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Research Article

The Effect of Nutritional Supplementation with *Amaranthus hybridus* Linn. Extract on Economic Performance of Mulberry Silkworm, *Bombyx mori* L.

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Abstract: The nutritional supplementation of *Amaranthus hybridus* Linn. plant extract were tested against III, IV and Vth instar larvae of silkworm for improving the performance of growth and cocoon characteristics of silkworm, *Bombyx mori* L. The various concentrations of *Amaranthus hybridus* plant extract (0.5, 1.0, 1.5, 2.0, 2.5 %) were administered to III, IV and Vth instar silkworm with mulberry. The larval weight, cocoon characteristics were influenced by various concentration of plant extract. The intensity of influence was depending on the time and dose exposure.The 2.0 % dose of extract was highly effective against the larval and cocoon characteristics of *Bombyx mori*. The mean larval weight, pupa weight, shell weight, shell ratio and filament length were increased at 2.0 % concentration of dietary supplementation over the control, whereas at 2.5 % concentration of plant extract caused adverse effect on the economic parameters. In the present study moderate concentration of *Amaranthus hybridus* extract have growth promoting effect in silkworm which helps to improve the economic performance of silkworm, *Bombyx mori.*
Keywords: Plant extract, *Bombyx mori*, economic performance.

INTRODUCTION

The silkworm *Bombyx mori* L. is a phytophagous insect and a typical monophagous feeder on mulberry leaves. Sericulture is an agro based popular cottage industry and plays a vital role in the improvement of rural economy of India. It is well known for its low investment and quick and high returns which makes it an ideal industry fitting well in to the socio-economic frame of India. India is the second largest silk producer in the World after China. Germany is the largest consumer of Indian silk. Increase larval growth and cocoon quality and quantity would result better economics for this industry and meet the production needs.

In recent years, many attempts have been made to improve the quality and quantity of silk through enhancing the leaves with nutrients, spraying with antibiotics, vitamins, hormones and hormone analogues, plant products or using extracts of plants. Plants are the richest source of organic chemicals on earth and phytochemicals have been reported to influence the life and performance of different insects [1].Various extracts of medicinal plants have been tested by supplementation in the silkworm *Bombyx mori* and were seen to influence the body weight, silk gland weight and the silk thread length in *Bombyx mori* [2]. The *Xanthium indicum* plant extract influenced the larval and cocoon characteristics of silkworm, *Bombyx mori* [3]. Dietary suplementation of the leaf, flower and pod extracts of *Moringa aleifera* [4]. Influence of commercial herbal tonic 'logen' and 'Alloe' on the economic performance of the larvae of *Bombyx mori* and elicited better response [5, 6].

Amaranthus hybridus Linn. (Amaranthaceae) commonly known as Smooth pigweed is an erect branched annual herb distributed throughout tropical and temperate regions of India as a common weed in the fields and wastelands [7, 8]. *A. hybridus* Linn. ethanol and aqueous extracts possess significant peripheral and central antinociceptive effects in laboratory animals[9].

Phytochemical analysis revealed the presence of polyphenols, tannins, flavonoids, steroids (including cardenolids), terpenoids (i.e., iridoïds, triterpenes and carotenoids), saponins and betalains. Some species of Amaranthacea could contain antinutritional factors such as oxalates, The *A. hybridus* extract showed the best antioxidant and xanthine oxidase inhibition activities and high nutritional value [10].

A. hybridus has been used traditionally for the treatment of liver infections and knee pain and for its laxative, diuretic, and cicatrisation properties [11]; the products are used particularly for stomach aches, diarrhoea, and dysentery. *A. hybridus* leaves are used as a vegetable [12].

There has been no attempt so far to study the effect of *Amaranthus hybridus* plant extract on the silkworm *B. mori.*

The present study is an attempt to evaluate the effect of nutritional supplementation of various concentration of plant extract on economic performance of mulberry silkworm, *Bombyx mori* L.

