International Journal of Veterinary Sciences and Animal Husbandry 2024; 9(3): 429-433

ISSN: 2456-2912
VET 2024; 9(3): 429-433

www.veterinarypaper.com
Received: 17-03-2024
Accepted: 22-04-2024

Ovais Ahmad Hajam
College of Temperate Sericulture Mirgund SKUAST-K, Jammu and Kashmir, India

Dr. Zia-H Rufaie
College of Temperate Sericulture Mirgund SKUAST-K, Jammu and Kashmir, India

Dr. Irfan Lateef Khan
College of Temperate Sericulture Mirgund SKUAST-K, Jammu and Kashmir, India

Dr. Shakeel Ahmad Mir
Division of Agri Statistics FOH Shalimar SKUAST-K, Jammu and Kashmir, India

Dr. Shaheen Gul
Division of Entomology FOH Shalimar SKUAST-K, Jammu and Kashmir, India

Dr. Zafar Iqbal Buhroo
College of Temperate Sericulture Mirgund SKUAST-K, Jammu and Kashmir, India

Dr. MF Baqual
College of Temperate Sericulture Mirgund SKUAST-K, Jammu and Kashmir, India

Corresponding Author:
Ovais Ahmad Hajam
College of Temperate Sericulture Mirgund SKUAST-K, Jammu and Kashmir, India

Influence of plant extract fortified mulberry leaf on some reeling parameters of silkworm, *Bombyx mori* L.

Ovais Ahmad Hajam, Dr. Zia-H Rufaie, Dr. Irfan Lateef Khan, Dr. Shakeel Ahmad Mir, Dr. Shaheen Gul, Dr. Zafar Iqbal Buhroo and Dr. MF Baqual

Abstract
Sericulture, is an agro-based industry for production of fabulous silk which is called queen of textiles. This industry has significant potential for socio-economic development of poor and marginal farmers who conduct silkworm rearing for production of raw silk. For production of quality silk one of the essential requirement is quality of leaf which contributes about 38.2% for success of cocoon crop. As the quality and quantity of mulberry leaf consumed by silkworm larvae greatly influence cocoon production, this study was carried out to investigate the effects of feeding silkworms fortified mulberry leaf with extracts from *Aloe vera*, *Ocimum sanctum* and *Withania somnifera.* Feeding fortified mulberry leaves with plant extracts significantly enhanced some post-cocoon parameters, including filament length, raw silk percentage, and denier. An average filament length of 1241 m was recorded in 3% *Withania somnifera* treatment during spring season as against 1082.17 m, which was recorded in control (T_{13}) where mulberry leaves without fortification were fed to silkworms. Similarly highest raw silk percentage of 17.91% was recorded in 3% *Ocimum sanctum* treatment during spring and 17.20% during autumn as against 15.7% and 14.5% recorded in control groups during spring and autumn seasons respectively. The values of denier were also within a narrow range across all treatments. This significant improvement in some post cocoon parameters can be attributed to the positive effects of fortifying mulberry leaves with plant extracts, which likely stimulated metabolic activities and silk protein synthesis in silkworms. The findings highlight the potential of utilizing these medicinal plant extracts as nutritional supplements for enhancing productivity in sericulture.

Keywords: Fortified mulberry leaf, reeling parameters, silkworm, *Bombyx mori* L.

Introduction
Silk is renowned as the most beautiful textile in the world, possessing unmatched splendor, natural luster, intrinsic affinity for dyes, great absorbance, light weight, soft touch, and long durability. Due to these distinctive features, silk is often referred to as the "Queen of Textiles." India is the only country in the world that produces all five types of commercial silks: Mulberry, Tropical Tasar, Oak Tasar, Eri, and Muga, among which Muga, with its golden-yellow appearance, is produced exclusively in India (Anonymous, 2024) [2].

Sericulture, or silk farming, involves the rearing of silkworms for the production of silk. As an agro-based industry, it is ideally suited for the socio-economic development of rural communities. The sericulture industry has the potential to generate employment worldwide and contribute to the GDP (Gross Domestic Product) of many countries, such as India, China, and Thailand (Chen, 2003; Chen and Gu, 2006) [9, 8]. Sericultural practices originated approximately 5000 years ago in the Chantong region of China and later spread to neighboring countries like Korea, Japan, and Vietnam (Needham, 1954) [20].

