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Effect of inorganic food additives on the productivity of the mulberry silk worm *Bombyx mori* l.

Gad, Abir A.; Salem, Magda H. and Zaitoon A. A.
Department of Economic Entomology, Faculty of Agriculture, Alexandria University

ABSTRACT

The effects of Potassium Iodide (100 µg / ml), Cupper sulphate (100 µg / ml), Potassium permenganate (10 µg / ml) and their mixtures on silk yield and female fecundity of the mulberry silk worm *Bombyx mori* were studied.. The obtained results indicated that the feeding of 5th instar larvae of *B. mori* on mulberry leaves treated with the tested chemicals or their mixtures significantly increased the weight of larvae, pupae and cocoon shells. Cupper sulphate (100 µg / ml) caused the most significant increase in both silk production and female fecundity 94.23 % and 94.08 %, respectively. Moreover, the effects of these chemicals and their mixtures on some physiological parameters such as the total haemolymph proteins and corpora allata size were studied.

Keywords: Inorganic food additive, Silk worm, *Bombyx mori*, Productivity.

INTRODUCTION

The field of nutrition is currently considered the major area of research in sericulture. It has been reported that the growth of larvae of *Bombyx mori* significantly improved when they were fed on mulberry leaves supplemented with different nutrients (Sarker *et. al.*, 1995). El-Sayed (1994) declared that ammonium sulphate increased the larval weight while ammonium acetate gave the highest silk gland weight. Also, El-Karaksy and Idriss (1990) and Gad (1996) revealed that ascorbic acid as a food additive significantly increased the silk yield, the weight of silk gland and cocoon shell. Radha *et al.* (1988) reported that a balanced supply of the three major nutrients, nitrogen, phosphorus and potassium is essential for growth and yield of mulberry shoot system. Also, affected nutrient contents of the mulberry leaves which in turn affected the growth and economic characters of the silk worm.

On the other hand, treatment with potassium iodide accelerated the larval growth, increased the weight of larvae, silk gland, cocoon and cocoon shell. It also increased the protein and RNA contents of the silk gland (Majumider, 1982; Abd-El – Aziz, 1997 and Gad, 2002). Moreover, treatment with potassium permenganate improved larval survival, pupal weight and silk quality (Gupta *et. al.*, 1990).

The present work was carried out to investigate the effect of potassium iodide, cupper sulphate, potassium permenganate and their mixtures on the mulberry silk worm *B. mori*, from bilological and physiological point of views.

MATERIALS AND METHODS

Insects:

All experiment were performed on 5th instar larvae of the mulberry silk worm *B mori*. Larvae were fed on mulberry leaves under laboratory conditions of 22 – 25 °C and 70 – 75 % RH. Newly hatched larvae were placed in rearing cages until the fourth instar. Fifth instar larvae were transferred to conventional trays with bottom wire gauze fixed on a wooden frame.

Chemicals:

All chemicals used in the present study were analytical grade purchased from Sigma (UK) and presented in Table 1.

Table (1): Inorganic chemicals used in this study.

Code	Inorganic Material and their mixtures
A1	Potassium Iodide (100 µg/ ml)
A2	Cupper Sulphate (100 µg/ ml)
A3	Potassium Permenganate (10 µg/ml)
A4	Potassium Iodide + Potassium Permenganate
A5	Potassium Iodide + Cupper Sulphate
A6	Potassium Permenganate + Cupper Sulphate

