The Effect of Dietary Supplements on the Development of Bombyx Mori L. Silkworms

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Abstract

We know that the silkworms consume leaves in large quantities. The scope of the research was their reaction to various additives for their food. Mulberry leaves spray-coated in several dietary supplements were administered starting with the 5th day of the 3rd instar. The substances used were flax (linseed) oil, hemp oil and 2.5% fat cow's milk. The research was performed on four different silkworm hybrid strands. Each hybrid was separated in 4 lots, a control group and one for each of the three supplements. The preliminary conclusions of the research were that the best results were obtained with the 2.5% milk supplement, where we observed the highest individual mass and silk quantity compared to the other lots.

Keywords: chrysalis weight, dietary supplements, nutrition, silk quantity, silkworm.

1. Introduction

Silkworms nutrition research has been a studied subject more closely in the last half century, but significant results were obtained only in recent years [1]. From an economic perspective, we are interested in a larger production of silk from a sample of eggs, as low-cost. We are mainly interested in a larger production of silk from a sample of eggs (viability, development features, silk percentage etc.)

2. Materials and methods

The biological material was represented from three hybrids combination [2] and one race of Bombyx mori L provided from SC. SERICAROM (Bucharest, Romania). Larval reared took place in the sericulture laboratory of University of Agricultural Sciences and Veterinary Medicine (Cluj-Napoca, Romania), respecting the standard techniques with controlled temperature (26±2°C), relative humidity (70 ± 10%) and photoperiod of 14 hours [3].

The larvae war fed with mulberry leaves form the Ucraina 107 variety [4] up to the 5th day of the 3rd instar. Starting with this age the fourth silkworm groups were divided into 4th experimental groups, including the control group too. Were administered mulberry leaves sprayed with linseed oil (Linum utisatissimum), hemp oil (Cannabis sativa L.) and milk 2,5% (1g oil to 150g leaves).

Oils were uniformly sprayed on fresh mulberry leaves and administered 4th times a day. During the developmental cycle, we monitored the weight and length of the larvae (day 1 instar IV and day 2 instar V) using an analytic scale and (electronic?) calipers. After spinning raw cocoon and shell weight was determinate and silk percentage was calculated.

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Table 1. Origin of the hybrids [2]

Hybrids	Country	Provider
(71x70) x (125x121)	Italia	Sericulture Experiment Station, Padua
Shunrei x Shogetsu	Japonia	Laboratory of Insect Genetics, National Institute of Agro biological Science, Kobuchisawa 6585, Kitakoma-gun, Yamanashi-hen
N 137 x C 146	Japonia	Laboratory of Insect Genetics, National Institute of Agro biological Science, Kobuchisawa 6585, Kitakoma-gun, Yamanashi-hen
Bacgokjam	Coreea	Department of Agriculture Biology, National Institute of Agricultural Science and Technology, Rural Development Administration Suwon

3. Results and discussion

To observe the larval evolution length and weight measurements were made. Interpretation of results was achieved when comparing hybrids with controls.

In table 2 we observe that the group treated with linseed oil from Bacgokjam race has the smallest value all the development period. Following measurements on the 2nd day of instar V we notice a 0.2757g and 0.17 cm average difference between the group that has been fed milk treated leaves and the one fed linseed oil trated leaves. A large difference is also encountered between the control group and the one fed leaves traded with linseed oil (0.7092 g and 0.65 cm).

Table 2. The larval length and weight at Bacgokjam (Mean ± SE)

Race	Length of IV th instar 1st day (cm)	Length of V th instar 2 nd st day (cm)	Differences (cm)	Weight of IV th instar 1 st day (g)	Weight of V th instar 2 nd day (g)	Differences (g)
linseeds oil treated	2.27 ± 0.4547	4.66 ± 0.5522	0.65	0.2114 ± 0.1014	1.6879 ± 0.3556	0.7092
hemp oil treated	2.75 ± 0.3779	4.81 ± 0.2331	0.5	0.3393 ± 0.0923	1.9797 ± 0.2589	0.4174
milk treated	2.34 ± 0.3836	5.14 ± 0.2066	0.17	0.2935 ± 0.1024	2.1214 ± 0.1990	0.2757
control	2.41 ± 0.3573	5.31 ± 0.4557	0	0.2730 ± 0.0662	2.3971 ± 0.3814	0

In table 3 are the length and weight measurements for the Shunrei x Shogetsu hybrid. In this case also the group on linseed oil treatment has the lowest value in compare with the control group. The difference between the two groups is 0.7643 g and 0.89 cm , measurements made in the 2nd day of instar V. The milk-treated group has a 0.2156 g and 0.14 cm difference in compare with the control.

