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Study of Nutritional Behaviors of Bombix Mori

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Abstract – As elements of aesthetic values, pests and as food, insects are important. Mori Bombyx L. He is an insect that is economically important. In the tropics, it is an edible insect that is eaten. The Silkworm Larvae, B. Mori. They are popular for the production of silk. When the larvae are ready to pupate, silk is produced. The larval stage as well as the pupal stage of B. in this study the nutritional behaviors of Bombix mori were studied. The pupal stage had a higher protein content (21.59 percent) than 20.79 percent in the larval stage. The larva's fat content was 17.57 percent, while the pupa's fat content was 19.90 percent. In the larva (6.34 percent), the ash content was higher than that in the pupal stage (5.50 percent). The proteins have two iso-electric points in the larval and pupal stages. The larval just as the pupal phases of silkworm B. Mori is wealthy in proteins and different supplements that are essential to people and their domesticated animals. These phases of advancement (hatchlings and pupae) are additionally rich wellsprings of a large portion of the fundamental mineral salts vital for typical human turn of events. These phases of advancement are acceptable possibility for food handling enterprises where more noteworthy ability to ingest oil and water is required.

Keywords: Bombyx Mori, Silkworm, Nutritional Behavior, Larvae, Nutrient Composition

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INTRODUCATION

The silkworm, Bombyx mori, is a monophagous lepidopteran creepy crawly tamed for more than 5,000 years. So as to be promptly devoured by silkworms, mulberry leaves reasonable as silkworm food must contain a few synthetic segments, for example, water (80%), proteins (27 percent) and starches (11 percent), different concentrates, minerals , nutrients, and so on, and must have great physical attributes simultaneously, for example, suitable delicacy, thickness and snugness (Koul, 1989). Mulberry leaf is the sole food and wellspring of nourishment for the silkworm, Bombyx mori, because of the presence of morin (Tribhuwan and Mathur, 1989).

Legay (1958) called attention to that silk creation relies upon the nourishment of hatchlings and that the nutritional estimation of mulberry leaves assumes a viable function in the creation of top notch casings. The physiology of this species has been concentrated widely because of the financial significance of silk creation throughout the long term. Seki and Oshikane, 1959, watched better development and advancement of silkworm hatchlings just as great quality cases when benefited from nutritionally improved leaves.

Bombyx mori includes the egg, larval, pupal and adult phases of the silkworm's life cycle and has a duration of about 45 days (Ganga, 2003). The first instar larvae hatch within 24 hours after an embryonic incubation period of about 10 days and pass through five successive larval instars that are behaviourally and morphologically distinct from each other. Ecdysis or moulting separate the larval instars. An organism 's growth depends on its nutritional status. The larval nourishment and nutritional estimation of mulberry leaves assume an extremely viable part in delivering quality cases in Bombyx mori (Legay, 1958). Mulberry leaf intake is not only related to animal growth, but also acts as a developmental signal. The body of insect fat also acts as an endocrine organ to provide adequate energy and acts as a sensor for integrating larval nutritional status with metamorphosis maturation signals (Simpson and Douglas, 2013). The non-feeding phases (pupal and adult) in silkworm obtain their energy from stored nutrients. The pupa metamorphoses into an adult by doing so. The silkworm took care of with nutritionally improved mulberry leaves could accomplish better silkworm hatchlings development and advancement and quality cover creation (Ito, 1983). Silkworm development is quicker than that of counterfeit eating regimens when taken care of with mulberry leaves (Kandylis et al., 2009).

Nourishment is a huge development controlling component in the silkworm. For the development and advancement of the silkworm Bombyx mori, proteins, certain sugars, B-complex nutrients, certain amino acids and certain minerals have been accounted for to be mindful. The silkworm hatchlings have been pulled in by three energizers in mulberry leaves, in particular, the attractant, gnawing factor and gulping factor.

