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# Impact of Sericin fortified mulberry leaves on the cocoon traits of silkworm *Bombyx mori* L.

**Jasmeena Qadir, RK Gupta, Kamlesh Bali, Magdeshwar Sharma and SK Gupta**

**Abstract**
The nutrition plays a crucial role in determining the good quality cocoon crop. An ingenious strategy involves the supplementation of nutrient enriched leaves to silkworm to improve the cocoon crop production. In the present investigation, the silkworm double hybrid FC1 × FC2 [(CSR6 × CSR26) × (CSR2 × CSR27)] was reared on fortified mulberry leaves with Sericin. Different instars *viz.*, 3rd instar, 4th instar and 5th in star was fed with Sericin fortified mulberry leaves separately. A significant increase in good cocoon percentage (98.33 %) and no stained cocoon, negligible flimsy (0.66%) and mountage-pressed cocoon (0.66 %), and least total defective cocoon (1.33 %) was found when 5th instar larvae were fed with Sericin fortified mulberry leaves in comparison to 3rd and 4th instar. This investigation revealed that not only protein supplementation during different larval stages but high rearing efficiency, silkworm breed, maintenance of hygiene during rearing, bed cleaning, mulberry leaf quality, and type of mountage used during spinning and environmental conditions maintained during rearing and spinning plays a major role in the successful cocoon crop production.

**Keywords:** Sericin, fortification, silkworm, defective cocoon

## Introduction
Silkworm, *Bombyx mori* being monophagous derives all the nutrients from mulberry leaf to build silk cocoon. The growth and development of silkworm larva is influenced by nutritional quality of mulberry leaves which ultimately determines the cocoon crop production. Silkworms switch 72-86 % of the mulberry leaf proteins into silk proteins and 30 % is derived from tissue and blood and 60 % of the absorbed amino acids are used for silk production (Lu and Ziang, 1988) [1]. Hence, nutrition plays an important role in determining the biological and economic parameters of silkworm. The seasonal fluctuations, agricultural practices, pest and disease attack afflicts the nutritional value, quality and quantity of mulberry leaf harvest. These factors immensely strike the larval growth and development and results in cocoon crop losses. The leaf quality particularly affects the growth, development and hence the overall cocoon production (Patil, 2003) [2].
An ingenious strategy involves the supplementation of nutrient enriched leaves to silkworm to improve the cocoon crop production (Masthan *et al.*, 2017) [3]. The improvement in the nutritional value of mulberry leaves by adding the nutrients augments the quality and quantity of silk (Saranya *et al.*, 2019) [4]. The fortification of nutrient supplements *viz.*, carbohydrates, proteins, vitamins, amino acids, sterols, antibiotics and hormones etc., enhance the crop production and improve the fibre quality (Aparupa, 2015; Hassan *et al.*, 2020) [5, 6]. Both quality and quantity of mulberry leaves influence the cocoon production. Besides leaf quality, the insufficient feeding of cocoons leads to small sized cocoons. The insufficient feeding in the fifth larval instar causes production of small sized cocoon (Kawaguchi and Kubota, 1996) [7]. The important parameters of the quality cocoon crop include, good cocoon percentage, pupation percentage, single cocoon weight, shell weight, shell ratio. The important parameters of the silkworm are influenced when proper food is not supplied because the quality and quantity of feed adversely affects the growth and development and ultimately the cocoon productivity traits (Ahmed *et al.*, 2015) [8]. Several attempts have been made to supplement the mulberry leaves with additional nutrients to get more cocoon yield and silk production. For instance, the fortification of amway protein (Rani *et al.*, 2011) [9], royal jelly, pollen grains, bee honey (Kamel *et al.*, 2016) [10], amino acids *viz.*, lysine, alanine, cysteine and glycine (Meeramaideen *et al.*, 2017) [11]. Improved the biological as well as economic parameters of silkworm. Hence, present experimental study has been designed to know the influence of

Sericin protein on the cocoon traits of silkworm, *Bombyx mori.*

## Materials and Methods

### Location of the research trial and methodology

The present investigation was conducted at Sericulture Research Laboratory of Division of Sericulture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during spring season of 2021-22. The silkworm eggs were procured from the Sericulture Development Department of Jammu and Kashmir Union Territory and then incubated under recommended conditions until hatching. The newly hatched worms were reared by following the standard rearing procedure suggested by Krishnaswami (1978) [12]. The silk cocoons were collected from the sericulture research laboratory and Sericin protein was extracted from silk cocoons by the method followed by Capar and Aygun (2015) [13]. The optimized Sericin dose was used for the fortification of mulberry leaves. The mulberry leaves were dipped in the Sericin solution and kept in shade to air dry the excess moisture.

