Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; Sp 9(3): 129-137
Received: 12-04-2020
Accepted: 14-05-2020

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Evaluation of economic traits of selected FC_1XFC_2 and FC_4XFC_3 double hybrids treated with different doses of cholesterol during IV and V instar silkworm *Bombyx mori* L

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DOI: https://doi.org/10.22271/phyto.2020.v9.i3Sc.11875

Abstract
The effect of different concentration of cholesterol treatment during 4th instar and economic characters were better manifested in larval weight except larval duration and significant improvement in cocoon characters and egg characters were observed in FC_1XFC_2 hybrid. Similarly, FC_4XFC_3 hybrid has been subjected for the cholesterol treatment during 4th instar showed an unchanged larval duration in control and treated silkworms and enhancement in larval weight, cocoon characters and filament characters were highly significant except denier and renditta at 0.01 M concentration showed a negative relationship with reference to cholesterol supplementation. The egg characters of FC_4XFC_3 hybrid responded relatively better in the performance of egg hatching and fecundity. The impact of supplementation of cholesterol during 5th instar silkworm hybrid namely, FC_1XFC_2 contributed to the improvement of all the economic parameters comprising larval characters, cocoon characters, filament characters and egg characters except unchanged larval duration in control and untreated batches. On the other hand, FC_4XFC_3 hybrid were subjected for the application of different concentration of cholesterol treatment during 5th instar and expression and manifestation of the larval characters and cocoon characters were responded significantly except larval duration and cocoon weight at 0.1 M concentration showed relatively low in the cocoon weight compare to control batches. The filament length and weight of FC_4XFC_3 hybrid showed a consistent increase in the improvement of the traits, whereas the denier and renditta were inversely related to control and negatively correlated but at 0.1M concentration showed positive trend with respect to Renditta as observed in the investigation. The egg characters namely, fecundity and egg hatching in relation to the cholesterol administration and its impact leads to the enhancement in the rate of traits of selected bivoltine.

Keywords: economic traits, FC_1XFC_2, FC_4XFC_3, cholesterol, silkworm

Introduction

Silk: The queen of textiles is the natural fiber, spells luxury, elegance, class and comfort, which is secreted by silkworm. India is the second largest producer of silk and also the largest consumer of silk in the world. The silkworm is a monophagous insect which depends on the mulberry for its complete growth and development. Due to this, silkworm requires specific quality of leaves during different phases of its growth and this reflects on the importance of mulberry cultivation practices.

Insects cannot synthesize their own steroids essential for lipid metabolism and ecdysteroid synthesis. Cholesterol is the dominant tissue sterol even in phytophagous insects, though plants rarely contain at appreciable levels. Endogenous cholesterol is produced in the silkworm by modifying the sterol components of the mulberry leaves. Sitosterol through 24-dealkylation pathway reported to be active in the silkworm larvae. The two intermediates in β-sitosterol dealkylation process i.e., fucosterol and desmosterol were very effective for the maintenance of larval growth.

The growth promoting effect of cholesterol could be largely attributed to the ecdysteroid synthesized from the prothoracic glands. Ecydesteroids play a significant role in insect growth and development including moulting and metamorphosis. A differential basal ecdysteroid level is maintained during larval growth. The relatively high ecdysteroid levels during early stage of the penultimate instar stimulate corpora allata to higher level of synthesis of juvenile hormone essential for larval growth. Precocious metamorphosis is induced when ecdysteroid production is reduced as corpora allata producing juvenile hormone. In view of the importance of the

ecdysteroid derivatives in the larval growth the effects of exogenous cholesterol on a number of nutritive parameters of consumption indices and economic traits of the silkworm hybrids are taken up in the present investigation.

Materials and Methods

In the present study two productive double hybrids namely $FC_1 \times FC_2$ and $FC_4 \times FC_3$ were chosen and reared throughout the year under Indian conditions were utilized. Rearing was conducted as per the standard package and recommendation (Krishnaswamy, 1978) [6] by providing healthy fresh leaves of V_1 mulberry variety.

The feed utilization study was confined only to IV and V instar larva as 80-85% of the total leaf consumed in these instar. On consumption of IV and V instar silkworm larvae three replicates were separated from each batches of double hybrids and kept in normal temperature of 28-30 ºC and 80% humidity condition Known quantities of mulberry leaves were provided to silkworm thrice a day taking utmost care to maintain the leaf moisture content to the maximum possible extent.

Sample of mulberry leaves used for feeding was placed in separate tray as dummy for dry weight determination of Ingesta. Additional larval batches of each hybrids were maintained in parallel to determine the dry weight and subsequent determination of daily increment in larval weight. The healthy larvae were unhealthy and dead larvae were removed. The litter was selected carefully on subsequent days of feeding. The excreta and left over leaf in the litter were manually separated and dried in an oven to a constant weight. Observation on dry weight of left over leaf, excreta, larval weight gain, cocoon weight and shell weight were recorded for all the replications of each treatment.

From these data, nutritional indices like, ingesta, digesta, approximate digestibility percentage (AD %), efficiency of conversion of ingested food (ECI), efficiency of conversion of digested food into body substance (ECD), consumption index (CI), growth rate and coefficient metabolism of the selected bivoltine $FC_1 \times FC_2$ and $FC_4 \times FC_3$, a newly evolved productive double hybrids were utilized in the present investigation. The freshly moulted 4th and 5th instar silkworm larvae were grouped into four batches, each batch having three replication of 100 silkworm and maintained constant of temperature 25±1 ˚C and 70±5% Relative humidity during the silkworm rearing.

Cholesterol treatment

Cholesterol (Procured from Sisco Research laboratories Ltd., Mumbai, India) was dissolved in small quantity of chloroform and diluted with ethyl alcohol to 0.01, 0.1 and 0.5M concentrations. The mulberry leaf was smeared on the ventral surface with 1ml solution and after drying fed to 4th and 5th instars larval stage in separate batches. The cholesterol - smeared leaf was offered first on the day of treatment, and after the leaf was fed upon completely to the group of 100 larvae. The batch-I larvae are considered as carrier control as the larvae fed with normal mulberry leaf sprayed with ethyl alcohol aliquots. However, the other three batches containing 100 larvae each (in three replicates) were fed on the three doses of uniformly smeared cholesterol treated leaves on 1st, 3rd and 5th day. Cholesterol supplemented leaf was provided during the first feeding on the day of treatment. A total of three feeding are provided every day.

