



# Effect of Tender Coconut Water as Feed Additive on the Cocoon Parameters of Silkworm *Bombyx mori*

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

## Article Information

DOI: <https://doi.org/10.56557/upjoz/2024/v45i174374>

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://prh.mbimph.com/review-history/3840>

Original Research Article

Received: 02/06/2024

Accepted: 06/08/2024

Published: 20/08/2024

## ABSTRACT

Impact of feeding tender coconut water to the 5<sup>th</sup> instar larvae of the multivoltine silkworms along with mulberry leaves seems yielding better results in improving certain aspects of cocoon quality and hence this study was planned to test the efficacy of enhanced feed in the silkworm *Bombyx mori* through diet which can enhance the economic performance of silkworms, potentially improving silk production. Supplementing the diet of silkworms with tender coconut water had improved their economic performance, leading to increased cocoon weight, pupa weight and shell weight ( $1.33\pm 0.17$  g,  $0.92\pm 0.12$  g and  $0.24\pm 0.34$ g) when compared to the control group. This suggests that incorporating tender coconut water into the diet of silkworms can enhance their productivity and economic value in Sericulture practices.

**Keywords:** Mulberry leaves; tender coconut water; feed additive; economic parameters of *Bombyx mori*.

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**Cite as:** S., Nivetha, Maheswari A. S., Anitha P., and Alli M.V. 2024. "Effect of Tender Coconut Water As Feed Additive on the Cocoon Parameters of Silkworm *Bombyx Mori*". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (17):318-25. <https://doi.org/10.56557/upjoz/2024/v45i174374>.

## 1. INTRODUCTION

The role of Silkworms (*Bombyx mori*) in the production of silk can be seen in their domestication history of over 5,000 years in India. It emphasizes the importance of Sericulture in various countries, including industrially advanced nations like Japan and Russia, as well as developing countries like India and South Korea [1]. Leaves of *Morus* species are very important due to their nutrition quality as it forms the primary food source for Silkworms (*B.mori*). Enriching these leaves with nutrients can significantly impact the health, growth, and development of silkworm larvae, ultimately influencing the quality and quantity of silk production. This practice has been shown to enhance the economic traits of silkworms, emphasizing the crucial role of nutrition in Sericulture for optimizing silk production [2].

The silkworm, scientifically known as *Bombyx mori* is a type of insect that feeds exclusively on mulberry leaves. Humans have greatly benefited from the silk produced by silkworms, and researchers have been exploring ways and means to enhance the growth and quality of cocoon production by silkworms by manipulating factors such as the type of mulberry variety and the incorporation of food additives [3]. Enriching mulberry leaves with additional nutrients, such as amino acids, is a method used to enhance the growth rate of the silkworm species *Bombyx mori*. Silkworm larvae, if they are fed with mulberry leaves enriched with amino acids, then, it is observed that there is a significant improvement in their growth. This approach aims to optimize the nutritional value of the silkworm's food source to promote better development and ultimately to increase silk production [4]. Silkworm nutritionists have been actively exploring ways to improve the nutritional supplements provided to silkworm rearers. Several studies have demonstrated the effectiveness of supplementing mulberry leaves with various nutrients such as protein, vitamins, amino acids, minerals, hormones, and antibiotics. These supplements have been found to enhance the performance of silkworms, resulting in higher yields of quality cocoons [5].

Extract of various feed additives such as *Ocimum sanctum* (Thulasi), egg white, yeast extract and *zea maize* flour etc. has been elicited various response in silkworm and on the economical characters such as cocoon weight,

shell weight and pupa weight in *Bombyx mori* [6,7,8,9].

The study of Umarani reported that increasing dose of supplementary diet soyabean is directly proportional to the quality of cocoons [10]. Ascorbic acid, pollen and soya flour were used by Abdellah as additives with mulberry leaves [11]. Whereas Nguku *et al.* used royal jelly. Mahmoud and Ashor, used the biofertilizer (Rizobactine) for fortification of mulberry leaves [12,13]. Mokayes *et al.*, used Legume as additives on mulberry leaves [14] the honeybee products and yeast for the same purpose [15].

Coconut water is a complex mixture of biologically active components, including vitamins, minerals, sugars, enzymes, proteins, amino acids, antioxidants, and growth hormones. Traditionally, coconut water has been used for both dietary and medicinal purposes due to its beneficial properties. However, there has been limited research on the effects of green coconut water on silkworms. The present study aims to evaluate the impact of immature green coconut water on the economic parameters of multivoltine silkworms, specifically *Bombyx mori*.

