the factors influencing this value. Leaf quality is affected by multiple variables, including soil and climatic conditions, seasonal variation, mulberry variety, as well as harvesting and storage practices. Additionally, the application of various foliar additives aimed at enhancing the nutritional value of mulberry leaves has been widely reported [14-16].

Leaf quality is affected by diverse factors such as soil conditions, climate, seasonal changes, mulberry variety,

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harvesting methods, and storage [11-14,16-23]. The quality of leaves is determined by their chemical composition, which is influenced by various factors like leaf maturity, their position on the branch, harvesting time and method, mulberry type, cli-mate, use of fertilizers, and maintenance techniques applied to the mulberry plantations [12,113].

Leaves collected in the morning exhibit different chemical compositions compared to those collected in the evening, primarily due to the influence of direct sunlight synthesizing organic compounds [16,17].

Fertilizer application post-pruning for leaf production compensates for substantial organic matter loss. Enhancing soil fertility via proper fertilizer application remains crucial in increasing leaf yield. Mulberry leaf nutritional value can be enhanced by applying organic and mineral fertilizers, resulting in leaves with higher protein and ascorbic acid content [13-15,17].

Mulberry variety also affects leaf quality, showcasing variations in yield and nutritional value among different varieties. High temperatures and low humidity can impact leaf quality, potentially causing drought during summer heat, compromising leaf harvests to varying degrees [21].

MATERIAL AND METHOD

The biological material consisted of mulberry leaves (*Morus alba*), collected between July 1st and 8th from trees growing along the county road DJ282 (approximately 1 km northeast of Breazu, Iași County). The leaves were harvested from the shoot tips twice daily, in the morning and in the evening, at 8:00 a.m. and 8:00 p.m., respectively, resulting in a total of 14 samples (P1–P14). All leaf samples were subjected to identical drying conditions. Subsequently, the naturally dried samples were analyzed using proximate analysis [24–30], and the obtained results were statistically evaluated [31,32].

RESULTS AND DISCUSSIONS

The data regarding the harvested leaf quantities and the results of the chemical analyses have been centralized in tables 1-2.

Table 1 Quantities of fresh and dried mulberry leaves

Sample	Date of collection	Time of collection	Fresh leaf weight (g)	Dry leaf weight (g)
P1	1 July	evening	999.46	632.6
P2	2 July	morning	1063.07	645.86
P3	2 July	evening	927.47	609.69
P4	3 July	morning	978.9	607.77
P5	3 July	evening	905.83	599.32
P6	4 July	morning	974.42	615.96
P7	4 July	evening	1011.87	631.3
P8	5 July	morning	974.43	617.21
P9	5 July	evening	996.23	650.81
P10	6 July	morning	987.47	634.6
P11	6 July	evening	976.06	626.36
P12	7 July	morning	968.52	618.95
P13	7 July	evening	982.68	618.77
P14	8 July	morning	933.28	603.87

Table 2. Chemical composition of naturally dried mulberry leaves

Specification		P1	P3	P5	P7	P9	P11	P13
Evening-harvested leaf samples	Water	8.2	8.2	8.3	7.9	8.2	8.1	8.2
	CP	21.3	21.5	21.1	21.2	19.4	21.7	21.8
	EE	9.5	9.6	9.4	9.2	8.3	9.5	9.7
	CF	3.5	3.5	3.5	3.6	3.6	3.5	3.4
	NFE	51,2	50,9	51,3	52,1	54,3	51	50,1
	Ash	9.5	9.6	9.4	9.2	8.3	9.5	9.7
Specification		P2	P4	P6	P8	P10	P12	P14
Morning-harvested leaf samples	Water	7.7	7.9	8.3	8	8.2	8.4	8.3
	CP	22	23	22.9	22.7	20.5	23.2	22.7
	EE	3.5	3.5	3.3	3.5	3.6	3.2	3.5
	CF	6.3	8.4	6.6	6.8	6.8	6.1	6.6
	NFE	51	47,1	48,5	49	52,1	48,9	48,8
	Ash	9.5	10.1	10.4	10	8.8	10.2	10.1

***Notes:** CP= Crude Protein; EE= Ether Extract; CF= Crude Fiber; NFE=Nitrogen-Free Extract; Ash= minerals.*

The moisture content of naturally dried leaves averaged 8.14 ± 0.133% (CV = 1.52%), with 8.11 ± 0.191% in samples collected in the morning and 8.15 ± 0.140% in those collected in the evening (Fig. 1).