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Uh, Sumioka et al. (1982) found that leaf utilization impacted the body's weight, which thusly affected silk creation. Leaf utilization legitimately influences the silk delivering limit of the silkworm (Muthukrishnan et al . , 1978). Casing characters are to a great extent needy, both quantitative and subjective, on the quality and amount of mulberry leaves (Koul, 1989). It has been discovered that the taking care of conduct of Manduca hatchlings raised on a fake eating regimen is not the same as that of caterpillar-took care of plant leaves.

Bombyx mori larval taking care of conduct through consistent perceptions of hatchlings all through larval turn of events. Notwithstanding this investigation, the conduct of starved hatchlings has additionally been seen to decide how diet hardship influences taking care of conduct. Ultimately, the study inspected crap and physical incitement in Bombyx hatchlings as potential triggers for taking care of. Shafique (1993) revealed that dry issue from the silkworm was straightforwardly corresponding to the nitrogen substance of the leaves. Silkworm sustenance alludes to the substances needed by silkworm for their development and metabolic capacities and are combined by different biochemical pathways, including industrially intriguing protenaceous silk fiber, acquired from ingested mulberry/fake eating routine nourishments and other nutritional segments.

Mahmood, (1989) inferred that contrasted with different dosages, the hatchlings with most extreme weight were created by leaves dunked in 0.2 percent N arrangement. Rehman (1997) reasoned that to a more prominent degree than control when utilized, ideal mineral portions in different blends were utilized to expand silk creation and silkworm development. Contingent upon the hereditary foundation of a life form and the communicated physiological or nutritional unit in quality guideline examines, the connection between the climate and qualities is viewed as bidirectional with food utilization effectiveness on quality articulation (Giacobino et al., 2003; Milner, 2004; Kang, 2008; Ogunbanwo and Okanlawon, 2009).

The current study is done to study the assurance of the nutritional conduct of Bombix mori in which the creepy crawly's supplement sythesis and nutritional worth have been resolved.

METHODOLOGY:

Collection and Preparation of Bombyx mori Larvae and Pupae

The larvae and the pupae of silkworm B. mori, used for this work, were obtained from the Ministry of Agriculture. The larvae were three weeks old and were hand-picked into a container of plastic that was used to transport them to the laboratory. They were permitted to stay for 3 hours. And in the lab, In a refrigerator, the larvae were asphyxiated for 3 h. then, oven-dried for 4 h at 60 o C. The pupas, with their cocoons, were handpicked. From the day they completed their cocoon formation, the pupae were one week old. The pupae were ovendried at 60 o C for 4 h along with their cocoons. Using a razor blade, the cocoons were later cut open and the pupae were poured into a container. Separately, the dried larvae and pupae were pulverised with a blender and stored in airtight bottles and placed in the refrigerator until necessary for analysis.

Nutrient Composition Analysis

By using the method explained by AOAC (1990), the moisture content, ash content, fat content and mineral content were determined. Utilizing the fire photometric strategy, sodium and potassium were resolved, while phosphorus was resolved utilizing the phosphovanadomolybdate reagent technique depicted by AOAC (2005) utilizing the Spectronic 20 Colorimeter. The Alpha 4 atomic absorption spectrophotometer has been used to determine other minerals, such as magnesium, iron , calcium , zinc, manganese, lead, nickel , copper and cobalt. The differential was determined by carbohydrates. By the method reported by Pearson (1970), the protein content was determined.

Determination of Anti-nutrient Composition

Youthful and Greaves (1940) utilized the phytin assurance measure. Oxalate was controlled by the cycle revealed by Day and Underwood (1986). Tannin was resolved through the technique revealed by Markkar and Goodchild (1996). The strategy revealed by Harbone (1973) decided the alkaloid, while the Bohm and Kocipal-Abyazan (1994) technique was embraced in flavonoid assurance.

Determination of Functional Properties of Silkworm Protein

The substance of saponin has been dictated by embracing the strategy detailed by Obadoni and Ochuko (2001). The techniques detailed by Coffman and Garcia (1977) were utilized in deciding the most minimal gelation focus, frothing limit and frothing steadiness. The water and oil ingestion limit strategies were controlled by Beuchat (1977), though emulsion limit and emulsion strength were dictated by the Yasumatsu et al. (1972) technique.

