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Review Article

RELEVANCE OF ANTIBIOTICS WITH REFERENCE TO SERICULTURE INDUSTRY

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ABSTRACT
There are many factors that influcence the success of production of silk. In recent years some antimicrobial agents have been used in for controlling of silkworm diseases and to improve the production of silk. Antibiotics play a vital role in improvement of disease resistance and growth enhancement in the animals and insects**.** Antibiotics administration shows promising results in harvesting superior crop and controlling the silkworm diseases. The link between antibiotics and silkworm is further strengthened by the present uses of silkworm in drug screening and pathogen studies systems due to its short larval period and ethically accepted model. In view of the above, the current review aims to focus on potentiality of antibiotics on the growth and control of silkworm diseases as well as establishing the silkworm as an effective tool for experimentation in the existing system of pathogen studies and drug screening.

KEY WORDS: Antibiotics, Silkworm growth, Silkworm diseases, Pathogen studies and Drug screening

INTRODUCTION

Insects, considered to be the most flourishing organisms on earth, do not produce antibodies, although they do develop natural immune systems. Microbes can oppose one another to inhibit the growth of other species called antagonism. The most significant and pronounced form of antagonism that widely occurs in the world of micro-organisms, is the formation of metabolites that slows down or inhibits completely the growth of other organisms.

Antibiotics are among the most frequently advocated medications in modern medicine which show promising results in controlling bacterial and viral diseases in animals. In sericulture the productivity and quality largely depends on the healthiness, growth of the silkworm larvae and the suitable environmental conditions. Growth and development of larvae depends on the intricate physiological processes that take place in the silkworm. Therefore improvement of silk quality means improvement of the feed nutrition and upkeep of the larval health, since silkworm is highly susceptible to infection caused by major pathogenic groups. Broad spectrum antibiotics viz., penicillin, streptomycin, tetracycline and chloramphenicol were already tried on silkworm and found successful. Antibiotics in silkworm are approved for four different purposes: disease treatment, disease prevention, disease control and for health maintenance or growth promotion (Phillips et al., 2004).

Antibiotics in Nutrition: Physiological Aspects

Many nutritional requirements are common to insects and higher animals for their proper growth and survival. Except for certain nutrients, the qualitative nutritional requirements of insects are more or less similar to those of higher animals. Antibiotics have improved weight and feed utilization in broiler chickens and turkeys, pigs, calves, beef cattle and replacement dairy heifers. The growth- rates of animals have been observed to increase through the feeding of low concentrations of antibiotics such as terramycin, penicillin, aureomycin and bacitracin (Weber et al., 1952). Beneficial effects of antibiotics by modulation of gut micro-flora and influence on mucosal immunity or through altering enzymatic activities has been extensively studied in humans, animals and many insects (Yeung et al., 2002).

Insect resources are vast and diverse due to their immense diversity. The exploitation and utilization of insect resources is classified into different categories. The most important are the insects of industrial resources which include the utilization of silkworm, honeybee, lac insect and dye insect. The silkworm is an important economic insect and also a tool to convert leaf protein into silk. The silkworm is considered as a powerful laboratory model for the basic research in biology. The development and economic production of sericulture largely and greatly depends on the metabolic modulations and molecular mechanism of silkworm, besides its genetic composition and immunological resistance (Babu et al., 2009).

When antibiotics were administered to the silkworm, there is shift in the nitrogen metabolism in favour of increasing the body weight and increased output of silk (Murthy and Sreenivasaya, 1953). Studies on auromycin and chloromycetin showed that their addition to the mulberry diet resulted in heavier caterpillars with increased nitrogen metabolism (Verma and Atwal, 1963). Shyamala and Bhatt (1962) reported that chloromycetin supplementation enhance the oxygen uptake of the gut of the silkworm. It was thought that these antibiotics exerted a beneficial influence in controlling the intestinal flora of the caterpillars. Ahmed et al. (2001) found that food assimilated, assimilation rate, assimilation efficiency, food

converted, conversion efficiencies were significantly higher in the antibiotic treated batches. The antibiotic feed supplementation not only showed prophylactic measures to prevent bacterial infections but also enhanced the nutrition and economic parameters in B.mori (Sheebha et al., 2008).

Potentiality of antibiotics with reference to growth of silkworm

A selected group of antibiotics, reserved for animal use only, were used to help growing animals digest their food more efficiently, get maximum benefit from it and allow them to develop into strong and healthy individuals. This was achieved by destroying or inhibiting undesirable bacteria in the gut which prevent optimum absorption of food (Phillips, 2007). Different antibiotics as growth stimulating factors are extensively used to enrich the nutrition of farm and other animals for their increased productivity (Baig, et al., 1990). Fortification of mulberry leaves is considered as one of the effective methods to enrich the silkworm diet. The biochemical parameters could be elevated by antibiotic supplementation in healthy larvae (Savithri and Murli, 2002).

Silkworm larvae obtain nutrients from mulberry leaves to build up body, sustain life, spin cocoons and egg production. Such nutritional requirements in food consumption have direct impact on larval and cocoon weight, amount of silk production, pupation and reproductive traits. In silkworm, Bombyx mori, studies were carried out by different workers after enriching mulberry leaves with small quantity of different antibiotics before feeding (Murthy et al., 1951; 1954; Shyamala et al., 1962, Verma and Atwal 1963). From these studies it was found that feeding of antibiotics along with mulberry leaves have increased the larval weight, growth, fecundity and silk content. The growth and development of silkworms and their economic characters are influenced to a great extent by the nutritional content of mulberry leaf (Ahamed, 1994; Shivakumar, 1995). Antibiotics are known to improve the growth of the larvae and to certain extent enhance the silk production (Radha et al., 1980).