India ranks as the second largest producer of raw silk after China and recorded an annual raw silk production of 36,582 MT during 2022-23 (Anonymous, 2024) [2]. The Union Territory of Jammu and Kashmir has 2800 villages where rearers are practicing sericulture and these rearers produce about 115 MT of raw silk annually. This avocation provides livelihood to 30,300 families in UT of Jammu & Kashmir (Bhat *et al*., 2020; Anonymous, 2024) [2]. Inspite having great potential for growth of this industry there are some factors like disease outburst, pests, and poor marketing of cocoons which contribute for decline of this industry.

For production of this fabulous thread silkworm *Bombyx mori* L. being a monophagous insect feeds exclusively on mulberry leaves, which contain proteins as the chief constituent, along with carbohydrates, vitamins, sterols, minerals and phagostimulants (Triubhuvan and Mathur, 1989) [29]. The quality and quantity of leaf consumed by the larvae greatly influence the production of cocoons. Numerous studies on silkworm nutrition have emphasized that the quality of the leaf directly impacts the growth and development of the silkworm, as well as overall silk production (Patil, 2003; Nagesh and Deviah, 1996; Sengupta, 1972) [21, 19, 26]. Lack of intake of essential nutrients like potassium, calcium and phosphorus by silkworm can severely affect the silkworm larval weight, cocoon and other silk parameters (Patil, 2003) [21].

In order to enhance the nutritional quality of mulberry leaf nutritional supplementation of mulberry leaves with plant extracts or other sources has shown promising results in enhancing the growth and economic traits of *B. mori* L. In an earlier study, mulberry leaves supplemented with spirulina as a food for *B. mori* L. were found to enhance the larval and cocoon characters (Venkataramana, 2003) [30]. Supplementation with aqueous extracts from plants like *Zingiber officinale*, *Lantana camara* and mulberry leaves increased the silk quality in silkworms (Manjunatha *et al*., 2017) [16]. The supplementation of an aqueous extract from *Vigna unguiculata* (cowpea) with mulberry leaves at different concentrations enhanced the quality and quantity of silk in *B. mori* (Saravanan, 2011) [25].

Plants are considered the richest source of organic chemicals on earth and phytochemicals have been reported to influence the life and behavior of various insects (Gouda, *et al*., 1997) [22]. Several extracts of medicinal plants have been tested through supplementation in the silkworm *Bombyx mori*, demonstrating their ability to influence body weight, silk gland weight, and silk filament length (Murugan *et al*., 1998) [17]. Dietary supplementation with leaf, flower, and pod extracts of *Moringa oleifera* (Rajeswari and Isaiarasu, 2004) [23] and Chitosan solution (Bin Li *et al*., 2010) [7] elicited varied responses in the final instar larvae of *Bombyx mori*. A commercial herbal tonic 'Iogen,' containing extracts of selected medicinal plants, exhibited positive responses from the larvae of *B. mori* L. (Balamurugan and Isaiarasu, 2007) [4]. The current study aims to investigate the potential benefits of fortifying mulberry leaves with extracts from *Aloe vera*, *Ocimum sanctum and Withania somnifera* renowned plants with diverse bioactive compounds and therapeutic properties. By supplementing mulberry leaves with these plant extracts, the research seeks to optimize the nutritional composition of silkworm diets, promoting improved growth, development and silk production. Through inclusive assessments of silk quality parameters and productivity, the study aims to contribute to sericulture practices and pave the way for sustainable and economically viable silk production.

Materials and Methods

The present investigation titled "Influence of plant extract fortified mulberry leaf on some reeling parameters of Silkworm, *Bombyx mori* L." was carried out at Division of Sericulture Crop Improvement of College of Temperate Sericulture, Mirgund, SKUAST-Kashmir during spring and autumn seasons from 2021-2023. The bivoltine silkworm (*B. mori* L.) hybrid (CSR2 × CSR4) was utilized for the study. The disease-free layings (DFL's) of hybrid were reared in accordance with the prescribed standard package of practices (Anonymous, 2003) [3]. The experiment was conducted using three plant extracts viz *Aloe vera*, *Ocimum sanctum* and *Withania somnifera*, obtained from the market. These plant extracts were prepared into three concentrations i.e. 1%, 2% and 3% before using them for enriching mulberry leaves for feeding silkworms. The experimental design consisted of nine treatment combinations (T_1 to T_9), each with different plant extracts and concentrations. Additionally, three mixed combinations were included, where all three plant extracts were combined @ 1%, 2%, and 3% concentrations, respectively. Two controls were used: one an aqueous control and other an absolute control. The experiment was conducted with three replications, having 200 worms each per replication/treatment. A Completely Randomized Design (CRD) was followed in this study. The plant extracts were dissolved in distilled water to prepare the required concentrations. These extracts were sprayed on mulberry leaves using an atomizer at a rate of 60 ml/200 g of leaf for 100 larvae, as per the method of Jeyapaul *et al*. (2003) [15]. The treated leaves were then air-dried for 15 minutes before feeding these to silkworms during 5th instar on alternate days. Various parameters were evaluated, including average filament length, denier and raw silk percentage.

