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# Effect of Salt, Nickel Chloride Supplementation on the Growth of Silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae)

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**Abstract:** The present investigation deals with the effect of nickel chloride supplementation on the growth of *Bombyx mori* L. (Lepidoptera: Bombycidae). The weights of mature *Bombyx mori* L. larvae were 1522.10±78.97, 1579.67±61.29, 1685.13±61.77, 1781.60±66.62, 1801.60±60.69 and 1426.07±89.48 mg for nickel chloride at 0 (Control), 100, 200, 400, 800 and 1600 ppm, respectively. The weights of male and female pupae were 648.03±37.97 and 763.57±55.44, 667.50±51.10 and 774.23±54.33, 682.60±61.78 and 811.47±61.13, 712.23±42.46 and 841.33±63.04, 746.77±45.73 and 871.30±50.47, 618.40±30.61 and 713.70±63.16 mg for nickel chloride for above applied doses. The weights of male and female adults were 300.67±70.07 and 546.27±61.67, 317.63±42.98 and 559.50±76.87, 331.90±48.93 and 571.50±80.46, 352.00±55.14 and 597.67±56.53, 373.17±46.53 and 645.23±55.34, 283.40±43.89 and 514.27±75.83 mgs for nickel chloride for above applied doses. The weights of male and female cocoons were 752.07±31.70 and 87.17±55.50; 769.23±49.84 and 889.10±50.40, 795.53±61.69 and 937.10±59.70, 841.33±42.25 and 970.53±62.33, 856.93±48.50 and 979.63±44.09, 717.27±32.13 and 822.13±64.96 mg for nickel chloride at 0(Control), 100, 200, 400, 800 and 1600 ppm, respectively. The results were statistically significant ($P<0.001$) among the concentrations. From the above results it may be concluded that nickel chloride can be used at low concentrations for enhancing the economic character of silkworm, *Bombyx mori* L.

**Key words:** Nickel chloride, *Bombyx mori* L., silkworm

## INTRODUCTION

The mulberry silkworm *Bombyx mori* L. is a beneficial insect producing the finest natural silk. Silk is called the "Queen of textiles". Sericulture is essentially a village based and welfare oriented industry that plays an important role in our national economy.

There are about 1000 varieties of silkworm[1], among them, bivoltine and multivoltine races are used for rearing in our country. *Bombyx mori* L. is a domesticated variety, which is believed to have been derived from the original mandarina silkworm Bombyx Mandarina Moore[2].

Nutrition is an important growth regulatory factor in silkworms like in any other organisms, the silk worm and the mulberry tree have a great partnership because the silkworm can not thrive without the leaves of mulberry plants and the quality of leaves of mulberry plants and the quality of leaves influence greatly the biology of these worms[3,4]

*Bombyx mori* L. is an oligophagous insect that feeds mainly on mulberry leaves. Significant advances in the research of silkworm nutrition began with development of artificial diets[5]. Advances in silkworm nutrition and in the development and use of artificial diets will be of great benefit to the silk industry. The effect of artificial diets with different nutrition on better production of cocoon crops and silk were investigated by many workers like Fukuda and Higuchiy[6], Yokoyama[7] and Hamamura[8], additions of extranutrients to the mulbery leaf in the silk worm enhance their growth and cocoon yield[9].

Salts may constitute a limiting factor in the growth of insects upon some diets[10]. The salt significantly enhanced the growth of the developmental stages, Decreased the developmental period, increased the cocoon characters and increased the reproductive potential of the worms at 0.25 and 0.50%.

Dietary supplementation of copper sulphate, nickel chloride and potassium iodide increased the economic parameters of the silkworm[11] The present investigation reports the effects of mulberry leaves enriched with nickel chloride, potassium iodide and their combinations on the growth and development of *Bombyx mori* L.

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## MATERIALS AND METHODS

The insect used for the present study was the mulberry silkworm, *Bombyx mori* L. is collected from the germ plasm bank of the Bangladesh Sericulture research and training Institute (BSRTI), Rajshahi, Bangladesh. Standard rearing techniques were followed.

**Effect of salt supplementation on the growth of *Bombyx mori* L.:** The growth of various stages of the silkworm, *Bombyx mori* L. is of paramount importance because a successful cocoon crop in sericulture depends mostly on a healthy larval growth. It has been well established that *Bombyx mori* L. requires certain essential sugars, protein, salts, amino acids and vitamins for its normal growth, survival and also for the growth of its silk glands and higher production of good quality silk[12].