## 2. MATERIALS AND METHODS

### 2.1 Collection and Rearing of *Bombyx mori*

The silkworm *Bombyx mori* (FC1XFC2) larvae were collected from the regular farmers who rear on large scale at Thanjavur District. The larvae were reared in our Department Sericulture Unit. The rearing room and appliances were thoroughly cleaned and the floor was washed with 5% bleaching powder solution. The whole rearing unit was disinfected by spraying with 2.5 percent sanitech in 0.5 percent slacked lime solution [16]. Bed cleaning was done once during first instar and twice during second instar. An optimum temperature of  $25 \pm 1^\circ\text{C}$  and  $75 \pm 5\%$  relative humidity was maintained [17].

### 2.2 Experimental Setup

The fifth instar larvae were selected for this study. Larvae were divided into two groups of fifty worms each. During the experimental set up, mulberry leaves were soaked in the tender coconut water (TCWT) and air-dried. TCWT coated mulberry leaves were fed to the larvae three times per day at 9.00 am 13.00 pm and 17.00 pm. The control group was fed with

untreated mulberry leaves. At this point of the present study, economical parameters of larvae and cocoon were monitored and measured. The larval weight, cocoon weight, pupae weight and shell weight were recorded.

## 2.3 Observation of Economic Characters of Silkworm

### 2.3.1 Larval weight of silkworm

In this study we recorded the effect of tender coconut water enriched mulberry leaves on the larval weight of the silkworm in 5<sup>th</sup> instar period (6 days) using a digital balance (0.01 g) [18].

### 2.3.2 Cocoon Characters of Silk worm

After the completion of larval period, the ripened larvae were mounted and the cocoons were harvested on the fifth day. The commercial parameters such as cocoon weight, pupal weight and shell weight were determined by adopting the standard procedure [19].

### 2.3.3 Cocoon, Pupae and shell weight

The cocoons were harvested randomly one week after pupation from each of the batch. The cocoon, pupae and the shell weight were recorded. Cocoons were weighed using an electronic balance and the weight was expressed in grams. After removing the floss, the cocoons were cut opened and the pupae were taken out without causing any damage. The pupae were weighted using an electronic balance. The shell of the cocoon after removing the floss and pupa was weighed using an electronic balance [20].

## 2.4 Statistical Analysis

All the values were statistically analyzed and are presented as Mean±Standard deviation.

## 3. RESULTS AND DISCUSSION

This study indicates that, the effect of tender coconut water feed on the cocoon parameters of silkworm *Bombyx mori*. The experimental setup, *Bombyx mori* L. larvae that were fed with mulberry leaves coated with tender coconut water (TCT) were monitored and compared with the control group (Fig. 1). The growth and development of silkworms, specifically *Bombyx mori*, heavily rely on a balanced nutrition. Previous studies have shown that supplementing mulberry leaves with additional nutrients has led

to significant improvements. In the current study, feeding 5<sup>th</sup> instars larvae with mulberry leaves treated with tender coconut water has shown promising results in enhancing various economical parameters related to silk production. It was observed that there was an increased larval weight, cocoon weight, shell weight and pupae weight because of the treatment with tender coconut water when compared to that of the control group (Figs. 2 and 3). The silk worm fed with mulberry leaf treated with tender coconut water showed the highest cocoon weight ( $1.33\pm 0.17$ ), pupae weight ( $0.92\pm 0.12$ ) and the shell weight ( $0.24 \pm 0.34$ ) when compared with the control group and it is significantly impacting the increasing trend in the weight of cocoon, pupae and in the shell (Table 1) (Figs 4 and 5).

The improved economic traits observed in silkworms may be attributed to the high concentration of essential micro-minerals, vitamins, phytohormones, antioxidants, and other complex nutrients found in tender coconut water. Previous studies have confirmed that minerals are essential for regulating in the growth of silkworms, similar to other organisms. To enhance economic parameters, scientists have investigated the effects of dietary mineral supplementation.

Dudcheewan *et al.*, had supplemented with young and matured coconut water in their study and carried out the research at day 2 and at day 4, of the fifth instar, with a total of two times or four times, to two Thai polyvoltine strains, Nang-Noi and Nang-Lai, of the silkworm, *Bombyx mori* experiment at the Mahasarakham University. They concluded that the supplementation with young coconut water two times was effectively impacting on the increase in the cocoon shell ratio. On the other hand, it was inferred that supplementation with mature coconut water for four times was found to be very effective for increasing the cocoon filament length. They further revealed that the difference in nutrient content between the young and matured coconut water and the method of supplementation of two times or four times brought about an increase in the specific cocoon characters [21].