Average filament length (m)

It was calculated by using the following formula:

$$\text{Filament length (m)} = \frac{\text{Total filament length (m)}}{\text{Total number of cocoons reeled}}$$

Denier

It was calculated by using the following formula:

$$\text{Denier} = \frac{\text{Weight of silk reeled (g)}}{\text{Length of silk reeled (m)}} \times 9000$$

Raw Silk percentage %

It was calculated by using the following formula:

$$\text{Raw silk (\%)} = \frac{\text{Weight of silk reeled (g)}}{\text{Weight of green cocoon}} \times 100$$

The data collected was compiled and analyzed using OP Stat standard statistical software described by Sheoran *et al*. (1998) [27].

Results and Discussion

1. Average filament length

Average filament length is an important attribute of silkworm breeds. The silk filament length obtained varies across breeds under different rearing conditions and seasons. With respect to the current study, supplementation with plant extracts significantly enhanced filament length compared to controls. During spring seasons the maximum filament length of 1240.83 m was recorded in the 3% *W. somnifera* treatment (T_9), followed by 1221.00 m in 3% *O. sanctum* (T_6) and 1211.34 m in 3% *A. vera* (T_3). In the autumn season, 3% *O. sanctum* treatment (T_6) exhibited the longest mean filament length of 1187 m, which was significantly higher than the control groups at 926-930 m. The results of the present study are in line with the findings of Islam *et al.* (2020) [14], where egg albumen concentrations significantly enhanced the average filament length, measuring 1253 m compared to 1071 m in the control group. The present findings are in line with the findings of Amit *et al.* (2015) [1] who has reported that filament length and raw silk percentage increased by 28.96%

over control. The results of the current study are further supported by Gouda *et al*. (1997) [22] who has reported longest silk filament of 873 m due to supplementation of 20% *Parthenium* leaf extract. This has been further confirmed by Murugan *et al*. (1999) [18] who found an increased filament length when mulberry leaves fortified with aqueous extracts of botanicals such as *T. procumbens, L. camara, C. inermae* and *C. sparsiflorus* were fed to silkworm hybrid of PM×CSR2.

2. Raw silk percentage

Raw silk percentage, defined as the proportion of pure silk fiber extracted from cocoon shells, is considered an important factor in determining cocoon quality. Supplementation with medicinal plant extracts significantly improved raw silk percentage compared to controls in both seasons. During spring, the highest raw silk percentage of 17.91% was recorded in 3% *O. sanctum* treatment (T_6), followed by 17.51% in 3% *A. vera* (T_3) and 17.49% in 3% *W. somnifera* (T_9). In autumn, 3% *O. sanctum* (T_6) again gave the maximum raw silk percentage of 17.20%, while 3% *W. somnifera* (T_9) resulted in 16.76%. The control groups consistently exhibited the lowest raw silk percentage of around 15.7% during spring and around 14.5% during autumn. The results of the present study corroborate with those of Islam *et al.* (2020) [14], who found that egg albumen concentration significantly improved raw silk percentage, registering 19.92% in the 10% concentration group compared to 16.60% in the control group. These findings suggest that the seasonality may influence the efficacy of these plant extracts on the silk production parameters.