### Test insect and details of treatment

Silkworm double hybrid (CSR6 × CSR26) × (CSR2 × CSR27) was used for feeding of the Sericin fortified mulberry leaf upto spinning of the cocoons. The silkworms were fed with normal food until 2nd instar. The Sericin fortified leaves were fed to three different instars *viz.*, 3rd, 4th and 5th once daily. The experiment was laid down in a completely randomized design with three replications each consisted of 100 silkworm larvae. The parameters were calculated by the following formulae:

### Good cocoon percentage

Good cocoons are superior in quality and ideal for reeling. After sorting, good cocoon percentage can be calculated by using the following formula:

$$\text{Good cocoon percentage} = \frac{\text{No.of good cocoon harvested}}{\text{Total no.of larvae retained after the 3rd mount}} \times 100$$

### Flimsy cocoon percentage

Flimsy cocoons are loosely spun cocoons constituting low silk content. It can be sorted and can be calculated by using the following formula:

$$\text{Flimsy cocoon percentage} = \frac{\text{No.of filmsy cocoon harvested}}{\text{Total no.of larvae retained after the 3rd mount}} \times 100$$

### Stained cocoon percentage

Stained cocoons are formed due to the oozing of liquefied contents of diseased and dead pupa inside the shell. It can be calculated by using the formula:

$$\text{Stained cocoon percentage:} \frac{\text{No.of stained cocoons harvested}}{\text{Total no.of larvae retained after 3rd moult}} \times 100$$

### Mountage pressed cocoon percentage

Mountage pressed cocoons are flat on sides due to over press by mountage. It can be calculated by the following formula:

$$\text{Mountage pressed cocoon percentage:} \frac{\text{Total no. of mountage pressed cocoons harvested}}{\text{total no.of larvae retained after 3rd moult}} \times 100$$

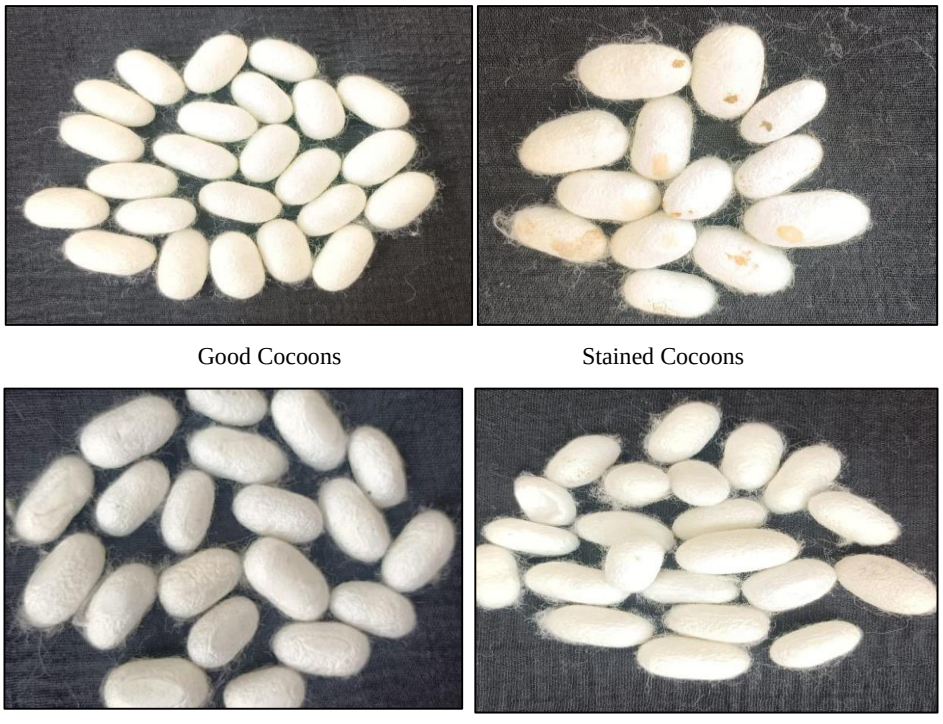
### Defective cocoon percentage

The defective cocoon comprises of the cocoons *viz.*, flimsy, stained, undersized, pierced encountered during cocoon sorting. It can be calculated by the following formula:

$$\text{Defective cocoon percentage:} \frac{\text{Total no.of defective cocoons harvested}}{\text{total no.of larvae retained after 3rd moult}} \times 10$$

### Statistical analysis

All the observations obtained for various parameters were tabulated and subjected to statistical analysis by using the SPSS version 26.0 (IBM SPSS 2019) [17].