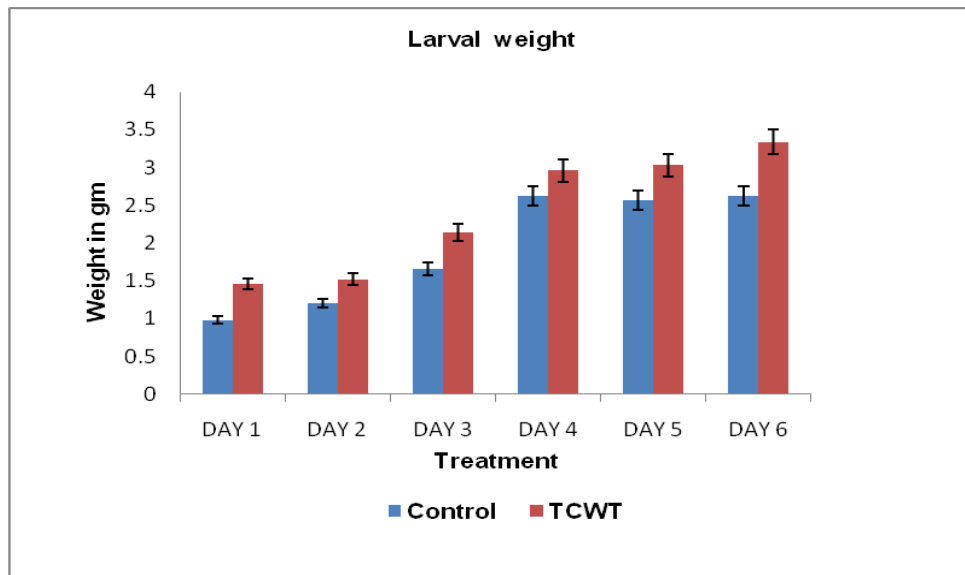
Walaa Sallam *et al.*, had conducted a study to analyze the importance of enriched mulberry leaves with nutrients like vitamin C (ascorbic acid) to enhance the silk production. The study highlighted the significant impact of nutrients such as lemon juice on cocoon indices and silk filament characteristics, demonstrating the

potential for improving silkworm growth and productivity through nutritional additives. Further their study emphasized that the highest concentration (4%) of lemon juice, sweet orange juice and ascorbic acid gave the highest mean of fresh cocoon weight, shell cocoon weight and silk

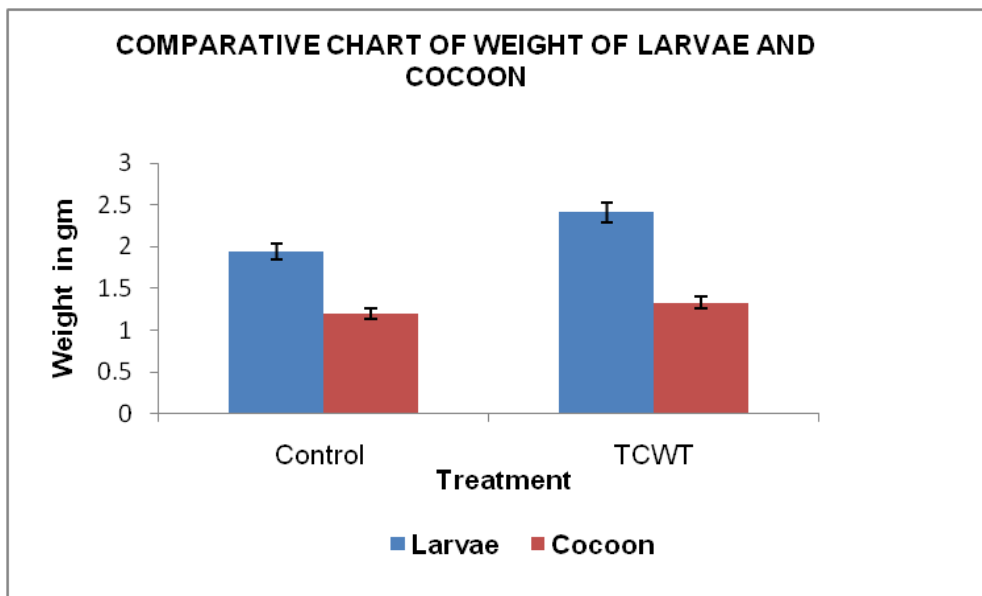
ratio and the highest concentration (4%) of ascorbic acid and lemon juice gave the highest mean of silk filament length as compared to 1%, 2% and 3% of ascorbic acid, lemon juice and sweet orange juice respectively [22].