MATERIALS AND METHODS

Animals:

The silkworm breed selected for the experiment was bivoltine hybrid (CSR_2 xCSR_4) Disease free laying of the silkworm, *Bombyx mori* were obtained from district sericulture office, Aurangabad. After hatching larvae were isolated from stock culture and feeding them with appropriate quantity of fresh mulberry leaves. The III, IV and V^{th} instar larvae were utilized for the experiment. After second instar, the larvae were acclimatized to the laboratory condition and divided in to six experimental groups including control. During this period larvae were fed four times a day and maintain necessary disinfection condition..

Plant materials:

The plant, *Amaranthus hybridus* was identified and authenticated by the department of Botany, Deogiri College, Aurangabad. The leaves of plants were collected, washed thoroughly with distilled water and shed dried. The dried leaves were powdered with the help of mechanical device. Further 50 gm powdered , thus obtained was subjected to extraction through soxhlet apparatus with 500 ml methanol solvent for 24 hrs. After 24 hrs, given extract was filtered and filtrate was evaporated completely. Evaporated extract material dissolved in distilled water and diluted to 0.5, 1.0, 1.5, 2.0 and 2.5 % concentration for further experiment. Fresh mulberry leaves were sprayed with each concentration and then dried in air for 10 minutes. Treated leaves of various concentrations were fed to III, IV and V instar larvae, four feeding per day The silkworm larvae fed mulberry leaves sprayed with distilled water and served as control. The feeding were maintained up to the cocoon stage of the silkworm. Larval weight, cocoon weight, shell weight, papal weight, filament length and cocoon shell ratio were determined for all doses. Results were presented as means ±S.D.,

Larval paramenters:

Silkworm weight: Ten larvae were randomly selected in each group and the larval weight was measured using electronic balance and it was expressed in gm.

Cocoon parameters:

Cocoon weight: Five days after spinning 10 cocoons were harvested and weighed.

Papae weight: After taking weight of cocoon the pupae were removed outside and weighed.

Cocoon shell weight: After taking weight of pupae the empty cocoon shell were weighed.

Cocoon shell ratio: Shell ratio is calculated by the formula,

$$\text{Cocoon shell ratio (\%)} = \frac{\text{Cocoon shell weight}}{\text{Cocoon weight}} \times 100$$

$$\text{Denier of the filament:} = \frac{\text{Single cocoon filament weight (gm)}}{\text{Single cocoon filament length (m)}} \times 9000$$

RESULTS AND DISCUSSION

The data on the effect of various concentration of *Amaranthus hybridus* plant extract on larval and cocoon characteristics of silkworm *Bombyx mori* are presented in Table-1. and figures.

Table-1: The effect of nutritional supplementation of *Amaranthus hybridus* Linn. Extract on the economic performance of silkworm, *Bombyx mori*.

Groups	Treatment	Larval weight (gm)			Cocoon Weight (gm)	Shell weight (gm)	Pupa weight (gm)	Shell Ratio (%)	Total silk length (m)	Denier	Filament weight (gm)
		III Instar	IV Instar	V Instar							
I	Control	0.397 ±0.005	0.522 ±0.006	2.328 ±0.10	1.574 ± 0.08	0.267 ±0.005	1.145 ±0.07	16.963 ±1.24	738 ±36	1.804 ±0.10	0.148 ±0.004
II	0.5 %	0.415 ±0.005	0.543 ±0.004	2.384 ±0.11	1.591 ±0.08	0.293 ±0.005	1.186 ±0.09	18.416 ±1.25	756 ±41	1.940 ±0.11	0.163 ±0.007
III	1.0 %	0.425 ±0.005	0.571 ±0.005	2.412 ±0.11	1.624 ±0.09	0.318 ±0.004	1.217 ±0.09	19.581 ±1.30	773 ±38	2.119 ±0.10	0.182 ±0.004
IV	1.5 %	0.436 ±0.004	0.597 ±0.05	2.508 ±0.10	1.711 ±0.10	0.349 ±0.005	1.389 ±0.08	20.397 ±1.28	823 ±37	2.088 ±0.12	0.191 ±0.004
V	2.0 %	0.473 ±0.006	0.608 ±0.006	2.662 ±0.11	1.804 ±0.10	0.374 ±0.006	1.432 ±0.09	20.731 ±1.34	889 ±44	2.004 ±0.12	0.198 ±0.005
VI	2.5 %	0.521 ±0.006	0.627 ±0.005	2.578 ±0.10	1.787 ±0.09	0.353 ±0.005	1.407 ±0.08	19.753 ±1.27	883 ±42	1.885 ±0.10	0.185 ±0.004

