

# Impact of Dietary Supplementation of *CASSIA TORA* Plant Extracts on Cocoon and Silk Performance of *BOMBYX MORI* L.

Barge S. B.<sup>1</sup> and Pardeshi A. B.<sup>2</sup>

<sup>1</sup>Department of Zoology Amolakchand College, Yavatmal (M.S) India

<sup>2</sup>P. G. Department of Zoology, Deogiri College, Aurangabad, (M.S) India

**Abstract:** The effect of *Cassia tora* plant extract were tested against IV and V<sup>th</sup> instar larvae of silkworm for improving the performance of cocoon characteristic of silkworm, *Bombyx mori* L. The various concentration of Methanol extract of *Cassia Tora* plant extracts (0.5, 1.0, 1.5, 2.0 and 2.5%) were supplemented to IV and V<sup>th</sup> instars silkworm with mulberry. The cocoon characteristic and silk performance were influenced by various concentration of plant extract. The intensity of influence was depending on the time and dose exposure. The plant extract at 2.0% concentration resulted into the improvement of cocoon and silk parameters. The mean larval growth index, pupa weight, shell weight, shell ratio, silk filament length, sericin and fibroin content of *Bombyx mori* were increased with this dietary supplementation of plant extract over the control. In the present study the plant extract of *Cassia tora* has growth promoting effect in silkworm which helps to improve the performance of cocoon and silk in *Bombyx mori*.

**Key-word:** Plant extract, *Bombyx mori*, economic performance.

## I. 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 (Rajasekaragouda *et al.*, 1997). 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* (Murugan *et al.*, 1998). Nutritional supplementation of *Amaranthus hybridus*, *Xanthium indicum*, *Alternanthera sessilis*, *Sida acuta*, *Coix aquatica* and *Ipomoea quamoclit* plant extracts were studied on larval growth and economic performance of silkworm, *Bombyx mori* (Pardeshi and Bajad (2014<sup>a</sup> and <sup>b</sup>; Barge and Pardeshi 2017, 2018, 2019, 2022) plant extracts on economic performance of mulberry silkworm, *Bombyx mori* L. Dietary supplementation of the leaf, flower and pod extracts of *Moringa aleifera* (Rajeswari and Isaiarasu, 2004). Influence of commercial herbal tonic 'logen' and 'Alloe' on the economic performance of the larvae of *Bombyx mori* and elicited better response (Balamurugan and Isaiarasu, 2007; Manimuthu and Isaiarasu, 2010).

The plant, *Cassia tora* L. is well known medicinal plant belonging to the family Leguminosae. This plant *Cassia tora*, has been used as laxative, antiseptic, antioxidant, antimicrobial, antidiarrhoeal, antidiuretic, antimutagenic and antiperiodic. It is also helpful to treat against opthalimic and skin disease (Shukla *et al.*, 2013). This plant is also traditionally well known for the treatment of hypertension, diabetes, skin disease, cough, pulmonary problems, and stomach problem (Bhargava *et al.*, 2020).

There has been no attempt so far to study the cocoon and silk performance after dietary supplementation of *Cassia tora* in silkworm *Bombyx mori*. The aim of this contribution is to evaluate the influence of the oral administration of methanol solvent plant extract on the cocoon and silk performance of silkworm, *Bombyx mori*.

## II MATERIALS AND METHODS

### Animal Collection

The silkworm breed selected for the experiment was Indian bivoltine hybrid (CSR<sub>2</sub> X CSR<sub>4</sub>) 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 IV and V<sup>th</sup> instar larvae were utilized for the experiment. After third 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 Collection

The plant, *Cassia tora* was identified and 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 50gm. powdered, thus obtained was subjected to extraction through Soxhlet apparatus with 500ml 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 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 was maintained up to the cocoon stage of the silkworm. Larval growth, cocoon weight, shell weight, pupal weight, filament length, cocoon shell ratio, sericin and fibroin were determined for all doses. Results were presented as means  $\pm$ S.D.

Larval parameters (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. After taking weight of cocoon the pupae were removed outside and weighed.

