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INFLUENCE OF SPIRULINA ON YIELD AND SILK QUALITY OF *BOMBYX MORI* (L.) (LEPIDOPTERA : BOMBYCIDAE) FED WITH MR-2 MULBERRY LEAVES

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Abstract

Sericulture is both an art and science of raising silkworms for silk production. Silkworm *Bombyx mori* is essentially monophagous insect feeding solely on mulberry leaves. The silkworm larvae are highly sensitive and respond to the changes in mulberry leaves and climatic factors. The supplementation and fortification of mulberry leaves is a recent technique on sericulture research. Fortification of the mulberry leaves by nutrient supplementation can increase the quality and productivity of silk. *B. mori* requires specific sugar, amino acid, proteins and vitamins for normal growth and development. Various nutrient substrates and extracts of medicinal plants have been tested by supplementation in the silkworm diet and were seen to influence the body weight, silk gland height and the silk thread length in *Bombyx mori.* Multivitamin and mineral compounds could increase the food intake, growth and permission efficiency of silkworms. Again nutrient supplement is good in improving the qualities of silk fibre which can be used for yield enhancement in sericulture industry. *Spirulina*, (Blue green algae) are free living, photosynthetic, and N_2 fixing bacteria found in fresh, marine water and terrestrial environments which contains 18 amino acids viz., glutamine, glycine, histidine, lysine, methionine, creatine, cysteine, phenylalanine, serine, proline, tryptophan, asparagine, pyruvic acid and vital vitamins like biotin, tocopherol, thiamine, riboflavin, niacin, folic acid, pyrodozoic acid, beta-carotene and vitamin B12. Silkworm derives over 70% of the protein from the mulberry leaves and in 5th instar up to 96% of ingested protein is used for silk protein synthesis and variation in the quantity or quality of nutrition have profound effect on insect development. The result obtained from the present study revealed a significant variance on nutritional traits between the different doses of spirulina treated MR2 leaves. It can be utilized as a source of proteins, lipids, vitamins and secondary metabolites.

Key words : *Bombyx mori*, Spirulina, Denier, Flavonoids.

Introduction

Chemical composition of mulberry leaf varies with variety and maturity. The mulberry leave are rich in flavanoids, alkaloids and polysaccharides components, which are known as the most potent compound by chemical constituent investigation (Wang *et al.,* 2008). The anti-inflammatory antioxidant and anticarcinogenic effects of flavanoids are some of the properties that have been under consideration in view of therapeutical purposes for several human diseases. Flavanoids are thought to be one of the most critical constituents in mulberry that have therapeutic activity (Snijman, 2007).

The silkworm larvae are attracted by three stimulants in mulberry leaves *viz*., the attractant, biting factor and swallowing factor (Hamamura and Naito, 1961). There is a need to recognize and integrate the physiological and nutritional requirements of the silkworm hybrids under ecological conditions in breeding and management programmes to make them need-based (Nagaraju, 2002). Sunmioka *et al*. (1982) have observed that the leaf consumption influenced the body weight which in turn influences the silk output. Therefore to boost the production of the silk, improved quality of leaf or mulberry variety has to be used for silkworm rearing. The relationship between the environment and genes has considered by directional with food consumption efficiency gene expression various depending on the genetic background of an organism and expressed physiological or nutritional unit in gene regulation studies (Giacobino *et al.,* 2003; Milner, 2004; Kang, 2008; Ogudanwo and Okanlawon, 2009). Further, the ingesta and digesta required for producing one gram of cocoon and shell (I/g and D/g) were worked out as described by standard gravimetric method (Waldbauer, 1968; Scriber and Feeny, 1975). The total annual demand for silk yarn and fresh cocoon is approximately 655 and 6,500 MTs, respectively, valued about 5000 million rupees.

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Materials and Methods

Supplement feed preparation

Studies were carried out on enriching the mulberry leaves with *Spirulina* in different concentrations to improve the silkworm nutrition. The experiments were conducted with silkworm race L **X** CSR 2 (multivoltine). *Spirulina* was dissolved in distilled water and diluted into 100ppm, 200ppm, 300ppm and 400ppm concentrations. The IIIrd, IVth and Vth instar larvae were utilized for the experiment. Third instar larvae were divided into five experimental groups including control, each group consisting 20 larvae. Four replications were maintained for each of the treatments. Fresh mulberry leaves were sprayed with aqueous extract of *Spirulina*, and then leaves were dried under fan before feeding to the silkworms till end of the fifth instar. During this period the worms were fed four times a

day and maintained with necessary disinfection conditions. The feeding were maintained upto the cocoon stage of the silkworm. The mature larvae from both control and experimental groups were isolated and mounted on separate plastic mount age (Netrika). The cocoons were collected on 5th day of mounting and were assessed for economic parameters *viz.,* cocoon weight, shell weight, filament length and weight, denier, raw silk percentage and silk productivity.

Results and Discussion

Studies on Cocoon Characters
Yield of cocoon by number

The maximum number of 93 cocoons per 100 larvae was recorded on T_4 400ppm *Spirulina* treated mulberry followed by 300ppm (90), 200ppm (88) and 100ppm (85), in contrast the least number of cocoons were recorded in control 81 per 100 larvae (Table 1).