Nutritional indices

Fresh leaves of mulberry were cut through midrib into two symmetrical halves, one half was used to find out the moisture content of the leaves and the other half was weighed and smeared with known volume of cholesterol. Equal and known quantity of leaf was offered to all silkworm batches, taking into consideration the consumption level on each day of 4th and 5th instars larval development. The left over leaf of the excreta were dried in a hot air oven at 80 ˚C till constant weight and the values were recorded. The initial and final wet and dry weights of larvae were recorded every day. Daily food consumption and utilization were recorded by following the standard gravimetric method. The dry weights of leaf ingested and digested by each larva were calculated and the nutritional indices such as approximate digestibility (AD), efficiency of converting leaf ingested (ECI) and leaf digested (ECD) into larval body substance, consumption index (CI), growth rate (GR) and coefficient metabolism (COM) were calculated as per the empirical formulae provided by Waldbauer (1968).

The cocoon harvested was utilized for evaluation of cocoon weight, shell weight and shell percentage and also fecundity and hatching percentage as quantitative traits, filament length, filament weight, denier as a qualitative trait.

Results and Discussion

The two potential hybrids namely, FC_1XFC_2 and FC_4XFC_3 were chosen for the treatment of different concentration of cholesterol at 0.01, 0.1 and 0.5 M during 4th and 5th instar separately through mulberry leaves and subjected for evaluation of various quantitative and qualitative traits to understand the influence of the cholesterol content.

Larval Characters: The larval characters of FC_1XFC_2 and FC_4XFC_3 hybrids namely, larval duration and larval weight are the two parameters in which there is no change in the larval duration in cholesterol treated silkworm batches and control batches whereas the larval weight. There is a significant difference among the cholesterol administered silkworm larvae compare to the untreated control larval weight. Among the different concentration of cholesterol 0.1 M concentration showed significant improvement in larval weight of FC_1XFC_2 hybrid (2.348g) compare to FC_4XFC_3 hybrid during 5th instar 5th day. But the remaining two concentrations at 0.01 and 0.5 M were relatively less in the increment of larval weight of both the bivoltine hybrids.

Cocoon Characters: The cocoon characters of FC_1XFC_2 and FC_4XFC_3hybrids with reference to cocoon weight are demarked with a the difference there is a maximum improvement in the cocoon weight (1.351g) 0.01 M cholesterol followed by (1.302g) at 0.5 M cholesterol in FC_4XFC_3 hybrid whereas the FC_1XFC_2 the 0.1 M cholesterol was very effective in FC_1XFC_2 hybrid in relation to the cocoon weight (1.339g). The cholesterol treated batches responded positively in all the concentration except 0.01M in FC_1XFC_2 hybrid similarly the shell weight and shell percentage were exhibited better in the expression and manifestation of cocoon traits effectively in all the three concentration of cholesterol but at 0.01M concentration was highly significant both in shell weight and shell ratio in FC_4XFC_3 hybrid, but remaining two concentration also showed better performance next to the 0.01 M cholesterol treatment in both the bivoltine hybrids. The silk content of the cocoon shell weight represents maximum proportion of silk productive parameters. The cocoon weight and the shell weight were parallel with each other are reflected the same pattern of expression in the cholesterol treated batches of the silkworm hybrids.

Filament Characters: Filament length and weight are the quantitative post cocoon characters. The effectiveness of the cholesterol in different concentration on silkworm larvae exhibited the maximum production of silk protein followed by the quantum and length of the filament was obviously reflected the maximum diameter in length especially in FC_4XFC_3 hybrid represents a maximum filament length in all the three concentration of cholesterol administered, but FC_1XFC_2 hybrid represents a slight improvement at 0.5M cholesterol treatments depicted in the fig 1.6 as a result of increase in the filament length and magnitude was positively correlated and the weight of the silk filament was increased proportionately therefore the trend observed in filament weight was increased in FC_4XFC_3 hybrid rather than the FC_1XFC_2 hybrid.

The denier referred to the thickness of the filament represented by the unit. The FC_1XFC_2 relatively less in the denier compared to FC_4XFC_3 hybrid in different concentration of cholesterol treated batches lesser than the thickness reflects the quality of the fiber higher the thickness poor in the quality of the fiber. Similarly, the Renditta is defined as the number of kg of tough cocoon required to produce 1 kg of raw silk. The results showed a significant contribution under at 0.1, 0.5 M cholesterol in FC_1XFC_2 and FC_4XFC_3hybrids were due to the influence of cholesterol supplemented during the 4th instar helps to add a more of synthesis of silk content in cocoon weight so that the number of cocoon required to produce 1 kg of raw silk was reduced in all the treated batches compare to control. This is the one of the important economic parameters facilitate the biomass in terms of cocoon production for the benefit of the farmers in sericulture industry.

Egg Characters: Egg characters namely, fecundity and hatching percentage of the two built in parameters showed a significant improvement in the fecundity rate of female mother moth and the FC_1XFC_2 hybrid are exhibits highest at 0.1 M followed by 0.01 M and 0.5 M cholesterol in FC_1XFC_2 hybrids. Whereas FC_4XFC_3 also showed an increased rate of fecundity but the rate was increased with higher concentration to lower concentration of cholesterol treatment as observed (fig:1.10 and 11).

Hatching percentage observed in FC_1XFC_2 and FC_4XFC_3 hybrids were most conspicuous and accelerates the maximum rate of hatching at 0.01M in FC_1XFC_2 and 0.1M in both the hybrids. But at 0.5M concentration of cholesterol administered batches noticed that a slight change was observed compare to control batches.

The evaluation of economic characters of in FC_1XFC_2 and FC_4XFC_3hybrids treated with different doses of cholesterol during 5th instar

In the present investigation the different concentrations of cholesterol were supplemented with mulberry leaves for the improvement of economic characters are explained as follows.

