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ECONOMIC AND NUTRITIONAL CHARACTERISTICS OF PHILOSAMIA RICINI RAISED ON CASTOR LEAVES FORTIFIED WITH PROBIOTICS - REVIEW

Chubanaro Aier Department of Zoology, St. Joseph university, Chumukedima, Nagaland - 797115.

Pazhuni Pfote Department of Zoology, St. Joseph university, Chumukedima, Nagaland - 797115.

Jeyaparvathi Somasundaram* Department of Zoology, St. Joseph university, Chumukedima, Nagaland - 797115. *Corresponding Author

ABSTRACT The gut microbiota affects silkworm growth and development and is particularly associated with food absorption, nutrient use, and disease immunity. The behaviour and evolution of insects are influenced by interactions with their microbiome. In cases of nutritional deficiency or other health conditions, certain microbes can be given as dietary supplements to promote insect reproduction, food conversion, and growth as well as health parasitic infection. An overview of insect-microbiota interactions is provided, as well as information on the function of probiotics, their typical application in the rearing of insects for food and feed, and their interactions with the host microbiota. The improvement of the silkworm's growth and development is greatly aided by nutrition

KEYWORDS : Silkworm, microbiome, probiotics, gut microbiota, symbiotic bacteria.

INTRODUCTION

The lepidopteran insect known as the silkworm is a typical example and plays a significant role in agriculture and the economy. Like the majority of lepidopterans, the silkworm is partnered with a sizable group of symbiotic bacteria. The technique of breeding silkworms to obtain silk is termed as sericulture. Sericulture is broadly divided into related activities such as food plant cultivation, upkeep to feed the silkworms, silkworm rearing to produce the silk cocoons, reeling the cocoons to unwind the silk filament, yarn production, weaving, and fabric processing [1]. Additionally sericulture is essential to agriculture. In India, sericulture is a highly organised industry that is heavily labor-intensive and rural in nature. The area under cultivation, which spans 22 States, is 172000 hect. functioning 258000 handlooms and 29340 power looms in 54000 villages [2]. Sericulture contributes significantly to the socioeconomic improvement of livelihood, employment, and income production through the most efficient use of natural resources [3]. Due to its enormous size and effective technique of rearing, the silkworm is used as a potent insect model for research. In particular, the silkworm genome sequence was the first one made available for Lepidoptera, the second-largest insect order, which includes the most important agricultural pests. In India, sericulture has developed into a significant rural sector. After China, India is the second-largest producer of silk globally. Even though the majority of this country's production is consumed domestically, the silk business has significant export potential. India is the only nation that produces all of the commercially recognised types of silk, including Mulberry, Tasar, Eri, and Muga. However, mulberry silk makes up more than 90% of all produced silk. Additionally, the organisation and growth of mulberry silk production is substantially better than average. One of the five naturally occurring silkworm species that has been fully domesticated and used for commercial purposes on the Indian subcontinent is the eri silkworm, *Samia ricini*. Millions of individuals in the nation have the option to earn a living through traditional sericulture, which involves raising silkworms for the manufacture of silk in addition to earning foreign currency. It is now necessary to diversify the entire sericulture process in order to effectively implement its output in the context of the modern world. The focus of current study has been on various biomedical uses for the proteins found in silkworm pupae. Pupae proteins are effectively used as anticancer agents, wound dressings, hepatoprotective and antiapoptotic action, antigenotoxicity, and more. As a result, silkworm pupae can be used as a food supplement, and their massive protein content opens up new possibilities for medicinal research [4].