Rahmathulla *et al*. (2003) observed that antibiotics administration with different concentrations significantly improved the rearing and cocoon parameters like larval duration, larval weight, growth index, single cocoon weight, single shell weight and shell ratio, average filament length, non breakable filament length, raw silk recovery percentage, denier, reelability and neatness and the better performances were recorded with the increase of antibiotics concentration. Oral administration of antibiotics along with mulberry leaves to healthy silkworm boost the growth, fecundity and silk contents (Tayade et al., 1988) as well as reduces the incidence of diseases (Rai and Devaiah, 1988).

Therapeutic effects of antibiotics with reference to diseases of silkworm

The mulberry silkworm, Bombyx mori L. has been domesticated for over 4,000 years and this domestication and continuous rearing of silkworm has resulted in loss of certain wild characters including their tolerance to microbial infections, as a result the silkworm becomes most susceptible to infection by major pathogenic groups leading to diseases and crop losses at farmer's level (Mamatha and Balavenkatasubbaiah, 2008).

The main objective behind the silkworm rearing is to produce qualitatively and quantitatively superior quality of cocoons which have a direct bearing on raw silk production. Silkworms are affected by a number of diseases due to various biological, chemical, physical, nutritional and environmental causes (Priyadharshini et al., 2008). In India wrong method of rearing, low nutritional status of mulberry and silkworm favour the multiplication of pathogen and contributes the crop losses due to diseases leading to uprooting of mulberry garden. In India, annual crop loss due to diseases was estimated to be 30-40 %.

Being poikilotherms, silkworms respond very quickly to the environmental changes, particularly to temperature and relative humidity (Priyadharshini et al., 2008). Higher or lower temperature and humidity, ventilation and feed adversely affect the physiological functions of the silkworms, as a result of which they become highly susceptible to diseases. Four silkworm diseases are very common in India viz., grasserie (viral), flacherie (bacterial), muscardine (fungal) and pebrine (protozoan). Mulberry leaves of poor nutritive value will not be able to provide sufficient quantity of essential requirement to the larva to produce anti-bacterial and anti-viral factor. It resulted in high rate of multiplication of infectious bacteria and development of flacherie disease (Nataraju et al., 2005). Virus diseases in Bombyx mori, particularly the nuclear polyhedrosis virus (NPV) account for 70-80% of the total loss and thus pose major problem in sericulture (Babu et al., 2005). In India the white muscardine is observed during high humid seasons. Muscardine infected larvae becomes inactive loses interest in feeding, dies, body gradually hardens and is covered with mycelia of pathogen and turns to white colour (Ramanjaneyulu, 1992). White muscardine disease caused by the fungus, Beauveria bassiana (Bals.)Vuill. is the most contagious and dreaded disease in silkworm which is more common during rainy and winter seasons in India (Chandrasekharan et al., 2006).

Antibiotics used for clinical purposes have therapeutic effects on silkworms infected with the pathogens (Staphylococcus aureus, Candida albicans) (Hamamoto, et al., 2004). Kaito et al. (2002) found that when ampicillin (200 µg), oxacillin (200 µg) or vancomycin (200 µg) was injected in the silkworm larvae after injection of the bacterium, at least 90% of the larvae survived for 4 days. Ganciclovir, foscarnet, vidarabine and ribavirin (antiviral agents) inhibit the proliferation of baculovirus in silkworm body fluid and had therapeutic effects (Orihara et al., 2008).

Silkworm as an animal model in screening of antibiotics

Animal models are important for the identification and evaluation of bacterial genes that are required for virulence and to study infectious stages at a molecular level (Kaito et al., 2005). Infection models of the nematode, Caenorhabditis elegans, and the fruit fly, Drosophila melanogaster, have already been reported but due to limitation on small body size it is difficult to handle

for injection experiments. The silkworm (Bombyx mori) is an easily bred invertebrate animal used for basic studies because of its importance in sericulture. The silkworm model is technically convenient, ethically acceptable and fast as larval period is short, and can be used on a wider scale in the study of pathogens and drugs (Iyengar, 2008). Silkworms are big enough for preparations of the haemolymph to be made and big enough for organs such as the midgut to be isolated (Hamimoto et al., 2004). The 50% effective dose (ED50) values obtained by injection of antibiotics into the silkworm haemolymph are consistent with those reported in mouse (Hamimoto et al., 2004). The body weight of silkworm larvae is almost 2 g (a tenth smaller than that of mouse), and therefore, the sample dose necessary for assay in silkworm is smaller than that of mouse. The body size of silkworm larvae is big enough to perform injection experiments easily and accurately compared to other small model animals, such as Drosophila melanogaster or Caenorhabditis elegans (Hamimoto and Sekimizu, 2005).

CONCLUSION

Antibiotics enhance feed consumption and growth by stimulating metabolic processes within the silkworm as well as reduce the occurrence of diseases which causes immense loss to sericulture industry. Antibiotics that are used in clinic to treat infection in mammals showed therapeutic effect in silkworm larvae infected with bacteria, virus or true fungi. As the 50% effective dose (ED50) antibiotics in the silkworm are consistent with mouse, the silkworm larvae infection system may provide a convenient and novel way to discover new antibiotics which have not been found using the existing systems of drug screening and pathogen studies.

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