Yield of cocoon by weight

With regard to weight of cocoon, the larvae fed on *Spirulina* T_4 400ppm treated mulberry was recorded maximum weight (23.50g) followed by 300ppm (21.70g), 200ppm (20.90) and 100ppm (19.20g). Least weight of 18.30g was witnessed in untreated control (Table 1) .

Studies on Silk Quality
Silk filament length (mts)

The maximum filament length of 710.50 mts was reeled from cocoon reared on silkworm larvae fed on mulberry leaves treated with *Spirulina* in 400ppm followed by 705.50 mts on 300ppm, 690.50 mts on 200ppm and 100ppm on 685.20 mts, whereas minimum of 680.15 mts was recorded on untreated control MR2 leaves (Table 2).

Filament weight (g)

Filament weight was found to be significantly maximum (0.20 g) when worms were fed on 400ppm *Spirulina* treated mulberry leaves followed by 300ppm (0.18g), 200ppm (0.17g) and 100ppm (0.16g). However, it was significantly minimum when worms were fed on untreated mulberry leaves (control) on 0.14(Table 2).

Denier

The silkworm larvae fed on mulberry leaves treated with *Spirulina* in 400ppm was recorded on highest denier of 2.54 followed by 300ppm (2.35), 200ppm (2.28) and 100ppm (2.19) whereas lowest denier 1.95 was recorded on control MR2 leaves (Table 2).

Raw silk percentage

After completing the reeling, maximum raw silk of 91.15 per cent reeled from larvae fed on mulberry leaves treated with *Spirulina* in 400ppm followed by 89.53per cent on 300ppm, 87.34 per cent on 200ppm and 85.25 per cent on 100ppm, whereas minimum raw silk per cent of 82.50 was recorded on control MR2 leaves (Table 2).

Efficiency of the nutrition gets nullified by the increase in consumption resulting in increased production of cocoon, shell and it is understand that dietary factors and related metabolic interactions has either a direct or indirect bearing. In the present study, treated mulberry leaves may have helped the silkworm larvae in a beneficial way, leading to the there in conversion and silk synthesis. The findings of the present study on feeding leaves with spirulina influenced various economic characters of III[rd], IV[th] and V[th] instar larvae of *B. mori*. The results corroborate the earlier findings of Frasisse and Arnoux (1954) and Balasundaram *et al*. (2007).

It may be thus inferred from the present study that the leaves treated with spirulina results in the production of improvement of the quality of cocoon and silk in respects to silk traits.

Table 2: Influence of supplement feed on silk quality of *Bombyx mori*

Treatments	Filament length (mts)	Filament weight (g)	Denier	Raw silk (%) **
T_1-MR2 mulberry leaves + 100 ppm *Spirulina*	685.20^{d} (26.17)	0.166^{c} (0.407)	2.19^{d} (1.47)	85.25^{d} (67.40)
T_2-MR2 mulberry leaves + 200 ppm *Spirulina*	690.50^{c} (26.27)	0.174^{b} (0.417)	2.28^{c} (1.50)	87.34^{c} (69.13)
T_3-MR2 mulberry leaves + 300 ppm *Spirulina*	705.50^{b} (26.56)	0.184^{b} (0.428)	2.35^{b} (1.53)	89.53^{b} (71.09)
T_4-MR2 mulberry leaves + 400 ppm *Spirulina*	710.50^{a} (26.65)	0.200^{a} (0.447)	2.54^{a} (1.59)	91.15^{a} (72.76)
T_5-Control	680.15^{e} (25.88)	0.147^{d} (0.383)	1.95^{e} (1.40)	82.50^{e} (65.24)
SED	**8.1785**	**0.0056**	**0.0985**	**0.3881**
CD (p=0.05)	**17.819**	**0.0122**	**0.2146**	**0.8456**

Values are means of Four replications: *values in the parenthesis are square root transformed values; **values in the parentheses are arc sine transformed values; in a column, means followed by common letter(s) are not significantly different (*P* = 0.05) by Duncan's Multiple Range Test

Table 1: Influence of supplement feed on yield of *Bombyx mori*

Treatments	Cocoon yield / 100 larvae by	
	Number	Weight (gm)
T_1-MR2 mulberry leaves + 100 ppm *Spirulina*	85^{d} (9.21)	19.20^{d}
T_2-MR2 mulberry leaves + 200 ppm *Spirulina*	88^{c} (9.38)	20.90^{c}
T_3-MR2 mulberry leaves + 300 ppm *Spirulina*	90^{b} (9.48)	21.70^{b}
T_4-MR2 mulberry leaves + 400 ppm *Spirulina*	93^{a} (9.64)	23.50^{a}
T_5-Control	81^{e} (9.00)	18.30^{e} (4.27)
SED	**1.8394**	**0.1647**
CD (p=0.05)	**4.0077**	**0.3589**

Values are means of Four replications: values in the parenthesis are square root transformed values; in a column, means followed by common letter(s) are not significantly different (P = 0.05) by Duncan's Multiple Range Test

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