Values are mean ± S. D. of ten observation.

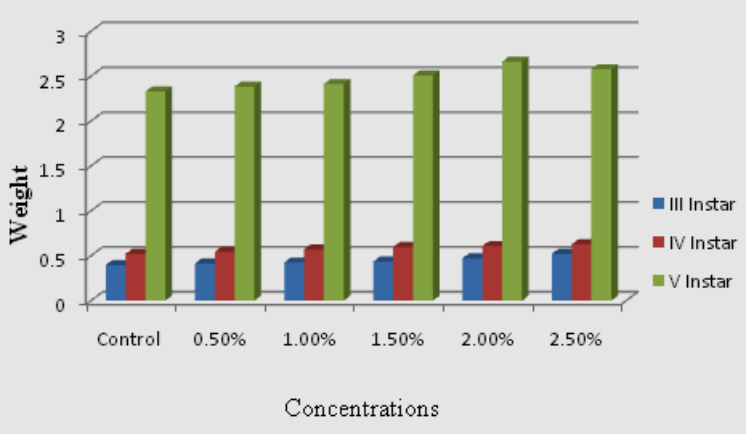

Fig-1: Effect of *A. hybridus* extract on larval weight of *Bombyx mori*

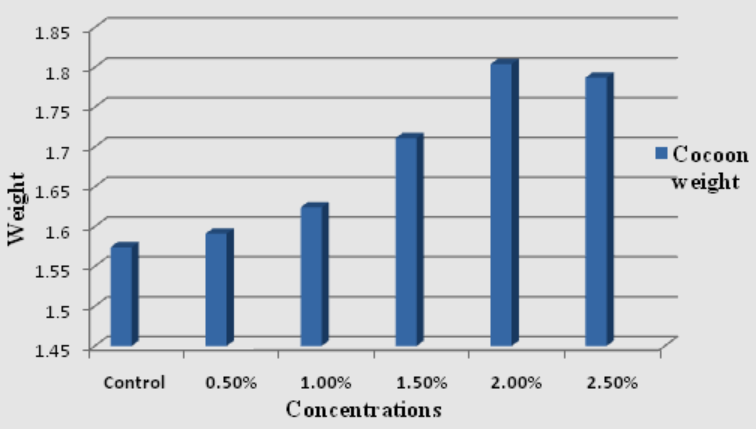

Fig-2 Effect of *A. hybridus* extract on cocoon characteristics of *Bombyx mori.*