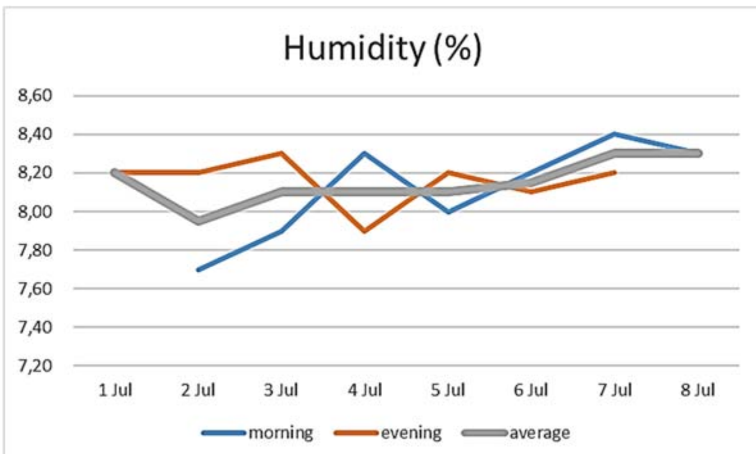

Fig. 1 Moisture dynamics in naturally dried leaves

Crude protein content averaged 21.89 ± 0.302% (CV = 2.91%), ranging from 19.40 to 23.20%. Higher values were generally observed in morning samples (22.43 ± 0.365%), whereas evening samples averaged 21.12 ± 0.355% (Fig. 2).

Crude fat, "Ether Extract" (EE), content averaged 3.48 ± 0.111% (CV = 2.47%), being slightly lower in morning samples (3.44 ± 0.141%) and higher in evening samples (3.52 ± 0.104%) (Fig. 3).

Crude fiber ranged from 6.0 to 8.4%, with an overall mean of 6.58 ± 0.233% (CV = 5.75%), specifically 6.8 ± 0.327% in the morning and 6.32 ± 0.197% in the evening (Fig. 4).

