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Role of Artificial Diets in Sericulture

Bhupen Kumar Sahu[1] and Ipsita Samal[2]
[1] M.Sc. (Ag.), Department of Sericulture, Assam Agricultural University, Jorhat, Assam
[2] Ph.D. Scholar, ICAR- Indian Agricultural Research Institute, New Delhi

SUMMARY

Mulberry Silkworm, Bombyx mori is a monophagous insect which has special significance in sericulture industry. Mulberry leaves are the traditional food for mulberry silkworm larvae due to presence of morin. The physiology of Bombyx mori L. has been studied comprehensively due to the economically valuable silk production. Mulberry belongs to the genus Morus of the family Moraceae. There are enormous types of mulberry, out of which white (Morus alba L.), red mulberry (M. rubra) and black mulberry (M. nigra) are predominant among the growers. Among them, only white mulberry is recognized as the food source for mulberry silkworm. Now a days, sericulture researchers have developed number of supplement nutrients with mulberry leaves for silkworm rearing. There are number of foods used as an ingredient for artificial diet of silkworm. Artificial diet encourages the small landless farmers to take up sericulture and it also helps to reduce labour cost for mulberry cultivation.

INTRODUCTION

Need for Artificial Diet

The growth and development of mulberry silkworm larvae is greatly influenced by mulberry leaves quality. Nearly 70 per cent of the mulberry silk produced by *Bombyx mori* is directly derived from mulberry leaf proteins. Hence, silkworm should be fed abundantly with good quality mulberry leaves for the successful cocoon production. Although the Mulberry (*Morus* sp.) leaf is considered as the traditional food for silkworm, but now a day's many attempts has been made to establish artificial diet. First time, artificial diets were applied in sericulture in Japan in 1977 for the rearing of young larvae of the silkworm. Though many artificial diets have developed after extensive research, but it was observed that silkworm exhibits better growth rate and cocoon production when fed by mulberry leaves only. The mulberry used must be fresh enough to meet the preference of silkworm; it must be fed 3 or 4 times a day. But such kind of rearing system has faced some problems:

- Rearing houses and farmer's habitation
- High land-cost for mulberry fields
- Requirement of intensive labour
- Good transportation facility

Basic nutritional requirement for Silkworm

Protein:

Almost 70% silk proteins produced by silkworm are directly derived from the mulberry leaf protein.

Vitamins:

For the growth and development of *Bombyx mori*, ascorbic acid (vitamin C) has always been regarded crucial nutrient. In fact, in mulberry leaves, ascorbic acid is present in large amounts. The increase in the cocoon and filament characters might be due to increased protein conversion efficiency of the silk glands as a result of increased availability of vitamins.

Salt:

The salt significantly improved the growth of the developmental stages, increased the cocoon characters, elicited early cocoon production and increased the reproductive potential of the silkworms. Nutritional supplementation of nickel chloride, potassium iodide and copper sulphate increased the economic parameters of the silkworm. It is reported that nickel chloride considerably increased the growth of silkworm larvae, pupae, adults and subsequently cocoon production but higher salt concentrations produced terminal effects on these parameters. The cocoon weight was increased after feeding silkworm larvae with nickel and zinc fortified mulberry leaves.

Sterol:

Insects require dietary sterols because there are unable to synthesize sterols. Sterols are crucial to insects for survival and development, since cholesterol is utilized not only as constituents of cell membranes, but also as precursors of moulting hormones, ecdysteroids. β-sitosterol present in the mulberry leaves and conversion of β-sitosterol to cholesterol is crucial for *Bombyx* larvae. Therefore, sterol requirement of *B. mori* should provide important information on the relationship between nutritional regulation and feeding behaviour.

Artificial Diet: An alternative to Silkworm Rearing

A complete rearing of the silkworm on artificial diets was first achieved in 1960.

Preparation:

Special mulberry gardens are maintained to meet the specific nutritional requirement of young instar silkworm, so artificial diet was developed in order to avoid such preconditions. Contrary to the initial belief that the popular and productive silkworm hybrids commercially exploited in India and their parental strains would accept the artificial diet for young instar rearing, they did not accept the diet and the Feeding Response (FR) was low. To overcome this limitation, it was realized that the only option available was to modify the selection response of silkworm for the feeding behaviour. Thus, commercial breeds were planned to change gradually to feed on artificial diet through selection. This would ultimately facilitate to develop a common artificial diet for all the evolved hybrids. When Japan faced a similar problem with silkworm strain, Sawa J regarding their abnormal feeding behaviour, efforts was made to evolve exclusive silkworm strains for rearing only on artificial diet. By exploiting the polyphagous nature of Sawa J, special strains and commercial hybrids were further developed for rearing on artificial diet. Different artificial diet composition were made. After 24 years of continued research, Hamamura15 reported the substances involved in 3 step feeding behaviour of *Bombyx mori* silkworm found in mulberry leaves as attracting factor (Citral), biting factor (βsitosterol, morin or isoquercitrin) and swallowing factor (cellulose powder) and supplementary factors (potassium diphosphate, sucrose, inositol and silicasol) in agar-agar jelly pure form were prepared.

Effect of Artificial diet on Silkworm:

The positive FR (Feeding Response) in the strains under the study on artificial diet feeding can be attributed to the presence of mulberry leaf powder in the diet composition which largely promotes the FR in silkworm. Nihmura suggested that it was highly desirable to include mulberry leaf powder or mulberry leaf extracts as feeding stimulatory substance in the artificial diet in order to evoke uniform and prompt FR of newly hatched larvae. The improved strains were developed which accepted the diet and performed well with respect to their economic traits and almost at par with that of mulberry reared counterparts.

CONCLUSION

It was generally considered that artificial diets could not be used for silkworm rearing throughout the whole instars for silk production, due to the cost of the diet. However, with the breeding of polyphagous silkworms and the development of low-cost artificial diets this practice may become possible. The new method of rearing of the silkworm on artificial diets is a renovated technique and it's rapid expansion is expected in sericulture. To improve the quality of artificial diet, the quality of mulberry leaf must be improved first. Since, the primary purpose of mulberry cultivation in most of the Asian countries is to feed the silkworm with its leaf, the impact of the salt that accumulated in leaf of mulberry on silkworm's growth and development need to be investigated in details. However, further studies such as genomic investigation, systematic biology-based researches and other extensive proteomic studies are necessary to elucidate more aspects in this area.

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