The information gathered was exposed to Analysis Of Variance (ANOVA) and where there were huge contrasts, treatment implies were thought about at a noteworthy degree of 0.05 utilizing the Tukey Test.

RESULTS:

The result of the supplement examination indicated that the debris content was 6.34 percent in the larval stage, while it was 5.50 percent in the pupal stage. The second most noticeable silkworm food class was protein, in which 20.79 percent and 21.59 percent

were acquired in the larval and pupal stages, individually (Table 1). The content of moisture ranged from 7.92 percent (in the larva) to 8.26 percent (in the pupa). The main source of food found in silkworms is carbohydrates. Silkworm proteins are more soluble in an acidic medium. At pH 1 and pH 12, the highest solubility achieved in the larval stage was 84.13 percent. The highest solubility was found at pH 1 and pH 11 in the pupal stage. There are two iso-electric points in each of the developmental stages (Figure 1).

The protein content of the larval (20.79 percent) and pupal (21.59 percent) phases was greater than that reported in B. By Finke (2002) Mori (93g / kg). Banjo et al . (2006) reported lower protein concentrations in Analeptes trifasciata F. (Cerambycidae: Coleoptera), Zonocerus variegatus L., and Rhynchophorus phoenicis F (Curculionidae; Coleptera). (Orthoptera: Pyrgomorphidae). Protein values of 258 g / kg and 324g / kg for female and male giant African crickets, Brachytrypes membranaceus L, were reported by Adeyeye and Awokunmi (2010). (Gryllidae: Orthoptera), resp. In Epiphora bauhiniae (Guerin Meneville) (Saturniidae: Lepidoptera), a protein content of 11.37 percent was reported. For the development and repair of animal body tissues, protein is essential. The larval stage as well as the pupal stage of B. Mori can adequately supply growing animals with this essential protein. The results of the solubility of proteins also testify to the fact that proteins are present in each of B's developmental stages. There were so many amino acids in Mori. The larval and the pupal phases have two iso-electric points. In acidic medium, the proteins present in each stage were more soluble than in alkaline medium (Figure 1).

Table 1: Nutrient composition of Silkworm, Bombyx mori

Parameters (%)	*B. mori*larvae	*B. mori*pupal
Ash content	6.34±0.84	5.50±0.51
Moisture content	7.92±0.98	8.26±0.66
Fat content	17.57±1.51	19.90±1.80
Crude fibre content	6.46±0.21	6.30±0.12
Crude protein content	20.79±2.22	21.59±2.91
Carbohydrate content	40.93±3.20	38.47±4.24

Each value is a mean ± Standard deviation of three replicates (Tukey Test)

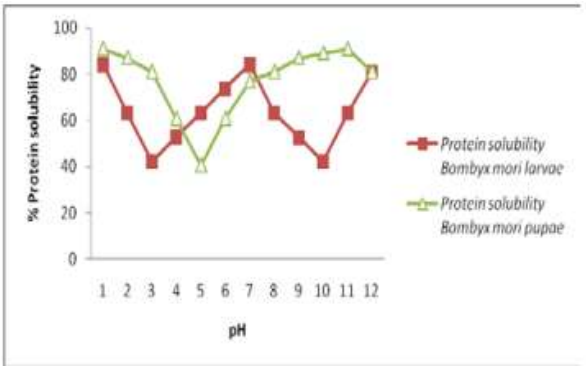

Figure 1: Percent Protein dissolvability of Silkworm larval and pupal stages, B. Mori.

Table 2 shows the aftereffects of mineral investigation in the larval stage and in the pupal stage. All the basic minerals in the silkworm are available. Phosphorus was the most noteworthy mineral acquired in the two stages. Copper was not found in the larval stage, however an irrelevant sum was acquired in the pupal stage (0.10 percent). In both the larval and pupal stages, iron, zinc, magnesium, calcium, potassium and sodium were obtained in different quantities. In both stages, the quantities of trace mineral salts are negligible, such as cobalt, nickel, copper, manganese and lead.