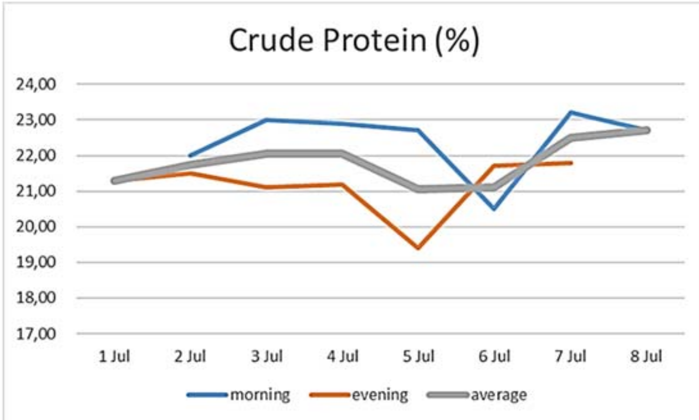

Fig. 2 Dynamics of crude protein content in naturally air-dried leaf samples

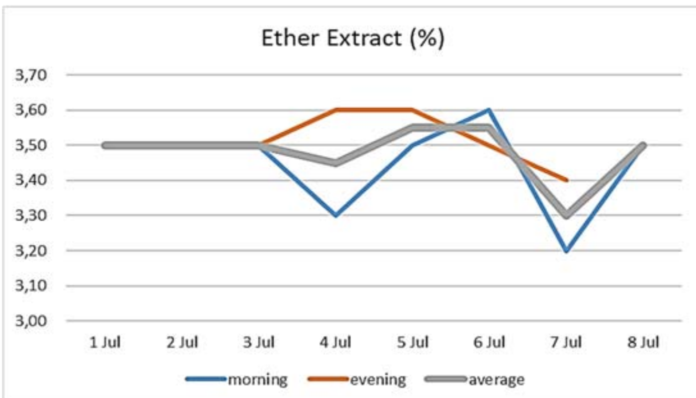

Fig. 3 Crude fat content dynamics in naturally air-dried leaf samples

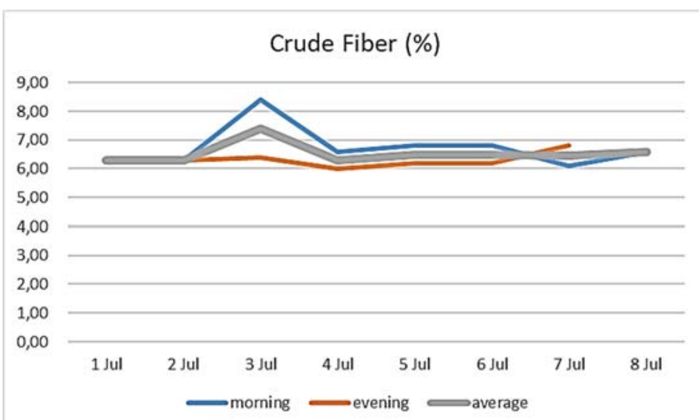

Fig. 4 Crude fiber dynamics in naturally dried leaves

Nitrogen-free extract (NFE) values ranged from 47.10 to 54.30%, with higher averages in evening samples (51.62 ± 0.457%) compared to morning samples (49.34 ± 0.488%). The overall mean was 50.28 ± 0.405%, CV = 2.28% (Fig. 5).

Ash content varied between 8.30 and 10.40%, with a mean of 9.64 ± 0.231% (CV = 38.87%). The difference between morning (9.87 ± 0.280%) and evening (9.28 ± 0.270%) samples was 0.69% (Fig. 6).

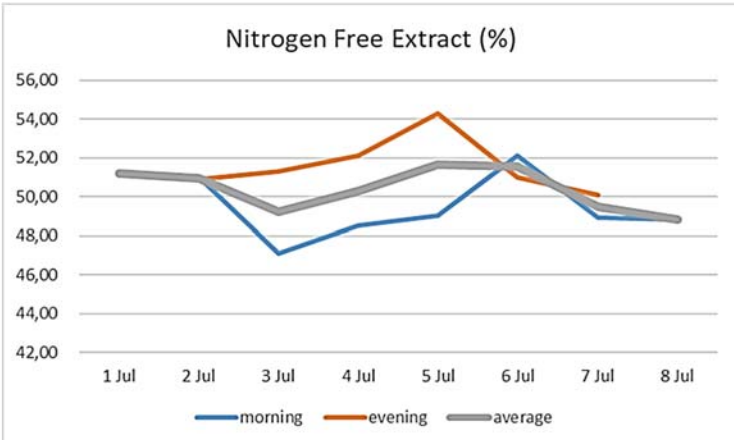

Fig. 5 Dynamics of Nitrogen-Free Extract (NFE) in naturally air-dried leaf samples

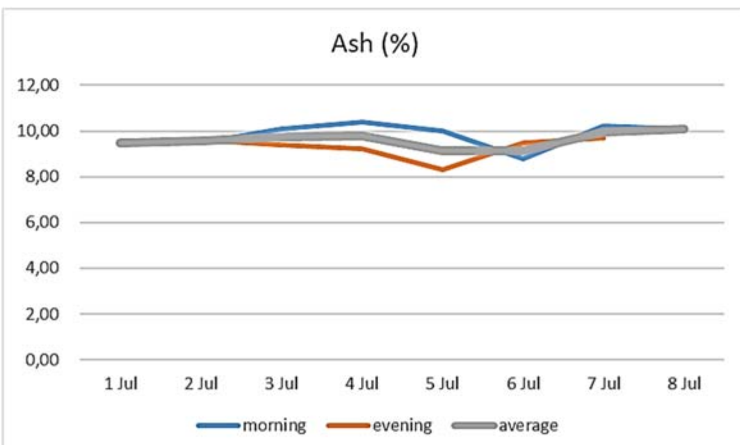

Fig. 6 Ash (minerals) dynamics in naturally dried leaves

The data obtained for naturally dried mulberry leaves are comparable to those of other forages preserved through drying, such as, in particular, alfalfa hay [24,33]. The crude chemical composition of alfalfa hay varies depending on the harvest time and the quality of preservation, but the average reference values (reported to dry matter - D.M.) are as follows: Dry Matter (D.M.) 85% – 90%, Crude Protein (C.P.) 15% – 21% (the leaves are the richest part, containing between 22% and 35% protein, while the stems contain only 10%–20%), Crude Fiber (C.F.) 20% – 36% (the fiber content increases as the plant matures, reducing digestibility), Ash (minerals) 7% – 10%, and Crude Fat (ether extract) 2.0% – 2.6%.

CONCLUSIONS

Mulberry leaves can represent a high-quality feed, comparable to or even superior to conventional forage plants such as alfalfa or clover, due to their high protein content. When used properly, they could serve as a sustainable, natural, and efficient alternative for improving farm animal nutrition.

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