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RESEARCH ARTICLE

FLACHERIE – A THREAT TO THE SOCIO ECONOMIC FABRIC OF INDIA: A REVIEW

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Abstract

Silk is a natural fiber preferred for clothing and its popularity just follows its counterpart cotton. Silk is preferred due to its luster and better handling characteristics. Silk is obtained from the saliva obtained from the salivary glands of the silkworms. Cultivation of silkworms is a source of employment to large strata of society. So, optimal growth and quality of silkworms is an aspect of great concern for the farmers. Research is focused to improve the quality of silk cocoons, which is mainly dependent on the mulberry leaves on which the larvae feed. *Bombyx mori* – L silkworms of the Mulberry type are especially prone to infection due to the attack of different pathogens. Major disease affecting silkworms is Bacterial flacherie. *Staphylococcus* species are mainly responsible for the damage. Measures of controlling this damage are of great necessity in order to get a quality output. This is achieved by using herbal extracts prepared from *Acalypha indica*, *Leucas aspera* and *Ocimum sanctum* for the containment of these microbes.

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Introduction:-

Silk is obtained by sericulture, a technique of farming of silkworms. Silk is a natural animal based textile fiber associated with luxury and class due to its sheer luster and elegance. Sericulture is an important industry providing a means of livelihood to a large number of people^{10,13}. Mulberry silkworm, *Bombyx mori* – L., is the preferred species for the production of silk cocoons. The quality of this species is generally affected by different viral, fungal and protozoan pathogens. Bacterial pathogens alone are responsible for causing cocoon loss to the extent of almost 70 %. Antibiotics are widely and effectively used to control these pathogens affecting particularly *Bombyx mori* – L⁴. Another problem encountered with the use of synthetic antibiotics is the capability of the pathogen to develop resistance to the antibiotic in a short time period, ultimately rendering it useless. Antibiotics developed from natural sources like crude medicinal plant extracts are capable of encountering this phenomenon of host resistance of the silkworm bacterial pathogens⁵.

India has a large geographical area of varying climatic conditions ranging from the colder Himalayan regions in the North to the warm temperate conditions of other regions. Hence this makes it possible for a varied and rich floral diversity, whose potential has yet not been fully tapped. Different plant based antibiotic compounds have been isolated by research scientists offering cure and even curbing many human, animal and insect ailments^{7, 12}. The efficacy of the extracts of common medicinal plants like *Acalypha indica*, *Leucas aspera* and *Ocimum sanctum* in controlling the invasion of pathogens causing Flacherie disease in mulberry silkworm has been assessed to ultimately provide a simple and effective solution for the control of silkworm diseases.

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Over the last few decades, a substantial number of plant species have been evaluated for their antimicrobial activity and many natural compounds derived from plant and either their crude extracts or purified extracts have been proved to be very effective in controlling the toxicity of synthetic antibiotics^{4, 9, 11}. Researchers have also noted the Chloroform bark extracts of *Thuja orientalis* to be very effective in controlling the invasion of pathogens of the type *Staphylococcus aureus* and *Bacillus thuringiensis* infecting *Bombyx mori*. Chloroform leaf extract of *Aegle marmelos* has been effective in controlling *Bacillus thuringiensis*, which is due to the presence of certain antibacterial compounds and phenanthrene carboxylic acid in the bark extract of *Thuja orientalis*⁹. Studies have indicated the efficacy of the extracts of *Leucas aspera* in controlling the antimicrobial activity. Hence proper identification of plant based antibiotics is necessary for the optimum growth and quality of silkworms. Flacherie is a major disease in silkworm and flaccidity of larva is the major symptom. The disease is common during summer and rainy seasons in all the sericulture areas of India.

Causes:-

The primary cause of Flacherie disease in silkworms is due to the physiological weakness of the organism combined with the invasion of pathogenic/non-pathogenic microbes. Research has shown that adverse environmental conditions encountered by the insect, starting from egg incubation and continuing during the rearing of silkworm, which includes starvation of silkworm, feeding of silkworms with poor nutritive quality of mulberry and improper handling of silkworm during the rearing are the causes for weakness in silkworms. Research has also attributed the physiological weakness in silkworms making them susceptible to different pathogenic microbes and bacteria like *Streptococcus* species, *Staphylococcus* species, *Bacillus thuringiensis*, *Serratia marcescens*, ultimately leading to Bacterial Flacherie on one hand, and non occluded viruses like BmIFV/BmDNV causing Viral Flacherie on the other.

In such physiologically weak larvae, even the non-pathogenic bacteria micro flora of the mid gut multiply at faster rate, alter the gut environment and penetrate up to haemolymph causing flaccidity. Physical factors like improper handling of silkworm lead to external body injury of the worm. The wound then gets infected with microbes leading to Flacherie.

Causative agents:-

The main causative pathogens observed are different bacteria like *Streptococcus* species, *Bacillus thuringiensis* and *Serratia marcescens*, and non-occluded viruses such as infectious Flacherie virus BmIFV and densovirus BmDNV. Flacherie is also caused by the combined infection of bacteria and viruses⁸.