Larval Characters: The larval character such has larval duration and larval weights are evaluated. The larval duration was unchanged in all the three concentration of cholesterol and untreated control batches during 5th instar. The maximum larval duration of 156h are recorded in both the bivoltine hybrids. Whereas the single larval weight of FC_1XFC_2 hybrid during 5th day of 5th instar showed an inclination towards increased larval weight with an increased concentration of cholesterol were 2.125g, 2.168g and 2.235g with 0.01, 0.1, and 0.5 M respectively administered on alternative days during 5th instar. The difference among the treated and control batches were highly significant in both the hybrids. (Table 1a and 1c)

Cocoon Characters: The cocoon characters such as cocoon weight, shell weight and shell percentage were referred as the quantitative parameters contributes the production of maximum biomass. The values 1.267, 1.339 are the cocoon weight at 0.01M and 0.1M concentration of cholesterol treatment greatly influenced in an increased cocoon weight in FC_1XFC_2 hybrid but at 0.5M concentration it is reduced below the range of cocoon weight of the control batches. In FC_4XFC_3 hybrid the improvement in the cocoon weight was highest (1.302) at 0.5M concentration and remaining two concentration of cholesterol (1.351) 0.01M and (1.252) 0.1 M is inconsistent compared to control batches in the FC_4XFC_3 hybrid.

The shell weight referred as the total silk content of the cocoon showed highly significant remarkable improvement in both the hybrids with the increasing concentration of cholesterol at 0.01 to 0.5 M but in the FC_1XFC_2 hybrid represents highest single shell weight, 0.332 at 0.5M and 0.268 at 0.01M and 0.224 at 0.1M in FC_1XFC_2 hybrid. The similarly 0.290 represented at 0.5M concentration, 0.271 at 0.1M, 0.283 at 0.01M in FC_4XFC_3 hybrid compare to control batches. The shell percentage is also represented as shell ratio is related to supplementation of cholesterol in different concentration fed to silkworm during 5th instar and nurtured to trigger the physiological system to improve the shell ratio with the increasing concentration of feeding additives treated at 0.01M (17.55), 0.1M (16.18) and 0.5M (26.47) in FC_1XFC_2 hybrid. Similarly 0.01 M (22.24), 0.1M (23.73) and 0.5M (20.83) percent of shell ratio were recorded in FC_4XFC_3 hybrid in the present investigation in relation cholesterol treatment. The FC_1XFC_2 hybrid responded positively at 0.01 and 0.1M cholesterol concentration but at 0.5M (20.83) the FC_4XFC_3 hybrid showed drastic attention and highly significant changes in the improvement and manifestation of shell ratio.

Filament Characters: In the filament characters are referred as qualitative parameters including the filament weight, length and denier. The filament length of two bivoltine hybrids as selected in present investigations has consistent in the magnitude of length because of increased shell weight and shell ratio reflected in the filament length is an indication of the improvement in the filament length with the increased concentration of cholesterol supplemented with different concentration through foliar application during 5th instar. The highest filament length were recorded are as 0.1M (992.05), (976.86) at 0.5M followed by (936.30) at 0.01M cholesterol doses in FC_1XFC_2 hybrid. Similarly, in the same trend was observed with an increased concentration of cholesterol at 0.01M (870.95), 0.1M (925.63) and 0.5M (989.67) meters were recorded in FC_4XFC_3 hybrid responded positively in favor of attention of the observer of the investigation.

The filament weight is other qualitative parameters depicted on the basis of magnitude of the filament length reflected as a filament weight. The increasing the filament weight the weight was increased 0.247, 0.256, and 0.316 with a concentration of 0.01M, 0.1M and 0.5M respectively in FC_1XFC_2 hybrids. Whereas the filament weight in FC_4XFC_3 hybrids represents as 0.265,0.257 and 0.254g with respective feeding additive 0.01M, 0.1M and 0.5M concentration of cholesterol respectively in relation to the filament weight and the other hand the denier is parameter varies from breed to breed however the denier at 0.01(2.37 d) and 0.1M (2.32d) showed relatively low in the denier and correlated whereas at

0.5 M the denier is increased more than the filament denier of control in FC_1XFC_2 hybrid. At the same time FC_4XFC_3 also subjected to record the denier in values are increased more than the control in all the concentration of cholesterol treatment is a negative relationship over the control.

Renditta: Renditta is the total quantum of cocoon required to be produce to obtain 1kg of raw silk the FC_1XFC_2 hybrids showed the lowest renditta from the lower concentration of cholesterol 0.01 M (4.7), 0.1M (5.20) and 0.5M (4.89) compared to the control (5.55) kgs of cocoon required to be produce in order to obtain 1kgs of raw silk. Whereas the FC_4XFC_3 hybrids in relation to administration of cholesterol at 0.01M was responded to obtain the lowest renditta. Level was about 3.22 compare to the renditta of control (5.0) whereas in 0.1M and 0.5M cholesterol concentration 5.12 treated represents and 5.39kg respectively.

Egg Characters: Fecundity refers to number of eggs laid by healthy female mother moth showed consistently an increased with increasing in concentration of cholesterol in FC_1XFC_2 hybrid, but in FC_4XFC_3 hybrid also showed a relative improvement at 0.01 and 0.1 M concentration of cholesterol and the fecundity level was declined at 0.5 M, compare to control, similarly the pattern of changes in rate of egg hatching exhibits a consistently increased with the increased concentration of cholesterol supplementation except 0.5 M in FC_4XFC_3 hybrid, but the differences among the hybrids the FC_4XFC_3 shows relatively low rate of egg hatching compare to FC_1XFC_2 hybrid in cholesterol treated batches.

The above said results of the investigation in the manifestation and expression of quantitative and qualitative traits of selected bivoltine double hybrids such as FC_1XFC_2 and FC_4XFC_3 silkworm were chosen and the results showed a consistent positive response with different concentration of cholesterol administered during larval stage of 4th and 5th instar and correlated over the untreated batches as a control it is a noteworthy that cholesterol is essential fatty acid derivatives is not synthesize in the mulberry leaf though it is essential to nurture the cellular activities and sub cellular energy mobilization cellular multiplication metabolism, physiological events etc. by which the cholesterol is high rich energy reservoir required to be supplemented for the robust growth, development and reproduction of the silkworm, *Bombyx mori*, however the phenotypic expression of economic traits of FC_1XFC_2 and FC_4XFC_3 hybrids responded in favor of quality and quantity except few traits and therefore it is an investigation to contribute an innovative research outcome to maximize the cocoon production with better quality needed for the present scenario of sericulture industry.