Important characteristics of Eri silkworm (*Samia ricini*)

Sericulture expands into the post-cocoon industries of silk reeling, twisting, weaving, dying, printing, and garment production in addition to the agricultural pursuits of plant cultivation, silkworm rearing, and seed generation [5]. Sericulture is divided into two categories: agriculture and industry. While the industry sector involves reeling, twisting, dying, printing, finishing, and knitting, the farm sector entails producing the food plants that silkworms eat and raising silkworms to generate cocoons and eggs.Sericulture encourages the use of safe chemicals to clean equipment and housing used for rearing silkworms, which aids in the promotion of the natural ecosystem [6]. Commercially known and produced natural silk comes in four different varieties. Mulberry silk, which makes up roughly 95% of global production, is the most significant of these. Eri silk, tassar silk, and muga silk are the three non-mulberry varieties of silk that are commercially manufactured. Other varieties of silk, outside mulberry, are typically referred to as non-mulberry silks. All these commercial types of silk are produced only in India. The four stages of the silkworm's life cycle are the egg (ovum), larvae, pupa, and moth (adult). The egg needs 10-14 days to hatch, the larvae takes 20-25 days, the pupa takes 10-14 days to mature, and the adult in 7 days. A maximum of 7 generations of silkworms can be raised in one year [7]. The multivoltine, polyphagous Eri silkworms consume a wide range of host plants. According to Singh and Das (2006) [8], the most important host plants are Castor (*Ricinus communis*), Kesseru (*Heteropanax fragrans Seem.*), Tapioca (*Manihot esculenta*), Papaya (*Carica papaya*), Jatropha (*Jatropha curcas)*, Barpat (*Ailanthus grandis*), and Payam (*Evodia flaxinifolia*). The feeding plants and nutrient content of the leaves have a significant impact on the morphological and economic properties of silkworms[8]. Of the five wild silkworms used for commercial purposes in India, only the eri silkmoth, Samia ricini, has been fully domesticated and used for indoor rearing. Eri-culture, or the raising of the eri silkmoth, has long been valued as a socio-cultural practise, especially in the Brahmaputra valley of Assam and the nearby hilly regions of Northeastern India. Tribal people also exploit this practise for food and use the silk of this insect to make clothing and other significant biomaterials.Better economics for the silk business would emerge from increased output of silk, both qualitatively and quantitatively. Information on nutritional ecology is necessary for a better understanding of insects' ethology and physiology in order to enhance silk production [9]. The nutritional value of castor leaves affects consumption, which is connected to the physiology of digestion, which, in turn, regulates eri silkworm growth and development as well as its economic characteristics. The optimal temperature range for Eri silkworms to grow is between 20°C to 35° C, whereas temperatures over that range result in decreased spinning, larval and pupal mortality, poor moth emergence, and adult sterility [10]. Silkworm are only capable of surviving when under human control. A pair produces 400–600 eggs in a single day. Body size is within a range that can be observed.

Use of Probiotics in Sericulture

Insects' gut flora is maintained or improved when feeds are enriched with enough probiotics, which promotes their health. Direct fed microbial method is the name of the procedure. When added to larval feed, nutritional supplements such vitamins, amino acids, proteins, and probiotics tend to boost the nutritional effectiveness and economic characteristics of the silkworm [11][12][13]. Probiotics are active, healthy bacteria that benefit the host by balancing the microbial population [14]. The popularity of products containing probiotic

bacteria has increased the significance of correct speciation. In the human physiology, probiotics participate in a wide range of beneficial health-promoting processes. The probiotic bacteria that bind to the intestinal epithelium are what produce the health benefits of the probiotics that are consumed. For many pathogenic bacteria, a strong natural biological barrier is created by probiotics adhering to the mucous membrane of the intestines [15]. The importance of probiotic bacteria's precise specialisations and the positive effects on mucosal immunity through the activity of gut micro-flora, which have been extensively studied in humans, animals, and many insects, is increasing as more products containing probiotic bacteria are investigated. Although commercial probiotic formulations are available for use in human, aquaculture, and veterinary medicine, none of them are especially made for sericulture [16]. According to reports, the gut microbiota affects silkworm growth and development and is particularly associated with food absorption, nutrient use, and disease immunity [17]. *Samia ricini*, an eri silkworm, is linked to symbiotic bacteria that are thought to serve the host's various physiological needs [18]. On the other hand, utilising probiotics and giving the silkworm artificial feeding has improved the silk's quality. Silk's potential has been further utilised for biomedical purposes [19]. The discovery of probiotics made it possible to investigate how well insects do when given benevolent microbes. The impact of the microorganisms is evaluated in particular for enhancing growth and reproductive performance and for reducing disease occurrence in demanding conditions of raising. Global HealthThe probiotics definition approved by the world community is "live microorganisms."that, when provided in sufficient doses, boost the host's health" [20].

