NUTRITION RESEARCH ON SILKWORMS *BOMBYX MORI* L.

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Abstract

Fresh mulberry leaves can be difficult to come by at times, therefore many substitutes, preservation methods and additives have been tested in order to accomplish several goals: to extend the time of year when Bombyx mori larvae can be grown, to increase the weight of the chrysalis and its nutritional value for human consumption, to improve the harvestable silk quantity and its quality. The main directions chosen for the research were the replacement of mulberry leaves with leaves of other plants more easily available around the year, formulations of pastes containing dried mulberry leaf powder, and finally, having fresh mulberry leaves sprayed with or immersed into various additives, from minerals to vitamins. This document summarizes nutrition research that was made public, starting from 1953 up until 2008.

Key words: *Bombyx mori* L., dietary supplements, nutrition, silkworm

INTRODUCTION

Research regarding silkworm nutrition experienced a real progress in recent years because of the development and introduction of artificial diets, which lead to the achievement of important benefits in the textile industry.

Fresh mulberry leaves can be difficult to come by at times, therefore many substitutes, preservation methods and additives have been tested in order to accomplish several goals: to extend the time of year when *Bombyx mori* larvae can be grown, to increase the weight of the chrysalis and its nutritional value for human consumption, to improve the harvestable silk quantity and its quality.

RESULTS AND DISCUSSION

The first tests made in order to obtain processed food (that could be preserved) for silkworms belong to a group of Japanese researchers (first experiments performed as early as 1953), without reaching any conclusive results. Later, they have managed to make a preparation that ensured the normal development of larvae, containing: 15g mulberry leaf powder, 30g Soybean Casein, 15g starch, 35g cellulose, 10g saccharose, 2g agar-agar, 500 mg ß-sitosterol, 500 mg Choline chloride, 500 mg Lecithin, 500 mg mixture of vitamins and 500 mg mixture of minerals (Mărghitaş L. Al., Sabău Al., 1992).

Using different substitutes (*Maclura aurantiaca* N., *Scorzonera hispanica* L., *Lactuca sativa* L., *Taraxacum officinale*) for mulberry leaf had a negative influence on silkworm growth (Paşca I. et all., 2008).

Salts administrated in food determined a decrease of the larval development period, growth characteristics of cocoon and reproductive growth potential by 0,25-0,50%. Administration of additional copper sulphate, nickel chloride and potassium iodide in the food increased economic parameters of the silkworms.

Rezuanul Islam et all. (2004) studied the effect of additional nickel chloride on silkworms growth. Nickel chloride was dissolved in distilled water at 100, 200, 400, 800, 1600 ppm concentrations. The most important growth in larvae weight was observed for the 800 ppm concentration, while the lowest one corresponded to the 1600 ppm concentration. Lots of researchers fed silkworms mulberry leaves treated with different substances in order to obtain an increase in cocoon production. These supplements included vitamins like ascorbic acid, folic acid, thiamine and multivitamin mixes (Etebari, 2004). In some studies the additional increase in the concentration of substances administered or increasing the period of administration has negative effect, determining the occurrence of hypervitaminosis.

Etebari (2004) reported production declines as a result of administration of ascorbic acid in high concentration in the silkworm food.
Etebari and Matindoost (2004) studied the effect of B3 hypervitaminosis on the biology of the silkworm Bombyx mori and have found an interruption of normal feeding and growth of larvae, also there is an increased mortality during molting. Larvae were fed with mulberry leaves supplemented with multimineral had at the end of the 5th instar a significant increase in body mass compared to the mass of larvae in the control group. The total protein content presented a significant increase in all multimineral treatments (Etebari and Fazilati, 2003). Increases in glycogen in the fat body have been reported after feed supplementation with potassium sulfate and zinc chloride bivoltine breeds (Hugar, 1998).

In the article "Bioaccumulation of cobalt in silkworm (*Bombyx mori* L.) in relation to mulberry, soil and wastewater metal concentrations" (2009), Muhammad Ashfaq, Sajjad Ali and Muhammad Asif Hanif studied the toxic effect of food contamination with cobalt (Co(II)), observing that although the mulberry tree is not a powerful cobalt accumulator and the larvae eliminate a significant part of the Co (II) contents in their excrements, the negative effect is easily observable – the larvae length in each life stadium, their growth and the mortality rate gets worse proportionally with increased concentration of cobalt used in irrigation of mulberry trees. Cobalt, in particular Co(II), is not a recommendable nutritive supplement.

Feeding of mulberry leaves with supplements of potassium iodide, cobalt chloride and calcium chloride increase the quantity of proteins in the sericigene gland (Dasmahapatra et all., 1989).

Administering of potassium sulfate in the food determines protein decrease in the fat body and the hemolymph (Nirwani and Kaliwal, 1996), but zinc chloride causes a significant decrease of fat body protein content and a significant increase in hemolymph protein content (Hugar, 1998).

Oral supplements of potassium permanganate lead to increase of protein content in both the fat body and the hemolymph (Bhattacharya and Kaliwal, 2004).

XiaoHui Yu, Hong Liua, Ling Tong in the article „Feeding scenario of the silkworm *Bombyx Mori*, L." published in 2008 in the BLISS, were trying to feed the larvae with mulberry leaves as little as possible, their main purpose being to turn leftovers of cabbage (*Letuca sativa* L.) that were unfit or unnecessary for human consumption into animal protein. They fed the larvae with mulberry leaves only during the first three stages of life (meaning 35% of the total amount of food) and then they fed the larvae with the cabbage leftovers (meaning 65% of the total amount of food). The process of protein extraction from larva's body was done on the third day of the 5th stage of life (when the protein concentration in the larva's body reaches the highest amount, about 70% of its weight; following to this point, the protein concentration decreases to 60%). The necessity of using mulberry leaves in these first stages of larval life is due to the larvae's inability to synthesize steroids from any other source of food, steroids that are so important in the larvae growth process.

According to the article "Application of Multi-vitamins as Supplementary Nutrients on Biological and Economical Characteristics of Silkworm *Bombyx mori* L." (by Kayvan Etebari and Leila Matindoost, 2005), multivitamin supplements had radically different results based on the concentration they were administered at. The most desirable effect (increased larval weight by over 10%) was obtained by treatment of mulberry leaves with a distilled water solution containing a 2.5% concentration of the multivitamin mix formula used. Using higher or lower concentrations lead to weaker result. A secondary effect (regardless of the concentration used) was a lowered rate of egg-laying for the next generation (but with an increased individual egg weight).

CONCLUSIONS

In recent years, Bombyx Mori nutrition research has finally started to yield decent results with regards to at least partial replacement of feeding material with alternates for fresh mulberry leaves (which can be difficult to obtain depending on season) and with regards to dietary supplements which

could improve both the quality and quantity of the silk thread (in case the desired outcome is harvesting for the textile industry) as well as the nutritional value of the chrysalis (in case the more desirable result is preparing silkworms for human consumption).

With additional research in the field, in order to better determine the optimal food preservation methods and beneficial additives that need to be used, silkworms could be grown all around the year as opposed to only seasonally, which could have strong positive economic implications in case the desired yields (silk and/or biomass) are not significantly negatively affected by the alternate nutrition.

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