Symptoms:-

During the early stage of infection, symptoms are not clearly visible and are difficult to identify.

The larvae become soft and flaccid. Retardation of growth of the affected larvae occurs, making them inactive and vomit gut juice. The faeces is observed to be soft with high moisture content. Sometimes chain type of excreta is observed. Often, rectal protrusion is also observed⁸.

When infected with *Bacillus thuringiensis*, symptoms of toxicity such as paralysis and sudden death are observed. After death, larvae turn black in color and emit foul smell. Sometimes, the dead larvae turn red when infected with *Serratia marcescens* during injury.

Control Measures for Prevention of Disease:-

A number of preventive measures need to be implemented right from the hatching stage for the optimal and healthy growth of the worm:

- ❖ Procurement of silkworm eggs produced from healthy parent moths is recommended, so that the progeny would be least susceptible to microbial infections.
- ❖ Incubation of silkworm eggs should be under optimum environmental conditions.
- ❖ Ensuring meticulous disinfection of silkworm rearing house, appliances and the surroundings of the rearing house with the use of quality disinfectants at recommended concentration, quantity and time schedule. Ensuring personal hygiene of workers during the rearing is also of utmost importance.
- ❖ Feeding the growing silkworms with quality mulberry leaves, so that they grow physiologically strong and express high level of resistance to microbial infection.

- ❖ Rearing of silkworms under recommended optimum temperature and humidity conditions so that the larvae grow healthy and gain resistance to infection. Strictly avoiding the rearing of silkworms under fluctuating temperature and humidity as such conditions make the silkworm weak and lose its ability to resist infection.
- ❖ Avoiding feeding of mulberry sprayed with insecticides/pesticides before the completion of the recommended 'safe period'. It has been observed that the silkworms fed on such leaves develop Flacherie symptoms.
- ❖ Avoid overcrowding during the rearing of silkworm as it leads to larval starvation, which when coupled with undesirable environmental conditions, results in substantial loss of resistance to diseases. It is always compulsory to provide good cross ventilation in the rearing room.
- ❖ Researchers have observed that excessive feeding of mulberry leaves lead to accumulation of uneaten leaves, which needs to be avoided. It has been observed that the uneaten leaves as well as accumulated faeces then ferment leading to increased bed temperature and humidity, making the silkworm weak with loss of resistance to infection.
- ❖ Avoiding improper handling of silkworm in order to prevent injury especially during feeding, bed extension and mounting stages.
- ❖ Regular checking of the larvae is to be done and suspected diseased larvae should be segregated from the healthy ones, and disposing them off by burning or burying.
- ❖ Dust bed disinfectants of good quality are to be used at the recommended schedule.
- ❖ Also, antibiotics incorporated in feed are recommended at the appropriate schedule and quantity to control Flacherie disease.

Effects on Silk Industry:-

Sericulture means cultivation of silkworms which finally produces SILK. The word silk sounds luxury and class. Till today, no other fabric can match it in luster and elegance. As long as human desire for silk garments continues, the demand for sericulture activity remains. Silk is the naturally produced animal fiber.

Silk is considered to be 'Queen of Fiber' which is proteinecious in nature. Archeological and Bibliographical evidences show that the sericulture was practiced in China about 2500 BC¹. In 12th century BC, it expanded outside China as Mulberry seed and silkworm egg were smuggled out. During 1920-30's world silk yield exceeds 60,000-70,000 tons, while in 1950-60's, it decreased to 30,000 tons. After 1970, showed rapid development and has become the vocation of small agricultural families in popular developing countries like, China, India, Vietnam and Thailand. Current annual production of silk is about 4,96,000 tons. India is 2nd largest producer of silk and the fact that nearly 6 million India's are involved in sericulture⁶. The losses occur mainly during the final stages of silkworm rearing resulting considerable energy and money loss. Bacteria such as *Streptococcus faecalis*, *Streptococcus liquifactions*, *Staphylococcus acrie*, *Staphylococcus epidermidis* and *Bacillus* species are commonly reported to cause Flacherie in silkworm. The leaf extracts along with biologically active principles from three medicinal plants such as Pakarkai (*Momordia charandia*), Tulsi (*Ocimum sanctum*) and Nilavembu (*Andrographis peniculata*) are tested for their potential in improving silk production².

Conclusion:-

Sericulture is a unique field of agriculture where silkworms are reared on an extensive scale to produce the fine material of clothing. Flacherie, is a disease affecting silkworms in particular and the economic losses to the farmer in general. It is mainly detected by the flaccidity of the worm in the larval stage. The incidence of diseases at the time of silkworm rearing severely reduces the production of silk. The disease is most common during summer and rainy season in all the sericulture areas of India. Control measures, if implemented from the larval stage, have proved to be effective in reducing both, the damage caused by the disease both on the quality of the silk produced by the worms and also the economic loss to the farmers.

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