The Economics of silkworm rearing after 5th instar larvae were given in three treatments of two doses of cholesterol showed a net increase in profit at 0.01, 0.1 and 0.5M cholesterol concentrations respectively. Gross profit is calculated with an account of higher cocoon weight and better silk content of cocoon. The net profit could increase by restricting the application to the time when greater reduction in consumption was observed in 5th day and extending the cholesterol applications to penultimate larval stage. Further, large amount of savings on leaf of 60.48, 75.36, 102 kg for 100 DFLs during 5th instar will be great advantage at the time of silkworm rearing during summer season in tropical climates.

The diminishing consumption rate of less preferred food was partially compensated by increased assimilation efficiency. Assimilation efficiency did not vary significantly as a function of reduced food consumption. It has been reported that cocoon weight and pupal weight were directly proportional to the concentration of JH and the feeding period (Akai *et al*., 1985 and Chowdhary *et al*., 1990) [4]. Ashfaq *et al*. (2001) [3] have mentioned that silkworm fed with ***M. nigra*** showed high food consumption, coefficient of nutrition utilization, larval size, larval weight and cocoon weight that may provide important factors for increasing silk tenacity and elongation. The growth and development of silkworm is under the continuous influence of factors operating within and outside of the body (Murugan *et al*., 1998) [7]. Ascorbic acid had effect on the growth of silkworm (Javed and Gondal, 2002) [5]. Mulberry leaves with the combination of Nitrogen (0.2%) which enhances the growth and silk production (Javed and Gondal, 2002) [5]. Protein supplemented (10%) mulberry leaf significantly improved larval growth and economic characters of silkworm (Amala Rani *et al*., 2011) [2]. Feeding mulberry leaves supplemented with distilled water alone slightly increased the weights of larva, pupa and cocoon shell. The diminishing consumption rate of less preferred food was partially compensated by increased assimilation efficiency. It was reported that cocoon weight and pupal weight were directly proportional to the concentration of JH and the feeding period (Akai *et al*., 1985 and Chowdhary *et al*., 1990) [4].

Table 1: Economic traits of FC_1 X FC_2 hybrid treated with different doses of cholesterol during fourth instar silkworm

Traits	Larval duration(h)	Larval weight (g)	Cocoon weight (g)	Shell Wight (g)	Shell percentage (%)	Filament length (mt)
Treatments	Mean±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	84±0.00	1.951±0.150	1.304±0.037	0.203±0.001	15.550±0.453	931.987±4.255
0.01 M	84±0.00	2.199±0.824	1.267±0.012	0.258±0.002*	20.367±0.123**	893.030±11.472
0.1 M	84±0.00	2.348±1.054	1.339±0.018**	0.266±0.002*	19.871±0.141**	863.099±12.107
0.5 M	84±0.00	2.066±0.397	1.253±0.025	0.267±0.004**	21.304±0.214**	951.000±9.780

Table 2: Economic traits of FC_1 X FC_2 hybrid treated with different doses of cholesterol during fourth instar silkworm

Traits	Filament weight (g)	Denier (d)	Renditta (kg)	Fecundity (no)	Hatching (%)
Treatments	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	0.257±0.015	2.478±0.159	5.545±0.337	526.667±10.408	81.333±1.528
0.01 M	0.221±0.003	2.223±0.005	5.184±0.059	561.667±10.408	86.667±1.528
0.1 M	0.219±0.003	2.283±0.002	4.384±0.060**	566.667±7.638**	88.000±2.000**
0.5 M	0.239±0.003	2.258±0.001	4.257±0.045**	545.000±5.000	82.000±1.00

** Highly significant (0.05%) probability, *significant, NS= Non significant

Table 3: Economic traits of FC_4 X FC_3 hybrid treated with different doses of cholesterol during fourth instar silkworm

Traits	Larval duration (h)	Larval weight (g)	Cocoon weight (g)	Shell Wight (g)	Shell percentage (%)	Filament length (mt)
Treatments	Mean±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	84±0.00	1.855±0.340	1.264±0.012	0.189±0.001	14.953±0.155	790.500±7.308
0.01 M	84±0.00	2.147±0.872**	1.351±0.008*	0.298±0.002**	22.052±0.026**	990.600±9.100**
0.1 M	84±0.00	1.923±0.358**	1.252±0.031NS	0.262±0.007**	20.925±0.065**	996.667±6.807**
0.5 M	84±0.00	2.038±1.481**	1.302±0.022NS	0.263±0.008**	20.222±0.220**	963.777±10.379**

Table 4: Economic traits of FC_4 X FC_3hybrid treated with different doses of cholesterol during fourth instar silkworm

Traits	Filament wt (g)	Denier (d)	Renditta (kg)	Fecundity (no)	Hatching (%)
Treatments	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	0.168±0.002	1.908±0.018	4.998±0.046	520.000±10.000	77.667±2.517
0.01 M	0.247±0.006**	2.241±0.057	5.029±0.119*	546.000±5.292	86.333±1.528 NS
0.1 M	0.270±0.003**	2.438±0.043	4.126±0.046	535.000±5.000 NS	83.000±3.606
0.5 M	0.300±0.020**	2.800±0.157	4.784±0.253**	529.333±5.132	81.667±1.528 NS