Finke (2002) reported the same trend in B. Mori. Mori. The 136.4 mg/100 g value was obtained in A. Trifasciata by Banjo et. al. (2006), whereas Adeyeye and Awokunmi (2010) reported male and female B values of 10880 mg / kg and 10936 mg / kg. Membranaceus, resp. The highest mineral salt obtained in R. Phoenicis ranged between 372.50 and 457.50 mg / kg (Omotoso and Adedire, 2007), while phosphorus (215.54 mg/100 g) was the highest mineral salt obtained in Cirinaforda Westwood (Saturniidae: Lepidoptera) (Omotoso, 2006). The pupal and larval phases of B. Mori is rich in important mineral salts, such as sodium (Na) , potassium (K) , calcium (Ca), iron (Fe), magnesium (Mg) and zinc (Zn). There were negligible quantities of minerals, such as lead (Pb), manganese (Mn) , copper (Cu), nickel (Ni) and cobalt (Co). The mineral values reported in B. by Finke (2002). Mori is consistently higher than all the values identified in this research. The incorporation of B's larval and pupal phases. Mori will greatly promote the normal functioning of the systems in the body in the diets of both adults and children.

Table 2: Minerals present in Silkworm, B. mori

Parameters (mg/100g)	*B. mori*larvae	*B. mori*pupal
Na	10.52±1.31	11.66±1.22
K	18.65±1.42	22.45±1.72
Ca	20.31±2.78	26.65±3.49
Mg	31.24±3.61	27.53±3.76
Zn	35.63±4.98	37.50±4.64
Fe	5.31±0.72	6.33±0.81
Pb	0.01±0.00	0.02±0.00
Mn	0.02±0.00	0.01±0.00
Cu	ND	0.10±0.00
P	37.66±4.10	41.35±5.82
Ni	0.01±0.00	0.10±0.00
Co	0.33±0.01	0.36±0.01

Each value is a mean ± Standard deviation of three replicates (Tukey Test). ND = Not Detected

The aftereffects of the utilitarian properties of silkworm proteins can be found in Table 3. The limit of the hatchlings to retain water was 175%, while the pupa was 115%. The capacity for oil absorption in the pupal (284.87 percent) was higher than in the larva (252.18 percent). In both phases, foaming capacity and foaming stability were not detected. Least gelation was 6 percent in both stages, while emulsion capacity and stability were 75 percent and 25 percent respectively in the larval stage. In the pupal stage, the emulsion limit was 75 percent, while emulsion dependability was 23 percent.

The physical-chemical properties that govern protein behaviour in foods are the functional properties of proteins in food. The insect can be easily incorporated, such as pie, cake and buns, into confectionery and comminuted foods. In the confectionery industries that deal with baking processes such as bread bakeries, the higher water absorption capacity demonstrates that the insect meat will be very useful. The higher ability to absorb oil also shows that the insect's meat will be useful in the industries of cake and pie making as they will easily bind to higher amounts of oil. No reported work on the functional properties of insects can be compared with this result, except for the work of Omotoso and Adedire (2008), in which R. reported higher water absorption capacity (93.33 percent) and higher oil absorption capacity (112.33 percent). Just phoenicis. There was no detection of the foaming capacity and stability. This shows that silkworm oil may not be useful in food industries where foaming is necessary to cause the food to rise. Emulsion capacity values (75 percent), stability (23 percent-25 percent) and lower gel concentrations (6 percent) are encouraging, indicating that silkworm meat is a good candidate for the food industry. Forming gels at 6% shows that in canned food the meat of this insect will be very good as the food will stay together in the can.

