



***Lethocerus indicus* (Le Peletier & Seville), a giant water bug as an important edible insect**

Laishram Sanahanbi Devi^{1*}, Ibemhal D Asem²

¹ Department of Zoology, Lilong Haoreiobi College, Thoubal, Manipur, India

² Department of Botany, Shree Shree Gourgobind Girls' College, Khurai Sajor Leikai, Imphal East, Manipur, India

Abstract

Lethocerus indicus is a water bug and it is liked by many who consumed edible insects. *Lethocerus indicus* is taken food in many parts of the world. Many communities of North Eastern India practised eating edible insects. *Lethocerus indicus* (Le Peletier & Seville) is a large aquatic insect of the Belostomatidae family. It has great nutritional values. *Lethocerus indicus* has been reported to contain higher protein and gross energy and various minerals such as sodium, calcium, and magnesium are reported to be present. It also contains fiber as well. The male sex of *Lethocerus indicus* has scent glands containing sex pheromones. The scent makes *Lethocerus indicus* more desirable by the insect consumer.

Keywords: Giant water bug, *Lethocerus indicus*, protein, mineral, scent

Introduction

A number of edible insects with great nutritional values are available as well as they are consumed by many people groups. In rural areas, people mainly suffer undernutrition, commonly PEM (protein-energy malnutrition), therefore, there is a need of alternative nutritional food sources ^[1]. Edible insects which are readily available could be consumed to overcome malnutrition. However, there is still a knowledge gap regarding their availability and macronutrients content. Insects are consumed as food and some considered as a delicacy. In India, some of the ethnic communities of Arunachal Pradesh, Assam, Kerala, Nagaland, Manipur, Chhattisgarh, Tamil Nadu and Madhya Pradesh have engaged in this activity ^[2]. Insects have mineral and protein content. And some authors have also reported the medicinal values of insects ^[3, 6].

Various parts of the world considered the consumption of insects is an playing an important role in the context of nutrition, including Asia and Latin America from the very beginning ^[7, 9]. 255 species insects which are edible are reported in India. It is practised in the North East region of India mostly and some tribal people of Indian Andaman Islands, Tamil Nadu, Kerala, Madhya Pradesh, Odisha, and Karnataka and they use termites, locust, ants and bees ^[10, 17]. Many communities of North Eastern India practised entomophagy and also entomophagy is a part of their culture. Some of the edible insects of North Eastern India include of *Bombyx mori*, *Hydrophilus triangularis*, *Lethocerus indicus*, *Apis dorsata*, *Apis mellifera*, *Apis cerana*, *Odontotermes* sp., *Oxy hyla*, *Solenopsis geminata*, *Samia Cynthia ricini*, *Antheraea proylei*, *Omphisa fuscinalis*, and *Zonocerus variegatus*, etc ^[18]. The nutritional quality of 5 edible aquatic insects of Manipur namely *Laccotrephes maculatus*, *Crocothemis servilia*, *Hydrophilus olivaceus*, *Lethocerus indicus*, and *Cybister tripunctatus* were studied ^[19]. Higher protein content and gross energy and minerals content were obtained reported in these 5 insects. Three species of *Lethocerus* spp, giant aquatic bugs are known from India. The 3 species are *Lethocerus deyrollei*, *Lethocerus patruelis* and *Lethocerus indicus* ^[20]. *Lethocerus indicus* is one among the preferred

edible insects by those consumed insects. The review paper presents the distribution, nutritional values and the chemical constituents of the scent of *Lethocerus indicus*.

Distribution of *Lethocerus indicus*

Lethocerus indicus (Le Peletier & Seville) belongs to the family Belostomatidae and sub-family Lethocerinae. *Lethocerus indicus* is a large aquatic insect of around 60-80 mm in length.

The male sex of *Lethocerus indicus* has scent glands only containing sex pheromones. These sex pheromones contribute the desired odour.