Table 3. The larval length and weight at Shunrei x Shogetsu (Mean ± SE)

Hybrids	Length of IV th instar 1st day (cm)	Length of V th instar 2 nd 1 st day (cm)	Differences (cm)	Weight of IV th instar 1 st day (g)	Weight of V th instar 2 nd day (g)	Differences (g)
linseeds oil treated	2.26 ± 0.3565	4.3 ± 0.2582	0.89	0.2509 ± 0.080	1.4088 ± 0.1445	0.7643
hemp oil treated	2.43 ± 0.2058	4.84 ± 0.2171	0.35	0.3312 ± 0.683	1.7065 ± 0.1792	0.4666
milk treated	2.42 ± 0.2201	5.05 ± 0.178	0.14	0.3286 ± 0.0835	1.9575 ± 0.1258	0.2156
control	2.405 ± 0.3149	5.19 ± 0.584	0	0.2880 ± 0.0588	2.1731 ± 0.4518	0

In the table 4 we have the results from the (71x70)x(125x121) hybrid measurement, were we observe an performance at the milk-treated group. The difference between the control and the milk – treated group is – 0.0255 g and– 0.14 cm in 2nd day of instar V. At this hybrid the smallest value are in the hemp – treated group. The difference between the control and the hemp – treated group is de 0.3475 g and 0.41 cm.

Table 4. The larval length and weight of (71x70)x(125x121) silkworm (Mean ± SE)

Hybrids	Length of IV th instar 1st day (cm)	Length of IV th instar 2 nd day (cm)	Differences (cm)	Weight of IV th instar 1 st 2 nd day (g)	Weight of V th instar 2 nd day (g)	Differences (g)
linseeds oil treated	2.47 ± 0.1494	4.94 ± 0.4671	0.12	0.2948 ± 0.0430	1.8283 ± 0.2800	0.2483
hemp oil treated	2.50 ± 0.0943	4.65 ± 0.2718	0.41	0.3233 ± 0.0638	1.7291 ± 0.2214	0.3475
milk treated	2.71 ± 0.1595	5.2 ± 0.4422	-0.14	0.3745 ± 0.0637	2.1021 ± 0.2829	-0.0255
control	2.39 ± 0.1792	5.06 ± 0.2914	0	0.3240 ± 0.0728	2.0766 ± 0.1930	0

In table 5 we observe that the groups which had treatments develop slightly differently compared to the control group. The largest difference is encountered for the milk treatment ones, 0.2444 g and 0.34 cm for the measurements in day 2 instar V.

Table 5. The larval length and weight of N137xC146 silkworm (Mean ± SE)

Hybrids	Length of IV th instar 1st day (cm)	Length of IV th instar 1 st day (cm)	Differences (cm)	Weight of IV th instar 2 nd day (g)	Weight of V th instar 2 nd day (g)	Differences (g)
linseeds oil treated	2.72 ± 0.1549	5.16 ± 0.3340	-0.41	0.3897 ± 0.0546	1.8440 ± 0.2479	-0.0122
hemp oil treated	2.69 ± 0.3414	5.14 ± 0.2366	-0.39	0.3946 ± 0.0891	2.0314 ± 0.2986	-0.1996
milk treated	2.92 ± 0.1398	5.09 ± 0.2885	-0.34	0.4414 ± 0.0506	2.0762 ± 0.1868	-0.2444
control	2.66 ± 0.1713	4.75 ± 0.2461	0	0.2950 ± 0.060	1.8318 ± 0.2256	0

In tables 6 through 9 below, we measure the dietary effect of various treatments at the cocoon stage of development. Total weight and shell mass are listed as average value and standard deviation (including for the control group), silk percentage is calculated from the average values. For the treated groups, we also run a two-sample independent student's t test (as described in [5] in order to be able to determine the statistical significance of the differences observed in cocoon weight between the control group and the groups fed leaves treated with various substances.