Good Cocoons Stained Cocoons

Mountage Pressed Cocoons Flimsy Cocoons

**Plate 1:** Different types of cocoons harvested

## Results

The effects of Sericin fortified mulberry leaves on the cocoon traits varied significantly when different larval stages were fed. A significant increase in flimsy cocoons, stained cocoons, mountage pressed cocoon and consequently total defective cocoon was recorded when Sericin fortified leaves were fed to 3rd and 4th instar larvae. In the 5th instar stage, no stained cocoons, negligible flimsy and mountage pressed cocoons and ultimately least total defective cocoon were also recorded with significant increase in good cocoon percentage in comparison to the 3rd and 4th instar larvae (Table 1).

**Table 1:** Effects of Sericin fortified mulberry leaves on the economic traits of silkworm

| Instar | Good cocoon (%) | Flimsy cocoon (%) | Stained cocoon (%) | Mountage pressed cocoon (%) | Total defective cocoon (%) |
|---|---|---|---|---|---|
| 3rd | 83.33±0.66$^{a}$ | 4.00±0.57$^{c}$ | 4.00±0.57$^{c}$ | 4.33±0.33$^{c}$ | 12.33±0.33$^{c}$ |
| 4th | 91.33±0.33$^{b}$ | 2.33±0.33$^{b}$ | 1.66±0.33$^{b}$ | 2.33±0.33$^{b}$ | 6.33±0.33$^{b}$ |
| 5th | 98.33±0.88$^{c}$ | 0.66±0.33$^{a}$ | 0.00±0.00$^{a}$ | 0.66±0.33$^{a}$ | 1.33±0.66$^{a}$ |

**Note:** Each value is a Mean ± SE of three replications. Means within a column followed by different letters are significantly different at $p < 0.05$.

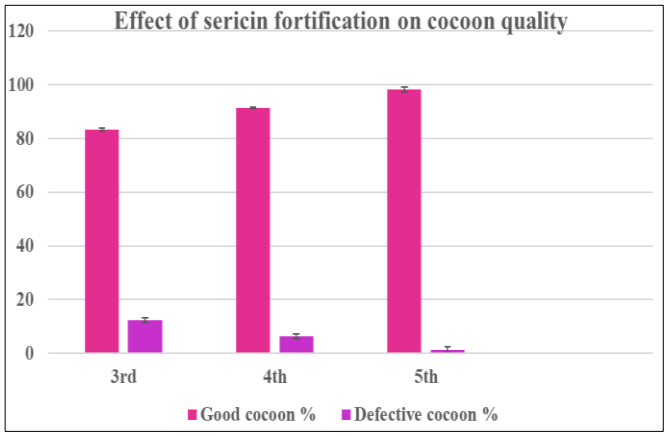



**Fig 1:** Effect of Sericin protein fortification during different larval stages on the cocoon quality.

The good cocoon percentage was significantly higher when 5th instar larvae were fed with Sericin fortified mulberry leaves in comparison to 3rd and 4th instar larvae. Whereas, the overall defective cocoon percentage was found significantly lower when 5th instar larvae were fed with Sericin fortified mulberry leaves, which is a desirable character from the economic point of view (Figure 1).

## Discussion

Good cocoon percentage is important for the quality raw silk production. Besides good cocoons, defective cocoons are also encountered during cocoon harvesting. The defective cocoons are unsuitable for reeling. In the current investigation, significantly, higher good cocoon percentage (98.33±0.88 %) and lower defective cocoon percentage (1.33±0.66 %) was noticed when the 5th instar larvae were fed with sericin fortified mulberry leaves in comparison to 3rd and 4th instar. The defective cocoons are formed due to improper mounting and lack of care during mounting of mature worms and accounts loss of 5-8 % of cocoon yield (Sahana *et al.*, 2020) [14]. However, the seasonal influences, environmental conditions *viz*., temperature and humidity maintained during rearing and spinning leads to defective cocoon production as well. Irrespective of larval stage, the current findings were found higher than previous author, Adeduntan (2015) [15] who found the maximum good cocoon (80 %) minimum flimsy cocoon (10.09 %) and minimum stained cocoon (1.47 %) and Fayaz *et al.* (2022) [16] who found maximum good cocoon percent (94 %) and defective cocoon (10 %). Hence, the quality of nutrition, the high rearing efficiency, hybrid silkworm breeds, maintenance of hygiene, bed cleaning frequency, during different stages and care during mounting plays a major role in production of good quality cocoons.

## Conclusion

The feeding of Sericin fortified mulberry leaves to 5th instar larvae significantly enhanced the good cocoon percentage and reduced the defective cocoon percentage in comparison to 3rd and 4th instar. Nonetheless, the quality of nutrition, the high rearing efficiency, hybrid silkworm breeds, maintenance of hygiene, bed cleaning frequency, during different stages and care during mounting influences the quality of cocoons. But the fortification of Sericin protein can play potential role in maintaining the nutritional stability during feeding stage and ultimately in producing the good quality of cocoons.

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