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

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

### Larval Growth Index:

Newly emerged thirty, III instar larvae of seven day old and V instar larvae of sixteen days old were weighed and the following formula was used to calculated as Growth Index (GI).

$$G.I =$$

$$\frac{\text{Final weight of v instar larvae (g)} - \text{Initial weight of larvae (g)}}{\text{Initial weight of larvae (g)}}$$

Cocoon shell ratio (%)

$$= \frac{\text{Cocoon shell weight}}{\text{Cocoon weight}} \times 100$$

Denier of the filament:

$$= \frac{\text{Single cocoon filament weight (gm.)}}{\text{Single cocoon filament length (m.)}} \times 9000$$

### Estimation of sericin and fibroin content:

The sericin and fibroin content of the cocoon was estimated by Muthukrishnan *et al.*, (1978). After the completion of the spinning the cocoons were collected, opened to remove the pupae. The shells were dry at 800 C and weighed. The cocoon shell was treated with 0.5% KOH for 6 hrs. and thoroughly washed in hot water. The following formulae were used to estimate the sericin and fibroin content and the percentage of sericin and fibroin in the total cocoon shell was then calculated.

Sericin (gm) = initial dry wt. of shell – dry wt. of shell after alkali treatment

Fibroin (gm) = dry wt. of shell – Sericin contain

$$\text{Fibroin \%} = \frac{\text{wt. of fibroin}}{\text{wt. of shell}} \times 100$$

$$\text{Sericin \%} = 100 - \text{fibroin \%}$$

## III. RESULTS AND DISCUSSION

The data on the effect of various concentration of *Cassia tora* plant extract on the larval growth, cocoon and silk performance of silkworm, *Bombyx mori* are

presented in Table-I. 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 cocoon weight, shell ratio, denier filament weight and filament length. The larval growth index was also increased in the increasing concentration of plant extract. Highest larval growth index 11.461 was found when 2.0 % concentration of methanol solvent plant extract supplemented to the silkworms.

The larvae produced cocoon and weight of cocoon from control group (1.446gm) 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 2.118gm at the concentration of 2.0% of plant extract fed to silkworm larvae. When the concentration of plant extract was increased the weight of pupae and shell also increased simultaneously.

The pupae weight and shell weight of control group were also smaller than the experimental groups. The weight of pupae and shell were maximum at 2.0% concentration of plant extract are 1.686 and 0.373gm respectively. The shell ratio in control group was 15.698 % while in experimental group, maximum shell ratio was 17.610% at 2.0 % concentration of plant extract. The silk or filament length of the reel able silk in control was 710m. While maximum length of silk filament was 793m, recorded in experimental group at 2.0% of concentration.

The fibroin content (80.35%) was observed more than the control (73.78) in silk after the supplementation of 2.0% concentration of plant extract while sericin content (19.65 %) was recorded higher than the control group of cocoons (26.22 %) after the supplementation of 2.0% plant extract of *Cassia tora*.

In the present study, dietary supplementation of *Cassia tora* plant 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 growth, cocoon weight, pupal weight, shell ratio, denier and filament length by enhancing feed efficacy than control whereas at 2.5 % concentration, the overall performance of cocoon were comparatively reduced.

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., (Nirman and Kaliwal, 1996; Etaberi *et al.*, 2004; Balasundaram *et al.*, 2008; Manimuthu and Isaiarasu, 2010; Khyade and Shendage, 2012) have showed that the growth and cocoon parameters could be improved with dietary supplementation of botanicals. A strong correlation was found to exist between growth of silkworm and silk production after leaf treatment of plant extracts, *T. terrestris*, *B. diffusa* and *P. niruri* and showed growth promoting effects due to presence of active compound which may enhance the bioavailability of nutrients for digestibility (Murugan *et al.*, 1998). Nutrition plays an important role in improving the growth and development of *B. mori* (Kanafi *et al.*, 2007). Alagumalai *et al.*, (1991) observed fortification of mulberry leaves with the flour of black gram and red gram to improve the larval growth and cocoon characteristics in *B. mori*. Similarly, the growth of silkworm larvae improved significantly upon feeding them with mulberry leaves supplemented with different nutrients (Sarker, 1993). Rajasekaragouda *et al.*, (1997) noticed the growth promoting effect of plant extract, *Tribulus terrestris* and *Psoralea corylifolia*. Nutritional supplementation of the plant extracts of *A. hybridus X. indicum*, *A. sessilis*, *S. acuta*, *C. aquitica* and *I. quamoclit* were improve the quality and quantity of silk in *Bombyx mori* (Pardeshi and Bajad, 2014 <sup>(a and b)</sup>; Barge and Pardeshi, 2017, 2018, 2019 and 2022).

