



RESEARCH ARTICLE

MILK AS A DIETARY SUPPLEMENT IN THE DEVELOPMENT OF THE SILKWORM *Bombyx mori* L.

Leodan Tadeo Rodríguez-Ortega¹, Alma Rosa Hernández-Rojas², Martha Patricia Chaires-Grijalva³, Filogonio Jesús Hernández-Guzmán⁴, Alejandro Alviter-Aguilar⁵, Álvaro Castañeda-Vildózola⁶ and Alejandro Rodríguez-Ortega^{7*}

¹Universidad Politécnica de Francisco I. Madero, Ingeniería en Producción Animal. Tepatepec, Hidalgo, México; ²Universidad Intercultural del Estado de Hidalgo, Tenango de Doria, Hidalgo, México; ³Universidad Autónoma de Tamaulipas. Unidad Académica Multidisciplinaria Mante, México; ⁴Universidad Autónoma Chapingo, Departamento de Ingeniería Agroindustrial, Texcoco, Estado de México; ⁵Universidad Autónoma Chapingo, Posgrado en producción Animal, Texcoco, Estado de México; ⁶Universidad Autónoma del Estado de México, Facultad de Ciencias Agrícolas, Campus el "Cerrillo", El Cerrillo Piedras Blancas, Toluca Estado de México; ⁷Universidad Politécnica de Francisco I. Madero, Ingeniería en Agrotecnología, Tepatepec, Hidalgo, México.

ARTICLE INFO

Article History:

Received 14th January, 2026
Received in revised form
24th February, 2026
Accepted 25th March, 2026
Published online 30th April, 2026

Keywords:

Silkworm, Pupa, Cocoon, Milk.

*Corresponding author:

Alejandro Rodríguez-Ortega

ABSTRACT

In this research, cow's milk was used as a growth promoter to increase the size of silkworm (*Bombyx mori* L.) cocoons and pupae. The experiment was conducted at the Entomology Laboratory of the Francisco I. Madero Polytechnic University, located in Tepatepec, Hidalgo, Mexico. Nine different commercial brands of milk were evaluated. The experimental design was completely randomized with ten treatments and ten replicates. The variables evaluated were pupa weight and cocoon weight. Fifth-instar larvae were fed three times a day by immersing mulberry leaves in each commercial milk treatment for approximately five minutes. The results were analyzed using the SAS statistical software, and the averages were analyzed using Tukey's test. We concluded that the best results were obtained with supplementation using Lala, Fortileche, and Nutrileche milk, with a statistically significant difference. We suggest that during the winter season it is recommended to feed silkworms with these milks to obtain good quality cocoons and pupae.

Copyright©2026,Leodan Tadeo Rodríguez-Ortega et al. 2026. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation:Leodan Tadeo Rodríguez-Ortega, Alma Rosa Hernández-Rojas, Martha Patricia Chaires-Grijalva et al. 2026. "Milk as a dietary supplement in the development of the silkworm *Bombyx mori* L.". *International Journal of Current Research*, 18, (04), 36885-36887.

INTRODUCTION

The silkworm is an insect that is farmed on a large scale. Its life cycle includes the egg, larva, pupa, and adult stages. Silk is obtained from the cocoon when the silkworms transform from larva to pupa. This insect belongs to the order Lepidoptera, a group that includes moths, which are nocturnal (including the silkworm), and butterflies, which are diurnal (Wu *et al.*, 2021). The mulberry tree is a multipurpose plant native to China. For over 5,000 years, it has been the sole food source for silkworms due to its excellent nutritional qualities, particularly its high protein and energy content. It is also used in various regions of the world for livestock feed (Martin *et al.*, 2007). Its cultivation began to implement sericulture in Asian countries. It represents the agronomic aspect of the sericulture industry because its leaves are the sole food source for the silkworm (*B. mori*) (Lepidoptera: Bombycidae). In Mexico, the area under mulberry cultivation is small and concentrated in the states of San Luis Potosí, Oaxaca, and Hidalgo, with introduced and

local varieties, identified as criollas. Their adaptability, morphological behavior, and productivity in different agroecological systems across the country are unknown (Rodríguez *et al.*, 2012). Furthermore, for its morphological development and to carry out its physiological functions, the silkworm requires two important nutrients: crude protein and carbohydrates. These are found in high concentrations in young mulberry leaves. The amount of nutrients, proteins, lipids, carbohydrates, vitamins, minerals, and water varies depending on the variety, soil fertility, climate, time of year, age, and the position of the leaves on the tree (Rodríguez *et al.*, 2012). Cow's milk provides a large amount of easily digestible, high biological, value protein, supplying the essential amino acids needed to meet nutritional requirements. Thanks to its nutrient content and excellent balance of nutritional quality and energy, it is a necessary food. (Fernández *et al.*, 2015). The objective of this research was to evaluate the weight gain in the cocoon and pupae of the silkworm *B. mori* L. by feeding fifth



