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EFFECT OF SOME MEDICINAL PLANT EXTRACTS ON FEEDING, GROWTH, DEVELOPMENT AND ECONOMIC PARAMETERS OF MULBERRY SILKWORM, *BOMBYX MORI* L.

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ABSTRACT

A study on aqueous leaf extracts (conc. 1%, dry wt. basis) of nine medicinal plants for their antifeedant activity and their effect on growth, development and economic parameters of mulberry silkworm, *Bombyx mori* L. *C. benedictus* and *J. curcas* exhibited highest antifeedant activity and the lowest activity was observed in *S. media* and *P. ovata*, the values being 51.18, 27.32 and –4.12, –3.47%, respectively over control. Further studies revealed higher larval weight gain in *S. media* (0.122g) and *P. ovata* (0.113g) over control (0.112); less terminal larval mortality in *S. media* (3.3%) and *P. ovata* (36.6%) over control; reduction in larval period in *S. media* (28.23 d) over control (29.30 d) and higher percent pupation and adult emergence in *S. media*. The cocoon weight was highest in *S. media* and *P. ovata* over control. The present investigation revealed the presence of feeding stimulatory and growth promoting factors in the two medicinal plant species, *S. media* and *P. ovata*.

Key words: *Bombyx mori*, medicinal plants, antifeedants, feeding stimulant

Studies on nutritional ecology of an insect is very important for its commercial exploitation (Scriber and Slansky, 1981). The dietary nutritional management directly influences the quality and quantity of silk production in *Bombyx mori* (Benchamin and Jolly, 1986). Murugan *et al.* (1998) studied the growth enhancing effect of some botanicals on silkworm, which have potential medicinal value. Such studies have also been earlier at Pantnagar, U.P. against *Bombyx mori* with encouraging results (Gautam, 2003.; Dubey, 2005.; Sharma, 2005).

Present study was therefore undertaken to study the effect of some medicinal plant extracts on feeding behaviour, growth, development and economic parameters of mulberry silkworm, *Bombyx mori* L.

MATERIAL AND METHODS

Chawki reared worms (9d old) of *B. mori* were obtained from Government Sericulture Station Haldwani, District, Nainital, (Uttarakhand) and reared in the Mulberry Sericulture/Bioactive Plant Natural Products Laboratory, Pantnagar on soft and fresh mulberry leaves. The leaves of nine medicinal plant species were collected from Medicinal Plants Research and Development Centre (MRDC), Pantnagar. The details of the plant species used in experiment are given in Table 1.

Effect of medicinal plant extracts on feeding behaviour of *B. mori*

Antifeedant activity of nine plant extracts was studied against 22 d old worms of *B. mori*, under laboratory conditions using no choice feeding bioassay method. The experiment was conducted in completely randomized design (CRD). Shade-dried leaves of each of the nine plant species (Table 1) were extracted in water and an aqueous extract of 1% conc. (dry wt.) was prepared.

Leaf discs of 9 cm^2 were cut from fresh and matured leaves of mulberry. These discs were later dipped in the extracts for approx. 2 minutes and air-dried for a while. Control leaf discs were treated with water only. The discs were kept in centre of pre sterilized corning glass petri dish containing an inner layer of moist filter paper. All the treatments were replicated thrice. Freshly moulted, 3h starved fifth instar worms of uniform size were released in each Petri dish and allowed to feed until more than 60% leaf area was eaten away in control (5 hr). The data on the leaf area consumed was recorded on graph paper in the various treatments and the calculation was made on the Antifeedant activity and Feeding inhibition by using formula given by Singh and Pant (1980).

Effect of aqueous extract of medicinal plants on growth, development and economic parameters of *B. mori* L.

This experiment is the follow up of previous experiment wherein the antifeedant effect of aqueous extract (conc. 1%, on dry wt. basis) of nine plant species was studied on 22d old worms of *B. mori.* Four plant species, two with feeding stimulant and two possessing antifeedant activity were selected for further studies on their effect on growth, development and economic parameters of *B. mori*. All the treatments were replicated three times and each replication

Table 1: Details of the plants species used in the experiment

S. No.	Common name*	Scientific name	Family
1.	Safed aranada	*Jatropha curcas* L.	Euphorbiaceae
2.	Common chickweed	*Stellaria media* L.	Caryophyllaceae
3.	Dauna	*Artemisia annua* L.	Asteraceae
4.	Citronella	*Cymbopogan winterianus* Jowitt.	Poaceae
5.	Isabgol	*Plantago ovata* Forsk.	Plantaginaceae
6.	Holy thistle	*Cnicus benedictus* L.	Compositae
7.	Jamun	*Syzygium cumuni* L.	Myrtaceae
8.	Patchouli	*Pogostemon patchouli* Pellet.	Lamiaceae
9.	Camphor	*Cinnamomum camphora* (L.) Sieb.	Lauraceae