Eri silk producing areas

India consumes the majority of the silks domestically, leaving little for export. Eri silk is currently largely manufactured in northeastern India, specifically in Assam, Manipur, Meghalaya, Nagaland, Arunachal Pradesh, and Mizoram. As castor is produced extensively as an oil seed crop, eri culture has recently spread to several non-traditional states, including Andhra Pradesh, Gujarat, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Karnataka, Maharashtra, Uttaranchal, Uttar Pradesh, Jharkhand, Bihar, West Bengal, Orissa, and Sikkim. More than 90% of India's cut cocoon and spun silk production comes from just its north-eastern region [21]. Eri cocoons have an open mouth and are constructed of intertwined layers of fibres rather than continuous filaments, making it impossible to reel them. The development of India's Eri silk production shows a sharp increase, from 127 MT in the first plan period (1951–1956) to 1530 MT in 2007–2008 contributing to the manufacture of silk by 8.4% [22]. In terms of production volume and potential, eri silk holds a significant place. The fiber's characteristics make it particularly appealing to use for making yarn, either on its own or in combination with other textile fibres that work well with it [23]. India has the special honour of being the only nation in the world to produce all the different types of natural silk.

Host plants of Eri silkworm

Castor is the host plant that the eri silkworm, *Samia cynthia ricini*, prefers most, followed by tapioca, with the usefulness of other hosts for continuous rearing during crop off-season[24]. The two most significant host plants for the eri silkworm are castor and tapioca, but other perennial tree species, such as kesseru and payam in the north-eastern states, may be an alternate source of food during the off-season. According to Kumar et al. (1993), in terms of cocoon harvest and other factors, kesseru leaves were second only to castor leaves [25]. Sachan and Bajpai (1973a) [26] found that feeding eri silkworms leaves from the Rosy castor variety first, then the S30, EB-31, and EB-16 cultivars, resulted in superior larval growth, development, and higher cocoon production. In many areas of South India, papaya plantations are also expanding significantly, and the leaves can be used in useful ways. When fed castor, the eri silkworm's progressive growth was superior. Furthermore, regardless of the diet utilised earlier, i.e. whether tapioca/castor was employed, the larvae receiving castor leaves during fifth instar showed better growth (Joshi, 1987) [27]. On the leaves of castor and tapioca, the eri silkworm culture adaption is widely used. Tapioca and castor are produced on huge scale in Erode, Salem, Dharmapuri, and Nammmakal districts of Coimbatore and Tamil Nadu. The feeding must be done economically and in accordance with the larvae's eating preferences and appetite. In addition to feeding , cleaning is also equally important for the well being of the silkworm rearing process as it helps in maintaining the health of the silkworm [24].

Life Cycle of Eri Silkworm

Fig 1: Lifecycle of Eri silkworm.

CONCLUSION

The polyphagous eri silk, Samia ricini, is an economically significant silkworm in the North eastern region of India and is associated with various symbiotic gut bacteria that provide several benefits to the host. The gut symbiotic microbiota plays an essential role in the growth, development, pathogenesis, and environmental adaptation of host insects. This review presents data that demonstrate that there is an increase in the economical value, nutritional value and growth rate of Eri silkworm, *Philosamia ricini* when fortified with probiotics. It has various influence on the silkworm's biological and economic characteristics. It is advisable to consider enrichment's adverse impacts in addition to its favourable benefits on biological and economic features. Additionally, each intervention affecting the natural composition of silkworm food should consider costs, environmental safety, and the viability of doing it on a large scale.

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