The maximum average filament length and highest raw silk percentage recorded may be attributed to the positive effect of fortifying plant extracts on larval, cocoon, and shell weight, leading to longer average filament length and higher raw silk percentage. The bioactive compounds and additional nutrients supplemented by the plant extracts likely stimulated the metabolic activities of the silkworm promoting better silk protein synthesis and deposition in the cocoon shell. The findings of the present study are in conformity with other studies that have reported the beneficial effects of plant extracts on silkworm growth and silk production. A study demonstrated that egg albumen supplementation in the mulberry leaf diet improved average filament length and raw silk percentage (Islam *et al*., 2020) [14]. Another study reported that fortification of mulberry leaves with *Parthenium hysterophorus* L., *Phyllanthus niruri* Hook and *Psoralea coryleifolia* led to better larval growth and improved economic traits of *B. mori* L. (Gobena and Bhaskar, 2015) [13]. In terms of the specific plant extracts used in current study, *A. vera* has been reported to improve the silk yield in mulberry silkworms (Deshmukh and Khyade, 2013) [10]. Similarly, *O. sanctum* has been found to have a growth promoting effect on silkworms, enhancing the commercial qualities of silk (Sujatha *et al*., 2015; Devi and Bai, 2015; Devi and Bai, 2014) [28, 12, 11]. *W. somnifera* and others have improved the growth and development of silkworm, *B. mori* L. leading to better economic traits (Bhaskar *et al*., 2004) [5].

3. Denier

Denier is an important characteristic for evaluating silkworm breeds for commercial exploitation, as it is a genetically controlled trait. The investigation across treatments revealed no remarkable differences in denier values, which spanned a narrow range from 2.90 to 3.02 across diverse concentrations of plant extracts and controls during both spring and autumn seasons. The highest denier of 3.00 was recorded in the absolute control (T_{14}) during spring, while the lowest denier of 2.58 was recorded in the mixture of 1% treatment (T_{11}) during autumn. Similar findings have been reported by Islam *et al.* (2020) [14] who has reported that the treatments regarding denier did not show significant difference. However, the highest value of denier (3.26) was recorded in T_4 (15% egg albumin), while the lowest value of 3.08 was recorded in T_1 (dipped in water). Gobena and Bhaskar, (2015) [13] reported significant decrease in filament denier in *P. coryleifolia* recorded was 2.367 and 2.307 for harvest I and II respectively followed by 2.437 and 2.427 in *P. niruri*, 2.469 and 2.447 in *P. hysterophorus* when compared to the aqueous control which recorded 2.564 and 2.533 and 2.630 and 2.632 in absolute control indicating an improvement in the quality of the silk filament. This could be attributed to the bioavailability of certain nutrients to the worms from the plant extracts which might have enhanced the protein synthesis particularly the fibroin synthesis in the posterior silk gland, which in turn might have influenced the filament denier. This finding was in confirmation with the finding of Santhoshkumar (1997) [24] who reported that, dust formulation of *L. camara* and *C. inermae* fortified mulberry leaves resulted in lowest denier when fed to silkworm larvae.

Table 1: Influence of Plant extract fortified mulberry leaf on the post cocoon parameters of silkworm *Bombyx mori* L. (Data of spring and autumn season).

Parameters	Average filament length (m)		Denier (d)		Raw Silk (%)	
Season / Treatments	Spring	Autumn	Spring	Autumn	Spring	Autumn
T_1 *A. vera* 1%	1137.34^{b}	944.670^{f}	2.98	2.80	16.57^{c}	15.56^{c}
T_2 *A. vera* 2%	1171.33^{a}	1035.00^{d}	3.01	3.17	16.89^{c}	16.11^{bc}
T_3 *A. vera* 3%	1211.34^{a}	1113.67^{bc}	2.95	2.94	17.51^{a}	16.53^{b}
T_4 *O. sanctum* 1%	1170.67^{a}	1020.67	2.90	2.88	16.75^{c}	15.70^{c}
T_5 *O. sanctum* 2%	1191.50^{a}	1088.00^{c}	2.93	2.72	17.30^{b}	16.25^{b}
T_6 *O. sanctum* 3%	1221.00^{a}	1186.67^{a}	2.99	2.78	17.91^{a}	17.20^{a}
T_7 *W. somnifera* 1%	1146.17^{b}	960.00^{ef}	2.90	2.70	16.52^{d}	15.48^{cd}
T_8 *W. somnifera* 2%	1192.67^{a}	1082.67^{cd}	2.89	2.67	17.08^{bc}	16.09^{c}
T_9 *W. somnifera* 3%	1240.83^{a}	1166.33^{ab}	2.95	2.67	17.49^{ab}	16.76^{ab}
T_{10} Mixture 1%	1116.84^{b}	934.33^{f}	2.93	2.63	16.39^{d}	15.41^{d}
T_{11} Mixture 2%	1148.17^{b}	972.33^{e}	2.95	2.58	16.51^{d}	15.43^{d}
T_{12} Mixture 3%	1163.67^{ab}	1023.00^{de}	2.93	2.86	16.56^{cd}	16.09^{c}
T_{13} Aqueous Control	1082.17^{b}	926.00^{f}	2.79	2.65	15.72^{e}	14.56^{e}
T_{14} Absolute Control	1086.34^{b}	930.67^{f}	2.93	2.76	15.73^{e}	14.44^{e}
C.D ($p \leq 0.05$)	87.83	66.26	0.14	NS	0.512	0.652