** Highly significant (0.05%) probability, *significant, NS= Non significant

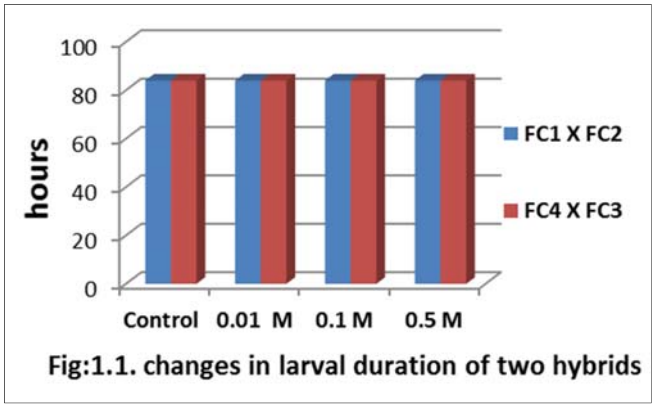


Fig:1.1. changes in larval duration of two hybrids

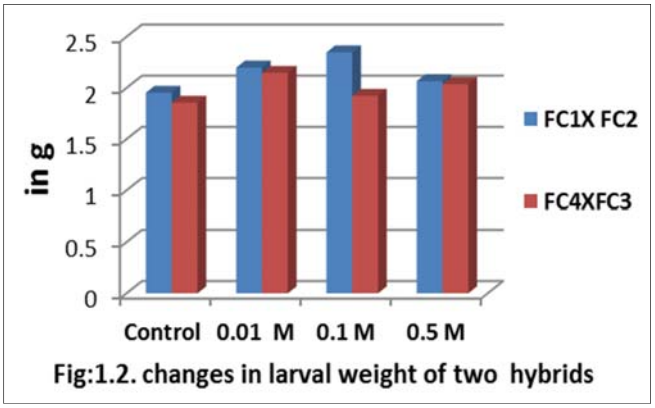


Fig:1.2. changes in larval weight of two hybrids

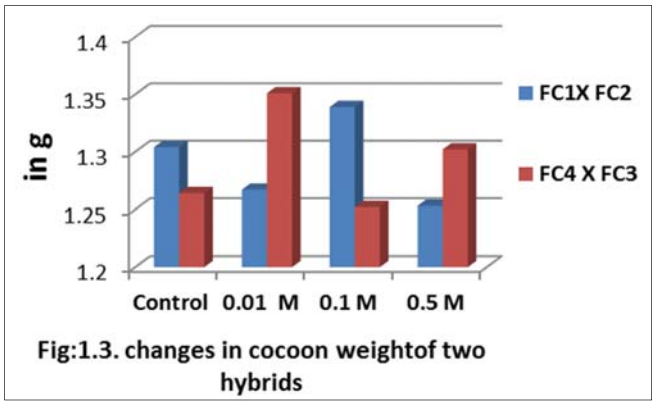


Fig:1.3. changes in cocoon weightof two hybrids

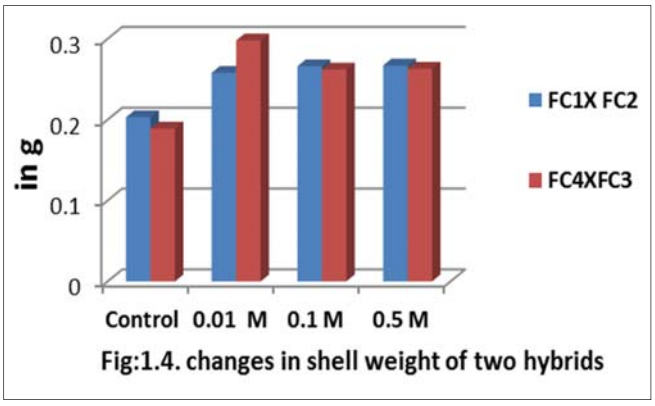


Fig:1.4. changes in shell weight of two hybrids

Fig 1: Manifestation of economic traits of bivoltine hybrids treated with different doses of cholesterol during fourth instar silkworm