Lethocerus indicus, a giant water bug is native to South & Southeast Asia and also in southeat China, New Guinea and Ryukyu Islands ^[21]. Three species of giant aquatic bugs namely *Lethocerus deyrollei*, *Lethocerus patruelis* and *Lethocerus indicus* are known from India. Among them, *Lethocerus indicus* is widely distributed in Jammu and Kashmir, Karnataka, Kerala, Andaman and Nicobar Islands, Rajasthan, Andhra Pradesh, Punjab, Arunachal Pradesh, Assam, Bihar, Delhi, Chandigarh, Goa, Himachal Pradesh, Gujarat, Manipur, Meghalaya, Tamil Nadu, Mizoram, Pondicherry, Tripura, Madhya Pradesh, West Bengal, Maharashtra, Orissa and Uttar Pradesh ^[22, 23]. A report put up that as many as 700 *Lethocerus indicus* specimens were reported to be found dead around the locality of Thiruvananthapuram district, Kerala which may be due the high intensity of floodlight, less availability of water in the vicinity and the lunar phase ^[20]. Giant aquatic bugs are found to inhabit mainly in lentic freshwater habitats ^[20]. It includes natural wetlands like the lakes, pools, marshes, swamps, ponds, and ditches. And artificial wetlands like the water channels and paddy fields. They feed on be on other insects, amphibians, molluscs, snakes, juvenile turtles and fish habitats ^[20].

***Lethocerus indicus* as Food**

Lethocerus indicus (Le Peletier & Seville) is eaten by many people of China, India, Burma, Laos, Indonesia, Vietnam and Thailand ^[24]. Thais used to collect a large number of *Lethocerus indicus*. Collection is done from rice grown

plain of Korat, Thailand and thus preserved bugs were found in Korat's food markets [25]. *Lethocerus indicus* and bug-paste were found to selling in the shop of Thai in Berkeley, California and in San Fransisco Thai Market [25]. In Thai, the bugs are called "mangda" and have been preserved by boiling in salt water and the bugs were used to make bug-paste condiments. The bug-paste of Thai is called "nam prik mangda" [25]. Clear alcohol bug extracts called "mangdana essence" were found selling in Southeast Asian markets in Berkeley, Oakland and San Francisco [25]. Giant water bug is consumed in Mexico and Thailand. In Mexico, it is known as "Cucarachon de agua", *Lethocerus americanus*. And in Thailand, it is known as "Mangda", *Lethocerus indicus* [26]. *Lethocerus americanus* and *Lethocerus indicus* live in water sources like ponds, fresh water rivers and streams and they are easy to be collected which can be done either by attracting to bright lights or with nets [27].

In Manipur, India, *Lethocerus indicus* is called by the "naosek". The scent of this bug makes the insect more desirable. *Lethocerus indicus* is taken commonly by roasting until cooked [19]. It is often eaten by smashing with "eromba" and "morok metpa". "Eromba" is a Manipur dish prepared by smashing a mixture of boiled appropriate vegetables combination, chillies and roasted or steamed fermented fish and salt. "Morok metpa" is a Manipuri side dish (a dip sort), its king ingredients are a bunch of chillies and fermented fish and salt. And some people take the bug by mixing the roasted form with "Singju". "Singju" is sort of Manipuri mixed vegetables salad but very different from a typical salad. In Manipur, the price of giant water bug is high. These days the population of this bug is dangerously declined in Manipur. Therefore, the study of the bio-ecology of these bugs particularly in Manipur is suggested [28].

Nutritional Value

Insects have higher fats and crude protein. They contain good nutrient and have amino acid, minerals, and vitamins. The micro-minerals include copper, magnesium, iron, calcium, manganese, sodium, selenium, phosphorus, zinc and potassium and the vitamins include, pantothenic acid, biotin and riboflavin [15, 29, 30].

Shantibala *et al.* [19] reported the nutritive contents of *Lethocerus indicus* from Manipur. It was reported that *Lethocerus indicus* was obtained to content good of the micro-nutrient compositions. Ca, K, Na, Mg, Fe, Zn and Cu contents were 96 ± 1.15 , 170 ± 4.62 , 8.55 ± 1.15 , 70.33 , 410 ± 6.69 , 29.5 ± 0.98 , and 1.1 ± 0.12 mg/100g, respectively [19]. The composition of protein, carbohydrates, lipid, moisture, fiber and ash were reported to be $22.67 \pm 0.36\%$, $1.54 \pm 0.20\%$, $13.75 \pm 0.09\%$, 46.93 ± 0.41 , $11.71 \pm 0.25\%$ and $3.24 \pm 0.16\%$, respectively and the energy was found to be 632.06 ± 1.30 Kcal/gm [19].