Table 3: Protein functional properties in Silkworm, B. Mori

Parameters (%)	*B. mori* larvae	*B. mori*pupal
Water absorption capacity	175±8.50	115.00±7.30
Oil absorption capacity	252.18±9.22	284.87±9.45
Foaming capacity	ND	ND
Foaming stability	ND	ND
Emulsion capacity	75.00±3.24	75.00±3.50
Emulsion stability	25.00±2.11	23.00±2.45
Least gelation	6.00±1.02	6.00±1.12

Table 4 shows the aftereffects of the silkworm's enemy of supplement organization. In both the larval stage (72.89 percent) and the pupal stage (110.16 percent), phytate was the most noteworthy enemy of supplement announced. Phytin phosphorus sums were higher at the two phases (20.54 percent in the hatchling and 31.03 percent in the pupa). At the larval stage, the measure of saponin present was lower (6.88 percent) than the sum acquired at the pupal stage (7 percent). In the larval, oxalate recorded the littlest measure of 0.91 percent, while in the pupal stage, 1.22 percent was gotten. The measure of flavonoid got in the pupal stage (11.54%) was more noteworthy than the measure of flavonoid got in the larval stage (11.33%). The substance of alkaloids and tannic acids in the larval stage was 8.55% and 1.93%, separately. Alkaloid was 8.61 percent in the pupal stage, while tannic corrosive was 2.04 percent.

Oxalates are substances found in plants, creatures and people that happen normally (Rahman et. al., 2013). Oxalates consolidate with calcium and magnesium to frame insoluble oxalates of Ca and Mg, bringing about low serum levels of Ca and Mg, just as renal disappointment because of kidney precipitation of these salts (kidney stones) (Rahman et al., 2013). There are a couple of generally unprecedented ailments which require severe limitations on oxalate. Type II absorptive hypercalciuria, enteric hyperoxaluria, and essential hyperoxaluria are these conditions (Rahman et al., 2013). Saponins are likewise different aggravates that happen normally that are broadly dispersed in all vegetable cells (Shi et al., 2004). Saponin has some advantageous human impacts. These impacts incorporate the advancement of the safe framework to shield it from malignant growth, the decrease of cholesterol levels, the decrease of disease hazard, the decrease of blood glucose reaction, the restraint of dental caries and the hindrance of platelet total in people. Such effects include promoting the immune system so as to protect it against cancer, lowering cholesterol levels, lowering the risks of contacting cancer, lowering blood glucose response, inhibiting dental caries and inhibiting platelets aggregation in humans (Shi et. l., 2004).

Table 4: Silkworm's anti-nutrient composition, B. Mori.

Constituents	*B. mori*larvae	*B. mori*pupal
Tannic acid (%)	1.93±0.12	2.04±0.24
Saponin (%)	6.88±0.18	7.00±0.88
Alkaloids (%)	8.55±1.26	8.61±1.12
Flavonoid (%)	11.33±1.34	11.54±1.93
Oxalate (mg/g)	0.91±0.07	1.22±0.01
Phytate (mg/g)	72.89±3.72	110.16±9.67
Phytin phosphorus (mg/g)	20.54±2.98	31.03±3.33

CONCLUSION:

The larval as well as the pupal stages of silkworm B. Mori is rich in proteins and other nutrients that are important to human beings and their livestock. These stages of development (larvae and pupae) are also rich sources of most of the essential mineral salts necessary for normal human development. It is a fact that these stages of development are good candidates for food processing industries where greater capacity to absorb oil and water is needed.

REFERENCES

Banjo A D, Lawal O A and Songonuga E A. (2006). The nutritional value of fourteen species of edibleinsects in southwestern Nigeria. Afr J Biotechnol., 5 (3): pp. 298-301.

Beuchat L R. (1977). Functional and electrophoretic characteristics of succinylated peanut flour protein. J Agriculture and Food Chem.,25(2): pp. 258-261.

Bohm B A and Kocipal-Abyazan R. (1994). Flavonoids and condensed tannins from leaves of Hawaiian Vaccinium reticulatum and V. calycinum (Ericaceae). Pac Sci ., 48(4): pp. 458- 463.

Finke M D. (2002). Complete nutrient composition of commercially raised invertebrates used as food for insectivores. Zoo Biology, 21: pp. 269–285.

Ganga G (2003). Comprehensive Sericulture. Vol. 2. Silkworm.

Harbone J B. (1973). Phytochemical Methods, London Chapman and Hall Ltd. pp 49-188.