The plants were collected from Medicinal Plants Research and Development Centre (MRDC), Pantnagar and the surroundings.
* Following Rastogi and Mehrotra (2004).

consisted of ten freshly moulted fifth instar larvae. The worms were released in the respective experimental boxes (Size: L35×W24xht.5") and fed with freshly treated mulberry leaves (4th from the top) wrapped with wet cotton swab around the petiole continuously for 2 days. Thereafter with the untreated leaves until the start of pupation. The observation was recorded on the following parameters – Weight gain/larva, larval period (d), Mortality (%), post larval period (d), pupation (%), adult emergence (%), cocoon weight (g), shell wt. (g), shell ratio (%), growth index (GI) following Pant and Dang (1969).

RESULTS AND DISCUSSION

Effect of medicinal plant extract on feeding behaviour of *B. mori*

The results of various treatments on leaf area consumed, antifeedant activity and feeding inhibition have been presented in Table 2.

Table 2: Effect of nine medicinal plant species on feeding behaviour of *B. mori*

Plant species	MLAC/ larva (cm^2)	Antifeedant activity (%)	Feeding inhibition (%)
J. curcas	4.39	27.32	15.81
S. media	6.29	–4.12	–2.02
A. annua	5.11	15.40	8.34
C. winterianus	4.59	24.01	13.64
P. ovata	6.25	–3.47	–1.7
C. benedictus	2.91	51.18	34.97
S. cumuni	4.71	22.02	12.37
P. patchouli	4.78	20.85	11.64
C. camphora	5.13	15.07	8.14
Control	6.04	–	–
SEM	0.850	–	–
CD at 1%	3.422	–	–
CD at 5%	2.509	–	–

MLAC–Mean leaf area consumed

Mean leaf area consumed (MLAC)

The highest MLAC was observed in *S. media* (6.29 cm^2) followed by *P. ovata* (6.25 cm^2). The minimum was in *C. benedictus* (2.91 cm^2) followed by *J. curcas* (4.39 cm^2), *C. winterianus* (4.59 cm^2), *S. cumuni* (4.71 cm^2), *P. patchouli* (4.78 cm^2), *A. annua* (5.11 cm^2), and *C. camphora* (5.13 cm^2).

Antifeedant activity

At 1% (dry wt.) concentration, the maximum antifeedant activity against full grown worms of *B. mori* was exhibited by *C. benedictus* (51.18%) followed by *J. curcas* (27.32%), *C. winterianus* (24.01%), *S. cumuni* (22.02%), *P. patchouli* (20.85%) and *A. annua* (15.40%), and *C. camphora* (15.07). The minimum antifeedant activity was observed in *S. media* (–4.12%) followed by *P. ovata* (–3.47%). The latter two medicinal plant species in fact, showed feeding stimulatory effect promoting feeding in silkworm, *B. mori*.

Feeding inhibition

The maximum feeding inhibition was observed on *C. benedictus* (34.97%) followed by *J. curcas* (15.18%) *C. winterianus* (13.64%), *S. cumuni* (12.37%), *P. patchouli* (11.64%), *A. annua* (8.34%) and *C. camphora* (8.14%). The minimum feeding inhibition was observed in *S. media* (–2.02%) and *P. ovata* (–1.70%), which is indicative of phagostimulant activity. Bohidar *et al.* (2001) observed slightly higher feeding activity than control on *O. basilicum*, *C. limon*, *O. sanctum*, *L. camara*, and *C. pallida* at the concentration of 25 mg/50 ml. Sharma (2005) observed a feeding deterrent activity in *Psoralea corylifolia* (conc. 8%) against fifth instar worms of *B. mori.*

Effect of plant extracts on growth and development of *B. mori*

Out of four plant species none of the plants could significantly increase or decrease the larval weight at 2 DAF over control. The maximum weight gain was observed

on *S. media* (0.122g) followed by *P. ovata* (0.113g), control (0.122), *A. annua* (0.064g) and *C. camphora* (0.050g) *A. annua* and *C. camphora* caused maximum larval mortality at 2 DAF (16.66% each) followed by *P. ovata* (6.66%), and *S. media* (3.33%). No mortality was observed in control.