Melo-Ruiz *et al.* [26] studied and reported macronutrient content of *Lethocerus* sp., giant water bug, *Lethocerus americanus* (Cucarachon de agua) and *Lethocerus indicus* (Mangda) from Thailand. They collected insect samples randomly at Xochimilco lakeside area from Mexico. The collected samples were transferred to the Metropolitan Autonomous University laboratory for determining taxonomy, their moisture and chemical constituents by using techniques in AOAC [31, 32] and samples from Thailand was bought from Warorot market in Chiang Mai, Thailand with the common name "Mangda" [27, 33]. The raw bugs

were prepared for air transportation and transported to Mexico for the determination of their taxonomy, moisture and macronutrient study according with AOAC [31]. Analysis of nutrients such as the determination of moisture, protein, minerals, lipids, fiber, and carbohydrate content was studied taking the insect samples from Mexico and Thailand. Determination of the moisture content was done and Kjeldahl method was used for the protein content determination. Determination of ash content (minerals) was also performed. Lipid content was determined by the using the method of semi continuous solvent extraction [31]. Determination of raw fiber performed by acid hydrolysis followed by the alkaline hydrolysis and the carbohydrate content was also determined.

They observed that percentage of the moisture contents were 52.25 percent for Mexico samples and 55.09 percent for Thailand sample. Protein content in Mexican samples was obtained to be 60.12 ± 0.5 gram per 100 gram of proteins and for the Thai samples, 53.11 ± 0.8 gram per 100 gram of proteins was reported. Total mineral content of 5.46 ± 0.7 gram per 100 gram and 6.75 ± 0.3 gram per 100 gram were obtained for insect samples from Mexico and Thailand, respectively. Lipid content analysis of the Mexican and Thai insects obtained to contain 5.72 ± 0.4 gram per 100 gram and 8.15 ± 0.7 gram per 100 gram, respectively. Fiber content was obtained to be 10.95 ± 0.80 and 12.23 ± 0.60 gram per 100 gram dry sample and the soluble carbohydrates 17.75 and 19.74 gram per 100 gram in the insect samples of Mexico and Thailand, respectively.

Chemical constituents

The male sex of *Lethocerus indicus* have scent glands and contain sex pheromones. These sex pheromones give the desirable scent. Many compounds were found to be constituents of the scent. Kiatbenjakul *et al.* [34] identified and reported potent sulfur-containing compounds, 3-sulfanylhexyl acetate and 3-sulfanyl-1-hexanol (tentatively identified) in male *Lethocerus indicus* scent glands.

Kiatbenjakul *et al.* [35] characterized the potent odorants in frozen fresh and salted boiled male giant water bug (*Lethocerus indicus* Lep. and Serv.). They performed the characterization by using direct solvent extraction/solvent-assisted flavour evaporation, gas chromatography-olfactometry, gas chromatography-mass spectrometry, aroma extract dilution analysis and stable isotope dilution assays and detected 20 and 27 potent odorants in frozen fresh and salted boiled male giant water bug, respectively. Most of the odorants were found to be lipid-derived compounds, which includes 2 abundant volatile compounds like (E)-2-hexenyl acetate and (E)-2-hexenyl butanoate. These volatile components give banana-like odours. In salted boiled male giant water bug, 2-Acetyl-1-pyrroline and 2-acetyl-2-thiazoline were detected. They are responsible for popcorn-like odours. In their further study, they obtained that (E)-2-hexenyl acetate was found to be an important character-impact odorant in male giant water bug aroma.