Ito T, (1983). Nutrition of the silkworm and the artificial diet (In Japanese). Japan Seric. J.Press, Tokyo, JP, pp. 292.

Kandylis K, Hadjigeisaiarasu Lorgiou I, Harizanis P (2009). The nutritive value of mulberry leaves (Morus alba) as a feed supplement for sheep. Trop Anim Health Prod. 41: pp. 17-24.

Koul, A. (1989). Relationship among leaf consumption, body weight and silk production in Bombyx mori L. Agric. Sci. Digest., 9(4): pp. 208-209.

Legay JM (1958). Recent advances in silkworm nutrition, Ann. Rev. Ent., 3: pp. 75-86.

Legay, J.M. (1958). Recent advances in silkworm nutrition. Ann. Rev. Ent., 3: pp. 75-86.

Mahmood, R. 1989. Effect of nitrogen on the larval development and silk yield of Bombyx mori L. M.Sc. (Hons.) thesis, Dept. Agric. Entomol., Univ. Agric, Faisalabad, Pakistan, pp. 133.

Markkar A O S and Goodchild A V. (1996). Quantification of tannins. A laboratory manual International Centre for Agricultural Research in dry Areas (ICARDA). Aleppo, Syria. 1- 25pp.

Muthukrishnan, J., Madhavan, S and Navarathna Jothi, V. (1978). Effect of restriction of feeding duration of food utilization, emergence and silk production in Bombyx mori L. (Lepidoptera: Bombycidae) Monitoire. Zool., 12: pp. 87-94.

Obadoni O B and Ochuko P O. (2001). Phytochemical studies and comparative efficacy of the crude extract of some homeostatic plants in Edo and Delta States of Nigeria. Global J Pure Applied Sci.,2: pp. 203-208.

Omotoso O T and Adedire C O. (2008). Potential industrial uses and quality of oil of oilpal weevil, Rhynchophorus phoenicis F. (Coleoptera: Curculionidae). Pak J Sci Industrial Res.,51: pp. 93-97.

Omotoso OT. (2006). Nutritional quality, functional properties and anti-nutrient composition of the larva of Cirinaforda (Westwood) (Lepidoptera: Saturniidae). J Zhejiang University Sci B., 7(1): pp. 51-55.

Rahman M M, Abdullah R B and Wan Khadijah W E. (2013). A review of oxalate poisoning in domestic animals: tolerance and performance aspects. J Animal Physiol, Animal Nutrition, 97(4): pp. 605-614.

Rehman, A. (1997). The impact of optimum dosages of minerals in various combinations on larval development and silk production of Bombyx

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mori L. M.Sc. (Hons.) Thesis, Dept. Agric. Entomol., Univ. Agric, Faisalabad, Pakistan.

Seki, K and Oshikane, K. (1959). Textile and Sericulture, Shinshu University, Res. Reports. Fac.

Shafique, M. (1993). Effect of feeding phosphorus and nitrogen treated mulberry leaves on the development of silkworm (Bombyx mori L.) and silk yield. M.Sc. (Hons.) Thesis, Deptt. Agric. Entomol., Univ. Agric, Faisalabad, Pakistan.

Shi J, Arunasalam K, Yeung D, Kakuda Y, Mittal G and Jiang Y. (2004). Saponins from edible legumes: Chemistry, processing and health benefits. J Medicinal Food, 7(1): pp. 67-78.

Simpson S J and Douglas A E (2013). Structure and Function (5th edition), ed. Published by Cambridge University Press. Cambridge University Press.

Sumioka HS, Kuroda H, Yoshitake N. (1982). Feed efficiency and expression of several characters of the silkworm, Bombyx mori L. under restricted feeding. Journal of Sericultural Science of Japan 51: pp. 415-419.

Tribhuwan, S and Mathur, S.K. (1989). The Morin factor in mulberry that attracted the Bombyx mori L. Indian silk. 28(5): pp. 39-40.

Young S M and Greaves J E. (1940). Influence of variety and treatment on phytin content of wheat. J Food Sci., 5: pp. 103-108.

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