CHAPTER - V

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Nutritional background of the larval stage significantly influences the status of the resulting pupae, adult and production of silk in the sericigenous insects. The leaf consumption of fifth instar larvae amounts to more than 75 percent of the total instars. The high intake of food by the fifth instar is to accumulate sufficient energy resources to support its metabolism during non feeding pupae and adult development. In silkworm the total consumption has a direct relevance on weight of larva, cocoon pupae and shell. The silkworm larval performance is dependent on the quantum and nutritional value of the leaves (Morohoshi, 1976) and water content (Horie et al., 1972). Many scientists reported positive correlation between the leaf quality and silkworm growth. Kafian (1960) reported that the palatability is a criterion for assessing the superiority of leaf as food for the silkworm.

The results of the present investigation throw considerable light on the possibilities of improving ericulture. Although castor is widely used as the primary food plant, kesseru can also be equally good when supplemented with the extract of secondary food plants like gamari and tapioca to enrich its nutritional value. Biochemical analyses of food plant leaves in the present study have revealed that the moisture content of mature castor leaves declines with age, which are consumed by the fifth instar larvae. Dipping castor leaves in the extracts of secondary food plants provided extra nutrients which was found to be reflected in the growth of the larvae and also on cocoon characters. Nutritional value of the food plant leaves vary significantly with seasonal changes. In spring season, castor leaves were found to be better in respect of moisture content and total nitrogen, while during the autumn they were found to be better in respect of crude fat and carbohydrate content. This may be accounted for better larval growth and fecundity in the autumn rearing and enhanced silk production during the spring season.

Fat is particularly well suited to be the main form of energy reserve for the silkworm larvae. The amount of energy from a given amount of fat is very much greater than that derived from the same amount of carbohydrate. It was reported that
fat is more useful in silkworm body than in the body of the host leaves. (Sastri, 1962)
Carbohydrates are utilized by silkworm as a source of energy and for synthesis of both lipid and amino acids. They are very important for healthy growth of silkworms, especially for the infant larvae. Some sugar possesses a gustatory stimulation effect on larval feeding (Ito, 1960). Carbohydrates are generally most effective in increasing fat-body glycogen. Fat body glycogen and haemolymph trehalose are dependent on the carbohydrate content in diet (Horie, 1978).

In the present study, the rearing performance of eri silkworm was found to be the best during autumn on castor leaves supplemented with the extract of gamari. This may be attributed to high protein, carbohydrate and fat content present in the mature leaves of gamari. Fortification of kesseru leaves with the extracts of gamari has significant positive influence in larval growth and rearing performance. This may be the result of increase in uptake of protein which is an important component of food required for larval growth and development of the silkgland and silk production. Sastri (1962) extensively investigated the relationship between the composition of mulberry leaves fed to the larvae and resultant silk production and observed that accumulation of protein in larvae depends largely on the concentration of the carbohydrate in leaves.

Yokoyama (1963) opined that the leaves of the host plant must be of high nutritive value and its seasonal growth is closely related to that of the silkworm. Quality performance of insect is dependent on weight gain from feeding. Jayaramaiah and Sannappa (1998) revealed that in eri silkworm Samia cyn. thia ricini, the larval duration, weight, survivability and effective rate of rearing have significant positive relationship with moisture, total carbohydrates and total amino acids of castor leaves. Biochemical evaluation of protein contents in haemolymph of the fifth instar larvae revealed no significant differences between control and treated groups reared on castor and kesseru. Silk gland protein content was found to be relatively higher in the kesseru treated groups than that of the castor treated groups.

The carbohydrate content of silkgland also exhibited similar trend. The silkworms fed on kesseru supplemented with plant extracts showed higher amount of carbohydrates in the haemolymph, which may be attributed to higher amount of carbohydrates in kesseru leaves. Supplementation of gamari and tapioca extract may
further improve the nutritional status of the leaves, which in turn may enhance the
growth and biochemical constituents in the silk gland. The important aspect of protein
metabolism during larval development is the synthesis of haemolymph protein
(Levenbook, 1985). Increase in the concentration of protein in the haemolymph
during larval development reaches its maximum in the late fifth instar larvae. Higher
amount of protein in the silk gland and maintaining a steady state in their
concentration in the haemolymph, which was observed in the present study may be
associated with the production of silk protein in the silk gland. In silkworm the supply
of amino acids for silk synthesis is derived from the haemolymph, in which they
accumulate in high concentration, and are in a state of continuous flux due to

Silk glands are important organs which produce liquid silk as the source of
cocoon fibre, which is used for spinning of the cocoon. Fukuda et al. (1959) studied
the day to day changes in total silk protein - fibroin and sericin, synthesized by
Bombyx mori larvae during fifth instar of development. They reported that the total
silk protein was found to increase from third day onwards till the end of silk spinning.
From the study they have concluded that sericin production ceased on the first day of
spinning, while formation of fibroin continued throughout the entire spinning period.
The amino acids utilized for silk protein biosynthesis are derived from diets and other
tissue, and are stored in the fat bodies or haemolymph. They are transferred to the silk
gland at the time of spinning.