All chemicals were dissolved in distilled water and used as a supplementary nutrients. Mulberry leaves were soaked in the chemical solutions for one hour, then air dried and offered to the 5th instar larvae at 48 $\pm$ 6 hrs. The control larvae were fed on mulberry leaves dipped in

distilled water only. The concentrations of potassium iodide, and potassium permenganate (100 µg / ml) chosen were according to Govindan *et al.* (1989). Each treatment was replicated four times and each replicate contained 50 larvae. The weight of mature larvae, pupae, cocoon shells and silk glands were recorded. After copulation of emerged adults, the number of deposited eggs per female was also recorded. The corpora allata (CA) volume used as an indicator of the glandular secretory activity of juvenile hormones (Wirtz, 1973). Ten 5th instar larvae were immediately taken before spinning from each treatment and control. The larvae were fixed in alcohol Bouin's solution till measurements were taken. Head capsules were dissected and the CA were removed. The Cas were drawn using Camera Lucida and CA surface areas were calculated using a Planimeter. Meanwhile, the total haemolymph protein of mature larvae was estimated using the method of Lowery *et. al.* (1951).

Data were statistically analyzed to check the significance of differences between treatments by using F test and L.S.D. (Snodgrass and Cochran, 1976).

RESULTS AND DISCUSSION

Last instar larvae of the mulberry silkworm (48 ± 6 hrs) were fed on mulberry leaves treated with cupper sulphate (100 µg / ml), potassium iodide (100 µg / ml), potassium permenganate (10 µg / ml) and the mixtures of these chemicals. The second day of last larval instar was chosen for these treatments according to the findings of Fukuda *et. al.* (1958) who reported that the direct formation of silk protein occurs during the period from the 3rd day of the last instar of silk worms till maturity.

Weight of mature larvae, silk glands and pupae:

The demonstrated results in Table 2 show that the heaviest larval, silk gland and pupal weight were 2.38, 0.7791 and 0.8936 g, gained for the (A2) treatment, followed by treatment (A6) where the recorded weights were 2.32, 0.6884 and 0.8903 g, respectively. The mixture (A5) gave 1.97, 0.6874 and 0.8733 g for larval, silk gland and pupal weight, respectively. Among the other treatments, the least weights of larvae, silk gland and pupae were 1.838, 0.5894 and 0.8054 g, respectively were recorded for treatment (A3) but they were still significantly heavier than those of the control (1.74, 0.3464 and 0.5465 g).

Table (2): Effects of feeding *B. mori* 5th instar larvae on mulberry leaves treated with different supplementar nutrients on some productivity criteria

Type of supplemented materials	Larval weight (g)	Pupal weight (g)	Cocoon shell weight (g)	Silk gland weight (g)
Control	1.74 ± 0.02^{c}	0.5465 ± 0.007^{c}	0.1378 ± 0.002^{d}	0.3464 ± 0.02^{d}
Cupper sulphate (100 µg/ml)	1.92 ± 0.01^{b}	0.8144 ± 0.02^{b}	$0.1941 \pm 0.006b^{c}$	0.6074 ± 0.01^{c}
Potassium Iodide (100 µg/ml)	2.38 ± 0.02^{a}	0.8936 ± 0.008^{a}	0.2893 ± 0.01^{a}	0.7791 ± 0.01^{a}
Potassium permengnate(0.001%)	1.84 ± 0.01^{b}	0.8054 ± 0.01^{b}	0.1821 ± 0.004^{c}	0.5894 ± 0.02^{c}
Pot. Iodide + Cupper sulphate	1.93 ± 0.01^{b}	0.8244 ± 0.01^{b}	$0.2013 \pm 0.003b^{c}$	0.6870 ± 0.02^{b}
Pot. Iodide+ Potassium permengnate	1.97 ± 0.02^{b}	0.8733 ± 0.009^{a}	0.2051 ± 0.006^{b}	0.6874 ± 0.02^{b}
Pota. permengnate + Cupper sulphate	2.32 ± 0.01^{a}	0.8903 ± 0.01^{a}	0.2659 ± 0.002^{b}	0.6884 ± 0.02^{b}

- Each value presents the mean $\pm$ SE .
- Means at each column followed by the same letter are not significantly different at $p \geq 0.05$

Silk production:

Table (2) demonstrated the weight of cocoon shell were 0.2659, 0.2093 and 0.2051 g. of the treatment (A2), the mixture (A6) and the mixture (A5), respectively. The least weight of cocoon shells (0.1829 g.) was recorded for the treatment (A3) but it was still higher than that of the control (0.1372 g.).