The abdominal gland juice of *Lethocerus* spp. was investigated and (E)-2-hexenyl acetate was reported to be the major volatile component and the second most volatile compound obtained was (E)-2-hexenyl butanoate [36]. (E)-2-hexenyl acetate and (E)-2-hexenyl butanoate with other 24 aromatic volatiles including 2 volatile compounds containing sulfur were obtained in the frozen whole insects [37]. The two sulfur-containing volatile compounds reported were methional and 2-acetyl-2-thiazoline.

Conclusion

Lethocerus indicus, giant water bug and it is one of the preferred edible insects. Many chemical constituents are responsible for the scent of *Lethocerus indicus*. The scent makes *Lethocerus indicus* more desirable by the insect consumer. It has great nutritional values. Good amount of protein and high gross energy and various minerals are present. Therefore, *Lethocerus indicus* may act as a good source of protein and minerals and may be suggested to include in the diet for those who consumed insects. And furthermore, the domestic farming of *Lethocerus indicus* may be a good source of income.

References

1. DeFoliat G R. Insects as food: why the western attitude is important. Annual review of entomology,1999;44(1):21-50.
2. Devi W D, Bonyansa R, Kapesa K, Mukherjee P K, Rajashekhar Y. Ethnotherapeutic practice of entomophagy species by the ethnic community of Tangkhul, Mao and Poumai community of Manipur, NER India. Journal of Ethnic Foods,2022;9(1):17.
3. Meyer-Rochow V B. Therapeutic arthropods and other, largely terrestrial, folk-medicinally important invertebrates: a comparative survey and review. Journal of Ethnobiology and Ethnomedicine,2017;13(1):1-31.
4. Senthilkumar N, Barthakur N D, Rao L. Bioprospecting with reference to medicinal insects and tribes in India: an overview. Ind Forester,2008;12:1575-91.
5. Rajkhowa D, Deka M K. Insect-based medicines: a review of present status and prospects of entomotherapeutic resources for human ailment. International Journal of Agriculture, Environment and Biotechnology,2016;9(6):1069-1079.
6. Mozhui Lobeno, L N Kakati, Victor Benno Meyer-Rochow. "Entomotherapy: a study of medicinal insects of seven ethnic groups in Nagaland, North-East India." Journal of Ethnobiology and Ethnomedicine,2021;17(1):1-22.
7. Menzel P, d'Aluisio F. Man eating bugs: the art and science of eating insects. Berkeley, California: Ten Speeds Press, 1998.
8. Van Huis A, Van Itterbeeck J, Klunder H, Mertens E, Halloran A, Muir G, et al. Edible insects: future prospects for food and feed security (No. 171). Food and agriculture organization of the United Nations, 2013.
9. Sahagún F B. *Florentine Codex*. Florence, Italy: Giunti Barbera Publishers. (in Spanish), 1979.
10. Rajan B K C. Tiny wild fauna and human food. My forest,1987;23(3):177-180.
11. Das S. Locust as food and manure. Indian Farming,1945;6:412.
12. Roy JK, Rao R K. Investigation on the diet of the Muria of Bastar District. Bull. Dept. Anthropol,1957;6:33-45.
13. Wilsanand V. Utilization of termite, *Odontotermes formosanus* by tribes of South India in medicine and food, 2005.
14. Sharief M U. Plants folk medicine of Negrito tribes of Bay Islands, 2007.
15. Srivastava SK, Babu N, Pandey H. Traditional insect bioprospecting as human food and medicine. Indian Journal of Traditional Knowledge,2009;8(4):485-494.
16. Srivastava S K, Babu N, Pandey H. Traditional insect bioprospecting—As human food and medicine, 2009.
17. Yesodharan K, Pabmanabhan P, Cini N U. Wild food traditionally used by the indigenous people of Parambikulam Wildlife Sanctuary, Western Ghats, Kerala, India. Journal of the Bombay Natural History Society (JBNHS),2011;108(1):41-46.
18. Chakravorty J. Diversity of edible insects and practices of entomophagy in India: an overview. J Biodivers Biopros Dev,2014;1(3):124.
19. Thangjam R, Kadam V, Ningthoujam K, Sorokhaibam M. A review on edible insects and their utilization in Northeastern Himalaya." Journal of Entomology and Zoology Studies,2020;8(3):1309-1318.
20. Shantibala T, Lokeshwari R K, Debaraj H. Nutritional and antinutritional composition of the five species of aquatic edible insects consumed in Manipur, India. Journal of Insect Science,2014;14(1):14.
21. Pattazhy S, Palot MJ. Mass mortality of Giant Water Bug *Lethocerus indicus* (Lepeletier & Serville, 1825) [Heteroptera: Belostomatidae] in Thiruvananthapuram, Kerala State, South India. Rec. zool. Surv. India,2021;121(2):315-317. DOI: 10.26515/rzsi/v121/i2/2021/152535
22. GOODwYN P E R E Z. Taxonomic revision of the subfamily Lethocerinae Lauck & Menke (Heteroptera: Belostomatidae). *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*,2006;695:1.
23. Thirumalai G. A synoptic list of Nepomorpha (Hemiptera: Heteroptera) from India. Records of the Zoological Survey of India Occasional Papers,2007;273:1-84.
24. Nesemann H, Sharma G. Observations on the life history of giant water bugs *Lethocerus* Mayr, 1853 (Heteroptera: Nepomorpha: Belostomatidae) in the Gangetic plains of India and Nepal. Journal of Threatened Taxa, 2013, 4474-4482.
25. Mitsuhashi J. Eatable insects of the world. Kokinshoin, Tokyo, 1984, 35.
26. Pemberton R W. The use of the Thai giant waterbug, *Lethocerus indicus* (Hemiptera: Belostomatidae), as human food in California. *The Pan-Pacific entomologist (USA)*, 1988.
27. Melo-Ruiz V, Moreno-Bonett C, Sánchez-Herrera K, Díaz-García R, Gazga-Urioste C. Macronutrient composition of giant water bug (*Lethocerus* sp.) edible insect in Mexico and Thailand. Journal of Agricultural Science and Technology A, 2016, 6(5).
28. Weil C. Fierce Food: The Intrepid Diner's Guide to the Unusual, Exotic and Downright Bizarre. USA: Penguin Group, 2006.
29. http://epao.net/epSubPageExtractor.asp?src=education.Science_and_Technology.Aquatic_edible_insects_of_Loktak_Lake_of_Manipur._Accessed on 2nd April 2023.
30. Akinnawo O, Ketiku A O. Chemical composition and fatty acid profile of edible larva of *Cirina forda* (Westwood). African Journal of Biomedical Research,2000;3(2):93-96.
31. Rumpold B A, Schlüter O K. Nutritional composition and safety aspects of edible insects. Molecular nutrition & food research,2013;57(5):802-823.
32. Association of Official Analytical Chemists (AOAC). Official Methods of Analysis, 16th ed. Arlington, V.A. : AOAC, 1995.