The rearing performance of the silkworm larvae is reflected in the production
of quality cocoon. Evaluation of the cocoon obtained from the rearing operations in
the present study has revealed no significant variation in cocoon weight between the
experimental groups. From the records of single shell weight it becomes evident that
all the treated groups exhibited higher shell weight than their control counterparts.
Castor leaves supplemented with the extracts of gamari was found to be the best in
terms of single shell weight and silk recovery percent, followed by tapioca and
gulancha extract supplement. The same trend was recorded in the kesseru treated
groups. Another interesting finding of the present study was significant increase in
shell weight and SR% during the month of summer in the treated groups
supplemented with gamari followed by tapioca in both the cases.
Larval duration which is an important criterion for silkworm rearing had a direct correlation with the economy of the rearing operation. Significant decline in the larval duration in *P. ricini* which was observed in the present study during spring and summer crop reared on castor leaves supplemented with the extracts of gamari, may be due to enrichment of the leaves with essential amino acids. Gamari leave being rich in protein content, exhibited positive influence on most of the aspects related to growth, development and economic characters of the cocoons as was observed in the present study. Das *et al.* (1996) who reported similar findings on *P. ricini* reared on castor leaves fortified with balanced amino acids is in close consortium with the present findings. Devina (2001) also found shorter larval duration and higher shell weight in castor fed larvae than the kesseru fed ones is in agreement with the present findings.

Quality of silk fiber which is the ultimate product of such a laborious process ultimately reflects the success rate of the rearing operation. The results obtained in the present study revealed that although the rearing performance on kesseru is not at per with castor, the quality of silk is better than castor in terms of the physical properties of fiber and yarn. It was very interesting to note that the tenacity, tensile strength and elongation at breaking of the fiber and yarn obtained from the cocoons reared on kesseru supplemented with tapioca was found to be higher than their castor fed counterparts followed by gulancha and gamari.

Rajkhowa (1998) studied the structure property correlation of non mulberry and mulberry silk fibers and found that percentage of strain at break is lower in finer filaments, except for fiber which is not reelable. He also reported that the strength of mulberry is the highest followed by muga and tasar. Eri is the weakest of all the four varieties. Toughness of eri and mulberry are low. Besides eri has the lowest modulus. Eri silk fibre was found to be highly viscoelastic which is reflected in the low modulus value of the fibre.

The reports of fibre analyses in this study clearly indicated that the quality of eri fibre can be improved by fortifying the host plant leaves with secondary food plant extracts. Silk yarn produced by the silkworm larvae fed with kesseru supplemented with tapioca and gulancha showed the best result in terms of toughness of fibre and yarn. Gulancha supplemented group, although failed to show any significant
improvement in terms of rearing performance, has exhibited maximum load bearing ability in the present study.

Mejankari leaf, which is a food plant of the silkworm *Antheraea assama* contains high amount of protein, starch and low percentage of crude fiber content and is the best in nutritive value followed by som and soalu (Dutta *et al.*, 1997). Choudhury (1981) reported that the mejankari silk produced by muga silkworm larvae fed with mejankari leaves valued more in fiber quality, but only the healthy and vigorous larvae were found to thrive on mejankari plant. This might be due to the variation in quantitative requirement of each of the nutrients and also the required balance of nutrients within the species owing to many factors including the synthetic ability of the organism and metabolic activities involving specific interrelation between certain nutrients (House, 1974). Similar reasons may also account for the low rearing performance with both castor and kesseru supplemented with the extracts of gulancha.

From the findings of the present experimental project, it may be recommended that the rearers of eri silkworm can use the extracts of gamari and tapioca to increase the production of eri silk. Although castor in the most popular host plant of eri silkworm, kesseru can also give the same result when supplemented with the extracts of gamari and tapioca. Moreover, the quality of silk obtained from the worms fed with kesseru is better than castor in terms of the physical properties of the yarn.

It is a well known fact that eri cocoons are open mouthed and cannot be reeled; hence spun like cotton. The denier of the yarn has been fixed during the time of spinning. Therefore, variation may occur due to the handling error during the processing operation. Despite of this fact, eri silk has certain excellent and unique textile properties, such as fineness, density, cross-sectional shape and surface properties etc., which play an important role in determining the end use of the fibre. Eri silk is finer than muga and tasar and even softer than mulberry silk. The tenacity of eri silk is 2.5-3.5 g/denier, and hence it requires proper twist to maintain dimensional stability of fabric especially for garments.

The secondary host plants are widely distributed in almost all places of North East India, especially in the forest areas wherein the wild counterparts of eri silkworm
of eri silk is 2.5-3.5 g/denier, and hence it requires proper twist to maintain dimensional stability of fabric especially for garments.

Eri is the softest and warmest amongst all the silks and has immense potential for commercial exploitation by making finest quality blankets, sweaters, ties and various knitwares for suiting materials. Besides, there is a good scope for eri as a blending material. It can be blended with wool, cotton, muga and tasar spun silk at the weaving stage. Hence there is an urgent need to explore the possibility of producing attractive value-added products from eri silk.

North Eastern India where eri is exclusively reared as a part time leisure job, adoption of advanced technology for rearing eri silkworm and bringing diversification in certain eri products such as quilt, various dyed fabrics, blended products, moil yarn etc that are already available, is urgently needed which may pave the way to make eri culture a full time vocation amongst the rearers of the region.
Plate 14. Products woven from Eri silk yarn.
A. Ladies shawl (Chaddar), B. Gents shawl and Kurta.
Plate 13. Eri silk fibre and yarn.
A. Kesseru fed group, B. Castor fed group.