Conclusion

The present study demonstrated that fortification of mulberry leaf with plant extracts of *Aloe vera*, *Ocimum sanctum* and *Withania somnifera* significantly improved the silk production parameters in silkworm *B. mori* L. The higher concentrations of these plant extracts enhanced the average filament length, raw silk percentage and other economic traits compared to the control groups. The additional nutrients and bioactive compounds present in these plant extracts likely stimulated the metabolic processes and silk protein synthesis in the silkworms. Therefore, supplementation with these plant extracts could be suggested to sericulture farmers in order to obtain better silk yield and quality.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Amit K, Govind M, Hugur II. Bio-potentiality of Waste pupae bio-protein as nutritional supplement to improve the economic traits in *B. mori* L. International Journal of Scientific Research. 2015;4(11):75-76.
2. Anonymous. Functioning of Central Silk Board & performance of Indian silk industry. Central Silk Board; c2024. p. 1-20.
3. Anonymous. Package of Practices for silkworm rearing and mulberry cultivation under temperate climatic conditions of Kashmir. Directorate of Extension Education, Sher-e–Kashmir University of Agricultural Science and Technology of Kashmir; c2003.
4. Balamurugan R, Isaiarasu L. Effect of the herbal tonic "Iogen" on the growth and cocoon parameters of mulberry silkworm, *Bombyx mori* L. Proceedings of the National Seminar on Applied Zoology ANJA College, Sivakasi; c2007.
5. Bhaskar RN, Sridevi G, Devaiah MC, Govindan R. Evaluation of medicinal plant extracts based on cocoon and reeling parameters of silkworm, *B. mori* L. (CSR2 x CSR4). Proceedings of the National Seminar on Progress of Research on Disease and Pest Management; 2003 Sep 12-13; Chintamani, India; c2004. p. 247-254.
6. Bhat MA, Buhroo ZI, Aziz A, Qadir J, Azam M. An overview of current scenario of sericulture industry in Jammu and Kashmir, India. International Journal of Current Microbiology and Applied Sciences. 2020;9(6):3813-24.
7. Li B, Su T, Chen X, Liu B, Zhu B, Fang Y, *et al*. Effect of chitosan solution on the bacterial septicemia disease of *Bombyx mori* (Lepidoptera: Bombycidae) caused by Serratia marcescens. Applied Entomology and Zoology. 2010;45:145-152.
8. Chen CH, GU SH. Stage dependent effects of starvation on the growth, metamorphosis and ecdysteriodogenesis by the prothoracic glands during last larval instar of silkworm *B. mori*. Journal of Insect Physiology. 2006;52:968-974.
9. Chen Y. Variable tolerance of the silkworm *Bombyx mori* to atmospheric fluoride pollution. Fluoride. 2003;36:157-162.
10. Deshmukh RB, Khyade VB. Utilization of *Aloe vera* (L) herbal tonic for treating mulberry leaves before feeding the fifth instar larvae of silkworm, *B. mori* L.(Race: PM× CSR2). International Journal of Biological Sciences. 2013;2(01):281-285.
11. Devi PSV, Bai MR. Antifungal effect of Ocimum sanctum L. against white muscardine disease of silkworm, *B. mori* L. Journal of Biopesticides. 2014;7(2):205-209.
12. Devi PV, Ramani Bai M. Effect of Ocimum sanctum L. plant extract on the economic parameters of silkworm, *B. mori* L. Journal of Entomology and Zoology Studies. 2015;3(2):62-64.
13. Gobena WS, Bhaskar RN. Fortification of Mulberry Leaves with Medicinal Botanical Plant Extracts Effect on Silkworm, *B. mori* L. (PM×CSR2) (Lepidoptera: Bombycidae) Larval Growth and Cocoon Traits. Journal of Biological Sciences. 2015;15:199-206.
14. Islam T, Khan IL, Gora MM, Khan MY, Bhat TA, Jan N. Influence of egg albumen supplemented mulberry leaf on some reeling parameters of Silkworm, *B. mori* L. The Pharma Innovation Journal. 2020;9(11):19-22.
15. Jeyapaul C, Padmalatha C, Singh AR, Murugesan AG, Dhasarathan P. Effect of plant extracts on nutritional efficiency in mulberry silkworm *B. mori* L. Indian Journal of Sericulture. 2003;42(1):18-22.
16. Manjunatha SE, Sanathkumar N, Kirankumar, Venkatesh. Toxicological effect of medicinal plant extract used against mulberry powdery mildew on growth, development of silkworm, *Bombyx mori* L. Cocoon and silk quality parameter. Journal of Entomology and Zoology Studies. 2017;5(6):872-876.
17. Murugan K, Jeyabalan D, Senthikumar N, Senthilnathan S, Sivaprakasam N. Growth promoting effect of plant products on silkworm. A Herbal tonic on silkworm Biotechnological Approach. Journal of Scientific and Industrial Research. 1998;57:740-745.
18. Murugan K, Jeyabalan D, Senthilkumar N, Krishna SS, Sivaprakasam N. Growth promoting effects of plant compounds on silkworm. Proceedings of the National Seminar on Tropical Sericulture; 1999 Dec 28-30; Bangalore, India; c1999. p. 107-108.
19. Nagesh, Deviah MC. Effect of Seri care-A feed additive on silk on silk productivity in silkworm, *Bombyx mori* L. Indian Journal of Sericulture. 1996;35:67-68.
20. Needham J. Science and civilization in China. Cambridge: Cambridge University Press; c1954. p. 1.
21. Patil SA. Nutritional management and quality improvement in sericulture-Keynote address. In: Bongale UD, editor. Nutritional Management and Quality Improvement in Sericulture. Bangalore: KSSRDI; c2003. p. 7-11.
22. Gouda R, Gopalan M, Jeyaraj, Natarajan N. Field performance of plant extracts on mulberry silkworm, *Bombyx mori* L. Entomon. 1997;22(3 & 4):235-238.
23. Rajeswari K, Isaiarasu L. Influence of the leaf, flower and pod extracts of Moringa oleifera on the growth and reproductive parameters of *Bombyx mori* L. Entomon. 2004;29(4s):331-338.
24. Santhoshkumar GH. Large scale evaluation of insect growth regulator activity of Lantana camara L. and *Clerodendron inermae* G. on *Bombyx mori* L. [M.Sc. Thesis]. Dharwad: University of Agricultural Sciences; c1997.
25. Saravanan M, Selvi S, Veeranarayanan M, Nadanam S. Studies on the nutritional supplement of mulberry leaves with Cowpeas (*Vigna unguiculata*) to the silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae) upon the