Terminal larval mortality was maximum in *C. camphora* (56.66%), followed by *A. annua* (43.33%), *P. ovata* (36.66%) and *S. media* (3.33%). Control registered no mortality.

A. annua and *C. camphora* increased the larval period as compared to control. Highest larval period was observed in *A. annua* (29.86d) followed by *C. camphora* (29.60d). *S. media* (28.23d) reduced the larval period as compared to control (29.30d).

Higher shell weight was observed in *S. media* (0.324g) followed by *P. ovata* (0.301g), control (0.296g), *C. camphora* (0.284g) and *A. annua* (0.269g), the differences were however non significant.

Shell ratio was maximum in *S. media* (21.46%) followed by *P. ovata* (20.33%) and control (20.60%). Lower value of shell ratio was observed in *A. annua* (18.63%) and *C. camphora* (1925%), the differences were however statistically non-significant.

Sridevi *et al.* (2004) studied the effect of extract (0.1 and 0.5%) of medicinal plants (*Tagetes erecta*, *Tinospora cordifolia, Leptadenia reticulata, Terminalia arjuna* and *Adhatoda vasica*) on cocoon and reeling parameters of mulberry silkworm *B. mori*. The extract treated mulberry leaves fed to silkworms resulted in the improvement of cocoon and reeling parameters.

Table 3: Effect of plant extracts on growth and development of *B. mori*

Plant species	Mean initial wt. (g)	Wt. gain (g) 2DAF	Mortality 2DAF (%)	Terminal larval mortality (%)	Larval period (d)	*Post larval period (d)	Mean pupal wt. (g)	Pupation (%)	Adult emergence (%)	Growth index
S. media	3.991	0.122	3.33	3.33	28.23	14.13	1.178	96.66	96.66	2.27
A. annua	3.990	0.064	16.67	43.33	29.86	14.9	1.181	56.66	86.66	1.93
P. ovata	3.954	0.113	6.66	36.66	29.10	14.2	1.180	63.33	93.33	2.15
C. camphora	3.949	0.050	16.66	56.66	29.60	14.86	1.880	43.33	86.66	1.94
Control	3.997	0.112	0.00	0.00	29.30	14.46	1.182	96.66	93.33	2.20
SEM	0.322	0.327	2.981	5.37	0.229	0.129	0.058	5.557	5.577	0.133
CD at 1%	1.445	0.146	13.349	24.065	1.02	0.578	0.264	24.974	24.970	0.419
CD at 5%	1.017	0.103	9.391	16.931	0.721	0.406	0.185	17.570	17.570	0.119

*The period between the commencement of cocoon spinning and adult emergence.
– DAF - days after feeding.

The maximum post larval period was observed in *A. annua* (14.90d) and *C. camphora* (14.86d). The highest pupal weight was observed in *C. camphora* (1.880g) followed by control (1.182g) and lowest in *S. media* (1.178g). The highest per cent pupation was observed in *S. media* and control (96.66% each) followed by those fed with *P. ovata* (63.33%), *A. annua* (56.66%) and *C. camphora* (43.33%). Maximum adult emergence was observed in *S. media* (96.66%) followed by control and *P. ovata* (93.33% each). In the treatments with *C. camphora* and *A. annua* per cent adult emergence was non significantly lower than control. With respect to growth index (GI) all the plant species were *at par* with control (2.20). The highest GI was observed in *S. media* (2.27) and the lowest in *A. annua* (1.93) (Table 3).

Effect of plant extracts on economic parameters of *B. mori*

Among the various treatments the highest single cocoon weight of 1.505g was observed in *S. media* followed by *P. ovata* (1.484). Rest of the treatments caused reduction in the cocoon weight as compared to control (1.478).

The present study concludes that mulberry leaves supplemented with extracts of *S. media* and *P. ovata* (at 1% conc. dry wt.) enhanced the growth, development and economic parameters of mulberry silkworm, *B. mori* (Table 4).

Table 4: Effect of plant extracts on economic parameters of *B. mori*

Plant species	Single cocoon wt. (g)	Silk shell wt. (g)	Shell ratio (%)
S. media	1.505	0.324	21.46
A. annua	1.450	0.269	18.63
P. ovata	1.484	0.301	20.30
C. camphora	1.473	0.284	19.25
Control	1.478	0.296	20.06
SEM	0.0612	0.02531	1.628
CD at 1%	0.274	0.113	7.289
CD at 5%	0.192	0.0797	5.128

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