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SeriNutrid- A Balanced Nutrient Diet for Silkworm (*Bombyx mori* L) Chawki Rearing

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ABSTRACT

Silkworm Bombyx mori L is a highly sensitive lepidopteron insect and responds sharply to changes in the feed quality. In Silkworm rearing, Chawki is considered as one of the important stages from which a successful cocoon crop is ensured. Rearing of silkworm on SeriNutrid Semi-synthetic diet) containing balanced nutrition, during the chawki stage ensures a successful and economically viable cocoon crop. Chawki rearing with SeriNutrid also means hygienic rearing, avoiding loss of crop due to missing larvae & minimizing disease outbreak and reduction in feeding frequency. This hypothesis is tested by extensive trial in the field by promoting chawki (Cake- Mari) obtained by feeding larvae on SeriNutrid cake. The weight of cocoon per 100DFL recorded 3-5% more than leaf chawki rearing and showed better quality of the cocoon, bringing at 5-10% higher price compared to cocoon obtained from leaf fed chawki.

Keywords: *SeriNutrid, Chawki Rearing, Cake- Mari, Larva, Cocoons, Semi-Synthetic Diet.*

1. INTRODUCTION

Silkworm *Bombyx mori* is a typical monophagus insect and mulberry (Morus sp) leaf is its sole food. The quantity of the leaf intake and its quality has got direct and positive correlation with quantity and quality of cocoon produced (Trivedy and Nair 1998). Rearing of silkworm on artificial diet containing balanced nutrition, at least during the young instar stage ensures a successful and economically viable cocoon crop. Boganow first gave the concept of artificial diet in 1908, developed for Calliphora vantoria (Blue butterfly) using a mixture of meat extract, starch, peptone, and minerals. During 1960, the development of semi-synthetic diet to rear the silkworm was initiated in Japan but could not be popularized due to unbalanced nutrients that lead to crop loss. Further development of semi-synthetic diet with better nutritive value was initiated by analyzing the feeding behavior of silkworm Bombyx mori L (Fukuda et al., 1960; Horie et al., 1995; Ito 1960, 1981 and Hamano 1985). The first practical artificial diet was formulated during 1972 (Horie, 1972) and the first large-scale artificial diet rearing of young silkworm was initiated in 1977. In India, the first semi-synthetic diet development program was initiated during1970s at CSR&TI, Mysore, but results were not encouraging. In the 1990s with the support of Department of Biotechnology, New Delhi, the effort was made to develop a semi-synthetic diet, which recorded partial success. A subsequent attempt was made to develop the semi-synthetic diet and observed the performance of different Bivoltine pure breed, which still had disadvantages of poor acceptability and survival rate (Magadam et al., 1994). Further, semi-synthetic diet named Nutrid was developed by CSR&TI, Mysore during 2005 & scaled-up by Sericare (Division of Healthline Pvt Ltd) and commercialized in the name of SeriNutrid that has overcome most of the problems. This promising semi-synthetic diet was developed by using locally available ingredients (soya flour, cellulose powder, salt mixture, a vitamin mixture, gelling agent etc.) along with dry mulberry leaf powder for rearing silkworm up to II moult. Research and fieldwork carried out for the past eight years by Sericare revealed that the performances of silkworms are better when reared on SeriNutrid during chawki rearing in comparison to leaf rearing. Based on these studies chawki rearing on SeriNutrid appears to be helping farmers in many ways:

- Getting stable cocoon crops by providing balanced nutrition
- Ensuring good hygiene eliminating early infection
- Reducing number of feedings to 4 against 13 feeding in conventional leaf rearing during first two instars
- Decreasing number of missing larvae during first two instars as no bed cleaning is involved during SeriNutrid fed
    - chawki stage
- Establishing chawki rearing with no dependency on mulberry garden

When we started looking into promoting "Chawki rearing" independent of mulberry garden, we looked into time spent on various activities involved in chawki rearing. Quality of cocoon yield depends on the quality of mulberry leaves provided to silkworm. The nutritional management of mulberry is very difficult unlike other crops and it varies from season to season. The present work investigates whether "Chawki rearing with SeriNutrid" can be a potential replacement of mulberry leaves for chawki rearing.

2. MATERIAL AND METHODS

The present study was carried out at MSSPC Chawki Rearing Center, Nandagudi village of Hoskote taluk, Bangalore rural district. The PM x CSR2 hybrid layings were used for the present study and were reared up to second moult both on SeriNutrid and mulberry leaves for comparison. A total of four replications were used with 1000 dfls in each replication. The silkworms were distributed to nearby villages by the CRC after the second moult and cocoon parameters and valuation were monitored.