**Effect of salt on the growth of *Bombyx mori* L. larvae:** To study the effect of salt on the growth of *Bombyx mori* L. larvae the concentration of the salt were prepared by mixing appropriate quantities of nickel chloride [$NiCl_2.6H_2O$] in distilled water. The concentrations were 0 (Control), 100, 200, 400, 800 and 1600 ppm. Control batches were raised on leaves treated with distilled water only. These were three replication per concentration each with 100 larvae. Treated leaves were chopped and supplied to the worms after hatching up to the third moult four times a day. For the fourth and fifth instar larvae whole leaves were supplied. The growth of larvae was determined after attaining maturity, i.e., one day before spinning ten larvae were taken randomly from each rearing tray and then weighted individually on an electronic balance on milligrams and calculated through statistical analysis.

**Effect of salt on the growth of *Bombyx mori* L. pupae:** After attaining maturity silk warm larvae formed cocoon within which they were transformed into pupae. To determine the weight of pupae from various concentration of nickel chloride, mature larvae from different trays were transferred to bamboo made mountages (1.8x1.2 m). After the formation of cocoons they were harvested and cut very carefully at one end obliquely with a sharp blade to observe pupal characters. In all the cases 10 males and 10 females were considered and the experiment was repeated thrice. The coefficient of variation (CV) and t-values were calculated by using standard statistical formula.

**Effect of salt on the growth of *Bombyx mori* L. adults:** After nine to twelve days of spinning the adults emerged from cocoons by rupturing the shells. Freshly emerged adults were individually weighted on an electronic balance in milligrams and calculated the values.

**Effect of salt on the *bombyx mori* L. Cocoon characters:** Cocoons were harvested after four to five days of spinning and weighted individually on electronic balance on milligrams and calculated the data.

## RESULTS AND DISCUSSION

The mature larval weights are shown in Table 1 and it was observed that the supplementation of mulberry leaves with nickel chloride produced the highest larval weight at 800 ppm and lowest at 1600 ppm.

The weight of male and female pupae (Table 2) *Bombyx mori* L. resulting from various concentration was observed of nickel chloride, the highest and lowest pupal weights were observed at 800 and 1600 ppm, respectively.

The data obtained in the present experiment, for adult, weights of *Bombyx mori* L. resulting from various treatments showed that heaviest and lightest moths were obtained at 800 and 1600 ppm nickel chloride respectively. It was reported that Cobalt exerts favorable effect on the growth of silkworm (Table 3)[13].

Table 1: Indicating the effect of nickel chloride on the mature larval weight (mg) of *Bombyx mori* L

| Concentration (ppm.) | Mean ± SD | CV (%) | t-value | Level of significance |
|---|---|---|---|---|
| 0 (Control) | 1522.10±78.92 | 5.18 | _ | _ |
| 100 | 1579.67±61.29 | 3.88 | -3.16 | P<0.01 |
| 200 | 1685.13±61.77 | 3.66 | -8.91 | P<0.001 |
| 400 | 1781.60±66.62 | 3.74 | -13.76 | P<0.001 |
| 800 | 1801.60±60.69 | 3.37 | -15.38 | P<0.001 |
| 1600 | 1426.07±89.48 | 6.27 | 4.41 | P<0.001 |
| F-Ratio | 145.15 | | | |
| CD at 0.05 | 108.52 | | | |

Table 2: Indicating the effect of nickel chloride on the mature pupal weight (mg) of *Bombyx mori* L

| Concentration (ppm.) | Mean±SD (Male and female respectively) | CV (%) | t-value | Level of significance |
|---|---|---|---|---|
| 0 (Control) | 648.03±37.97 | 5.85 | _ | _ |
| | (763.57±55.44) | 7.26 | | |
| 100 | 667.50±51.10 | 7.65 | -1.68 | NS |
| | (774.23±54.33) | 7.01 | (-0.77) | NS |
| 200 | 682.60±61.78 | 9.05 | -2.61 | P<0.05 |
| | 811.47±61.13 | 7.53 | -3.18 | P<0.01 |
| 400 | 712.23±42.46 | 5.96 | -6.17 | P<0.001 |
| | 841.33±63.04 | 7.49 | -5.07 | P<0.001 |
| 800 | 746.77±45.73 | 6.12 | -9.19 | P<0.001 |
| | 871.30±50.47 | 5.79 | -7.87 | P<0.001 |
| 1600 | 618.40±30.16 | 4.94 | 3.38 | P<0.01 |
| | 713.70±63.16 | 8.84 | 3.27 | P<0.01 |
| F-Ratio | 20.33 | | | |
| | 12.78 | | | |
| CD at 0.05 | 73.64 | | | |
| | 89.83 | | | |

