The Effect of Some Additives on the Bioproductive Performances of SilkWorm Bombyx mori L.

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Abstract
Nowadays, worldwide in sericulture domain, researches are aimed to find new efficient alternatives for the feeding of mulberry silk worm through the use of some fodder additives which allow the improvement of bioproductive parameters and silk line quality. The present work represents a review of the use of such substances (mineral and vitamin additives) and of the experiments carried out to point out their effects on silkworms (Bombyx mori L.). Research conducted worldwide revealed the fact that the use of mineral and vitamin additives in silkworm Bombyx mori L., improve the growth rate of larvae, protein and mineral content of haemolymph, the protein content, DNA and RNA content of the sericigen glands, and the quality parameters of cocoon and silk line. Researches showed that the use of these additives doesn’t affect the quality of the silk.

Keywords: silkworms, fodder additives, bioproductive performances.

1. Introduction

Researches made worldwide, in the last years, in silk worm nutrition field, showed the great importance of some additives on the biological stage of this species. These additives improve silk worm performances having a positive influence on the biological and economical parameters like larva weight, cocoon weight, silk cover weight and butterfly productivity regarding the number of eggs.

This work aims to present in a concise manner, some of the studies, which involved the use of mineral and vitamin supplements.

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Effect of the minerals

As it is known, different minerals au a major role in the osmotic pressure regulation of the intra and extra cellular liquid, maintaining the ionic balance of the cells and participate, as cofactors, in different enzymatic systems.

Organic selenium in form of Sel-plex, which is chemically bound to a chelant agent or binder represented by a aminoacids and peptides. To made organic selenium, yeasts like Saccharomices cerevisiae are being used, which in an environment without sulphur, incorporates selenium in form of methionine or selenomethionine, in higher quantities than their nutritive demands. These strains are able to form 97% selenomethionine. Sel-plex is the commercial form and it is made by Alltech Inc. and it is in fact organic selenium on a strain of Sacharomices cerevisiae.

Selenium in form of selenocystein is an essential part of enzymes family called glutathione-peroxidase (Gsx-Px). First enzyme is glutathione-peroxidase called cytozolic was identified in 1973 and since than there have been identified over 20 selenoproteins which fulfill different functions in organism, like: antioxidant defense, redox
regulation of gene expression, sperm structure and thyroid hormone metabolism. 

Hu [1] studied the effects of some amino acids rich in selenium (selenomethionine, cysteine, tyrosine) extracted from the silk worm chrysalides, belonging to the Ziyang Chinese race, on the hepatic human cells. These seleno-amino acids, in concentrations of 0.5; 1.5 and 2.5 µmol/l which correspond to a concentration in proteins of 1.87; 5.61 and 9.35 mg/ml, inhibited cellular viability, modified the cell cycle and they caused cellular apoptosis. Unlike the normal amino acids isolated from the chrysalides of a different breed, they don’t show inhibitory effect on the human hepatic cells.

Ziyang breed chrysalides enriched with selenium from Shanxi county (0.409 mg Se/kg dry chrysalides) have a 215 times bigger Se content than the ones from Luiyang breed, fact that demonstrates that silk worms have a greater accumulation capacity of Se in their own proteins. Similar results were recorded by Bojan C. [2], who administered organic selenium, zinc nitrate and potassium nitrate to larvae, in doses of 100, 200 and 400 ppm. Organic selenium influenced the body weight gain of the larvae, proportional with the dose applied (100-400 ppm); this effect was observed also to the other minerals used; cocoon weight, the weight of the silk cover and the total protein content of the silkworm’s haemolymph presenting higher levels. The silk thread was longer and had a greater resistance, with a high content of fibroin, as a consequence of mineral supplementation of leafs.

A series of mineral salts added in silk worms feed led to the shortage of larval stage, the improvement of cocoon characteristics and the larva productive potential.

Islam [3] studied the effect of nickel chlorinate on the growth of silk worms. Nickel chlorinate was dissolved in distilled water in dilutions of 100; 200; 400; 800 and 1600 ppm. They made 3 repetitions for each dilution. The treated leafs were administered at ages of 4 and 5. The best result was noticed at Ni chlorinate in concentration of 800 ppm group and the lowest results were observed at the 1600 ppm concentration group. Cocoons weight presented a gradual increase correlated with the increase of concentration but the supplementation with 1600 ppm reduced the cocoons weight, but had an inhibiting effect.