**Table 1. Effect of tender coconut water on the cocoon characters of *Bombyx mori***

Treatment	Cocoon weight(gm)	Pupae weight(gm)	Shell weight(gm)
Control	1.20±0.20	0.86±0.15	0.23±0.04
TCWT	1.33±0.17	0.92±0.12	0.24±0.34



**Fig. 1. Effect of Tender Coconut Water on the Larval Weight of Silkworm**



**Fig. 2. Comparison on the effect of Tender coconut water fortified mulberry feed to the silkworm larvae and cocoon**

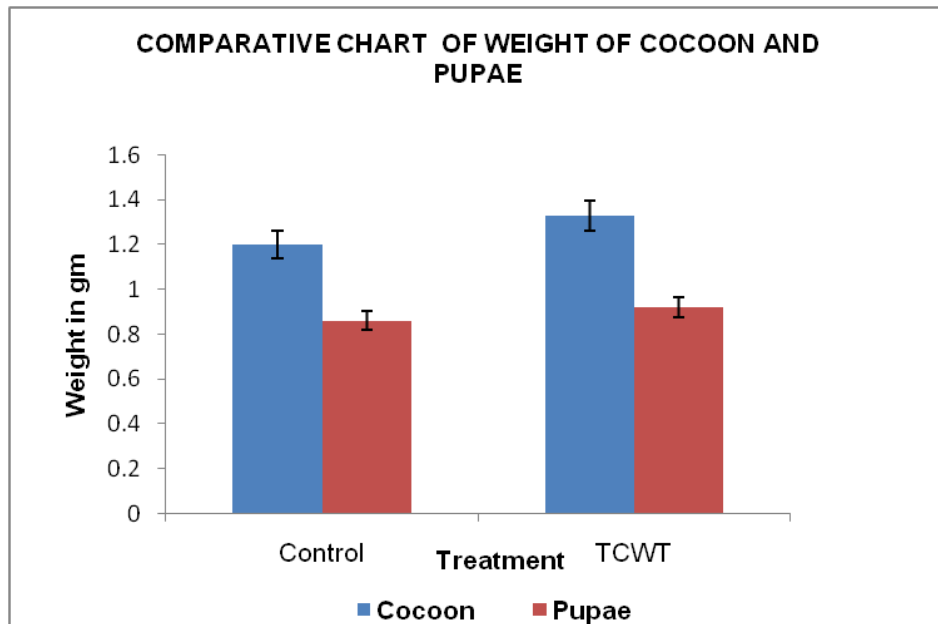


Fig. 3. Comparison on the effect of Tender coconut water fortified mulberry feed to the silkworm cocoon and pupae

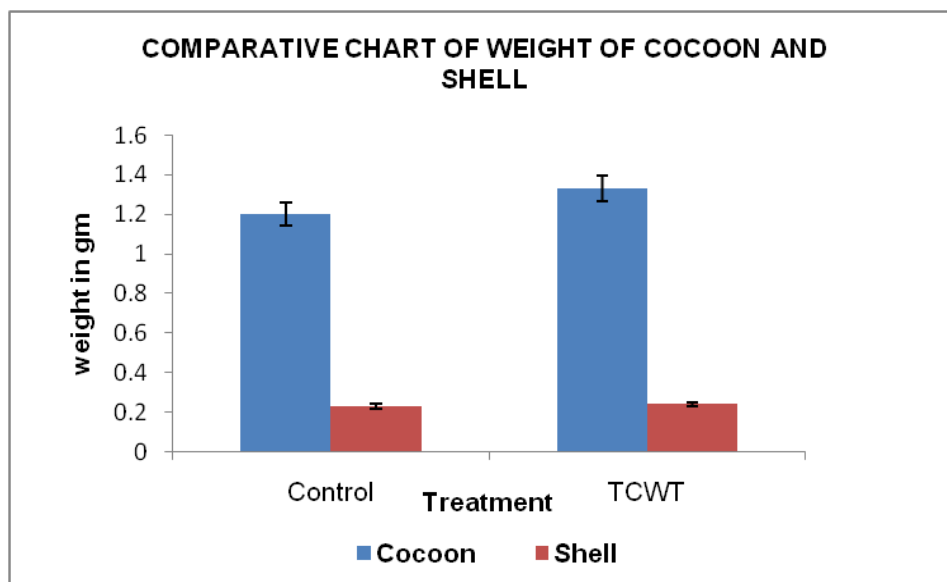


Fig. 4. Comparison the effect of tender coconut water fortified mulberry feed to the silkworm cocoon and shell

