Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 02 (MAR-APR, 2024)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Is Silkworm Pupae Edible - Boon or Curse

(*K. Thanga Roja[1], Dr. M. Mithilasri[1] and Dr. M. Saratha[2])
[1]Tamil Nadu Agricultural University, Coimbatore (District), Tamil Nadu
[2]Regional Extension Centre, Gobichettipalayam, Erode
*Corresponding Author's email: rojathanga@gmail.com

One insect that is a member of the lepidopteran order is the silkworm. A silkworm's life cycle typically consists of five phases, with a total duration of seven weeks. In South East Asia, namely Japan, Korea, and India, silkworm pupae are mostly utilized as animal feed and fertilizer. They are one of the primary by-products of the silk industry. Since they have been consumed for more than 2000 years in China, silkworm pupae are also utilized as food insects. There exist numerous species of silkworm pupae; currently, *Bombyx mori*, *Antheraea pernyi*, *Antheraea yamamai*, *Samia ricini*, *Antheraea mylitta*, *Antheraea roylei*, and other species are the primary commercial silkworm pupae utilized for research purposes.

For an eternity, silkworm pupae have been a valuable source of high-grade lipids and proteins. With its 18 amino acid composition, silkworm pupae proteins are good for human health and sufficient in essential amino acids to satisfy human needs. Many unsaturated amino acids, notably Omega-3 fatty acids, are found in silkworm pupae oil.

The active components of silkworm pupae have been proven in multiple studies to exhibit a range of pharmacological properties in recent years, including immune-modulatory, hepatoprotective, antibacterial, antioxidant, and anticancer properties. This opens up more possibilities for using silkworm pupae. This page summarizes knowledge about using silkworm pupae as a food source and medicinal substance. Intending to illuminate the connection between silkworm pupae and health and offer a resource for their pharmaceutical application, the article addresses the potential applications.

Composition of Silkworm pupae

Pupae of silkworms are highly nutrient-rich. The composition of dried silkworm pupae were water, fat, protein, glycogen, chitin, ash and others in the proportion of 7.18, 29.57, 49.98, 4.65, 3.73, 2.19 and 3.70 per cent whereas in squashed pupa it was 6.32, 15.20, 60.77, 5.78, 4.68, 2.73 and 4.57 per cent respectively. The most abundant dry matter in silkworm pupae is protein, which makes about 55.60 per cent of the pupae's dry weight (*Bombyx mori*). With the exception of Eri silkworm pupae, all species of silkworm pupae have almost the same amino acid content, with 18 amino acids making up each protein. Out of them, eight essential amino acids satisfy WHO/FAO/UNU standards. Furthermore, ten non-essential amino acids satisfy human requirements.

Silkworm pupae oil

Oil content in silkworm pupae is surpassed only by protein content. With a composition of 26.20 per cent, Eri silkworm pupae have the highest oil content among the four kinds of silkworm pupae. Unsaturated fatty acids are abundant in all the oils extracted from silkworm pupae, with *Antheraea pernyi* having the highest percentage at 77.71 per cent. Furthermore, eicosapentaenoic and docosahexaenoic acids - two Omega-3 fatty acids that are crucial for maintaining human health, are also present in silkworm pupae. In addition to being high in

oils, silkworm pupae are also high in unsaturated fatty acids, particularly polyunsaturated fatty acids, which offer important nutritional benefits as a source of edible oil.

Minerals in silkworm pupae

An essential function of minerals is seen in living things. Silkworm pupae contain minerals in a variety of forms. Up to 25 distinct types of minerals have been found in silkworm pupae, and these minerals may be involved in some physiological processes in the organism. Among the eight minerals found in the three different kinds of pupae, it is evident that the pupae contain larger concentrations of phosphorus, calcium, and magnesium. Due to the extremely low sodium-to-potassium (Na:K) ratio in silkworms, which indicates that eating silkworm pupae may lessen the risk of non-communicable diseases. Selenium, which can be enhanced in the pupae protein, is another abundant element in certain pupae. Pupae rich in selenium are crucial for protecting against oxidative stress and preventing cancer.

