RESEARCH REGARDING CHEMICAL COMPOSITION OF THE MULBERRY LEAVES FROM SELECTED MULBERRY HYBRID

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Abstract

During the growth of silkworm larvae study, also was done a research which aimed to determine the chemical composition of mulberry leaves from a Romanian Selected Hybrid. The results showed that advancing in the vegetation stage at the same time with different periods of the silkworm larvae's growth, the mulberry leaves experience an aging process being noticed through its quality decreasing from chemical composition point of view. So, for example, the CP which was in average 20.78±0.627% (from DM), decreased during the study with 2.87%; while the CF had an average of 18.10±0.271%, (from DM) increased with 1.47%.

Key words: leaves, mulberry, silkworm larvae, chemical composition

INTRODUCTION

The success in the silkworm larvae's growth is influenced by multiple factors. Among them, nutrition plays a decisive role. The quality of the mulberry leaves administered in larvae's feeding directly influences their growth, health and vitality, but also the quantitative and qualitative silk production. For this reason, this research is useful for that area of interest, namely to determine the nutritional value of the mulberry leaves.

MATERIAL AND METHOD

The research was done during the growth period of the silkworm larvae from summer series, the biologic material being represented both by silkworm larvae and mulberry leaves which were administrated.

The vegetal biological material used in the experiments was the Selected mulberry hybrid, of Romanian origin. The hybrid has a great economic importance, because it is acclimated to colder areas of Romania. It has a medium vigor, with tardy budding, very resistant to frost and drought. It is resistant to bacterial attack.

It has sprouts of a lighter color and leaves of medium size (264 cm^2), of heart shape, consistent, which are hardly faded. The leaf surface is smooth, of dark green color, with a pronounced brightness. The stem which presents a groove, contains more latex and has an average length of 6 cm.

It has good results in culture as bush or tree.

The animal biologic material was the simple hybrid of silkworm called *Record*, which is a cross between Japanese and Chinese breeds. It presents stable and uniform characteristics and a pronounced level of heterosis.

Working methods aimed to determine the nutritive value of the mulberry leaves taking into account the chemical composition.

The chemical composition was determined using the „Proximate Analysis" scheme and the digestibility (approximate digestibility) through „*in vivo*" method- simple digestibility with a single period control. [23]

The chemical analyses were done on samples previously dried to 65°C and grinded. The obtained results were processed and noted in tables being expressed in both fresh and dried leaves. [7]

The collected samples moisture determination was done by drying them into the hot air oven for 4-5 hours at 105°C. [15]

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The ashes content was determined using the incineration of the samples method, [16]

To determine the protein content (CP), the Kjeldahl method was used. [17]

The fat content (EE) was determined using Soxhlet method; its principle is based on the fat property of dissolving in the organic solvent (such as, petroleum ether). [18]

The crude fibre (CF) was determined by the sample acid-basic hydrolyse, after which from the leaf is removed the hydrolysable part, on the filter paper remaining only the cellulose and minerals; by calcination are determined the minerals and the crude cellulose is calculated through difference. [19]

Nitrogen free extract was calculated through difference from fresh leaf or dried one. In the first case, from 100 were decreased the percentages of water, protein, fat, cellulose and ashes. In the second case, from the dry matter percentage were decreased the percentages of crude protein, extract etherate, crude fiber and ash. [21]

The main experimental data obtained were statistically processed being calculated the arithmetic average, variance, the average standard deviation and the variability coefficient. [20]

During the silkworm larvae growth, the research objective was to establish the nutritive values of the mulberry leaves depending on its maturity and silkworm larvae age, respectively.

There were organised an experimental lot formed from 150 larvae, which were grouped in three repetitions of 50 larvae each.

In each repetition were used trays with paper sized accordingly with the larvae's age and size.

To each repetition had been administered the same quantity of mulberry leaves from which previously were collected samples for chemical analyses.

The larvae growth was held during 31st of July and 31st of August, respecting the breeding technology recommended by the specific literature.

For the young silkworm larvae, the mulberry leaves were administered chopped (strips of 1 cm for first larval stage, of 2 cm for second larval stage, of 3 cm for third larval stage) and for the adult ones whole leaves (larval stages fourth and fifth).

RESULTS AND DISCUSSIONS

The values regarding the mulberry leaves chemical composition evolution throughout growth period of the silkworm larvae were centralised (table 1) and statistically processed (table 2).

The average values obtained for each nutrient separately are set in the limits presented by specific literature, where the data regarding the crude chemical composition of the mulberry leaves varies according to each author, to the research period, to the varieties of mulberry, etc.

Table 1 The chemical composition evolution of the Selected hybrid mulberry tree leaves during the silkworm larvae (%)

Determi-nation	water	DM	CP		EE		CF		NFE		Ash	
			F*	DM**	F	DM	F	DM	F	DM	F	DM
I	71.96	28.04	6.13	21.86	0.83	2.96	4.92	17.55	12.23	43.61	3.93	14.02
II	71.75	28.25	6.23	22.05	0.87	3.08	4.99	17.66	12.13	43.12	3.98	14.09
III	71.03	28.97	6.21	21.44	1.12	3.87	5.18	17.88	12.43	42.90	4.03	13.91
IV	70.13	29.87	5.85	19.58	1.23	4.12	5.49	13.38	13.05	43.69	4.25	14.23
V	65.24	31.76	6.03	18.99	1.42	4.47	6.04	19.02	13.59	42.79	4.63	14.73
Average	70.62	29.38	6.09	20.78	1.09	3.70	5.32	18.10	12.71	43.22	4.17	14.20