In the present study, the weight of silkworm larvae, the average pupa weight, shell weight, shell ratio, silk filament length, sericin and fibroin content were also increased with this supplementation of plant extract, *Cassia tora*. It might be due to bioactive compounds which have growth promoting and nutritive nature of this plant. Murugan *et al.*, (1998) noticed a strong correlation between the growth of silkworm and the silk production in the silkworm after the treatment of plant extracts. Sithi *et al.*, (2023) recorded the effect of herbal plants, *Cucurbita moschata* and *Ipomoea batatas* extracts on the biological characteristics of silkworm *B. mori*. Saravanan *et al.*, (2011) observed the supplementation of *Vigna unguiculata* aqueous extract with mulberry leaves at different concentration enhanced the quality and quantity of silk in *Bombyx mori*.

**Table: Effect of dietary supplementation of *Cassia tora* plant extracts on the cocoon and silk performance of mulberry silkworm, *Bombyx mori* L.**

Group	Treatment Concentration	Growth index	Cocoon weight (gm)	Shell weight (gm)	Pupa weight (gm)	Shell ratio (%)	Total silk length (m)	Denier	Filament Weight (gm)	Sericin (%)	Fibroin (%)
I	Control	9.566 ±1.09	1.446 ±0.08	0.227 ±0.004	1.150 ±0.08	15.698 ±1.21	710 ±48	2.129 ±0.8	0.168 ±0.005	26.22 ±1.31	73.78 ±1.75
II	0.5%	10.457 ±1.09	1.714 ±0.10	0.268 ±0.006	1.362 ±0.06	15.635 ±1.32	736 ±46	2.225 ±0.9	0.182 ±0.006	24.39 ±1.88	75.61 ±2.09
III	1.0%	10.747 ±1.12	1.836 ±0.011	0.294 ±0.007	1.482 ±0.08	16.013 ±1.30	742 ±39	2.389 ±0.12	0.197 ±0.007	22.49 ±1.19	77.51 ±1.91
IV	1.5%	10.852 ±1.14	2.092 ±0.10	0.355 ±0.008	1.609 ±0.09	16.969 ±1.34	763 ±42	2.642 ±0.11	0.224 ±0.008	20.56 ±1.34	79.44 ±2.38
V	2.0%	11.461 ±1.16	2.118 ±0.11	0.373 ±0.009	1.686 ±0.10	17.610 ±1.39	793 ±49	2.746 ±0.12	0.242 ±0.009	19.65 ±1.84	80.35 ±1.62
VI	2.5%	11.309 ±1.15	2.106 ±0.12	0.375 ±0.010	1.682 ±0.10	17.806 ±1.44	786 ±48	2.461 ±0.13	0.215 ±0.008	20.58 ±1.59	79.42 ±1.56

± indicates S.D. of three observations

Fig. (a) Effect of dietary supplementation of *Cassia tora* plant extract on shell ratio

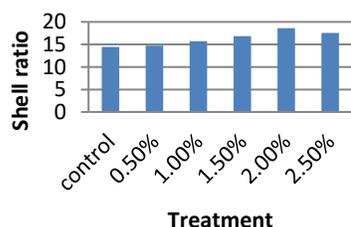
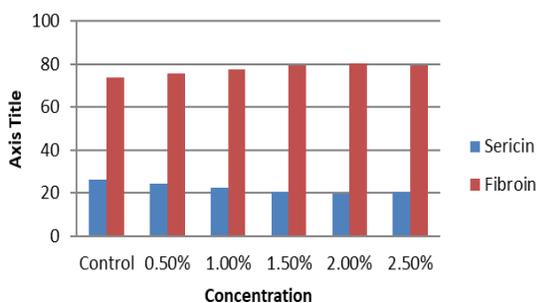


Fig. (b) Effect of dietary supplementation of *Cassia tora* plant extract on sericin and fibroin (%) contents of *Bombyx mori*.



#### IV. CONCLUSION

The study results concluded that, the dietary supplementation of moderate concentration of plant extract caused beneficial effect on cocoon and silk performance of silkworm, *Bombyx mori* whereas the higher concentration of plant extract caused adverse effect.

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