Table 6. The effect of dietary on the raw cocoon parameters of Bacgokjam silkworm

Hybrid	Cocoon weight (g) (Mean ± SE)	Shell weight (g) (Mean ± SE)	Silk %	t	Significance
linseeds oil treated	1.2461 ± 0.198	0.2659 ± 0.0262	21.34%	4.03539	XX
hemp oil treated	1.2845 ± 0.2596	0.2772 ± 0.0696	21.58%	3.59204	XX
milk treated	1.584 ± 0.2454	0.3507 ± 0.0236	22.14%	0.52956	n.s
control	1.6334 ± 0.1641	0.3642 ± 0.0219	22.30%	-	-

n.s - p>0.05; X – p<0.05; XX – p<0.01; XXX – p<0.001

Table 7. The effect of dietary on the raw cocoon parameters of Shunrei x Shogetsu silkworm

Hybrid	Cocoon weight (g) (Mean ± SE)	Shell weight (g) (Mean ± SE)	Silk %	t	Significance
linseeds oil treated	1.5451 ± 0.2052	0.3153 ± 0.0522	20.41%	-0.05707	n.s
hemp oil treated	1.3586 ± 0.1027	0.2858 ± 0.0498	21.04%	1.51848	n.s
milk treated	1.6218 ± 0.1492	0.3993 ± 0.0397	24.62%	-0.68632	n.s
control	1.5377 ± 0.2497	0.3838 ± 0.0647	24.96%	-	-

n.s - p>0.05; X – p<0.05; XX – p<0.01; XXX – p<0.001

Table 8. The effect of dietary on the raw cocoon parameters of (71x70)x(125x121) silkworm

Hybrid	Cocoon weight (g) (Mean ± SE)	Shell weight (g) (Mean ± SE)	Silk %	t	Significance
linseeds oil treated	1.1268 ± 0.1455	0.2088 ± 0.0156	18.53%	5.50023	XXX
hemp oil treated	1.344 ± 0.2938	0.2314 ± 0.067	17.22%	1.78677	n.s
milk treated	1.7093 ± 0.2463	0.2794 ± 0.0237	16.35%	-1.712	n.s
control	1.5067 ± 0.1632	0.2559 ± 0.0285	16.98%	-	-

n.s - p>0.05; X – p<0.05; XX – p<0.01; XXX – p<0.001

Table 9. The effect of dietary on the raw cocoon parameters of N137xC146 silkworm

Hybrid	Cocoon weight (g) (Mean ± SE)	Shell weight (g) (Mean ± SE)	Silk %	t	Significance
linseeds oil treated	1.4335 ± 0.26	0.2777 ± 0.04	19.37%	0.85543	n.s
hemp oil treated	1.2496 ± 0.1746	0.2548 ± 0.047	20.39%	2.79508	X
milk treated	1.961 ± 0.1739	0.3707 ± 0.0578	18.90%	-3.79309	XX
control	1.5518 ± 0.1672	0.3282 ± 0.065	21.15%	-	-

n.s - p>0.05; X – p<0.05; XX – p<0.01; XXX – p<0.001

From the tables 6 through 9 we notice that the highest value for cocoon weight (1.961g) and shell weight (0.3993g) is observed for the N137xC146 on milk treatments, but the silk percentage (18.90%) is lower than that of the control. The (71x70) x (125x121) hybrid on linseed oil treatment has the lowest cocoon weight (1.1268 g) and shell weight (0.2088 g), but the silk percentage (18.53%) is close to that of the milk-treated N137xC146 hybrid. The silk percentage of the milk-treated Korean Bacgokjam hybrid (22.14%) is close to that of the control group for the same hybrid. The hybrid with the highest silk percentage was Shunrei x Shoghetsu, with the control group (24.96%) and milk-treated group (24.62%) having similar values. We also observe that both the Bacgokjam and Shunrei x Shoghetsu hybrids have a consistently higher silk percentage compared to the other two, regardless of the treatment used on the administered food.

4. Conclusions

From a silk production standpoint, we observe that best results were obtained with the milk treatment for the N137xC146 hybrid, while the Bacgokjam control group was very close in performance. Generally, all groups consuming the milk treated leaves had improved results compared to the others of the same hybrid, while those consuming

hemp oil treated leaves yielded inferior results. We are suspicious of possible contamination with toxins or biological agents which could have lead to the radical drop in viability for some groups, so we recommend the repeat of the experiment in similar conditions in order to confirm the results (especially for the lower viability groups).

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