Bhattacharya [4] studied the effects of potassium chlorinate on Bombix mori L. larva. After food supplementation with 50; 100 and 150 ppm potassium chlorinate they analyzed: glycogen and total proteins from the fat body, lipids and total proteins from hemolymph. An increase in the protein content, glycogen and total lipids in haemolymph and fat body has been observed. The larvae fed with mulberry leafs supplemented with multiminerals showed a greater body weight at the end of larval stage comparative with the larva that didn’t received supplements. Total proteins present a significant increase in all treatments with multiminerals [5].

It had been observed the increase of glycogen level and of fat body proteins as a response of food supplementation with potassium sulfate and zinc chlorinate at bivoltine breeds [6].

Wiggleswarth [7] formulates the hypothesis that the fat body of insects is the main place where proteins synthesis takes place and intermediates amino acids metabolism. A feed supplemented with potassium iodide, cobalt and calcium chloride and potassium nitrate determined an increase in the mass of the sericigen glands, increased the proteins quantity in sericigen gland și the DNA and RNA content in the cells from the sericigen gland epithelia [8]. The supplementation of food with potassium permanganate leads to an increase of proteins from hemolymph and insect’s fat body [9]. Similar results had been reported with potassium nitrate supplementation [10].

Mineral salts lead to an increase of fat body synthetic activity, an increase of hemolymph proteins and to the increase of sericigen gland weight which leads to a concomitant increase of cocoons weight and silky cover.

Effect of the vitamins

Vitamins play a major role in the organism in physiological processes, being considered biocatalyst, with an important role in processes like growth, reproduction, metabolism, etc.

Other researchers administered mulberry leafs treated with vitamins (ascorbic acid, pantothenic acid, folic acid and multivitamins) in silk worm food [11-12]. Etebari [11] administered a vitamin complex (ascorbic acid, thiamin, riboflavin, pyridoxine, B12, niacin, calcium panthotenate, vitamins A and D3) to silk worm, in concentrations of 1, 2.5 and 5% in the 4th and 5th larval stages, supplementation being executed by
pulverizing the vitamin substances on to the leafs. Larvae body mass, cocoon mass, chrysalis weight and egg productivity compared to the control group. The vitamin treatment, 2.5%, determined an 10.2% increase of the larvae body weight, the highest increase in growth being recorded in the 5th day of the 5th larval stage. The vitamin treatment 5% determined a reduction in the majority of the biological characteristics, except the cocoons weight, which was increased by 4.7%. The vitamin complex treatment led to a significant increase in the egg number laid by the butterflies, often a decrease of hatching rate being observed.

Etebari [11] reports a drop of production as a result of ascorbic acid supplementation in a high concentration in silk worm food. Cappellozza [12] showed that the lack of ascorbic acid in larva food fed with artificial feed especially during the first and the last larval stage, produces beneficial effects regarding cocoon production without influences on the survival percentage and larva cycle. The artificial diet administered to the larvae contained dry mulberry leafs, but the main effect of the leaf drying process is the degradation of the ascorbic acid. The effect of the ascorbic acid on the larvae was determined by introducing only this vitamin in the silkworm’s diet, at a level of 2% pure ascorbic acid (Sigma, Italy, 99% purity). Cappellozza [12] recorded the negative effect of Vitamin C on the development and productivity of the silkworm, as a result of diet supplementation with ascorbic acid. Ito [13] showed that absence of ascorbic acid in the first 20 days of growth influences the larvae growth and weight, followed by the assumption that Vitamin C has adverse effects on the silkworms [14]. Etebari [15] studied the effects of hypervitaminosis with vitamin B3 on the biology of silk worm Bombyx mori, following: larva weight, cocoon weight, silk cover weight and of pupa, total proteins, glycerol and some minerals like K, Na and Ca. The high quantity of vitamin B3 administered in larva food leads to a feeding interruption, accident in larva development and to an increase mortality during shedding. Larva presents indigestion, darkening tegument and dejections in form of a brown liquid. Larval stage increased to 31 days and only a few larvae turned into pupae.

This treatment led to significant increases in the

4. Conclusions

Mineral elements in inorganic form or bounded in organic combinations (Sel-plex) positively influences larva weight, the total protein content of their body, the majority of the cocoon biological parameters and the majority of the technological parameters of the silk thread.

The treatment with a moderate dose of the vitamin complex, led to a significant increase of the bioproductive parameters of the larvae and butterflies of the Bombyx mori L. species but a high concentration of vitamins negatively influenced the larva performance and their survival rate.

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