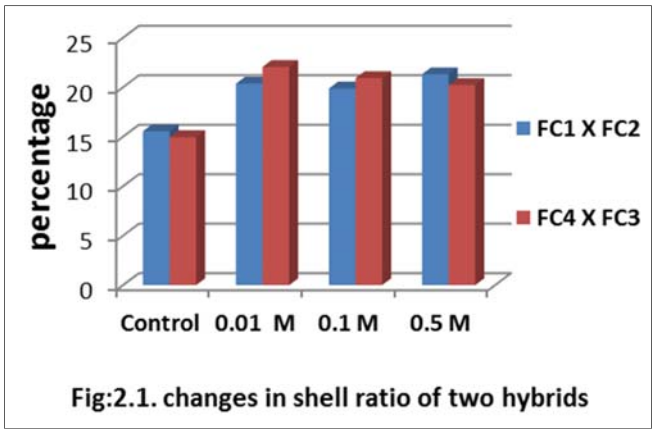


Fig:2.1. changes in shell ratio of two hybrids

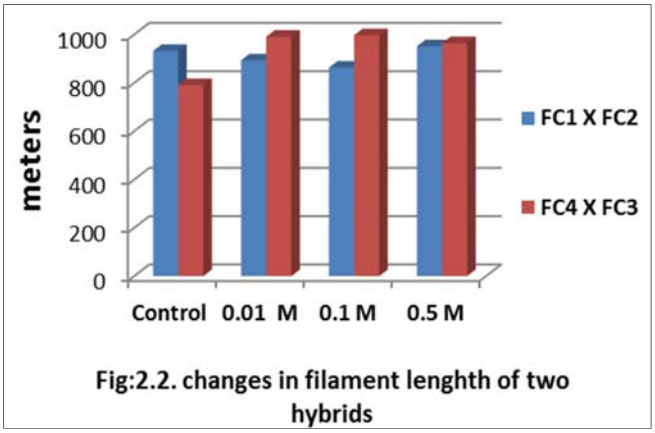


Fig:2.2. changes in filament lenghth of two hybrids

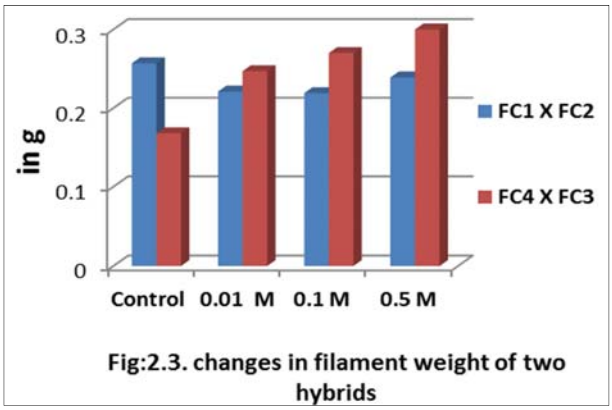


Fig:2.3. changes in filament weight of two hybrids

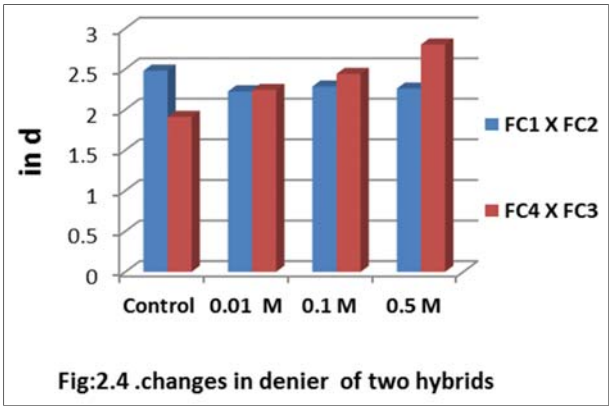


Fig:2.4 .changes in denier of two hybrids

Fig 2: Manifestation of economic traits of bivoltine hybrids treated with different doses ofcholesterol during fourth instar silkworm

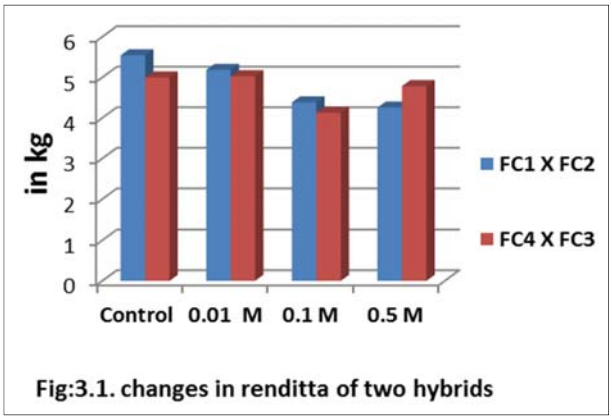


Fig:3.1. changes in renditta of two hybrids

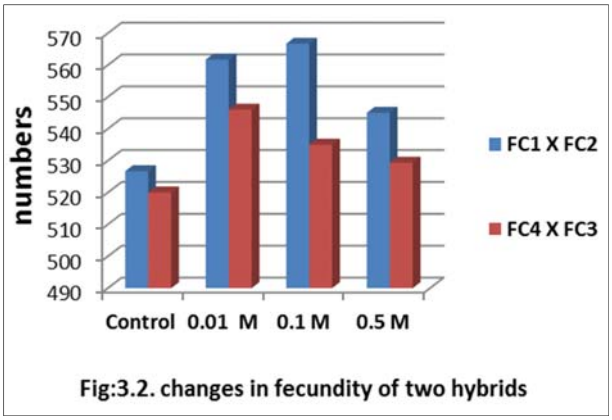


Fig:3.2. changes in fecundity of two hybrids

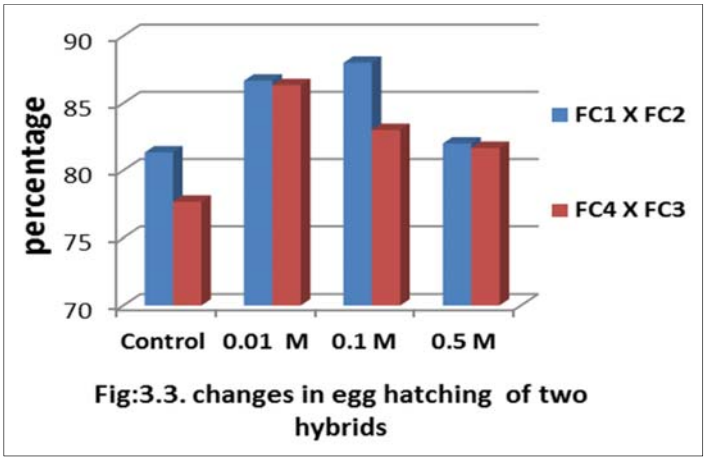


Fig:3.3. changes in egg hatching of two hybrids

Fig 3: Manifestation of economic traits of bivoltine hybrids treated with different doses of cholesterol during fourth instar silkworm

Table 5: Economic traits of FC_1 X FC_2 hybrid treated with different doses of cholesterol during fifth instar silkworm

Traits	Larval duration(h)	Larval weight (g)	Cocoon weight (g)	Shell Wight (g)	Shell percentage (%)	Filament length (mt)
Treatments	Mean±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	156±0.00	2.032±0.256	1.304±0.037	0.203±0.001	15.550±0.453	931.987±4.255
0.01 M	156±0.00	2.152±0.352**	1.442±0.037	0.268±0.042**	17.549±2.430*	936.295±15.423*
0.1 M	156±0.00	2.168±0.495**	1.384±0.009 **NS**	0.224±0.001	16.183±0.526*	992.467±5.873**
0.5 M	156±0.00	2.235±0.431**	1.254±0.017	0.332±0.020**	26.466±1.004**	976.803±5.326**

Table 6: Economic traits of FC_1 X FC_2hybrid treated with different doses of cholesterol during fifth instar silkworm

Traits	Filament weight (g)	Denier (d)	Renditta (kg)	Fecundity (no)	Hatching (%)
Treatments	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	0.257±0.015	2.478±0.159	5.545±0.337	545.000±5.000	87.000±2.000
0.01 M	0.247±0.002 **NS**	2.371±0.054	4.702±0.029 **NS**	562.333±2.517 **NS**	89.000±1.000
0.1 M	0.256±0.002*	2.321±0.031	5.195±0.041	581.000±4.359	92.000±2.000
0.5 M	0.316±0.003**	2.911±0.012	4.886±0.046	580.000±4.359	90.000±2.646**

** Highly significant (0.05%) probability, *significant, NS= Non significant

Table 7: Economic traits of FC_4 X FC_3 hybrid treated with different doses of cholesterol during fifth instar silkworm