Vitamins and other ingredients in silkworm pupae

Apart from the components mentioned above, silkworm pupae are abundant in vitamins. The principal vitamins found in silkworm pupae are VC, VE, VB1, VB2, VB3, VB5, VB7, VB9, VB12, and VB12. Silkworm pupae are also rich in five tocopherols and phospholipids. Silkworm pupae also contain uncommon dimethyladenosine compounds. Furthermore, polyphenols and flavonoids are present in silkworm pupae. Biologically active sugars found in silkworm pupae can be categorized into two primary groups: separated and purified polysaccharides and chitosan and chitin. While not cytotoxic, silkworm pupae's chitosan and chitin—particularly carboxymethyl chitosan—have significant physiological activity. The biofunctional activities of these compounds form the foundation for the pharmacological actions exhibited by silkworm pupae.

Allergens in silkworm pupae

There are currently 26 silkworm pupae proteins known to cause allergies. Except for arginine kinase, no other protein was identified as allergenic in silkworm larvae. The WHO and the International Union of Immunological Societies (WHO/IUIS) Allergen Nomenclature Sub-committee (www.aller gen.org) have formally confirmed and registered no allergens of silkworm pupae, except for arginine kinase (legally known as Bomb m 1). It has been documented that silkworm larvae, but not pupae, contain arginine kinase as an allergen. Additionally, arginine kinase gene expression is expressed at a relatively modest level in pupae and increases as larvae mature. Therefore, more research is required to determine whether arginine kinase in silkworm pupae is allergenic.

One processing method that shows promise for utilizing the bioactive qualities of silkworm pupae is enzymatic hydrolysis. This procedure may also be a useful way to reduce allergenicity. In order to process hypoallergenic proteins, efficient techniques might be established by comprehending the structure–allergenicity link of allergens in silkworm pupae. To fully understand how allergens affect silkworm pupae's immune systems, more research is necessary.

Important applications

Pupae of silkworms are an important source of insects used in pharmaceuticals and other health-related products. The protein powder of silkworm pupae has been added to bread, cookies, noodles, and other foods in addition to being consumed directly. Additionally, the toughness and cooking yield of emulsion sausages were improved by using silkworm pupae flour in place of 10% lean pork, which was a unique protein element. Despite active compounds in silkworm pupae, their pharmacological activities are still unclear. There were more possibilities of utilizing silkworm pupae as food additives as shown by many studies on how they work.

But, one of the most significant barriers to using edible insects as a direct food source is customer acceptance. Eliminating proteins or other bioactive components that cause allergies in humans from silkworm pupae may thereby increase customer acceptability. Future studies should focus on developing methods for collecting and purifying silkworm pupae proteins for use in the food industry. Consumers can easily consume complex amino acids derived from silkworm pupae hydrolysis.

Fishmeal made from silkworm pupae is also utilized in the breeding of fish, poultry, and invertebrate species. Using silkworm pupae could lessen the need for additional protein feed sources while improving digestibility, moulting time, and antioxidant capacity. In addition to being eaten raw or as part of a meal, silkworm pupae can be used as animal feed to satisfy human hunger.

Conclusion

This article provides an overview of the components of silkworm pupae and emphasizes the use of minerals and silkworm pupae oil as a functional diet and medication. Because of this, silkworm pupae show promise for usage in the pharmaceutical and biomedical industries. Since silkworm pupae are increasingly being used in human diets, it is important to find out if any potential negative reactions to the substances they contain exist. Therefore, to confirm the pharmacological properties of silkworm pupae, clinical trials must be carried out immediately. To improve human health, researchers should concentrate on investigating the pharmacological properties of silkworm pupae in the future, both in clinical trials and at the molecular level.