Kanafi had examined the effect of different vitamins on the nutritional enrichment of mulberry leaves and it was found that all the vitamins showed a positive effect on the *Bombyx mori* growth and development [23].

Quraiza et al., had observed a significant increase in the protein content of the silk gland, fat body, and muscles of *Bombyx mori*, when fed with 1% and 2% ascorbic acid [24].

Ganga et al., too had examined the dietary supplementation of wheat and rice flours resulting an increase in fibroin content of the silkworm [25].

The previous study of Nivetha et al., which was conducted to test the impact of yeast extract on the economic traits of silkworm, *Bombyx mori* L. had revealed that the mulberry leaves treated with 0.5% and 1% of yeast extract

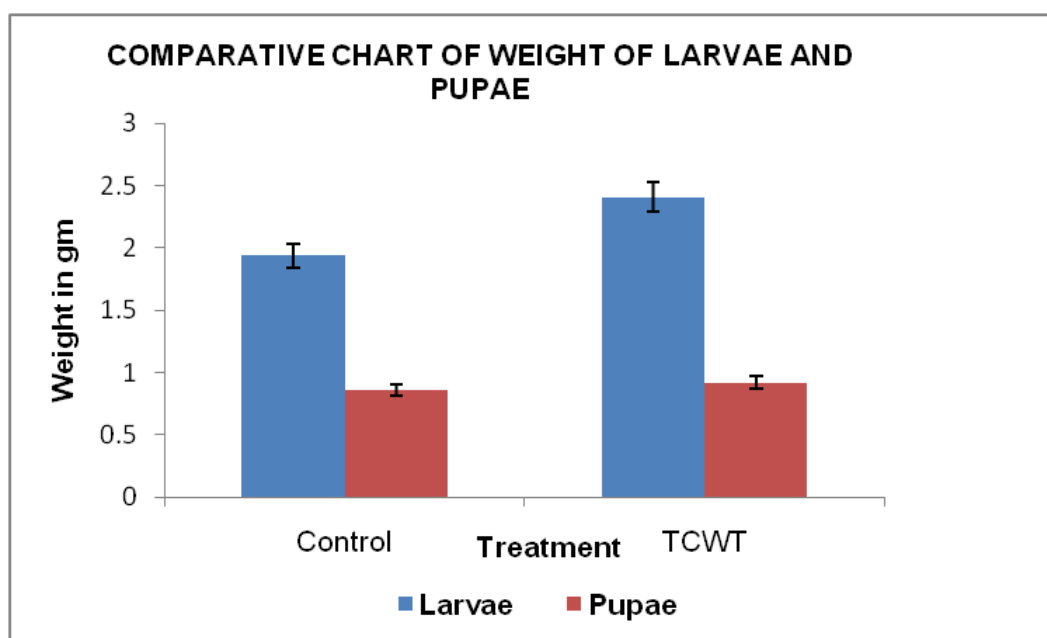


Fig. 5. Comparison on the effect of tender coconut water fortified mulberry feed to the silkworm larvae and pupae

(YES1, YES 2) which were fed to silkworm larvae, were found to be giving a significant result in the larval weight ( $2.68 \pm 0.17$ ), cocoon weight ( $2.10 \pm 0.20$ ) and in the shell weight ( $1.70 \pm 0.15$ ) at 1% concentration of yeast. Therefore, they revealed that the yeast extract is positively and significantly impacting on the cocoon parameters and the current result coincide with the previous result [26].

#### 4. CONCLUSION

The study aimed to assess the impact of feeding silkworm larvae with fortified mulberry leaves with tender coconut water on the growth and cocoon quality of silkworm. Results indicated that the tender coconut water had significantly improved the larval weight, cocoon quality, pupal weight, and the shell weight when compared to the control group. This suggests that the tender coconut water plays a crucial role in enhancing the growth and quality of *Bombyx mori* cocoons when incorporated into their diet.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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