Number of deposited eggs:

As shown in Figure (1), treatment (A2) was significantly increased the number of deposited eggs per female (419.5 eggs / female) followed by the treatment (A6) (394.2 eggs / female). And the treatment (A5) (394 eggs / female) when compared to the untreated control (246 eggs / female). The obtained results partially agree with Chakrabarti and Medda (1978) who reported that potassium iodide increased body weight, cocoon shell and number of deposited eggs. Also, Majumider (1982) studied the effect of potassium iodide on the growth and reproduction of the mulberry silk worm *B. mori*. He indicated that the lower doses of potassium iodide had similar effects to those previously observed with thyroxine. Govindan *et. al.* (1989) treated 5th larval instar of *Samia cynthia ricini* with potassium iodide and cupper sulphate at 50, 100 and

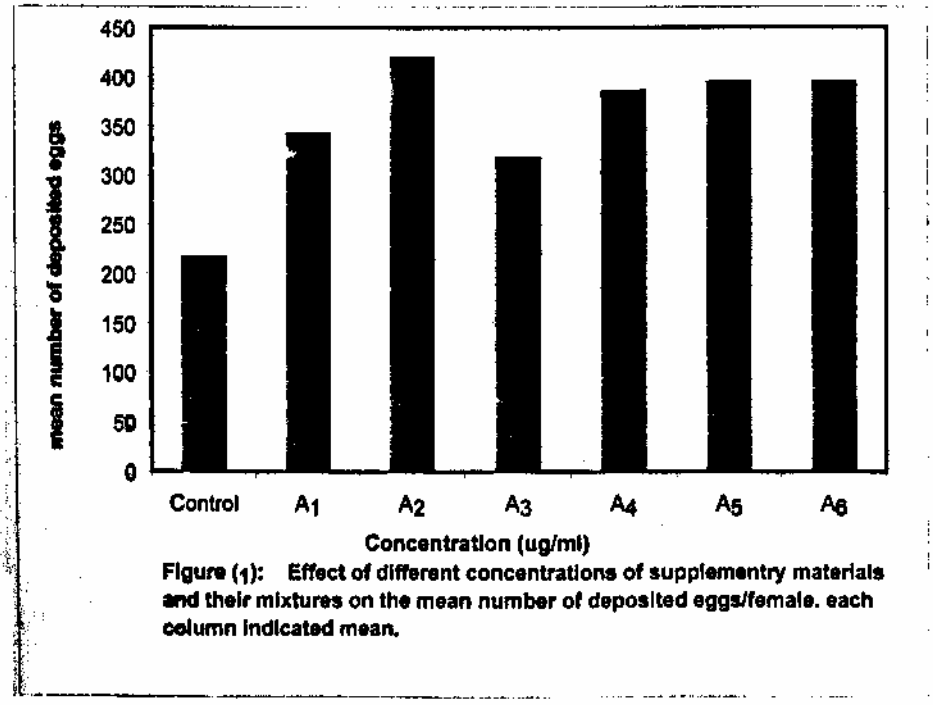

Figure (1): Effect of different concentrations of supplementry materials and their mixtures on the mean number of deposited eggs/female. each column indicated mean.

150 µg / ml which increased the weights of larvae, cocoon, pupae and cocoon shells. Similar results were recorded by Abd El- Aziz (1997). Thyagaraja *et. al.* (1985) indicated that thyroxine fed to multivoltine and bivoltine silk worm races enhanced the growth and development of larvae while shortened larval duration leading to an increase in cocoon shell weights. Gupta *et. al.* (1990) found that the use of potassium permenganate improved larval survival, pupal weight and silk quality of *B, mori* larvae. Gad (2002) recorded that potassium iodide increased the weight of larva, pupae, silk gland, cocoon shell, pupae and number of deposited eggs *B. mori*. Also, Ramadan and Aly (2002) found that supplementing with Nickel chloride and sodium chloride have also increased the cocoon shell weight of *B. mori*.