activities of midgut digestive enzymes. International Journal of Nutrition, Pharmacology, Neurological Diseases. 2011;1(2):157-162.
26. Sengupta K, Singh BD, Mustafi JC. Nutrition of silkworm, *Bombyx mori* L. Studies on the enrichment of mulberry leaf with various sugars, proteins, amino acids and vitamins for vigorous growth of the worm and increased cocoon crop protection. Indian Journal of Sericulture. 1972;11:11-27.
27. Sheoran OP, Tonk DS, Kaushik LS, Hasija RC, Pannu RS. Statistical Software Package for Agricultural Research Workers. In: Hooda DS, Hasija RC, editors. Recent Advances in Information Theory, Statistics & Computer Applications. Hisar: Department of Mathematics Statistics, CCS HAU; c1998. p. 139-43.
28. Sujatha K, Sathish J, Anitha J. Effect of Medicinal Botanical (*Ocimum sanctum*), Family, Labiateae on Commercial Parameters of the Silkworm, *B. mori* L. International Journal of Multidisciplinary and Current Research. 2015;3(Jan/Feb issue):76-8.
29. Triubhuvan, Mathur SK. The morin factor in mulberry that attracted the *Bombyx mori* (L). Indian Silk. 1989;28(5):39-40.
30. Venkataramana P, Rao STVS, Reddy SP, Suryanarayana N. Effect of Spirulina on the larval and cocoon characters of silkworm, *Bombyx mori* L. Proceedings of the National Academy of Sciences, India. 2003;73B(1):89-94.

How to Cite This Article
Hajam OA, Zia-H R, Khan IL, Mir SA, Gul S, Buhroo ZI, *et al.* Influence of plant extract fortified mulberry leaf on some reeling parameters of silkworm, *Bombyx mori* L. International Journal of Veterinary Sciences and Animal Husbandry. 2024;9(3):429-433.