33. Nielsen S S. Food Analysis Laboratory Manual, 2nd ed.. USA: Springer, 2010.
34. Hopkins J. *Extreme Cuisine: The Weird and Wonderful Foods That People Eat*. Tuttle Publishing, 2019.
35. Kiatbenjakul P, Intarapichet K O, Cadwallader K R. Identification of potent sulfur-containing odorants in scent glands of edible male giant water bug, *Lethocerus indicus* (Lep. and Serv.). *Flavour and Fragrance Journal*, 2014;29(2):107-113.
36. Kiatbenjakul P, Intarapichet K O, Cadwallader K R. Characterization of potent odorants in male giant water bug (*Lethocerus indicus* Lep. and Serv.), an important edible insect of Southeast Asia. *Food chemistry*, 2015;168:639-647.
37. Devakul V, Maarse H. A second compound in the odorous gland liquid of the giant water bug *Lethocerus indicus* (Lep. and Serv.). *Analytical Biochemistry*, 1964;7(3):269-274.
38. Mahattanatyawee K, Rouseff R L. *In advances and challenges in Flavor Chemistry and Biology*, T. Hofmann, W. Meyerhof, P. Scheieberle (eds). Deutsche Forschungsanstalt fur Lebensmittelchemie: Freising, Germany, 2010, 394-397.