Figure 1. Graphical representation of silkworm feeding on mulberry leaves impregnated with milk. Image generated with Artificial Intelligence (ChatGPT)

instar larvae with different types of commercial milk in the Mezquital Valley, Hidalgo, Mexico.

MATERIALS AND METHODS

This research was conducted at the Francisco I. Madero Polytechnic University, located in Tepatepec, Hidalgo, Mexico. The region has a predominantly cool temperate climate with an average annual temperature of 17°C and an annual rainfall of 540 millimeters. Its geographic coordinates are 20° 15' 20" north latitude and 99° 00' 10" west longitude of the Greenwich meridian, and it is located 53 kilometers from the state capital (Inegi, 2010). *B. mori* silkworms in good physical condition and of a suitable size were used for each treatment. It should be noted that the silkworms used were in the fifth instar of their life cycle (Figure 1). The selection of silkworms was completely random, taking ten specimens as replicates for each treatment: Control, Nutri leche, Alpura, Lala, Forti leche, Santa Clara, Raw cow's milk, Strawberry Alpura, Chocolate Alpura, and Evaporated Carnation.

A completely randomized experimental design was used, with each treatment placed on a Styrofoam tray containing ten larvae. There were nine treatments, each using a different type of commercial milk, and a control for comparison. During the experiment, mulberry leaves were washed with clean water, dried at room temperature, and then immersed in containers holding each of the milks. The leaves remained submerged in the treatments for approximately five minutes before feeding the insects. The results were analyzed using the statistical software (SAS, 2004), and Tukey's test was used to compare means and determine if there were significant differences between the treatments.

RESULTS AND DISCUSSION

Using Tukey's test for mean comparison ($P < 0.05$), significant differences in cocoon weight were found (Figure 2). The best averages were obtained with Lala, Fortileche, and Nutri leche milk, while the treatments with Santa Clara, Alpura strawberry flavor, and Carnation evaporated milk showed low averages. Similar data were reported by Sisodia and Gaherwal (2019), who found that cocoon weight increased compared to the control and suggested feeding silkworm larvae with mulberry leaves soaked in cow's milk during the fifth larval stage to

obtain better weight and spinning yield. Ruiz *et al.* (2023), determined that mulberry foliage supplemented with milk has a positive effect on the growth and weight of *B. mori* larvae. Furthermore, it promotes early larval maturation, accelerating the start of cocoon construction. They assert that cow's milk induced a significant increase in productive traits such as cocoon weight, silk percentage, and pupa weight, and was directly related to increased silk production yield.

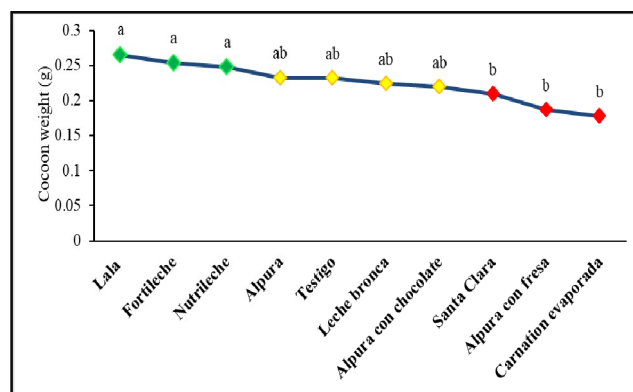


Figure 2. Average results of silk cocoon weights, where larvae were fed with mulberry leaves impregnated with different types of milk

Regarding the average weight of pupae, we determined that there is no statistically significant difference between treatments, which means that the different types of milk do not have an effect on weight gain (Figure 3).