The effects of these inorganic chemicals and their mixtures on corpora allata (CA) surface area and total haemolymph protein were studied. According to Pflugefelder (1948), CA volume was used as an indicator for its activity. CA hormone (JH) has a significant role in protein biosynthesis (Minks, 1967). Moreover, JH interferes with the action of the silk glands in lepidopterous insects (Novak, 1966). Figure (2) indicated that the treatment

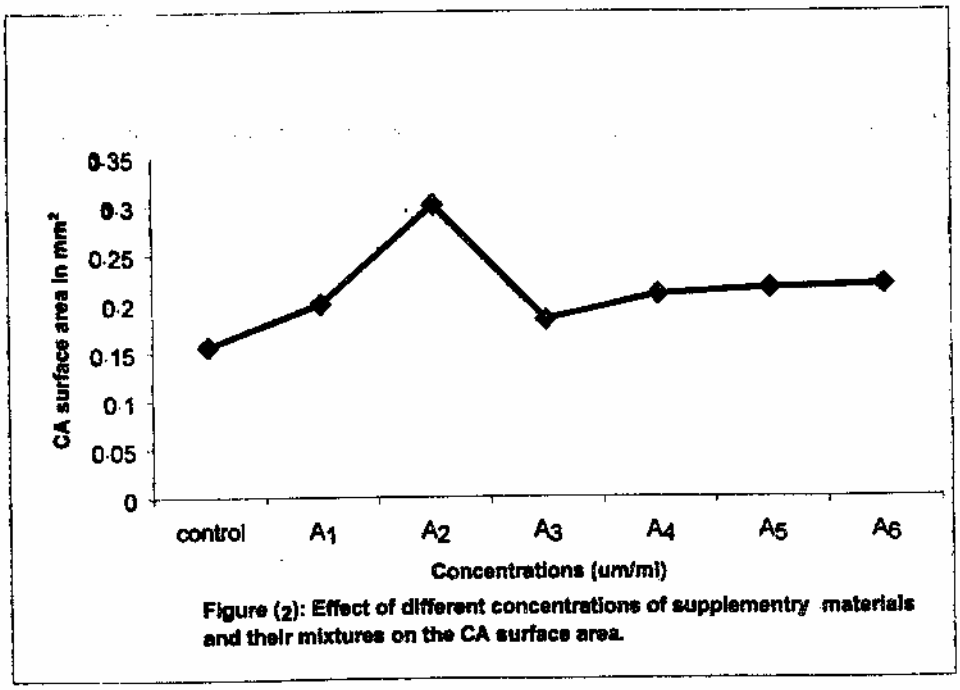

Figure (2): Effect of different concentrations of supplementry materials and their mixtures on the CA surface area.

(A2) and its mixture (A6) when used as food additive increased the CA surface area by about 57.7 % and 40.5 %, respectively as compared to control. The present results in Figure (3) showed that treatment (A2) increased the total haemolymph protein by 33.5 mg / ml followed by treatment (A6) (31.6 mg / ml) and treatment (A5) (30.2 mg / ml), while the control value was 17.6 mg / ml.

In conclusion cupper sulphate was found to be the most effective supplementary nutrient followed by the mixture of potassium permenganate + cupper sulphate, while the least effective was potassium permenganate only. The synergistic effect of cupper sulphate and potassium permenganate will need further investigation.