Traits	Larval duration (h)	Larval weight (g)	Cocoon weight (g)	Shell Wight (g)	Shell percentage (%)	Filament length (mt)
Treatments	Mean±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	156±0.00	1.875±0.171	1.264±0.012	0.189±0.001	14.953±0.193	790.500±7.308
0.01 M	156±0.00	1.976±0.875**	1.271±0.011	0.283±0.001	22.241±0.673*	870.950±18.547*
0.1 M	156±0.00	2.090±0.160	1.141±0.008 NS	0.271±0.008 *	23.726±0.555*	925.629±15.167*
0.5 M	156±0.00	1.952±0.453NS	1.392±0.010	0.290±0.010**	20.830±0.594*	989.667±8.168**

Table 8: Economic traits of FC_4 X FC_3 hybrid treated with different doses of cholesterol during fifth instar silkworm

Traits	Filament weight (g)	Denier (d)	Renditta (kg)	Fecundity (no)	Hatching (%)
Treatments	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Control	0.168±0.002	1.908±0.018	4.998±0.046	539.000±3.606	82.333±2.082
0.01 M	0.265±0.004**	2.742±0.022	4.218±0.043*	547.000±6.083*	85.667±1.525
0.1 M	0.257±0.002	2.495±0.026	5.123±0.031 NS	566.000±4.000**	89.000±1.000 NS
0.5 M	0.254±0.005**	2.312±0.022	5.388±0.052 NS	543.667±6.658*	82.667±2.082

** Highly significant (0.05%) probability, *significant, NS= Non significant

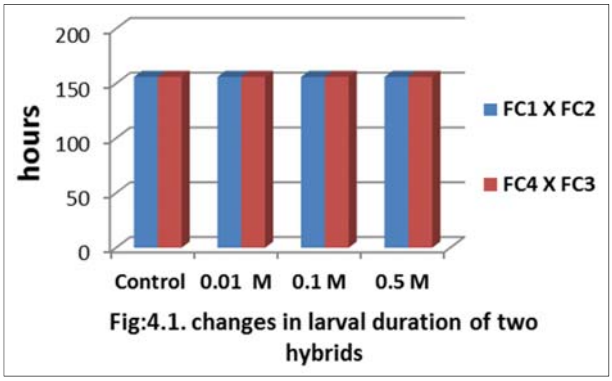


Fig:4.1. changes in larval duration of two hybrids

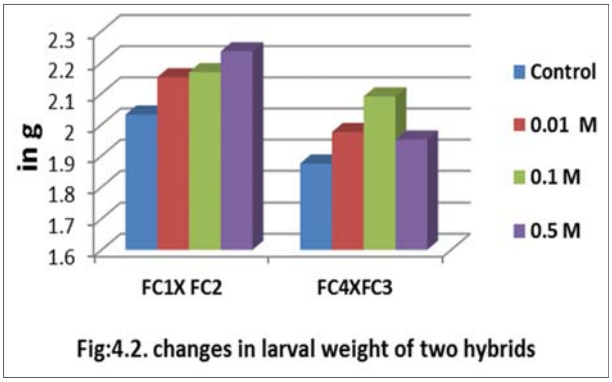


Fig:4.2. changes in larval weight of two hybrids

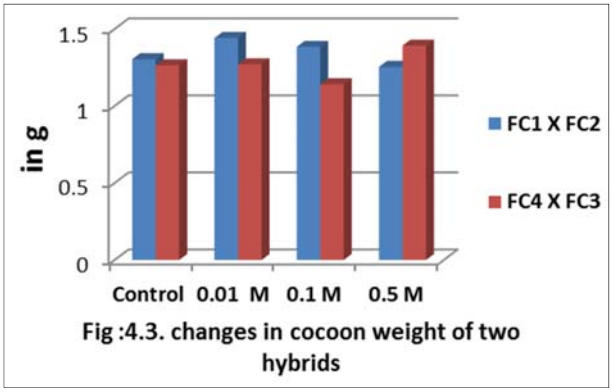


Fig :4.3. changes in cocoon weight of two hybrids

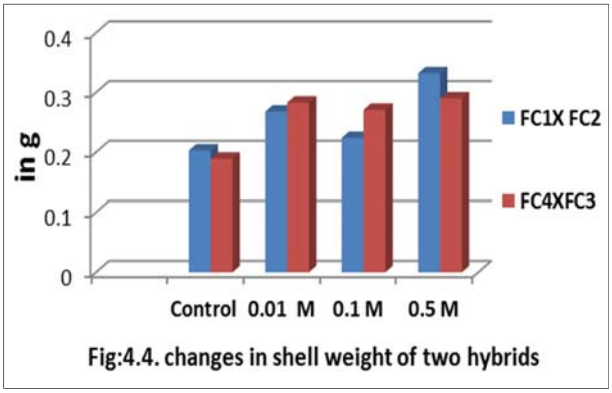
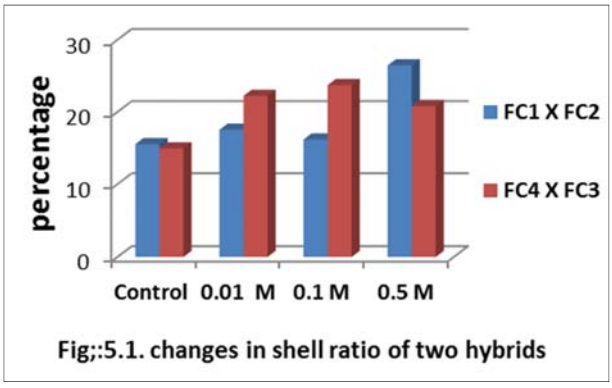


Fig:4.4. changes in shell weight of two hybrids

Fig 4: Manifestation of economic traits of bivoltine hybrids treated with different doses of cholesterol during fifth instar silkworm