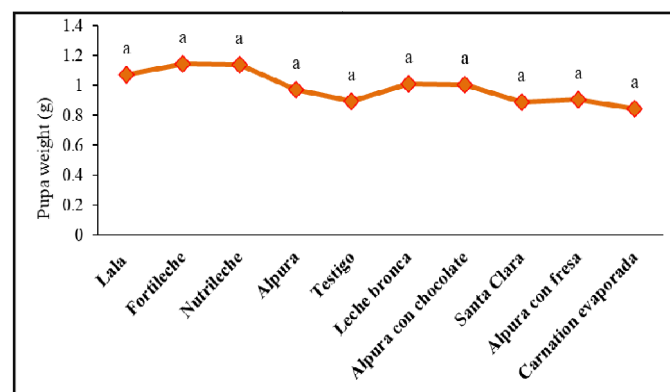


Figure 3. Average pupal weight results for the silkworm *B. mori*.

Sisodia and Gaherwal (2019), report that lactose is the main carbohydrate component of milk and that *B. mori* has been shown to possess the enzyme beta-glucosidase, which is active on both cellobiose and lactose. The presence of this enzyme suggests that the larvae can feed on milk, as lactose presents no digestive problems. The main protein component of milk is casein, which has been shown to be beneficial for the development of *B. mori*. These researchers mention that casein contains a high amount of glutamic acid, and the larvae require this amino acid, as well as aspartic acid, for proper growth. Finally, they suggest that the addition of different vitamins to the nutritional enrichment of mulberry leaves has a positive effect on the growth and development of the larvae.

CONCLUSION

This research concludes that, for the winter season in the study region, it is recommended to feed fifth instar silkworm larvae with fresh mulberry leaves enriched with Lala, Fortileche, and Nutri leche milks to obtain cocoons and pupae with a good average weight.

REFERENCES

- Fernández F. E., Martínez H. J. A., Martínez S. V., Moreno V. J. M., Collado Y. L.R., Hernández C. M., y Morán R. F. J. (2015). Documento de Consenso: importancia nutricional y metabólica de la leche. *Nutrición Hospitalaria*. 31(1):92-101.
- Inegi. (2010). Compendio de información geográfica municipal 2010 de Francisco I. Madero Hidalgo. México. 9 p.
- Martín, G.J., Noda, Yolai., Pentón, Gertrudis., García, D. E., F. García., González, E.; Ojeda, F., Milera, M., López, O., Ly J., Leiva, L., y Arece, J. (2007). La morera (*Morus alba* Linn.): una especie de interés para la alimentación animal. *Pastos y Forrajes*, Vol. 30.
- Rodríguez, O. A., Martínez, M. A., Ventura, M. A., y Vargas, M. J. (2012). Adaptación de tres variedades de morera (*Morus* spp.) en el estado de Hidalgo. *Revista Mexicana de Ciencias Agrícolas*, Vol.3 Núm. 4, pp. 671-683.
- Rodríguez, O. A., Martínez, M. A., Ventura, M. A., Vargas, M. J., Muhamed E. y Lara, V. F. M. (2013). Evaluación de variedades de morera en la alimentación del gusano de seda (*Bombyx mori*) en Hidalgo, México. *Revista Mexicana de Ciencias Agrícolas*, Vol. 4, Núm. 5, pp 701-712.
- Ruiz-Eraza, X., Zambrano-González, G., Castañeda-Vildozola Á., Rodríguez-Ortega, L. T., Pro-Martínez, A., Hernández-Guzmán, F. J., & Rodríguez-Ortega, A. (2023). Silkworm (*Bombyx mori* L.) fed with mulberry (*Morus alba* L.) leaves and cow's milk. *Agro Productividad*. <https://doi.org/10.32854/agrop.v16i9.2510>
- Sisodia S. and S. Gaherwal. (2019). Effect of bovine milk on the growth and economic traits of silkworm *Bombyx mori* neha. *International Journal of Research and Analytical Reviews (IJRAR)*. Volume 6, Issue 2.
- Statistical Analysis System (SAS). (2004). SAS/STAT User's guide. (Release 9.1) SAS publishing, Cary (NC). 1-7:180.
- Wu, X., He, K., Velickovic, T. C., & Liu, Z. (2021). Nutritional, functional, and allergenic properties of silkworm pupae. *Food Science & Nutrition*. 9, 4655– 4665. <https://doi.org/10.1002/fsn3.2428>