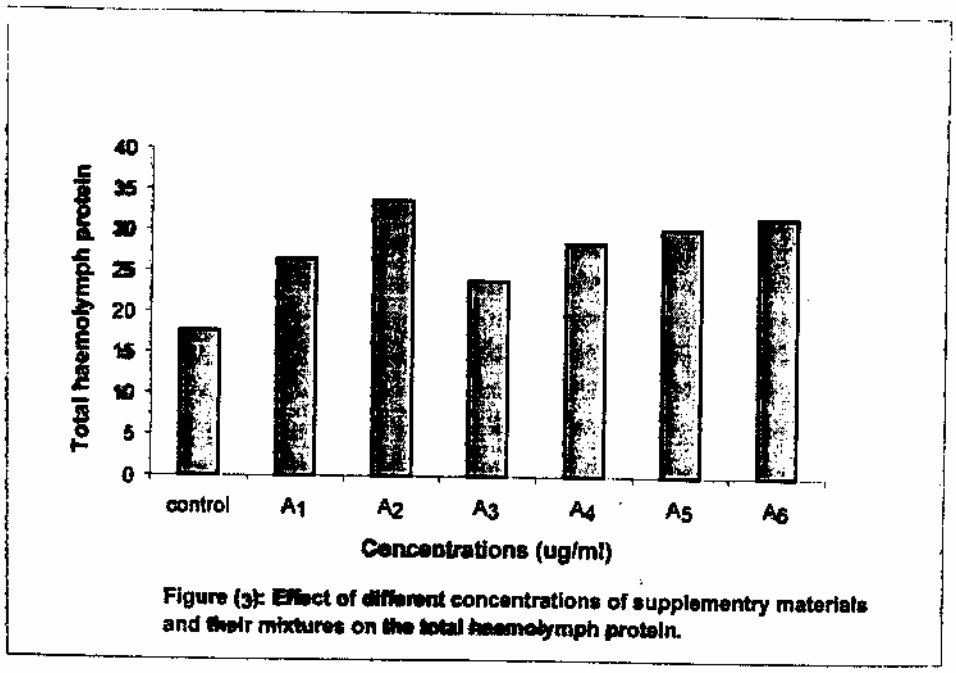

Figure (3): Effect of different concentrations of supplementry materials and their mixtures on the total haemolymph protein.

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تأثير استخدام بعض المواد الغير عضوية كإضافات غذائية على أنتاجية ديدان الحرير التوتية

عبير جاد – ماجدة سالم – أحمد زيتون
كلية الزراعة جامعة الاسكندرية- قسم الحشرات الأقتصادية

يهدف هذا البحث إلى دراسة تأثير استخدام بعض المواد الغير عضوية مثل يوديد البوتاسيوم بتركيز (١٠٠ ميكروجرام / مل ماء) كبريتات النحاس (١٠٠ ميكروجرام / مل ماء) و برمنجنات البوتاسيوم (٠,٠٠١%) و خلائط هذه المواد معا بنفس التركيزات السابقة على بعض الصفات و القياسات البيولوجية و الفسيولوجية و الأنتاجية للعمر اليرقى الخامس بغرض زيادة أنتاجيتها من الحرير و البيض. و تستخدم هذه المواد بإضافتها على أوراق التوت و تقديمها إلى يرقات العمر الخامس من ديدان الحرير التوتية.

تشير النتائج إلى زيادة معنوية فى كل من أنتاجية الحرير و خصوبة الأناث لجميع المعاملات و أن كان أفضلها كبريتات النحاس حيث قدرت الزيادة المعنوية فى أنتاجية الحرير و انتاج البيض حوالى ٩٤,٠٨% و ٩٤,٢% على التوالى.

تم دراسة تأثير هذه المركبات على بعض القياسات الفسيولوجية كمستوى البروتينات فى دم اليرقات المعاملة و أيضا حجم الغدة التعادلية (الكوربورا اللاتا) و بينت النتائج أن استخدام كبريتات النحاس أدى إلى اكبر زيادة معنوية فى مساحة سطح غدة الكوربورا اللاتا و كذلك مستوى بروتينات الدم فى اليرقات المعاملة.