Fig;:5.1. changes in shell ratio of two hybrids

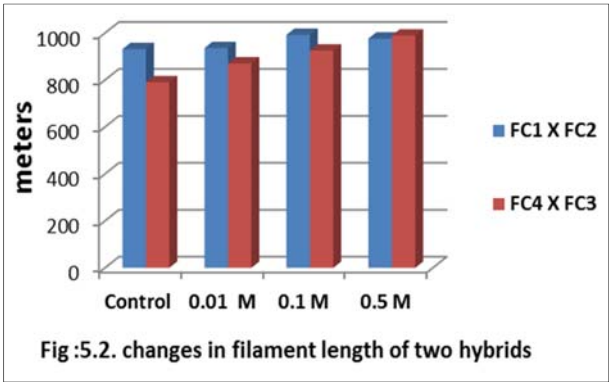
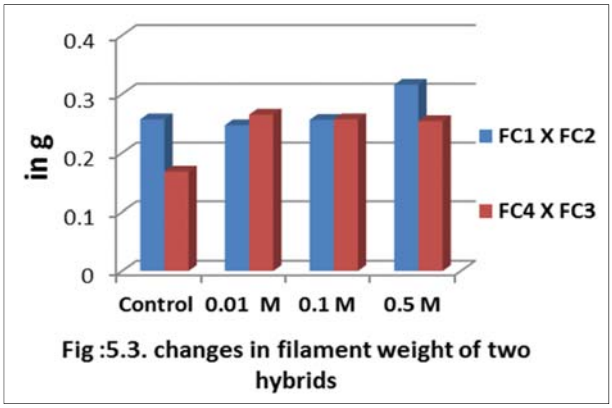


Fig :5.2. changes in filament length of two hybrids



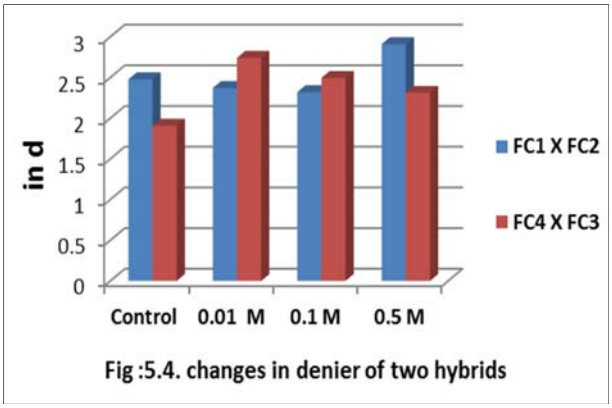
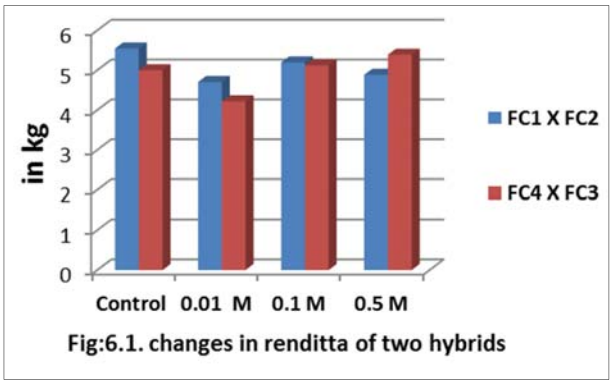
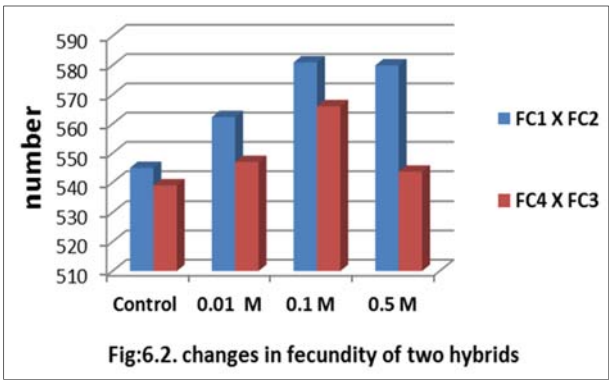


Fig 5: Manifestation of economic traits of bivoltine hybrids treated with different doses of cholesterol during fifth instar silkworm





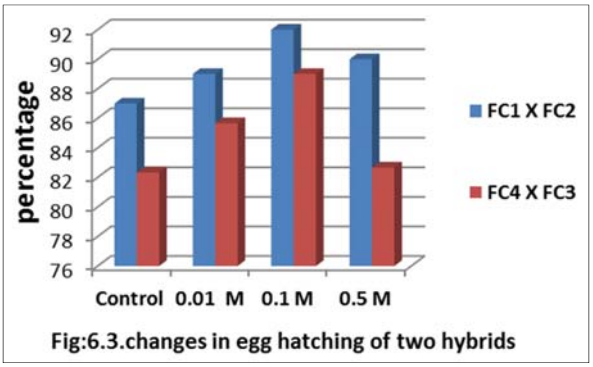


Fig 6: Manifestation of economic traits of bivoltine hybrids treatedwith different doses of cholesterol during fifth instar silkworm

Conclusion

The effect of different concentration of cholesterol treatment during 4th instar and economic characters were better manifested in larval weight except larval duration and significant improvement in cocoon characters and egg characters were observed in FC_1XFC_2 hybrid. Similarly, FC_4XFC_3 hybrid has been subjected for the cholesterol treatment during 4th instar showed an unchanged larval duration in control and treated silkworms and enhancement in larval weight, cocoon characters and filament characters were highly significant except denier rand renditta. The egg characters of FC_4XFC_3 hybrid responded relatively better in the performance of egg hatching and fecundity. The impact of supplementation of cholesterol during 5th instar silkworm hybrid namely, FC_1XFC_2 contributed to the improvement of all the economic parameters comprising larval characters, cocoon characters, filament characters and egg characters except unchanged larval duration in control and untreated batches. On the other hand, FC_4XFC_3 hybrid were subjected for the application of different concentration of cholesterol treatment during 5th instar and expression and manifestation of the larval characters and cocoon characters were responded significantly except larval duration and cocoon weight. The filament length and weight of FC_4XFC_3 hybrid showed a consistent increase in the improvement of the traits, whereas the denier and renditta were inversely related to control and negatively correlated. The egg characters namely, fecundity and egg hatching in relation to the cholesterol administration and its impact leads to the enhancement in the rate of traits of selected bivoltine.

Acknowledgement

The authors greatly acknowledge to Department of Studies in Sericulture, University of Mysore, Manasagangothri, Mysore-570006 for providing facilities to conduct research.

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