3. REARING PROCEDURE

The rearing rooms and equipment were thoroughly disinfected with Sanitech before rearing and strict hygiene was maintained throughout the rearing. 1000 dfls were procured and incubated at 25±1ºC and relative humidity (RH) of 80±2% up to head pigmentation stage and then egg sheets were covered in black cloth for 24 hours to allow the embryos to grow uniformly. The subsequent day, early morning at 6 am the eggs were exposed to bright light for 1-2 hours to get uniform hatching.
Procedure for Semi Synthetic diet (SeriNutrid) rearing up to II instar:

Before brushing, the outer surface of SeriNutrid pack, rearing trays and polythene sheets were cleaned with 70% alcohol and other necessary hygiene practices. Care was taken to brush the larva in a fully closed plastic tray with polythene sheet spread on it. During first instar 2 kg and in second instar 4.5 kg SeriNutrid was used per 100 dfls. During the feeding stage the trays were piled up to maintain the relative humidity and during the moulting stage trays were kept on the rearing stand for allowing the bed to dry. The room temperature was maintained at 27-28°C for leaf chawki and 29-30°C for SeriNutrid Chawki. In SeriNutrid Chawki room humidity was not maintained but in leaf chawki 75-80% humidity was maintained.

Following parameters of rearing were studied both for SeriNutrid and leaf chawki.

Feed Response %

Feed response percentage was calculated after 48 hours of brushing. 25 brushed DFLs were counted to get the total number of larvae brushed. Unequal larvae were counted at the end of 48 hours. Feed response percentage was calculated by using the formula.

$$\text{Feed response \%} = \frac{(\text{Total number of larvae brushed} - \text{Unequal larvae}) \times 100}{\text{Total number of larvae brushed}}$$

Weight of Chawki Instar Larvae

The weight of 10 larvae after first moult and second moult were taken for each replication.

Larval Duration

The larval duration of silkworm was studied by counting the days and hours from the time of brushing up to spinning. Instar duration also calculated by considering the day and time of moult out larvae to the day and time of entering into the next moult or spinning.

Time spent for 1000 dfls Chawki Rearing:

Time spent by CRC personnel in chawki rearing was recorded from the day of brushing to second moult for both SeriNutrid and leaf fed chawki.

Cocoon Parameters

Average Cocoon Weight

10 male and 10 female cocoons were taken from each treatment and were weighed. The weight of average cocoon was calculated.

Average Shell Weight

Ten male and female cocoons were taken and were cut and their respective cocoon shells are weighed.

Shell Ratio

The value of shell ratio is expressed in percentage. It is assessed by using the formula

$$\text{Shell ratio} = \frac{\text{Average shell weight} * 100}{\text{Average cocoon weight}}$$

Cocoon yield per 100 dfls and cocoon rate per kg:

Yield /100 dfls and cocoon rate per kg were recorded.

4. RESULTS AND DISCUSSION

During chawki rearing, silkworm larvae require a balanced diet, in order for larvae to perform to the fullest potential with regard to the cocoon and cocoon shell production. As the nutrient content in the mulberry leaves vary with age and season, the leaves do not provide balanced nutrition. Use of semi-synthetic diet is the only viable alternative to provide balanced nutrition to chawki instar silkworm. The present work is carried out to analyze the economic characters of chawki rearing on SeriNutrid in comparison to leaf rearing.

Feed response %: From the present study it is clear that cross breed reared on SeriNutrid and leaf, there was no significant difference in feed response. Feed response on SeriNutrid batches were 99.17% where as in leaf batches it was 100%. It is known that when larvae come in contact with food, odors are sensed by receptor cells present on the antenna and maxillary palpi, which causes the larvae to consume the SeriNutrid. This indicates that SeriNurtid used in this rearing is as good as mulberry leaf from the acceptance point of view.

Weights of Chawki Instar Larvae:

Recently there was a report that the larval growth and cocoon characters are good in case of silkworm reared on artificial diet up to second instar (Rajaram et al., 2012). The results obtained in this study are in agreement with these findings. The first instar ten larval weights for SeriNutrid batch was 0.0613g against 0.0572g for leaf batch. The second instar larval weight for SeriNutrid batch was 0.2902g against 0.2834g for leaf batch. The results confirmed that the nutritional indicators of SeriNutrid chawki were better than the control leaf chawki batches.

Larval Duration:

In the present study, it was found that first instar feeding period was 84 hours in leaf reared batches and 87 hours in SeriNutrid batches. It was also observed that moulting period was 2-3 hours more in SeriNutrid reared batches (27-28 hours) than leaf feed batches (24 hours). This trend is similar to an earlier study (Magadum et al., 1994), according to which the larval duration was prolonged in diet fed batches by 1-1.5 days as compared to leaf fed batches. However, in the present study, we found that larval duration prolongation was limited to only five hours in the case of SeriNutrid batches when compared to leaf fed batches. In addition, we also observed that in late instar rearing (III to V), the feeding and moulting durations were same in diet fed and leaf fed batches.

Time Spent for 1000 dfls Chawki Rearing:

In the present study, it was found that time spent about 80 active minutes to rear 100 dfls up to II instar for chawki fed by SeriNutrid, where as they spent at least 135 active minutes for chawki fed by leaf. Further, there was no requirement of the mulberry garden and men folk time for harvesting and getting mulberry leaves in case of SeriNutrid fed chawki rearing (Table 1).