* fresh leaves; ** dry matter

Table 2 Statistical indexes regarding the chemical composition of the mulberry tree leaf (expressed in DM-dry matter)

	n	$\sum x$	$\sum x^2$	s^2	$\overline{X}$	$\pm S_{\overline{X}}$	s	Cv	Min.	Max.
DM	5	146.89	4324.48	2.286	29.38	0.676	1.512	5.147	28.04	31.76
CP	5	103.92	2167.73	1.965	20.78	0.627	1.402	6.744	18.99	22.05
EE	5	13.50	70.13	0.433	3.70	0.294	0.658	17.775	2.96	4.47
CF	5	90.49	1639.16	0.367	18.10	0.271	0.606	3.349	17.55	19.02
NFE	5	216.11	9341.38	0.168	43.22	0.183	0.409	0.947	42.79	43.69
Ash	5	70.98	1003.04	0.103	14.20	0.143	0.320	2.256	13.91	14.73

The average relative humidity of the mulberry leaves during the research was 70.62%, and an decreasing evolution being registered average values between 71.96% (at the first determination corresponding to the first age of the silkworm larvae) and 68.24% (to the last determination when the silkworm larvae are in the age V^{th}). The dry matter represented 29.38±0.676%.

The mulberry leaves humidity influences its consumption by the silkworm larvae. The larvae, especially in the early stages of life, prefers young leaves with a high percentage of water. In the data presented by different authors, the average humidity of the mulberry leaves varies between 60-75%. [9]

The crude protein from mulberry leaves was estimated around 6.16% in the fresh leaves, 20.97% when it was expressed in DM and 24.36% in OM. [6]

Depending on the variety, the dry matter of the mulberry leaves varies between 23.61-27.56%. [11]

The mulberry leaves humidity is lower to the common mulberry variety (69.80- 73%) compared with the selection varieties. [3]

Throughout vegetation period, the humidity of the mulberry leaves decrease from 71.85- 77.81% in the spring, to 68.42-75.64% in the summer and to 64.10- 73.64% in the autumn. [8]

In the specific literature, the crude protein from mulberry leaves has the following average values: 32.40% in the spring, 28.21% in the summer and 24.53% in the autumn [2], during the morning 26.80% and evening 29.10% [12]; it also varies between 22.55 and 25.73% depending on the mulberry variety. [11]

The crude protein had an average value of 6.09% (20.78±0.627% from DM). It is noticed a progressive decreasing of the protein content throughout the studied period, the content decreasing being with 2.87 percentage points, from 21.86% to 18.99%, respectively.

The average CP contents are 21.1 and 20.9 (% in DM) in spring and autumn, respectively. [22]

The protein content in the mulberry leaves may be considered a real indicator of the leaf's quality. [1] The protein intake from mulberry leaves strongly influences both the silkworm larvae growth and development and, especially, the silk production of the larvae.

The fat content from the mulberry leaves was in average 1.09% in the fresh leaves, and 3.70% ± 0.294 in DM. It is the only nutrient with a high variability, of 17.775%.

The fat content increased uniformly throughout the silkworm larvae growth, from 0.83% to 1.42% when it was expressed in fresh leaves, or 2.96% to 4.47% respectively, when it was reported to the dry matter.

The limits presented by specific literature regarding the fat content in mulberry leaves are 2.85- 6.07%. [13]

The crude cellulose was in average 5.32% in fresh leaves, 18.10±0.271%, respectively when in was reported to DM. Throughout the research, for a month, the crude cellulose increased with 1.47 percentage points, from 17.55% to 19.02%, respectively.

The cellulose is highly responsible for aging processes of the mulberry leaves. As the cellulose content grows, the leaf becomes tougher and rougher, being more difficult to be consumed by the silkworm larvae.

For this reason, in the silkworm larvae's growth are considered the most valuable mulberry varieties, the ones that have a lower cellulose content.

The values obtained for crude cellulose from mulberry leaves were comparable with

the ones from specific literature. For example, the crude cellulose quota varies between 12.33-14.38% to the common mulberry tree and between 10.43- 13.70% to different selected varieties. [4] Throughout the mulberry vegetation period, the cellulose content from leaves increase from 14.47 to 21.16%. [13]

Nitrogen free extract represented in average 43.22±0.183% from the dry matter of the mulberry leaves; the average values decreased from the first determination to the third, from 43.61% to 42.90%, then was an increasing to the fourth determination, being 43.69%, decreasing to the last analyses to 42.79%.

The ash represented in average 4.17% in the fresh leaves and 14.20±0.143% from dry matter.

The minerals from the mulberry leaves throughout the research registered a continuous increase from analyze to another. The average values varied from 3.93% to 4.68% to fresh leaves and from 14.02% to 14.73% from dry matter. An exception was registered to the third determination.

The obtained data regarding the mineral content are in conformity with the ones from specific literature, 9.13- 17.38% [13], 11.52-12.80% [11], 8.7- 13.15% [3].

CONCLUSIONS

- Expressed to dry matter from the mulberry leaves, Selected Hybrid the average values were: CP -20.78±0.627%, EE - 3.70±0.294%, CF - 18.10±0.271%, NEF - 43.22±0.183% and ash- 14.20±0143%.

- At once with vegetation advancement and implicitly during each growth period of silkworm larvae, the mulberry leaf ages and its quality from the chemical composition point of view is decreasing.

- During the 30 days of the research, was noticed a decreasing of the moisture with 3.72% and of the CP with 0.1% and in the same time an increasing of the CF with 1.12%.

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