Note: NS= Non significant

Table 3: Indicating the effect of nickel chloride on the mature adult weight (mg) of *Bombyx mori* L

| Concentration (ppm.) | Mean±SD (Male and female respectively) | CV (%) | t-value | Level of significance |
|---|---|---|---|---|
| 0 (Control) | 300.67±70.07 | 23.30 | _ | _ |
| | 546.27±61.67 | 11.29 | | |
| 100 | 317.63±42.98 | 13.53 | -1.13 | NS |
| | 559.50±76.87 | 13.74 | -0.74 | NS |
| 200 | 331.90±48.93 | 14.74 | -2.00 | NS |
| | 571.50±80.46 | 9.45 | 1.36 | NS |
| 400 | 352.00±55.14 | 15.66 | -3.15 | P<0.01 |
| | 597.67±56.53 | 9.45 | -3.37 | P<0.01 |
| 800 | 373.17±46.53 | 12.47 | -4.72 | P<0.001 |
| | 645.23±55.34 | 8.57 | -6.54 | P<0.001 |
| 1600 | 283.40±43.89 | 15.48 | 1.14 | NS |
| | 514.27±75.83 | 14.74 | 1.79 | NS |
| F-Ratio | 10.19 | | | |
| | 6.28 | | | |
| CD at 0.05 | 83.37 | | | |
| | 109.03 | | | |

Note: NS= Non significant

Table 4: Indicating the effect of nickel chloride on the cocoon weight (mg) of *Bombyx mori* L

| Concentration (ppm.) | Mean±SD (Male and female respectively) | CV (%) | t-value | Level of significance |
|---|---|---|---|---|
| 0 (Control) | 752.07±31.70 | 4.21 | _ | _ |
| | 878.17±55.50 | 6.32 | | |
| 100 | 769.23±49.84 | 6.48 | -1.59 | NS |
| | 889.10±50.40 | 5.67 | -0.80 | NS |
| 200 | 795.53±61.69 | 7.75 | -3.43 | P<0.01 |
| | 937.10±59.70 | 6.37 | -3.96 | P<0.001 |
| 400 | 841.33±42.25 | 5.02 | -9.26 | P<0.001 |
| | 970.53±62.33 | 6.36 | -6.66 | P<0.001 |
| 800 | 856.93±48.50 | 5.66 | -9.91 | P<0.001 |
| | 979.69±44.09 | 4.54 | -7.14 | P<0.001 |
| 1600 | 717.27±32.17 | 4.45 | 4.22 | P<0.001 |
| | 822.13±64.96 | 7.90 | 3.59 | P<0.001 |
| F-Ratio | 42.53 | | | |
| | 29.01 | | | |
| CD at 0.05 | 71.87 | | | |
| | 98.65 | | | |

Note: NS= Non significant

The weights of male and female cocoons showed that nickel chloride at 100, 200, 400 and 800 ppm gradually increased the cocoon weight but at the highest concentration, i.e, 1600 ppm weight was significantly reduced (Table 4).

Nutrition is an important growth regulating factor in silkworm, like in any other organisms. Various minerals take part in regulation of osmotic pressure of intra and extra cellular fluids in the maintenance of an ionic balance suitable for the activity of living cells and as co-factors in some enzyme systems and as integral part of other systems. The known essential trace elements for insects growth include iron, nickel, copper, manganese, zinc and iodine[14].

Our present investigation, it was found that nickel chloride significantly increased the growth of larvae, pupae and adults but higher salt concentrations produced deleterious effects on these parameters. The present findings, the larvae pupal and adult growth in *Bombyx mori* L. were enhanced at the concentration of 800 ppm and the economic characters (cocoon characters) of the mulberry were enhanced at 800 ppm of nickel chloride.

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