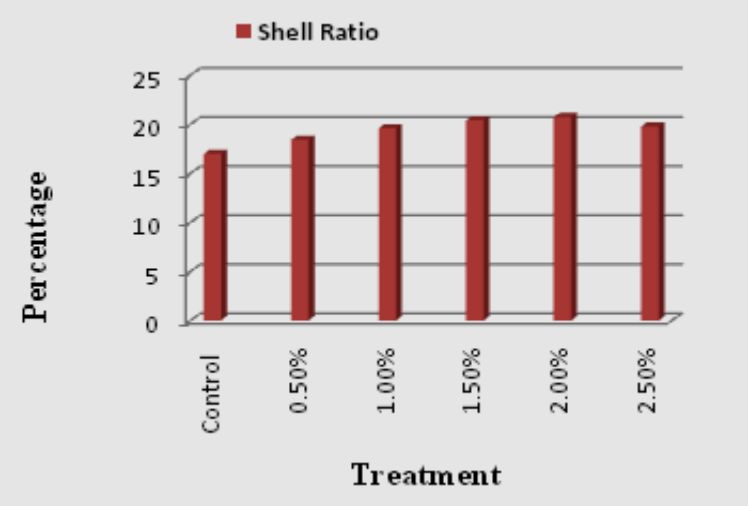

Fig-3 Effect of *A. hybridus* extract on shell ratio

The dietary supplementation with various concentrations (0.5, 1.0, 1.5, 2.0 %)of plant extract to the silkworm larvae resulted in an increase in larval weight in third, fourth and fifth instar larvae. Cocoon weight, and filament length were also found to be increased.

The third instar larvae in the control group grow with an initial weight of 0.397 gm. It gradually increases with the increasing concentration of plant extract. The recorded weight was gradually increased up to the fifth instar larvae (2.662 gm) at 2.0 % concentration of plant extract while at 2.5 % concentration larval weight was reduced (2.578 gm) due to the plant extract containing secondary bioactive metabolites.

The larvae produced cocoon and weight of cocoon from control group (1.574 gm) were lesser than experimental groups where larvae fed with various

concentration of plant extract. When the concentration of plant extract was increased the cocoon weight also increased simultaneously. The maximum cocoon weight obtained in the present experiment was 1.804 gm at the concentration of 2.0% of plant extract fed to silkworm larvae.

The pupae weight and shell weight of control group were also smaller than the experimental groups. When the concentration of plant extract was increased the weight of pupae and shell also increased simultaneously. The weight of pupae and shell were maximum at 2.0% concentration of plant extract are 1.432 and 0.374 gm respectively.

The shell ratio in control group was 16.963 % while in experimental group, maximum shell ratio was 20.731 % at 2.0 % concentration of plant extract.

The silk or filament length of the reel able silk in control was 738 m while maximum length of silk filament was 889 m, recorded in experimental group at 2.0% of concentration.

In the present study the treatment of plant *Amaranthus hybridus* extract at the concentration of 0.5 %, 1.0 %, 1.5 % and 2.0 % may have beneficial effect on the growth of the silkworm *Bombyx mori* and also increased the larval weight , cocoon weight, pupal weight, shell ratio and filament length by enhancing feed efficacy than control whereas at 2.5 % concentration, the overall performance of silkworm were comparatively reduced.

DISCUSSION:

Many researchers showed that the larval and cocoon characters improve by different concentration of plant extract and their natural formulation such as Ascorbic acid, folic acid, thiamin, vitamins, hormones, Alloe tonic etc. The growth and cocoon parameters could be improved with dietary supplementation of botanicals [5, 13,14,15,16]. Nutrition plays an important role in improving the growth and development of *B. mori* [17]. The fortification of mulberry leaves with the flour of black gram and red gram to improve the larval growth and cocoon characteristics in *B. mori* [18]. Similarly, the growth of silkworm larvae improved significantly upon feeding them with mulberry leaves supplemented with different nutrients [19]. [1, 3] noticed the growth promoting effect of plant extract, *Tribulus terrestis* and *Psoralea coryllifolia*. In the present study, the weight of silkworm larvae, cocoon weight, shell ratio and filament length were increased with dietary supplementation of plant extract, *Amaranthus hybridus.* It might be due to secondary bioactive compounds which have growth promoting and nutritive nature of this plant andnoticed a strong correlation between the growth of silkworm and the silk production in the silkworm after the treatment of plant extracts [2] . The supplementation of *Vigna unguiculata* aqueous extract with mulberry leaves at different concentration enhanced the quality and quantity of silk in *Bombyx mori* [20].

The study results concluded that, the treatment of *B. mori* larvae with moderate concentration of *A. hybridus* plant extract caused beneficial effect on economic parameters, whereas the higher concentration of plant extract caused adverse effect.

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