Table: 1 Comparative Study of Manpower Required 100 dfls Chawki

Instar	Day	SeriNutrid rearing time (minutes)	Leaf rearing time (minutes)
First I Instar	I	12	16
	II	8	16
	III	20	14
	IV	4	10.5
	Total	44	56.5
Second Instar	V	4	24
	VI	20	36
	VII	12	20
	Total	36	80

Cocoon Yield, Average Cocoon Weight, Average Shell Weight and Shell Ratio:

In the present study cocoon yield was 3-5% more in SeriNutrid batches than leaf reared batches and former showed better quality, bringing in 5-10% higher price. The average yield obtained for SeriNutrid chawki was 73 kg where as in leaf reared chawki it was 69 kg (Table 2) for every 100DFL. The farmers reported that cocoon prices were higher in SeriNutrid reared chawki (Cake-Mari) reared batches (Rs. 400/kg) than leaf reared batches (Rs. 393/kg). The average cocoon weight, shell weight, and shell ratio were 1.884 g, 0.349g and 18.554% respectively in the Cake- Mari batches, where as in leaf chawki reared batches the average cocoon weight, shell weight, and shell ratio were lower at 1.813g, 0,327g and 18.018% respectively (Table 3).

Table 2: Cocoon Yield and Cocoon Rate in Cake-Mari and Mulberry leaf Reared Batches

Replication	SeriNutrid Reared Chawki			Mulberry leaf Reared Chawki		
	No of DFLs	Yield/100 DFLS (kg)	Cocoon Rate /kg (Rs.)	No of DFLs	Yield/100 DFLS (kg)	Cocoon Rate /kg (Rs.)
R1	1000	75.4	410	1000	70.4	400
R2	1000	70	390	1000	67	385
R3	1000	73.6	404	1000	70	395
R4	1000	72.9	397	1000	68.9	390
	Avg	73	400	Avg	69	393

Table 3: Cocoon Weight, Shell Weight and Shell Ratio in Cake-Mari and Mulberry Leaf Reared Batches

Replication	SeriNutrid reared chawki			Mulberry leaf reared chawki		
	Cocoon weight g	Shell weight g	Shell ratio (%)	Cocoon weight g	Shell weight g	Shell ratio (%)
R1	1.906	0.360	18.857	1.851	0.338	18.260
R2	1.860	0.335	17.992	1.801	0.323	17.934
R3	1.891	0.349	18.452	1.798	0.322	17.909
R4	1.880	0.355	18.877	1.803	0.324	17.970
Avg	1.884	0.349	18.544	1.813	0.327	18.018

This data is in agreement with earlier report (Trivedy et al. 2003) showing that the performance of the breeds and hybrids exclusively evolved for semi-synthetic diet rearing on the economic characters of cocoons was encouraging and saves 52.87% on cost of chawki rearing against mulberry leaf rearing and similar indicators were provided by various researchers (Roychoudhury, 2003; Sannamvong 1988; Sannamvong & Quiniones 1990). The results revealed that silkworm fed with artificial diet had better performance in most of the characters like larval mortality; quality cocoon production and cost-effectiveness. The present study also showed similar results.

Fig 1: SeriNutrid – Ready to Feed for Silkworm

Fig 2: Mulberry Leaves for Silkworm

Fig 3: First Moult Silkworm Larvae on SeriNutrid

Fig 4: First Moult Silkworm Larvae on leaf

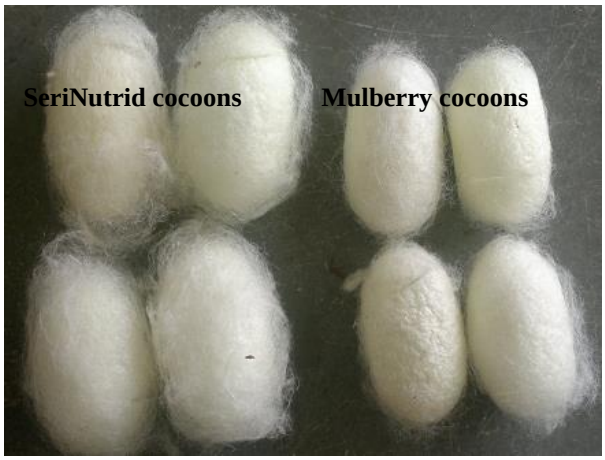

Fig 5: Silkworm Cocoons Reared on SeriNutrid and Mulberry Leaves

Comments and Observations by CRCs

- There is a uniform settling of moult with SeriNutrid when compared to leaf chawki.
- The labour requirement is less in case of SeriNutrid Chawki.
- Time spent in CRC is less when compared to leaf chawki, therefore, we can spend equal time for family related activities while managing CRC.
- There is no need to maintain the mulberry garden which is highly laborious and tedious work.
- Further, farmers who buy SeriNutrid chawki from us have reported better yield and better valuation for the cocoon.
- We can market SeriNutrid fed chawki as a special chawki at premium price and this is helping us get a better profit on a continuous basis.

5. CONCLUSION

The study revealed that SeriNutrid provides a most viable alternative for chawki rearing by increasing the yield and quality of the cocoons. It was also observed that there was 5-10% premium on the price for SeriNutrid reared batches.

6. ACKNOWLEDGEMENT

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