

## A review on Ethnomedicinal practices of insects in Assam, India

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### Abstract

Ethno-medicine is an ancient subject that predates modern medical science, as nature has been the ultimate source of life-changing and life-saving medications for ages with plant and animal products extensively used as therapeutics. This review focused mainly on the insects that are traditionally used by different ethnic groups belonging to Assam, India for treating various diseases. Around more than 60 species of insects are recorded in this review article and various insect-derived substances such as honey, cocoon, and whole body of that particular insect have been employed to treat ailments ranging from body aches to cancer. Further research needs to be done to validate the therapeutic potential of insects by identifying the active compounds and developing evidence-based approaches for integration into modern healthcare systems.

**Keywords:** Ailments, ethno-medicine, ethnic groups, entomotherapy

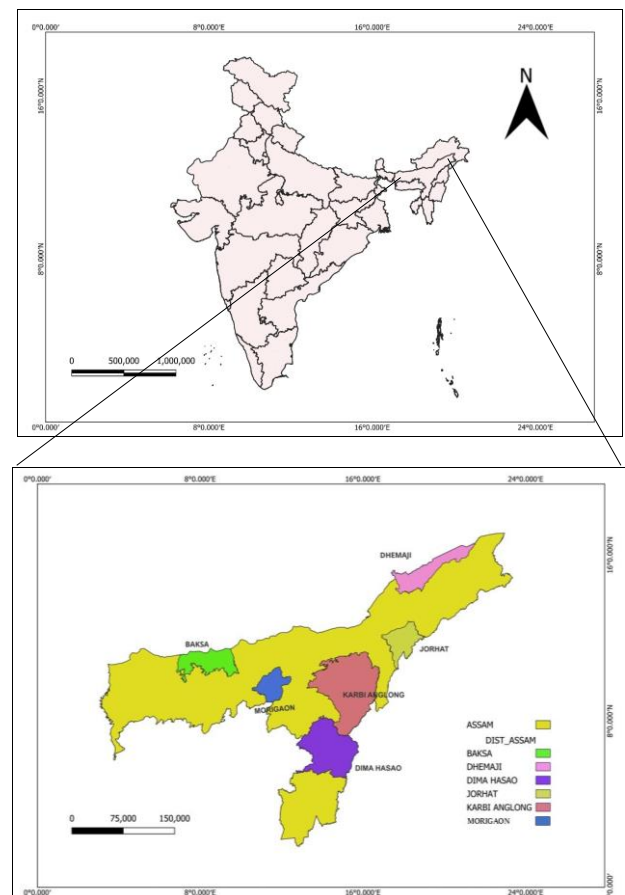
### Introduction

India is home to different ethnic communities with different beliefs about natural resources. Ethno-medicine concentrates on the ethnic beliefs of these communities along with the use of various resources like plants and animals in the prevention and treatment of different diseases or illnesses. It also aims to document and preserve the immensely rich and diverse traditional medicinal knowledge and practices to understand how they relate to modern biomedicine. Ethnomedicine has been utilized as a beginning point for the development of medications, particularly those that use reverse pharmacological procedures, and it acts as a significant alternative to other recognized therapies used in modern society (Thangjam *et al.*, 2020) [17]. Although most conventional therapies focus on plant resources and their derived compounds, flora also plays an important role in traditional medicine in several cultures. According to current estimates, 8.7% of significant chemicals utilized in contemporary medicine come from animals or are derived from them (Altaf *et al.*, 2020; Hassan *et al.*, 2023) [2, 8]. The concept of practicing ethno-medicine is not new, it has been reported that different by-products like horns and bones form important constituents in the preparation of curative, protective, and preventive medicines (Solanki and Chutia, 2009) [16]. WHO reported that the percentage of the population using traditional medicine for primary health care in developing countries is more than that of developed countries (Solanki and Chutia, 2009) [16]. According to Chakraborty (2014), insect constitutes about 80% of all animals and are very successful in adapting and surviving according to their environment (Estelle *et al.*, 2019; Hassan *et al.*, 2023) [7, 8].

Assam has a rich cultural identity because of the different ethnic groups dwelling in this region. Ethno-medicine in Assam often incorporates spiritual and ritualistic elements. This biodiversity-rich region in India is situated to the North-East direction. The current review article makes an effort to emphasize the resources based on insects or

products derived from insects utilized by the ethnic tribes of Assam, India.

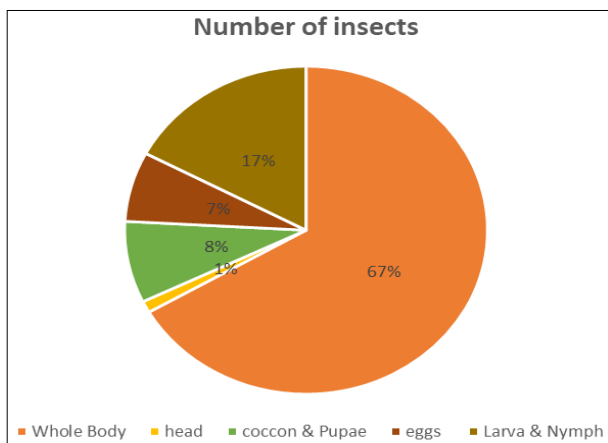
The study area for this review work is selected as Assam, India which is located in the North-East region of India as shown in Figure 1.



**Fig 1:** Showing study area

**Therapeutic applications of insect parts and life stages**

Insects and insect parts, spanning their adult, cocoon, pupal, egg, or larval stages, are extensively utilized in ethnomedicine for treating a wide array of ailments. These include alleviating pain conditions such as headache, stomachache, chest pain, and joint pain, as well as managing various inflammations like conjunctivitis and arthritis. Furthermore, they are frequently used to treat gastrointestinal problems such as indigestion, diarrhea, dysentery, constipation, bloating, and vomiting. In addition, insects are used to treat ailments such as malaria, cholera, jaundice, diabetes, asthma, pneumonia, and typhoid. In rare situations, they also show analgesic and antipyretic qualities. This investigation of ethnomedicine practices utilizing body parts and insect products as treatment cures accommodates a thorough evaluation of 33 families and 74 insect species. Notably, the family Vespidae emerged as a focus point, with the most species which was 7 in number. Among the insect species employed in ethnomedicine, a substantial majority, constituting around 67%, were utilized as a whole body which is depicted in Figure 3. The mature insect's full body as well as body sections like the head or legs were all used in this manner. Furthermore, around 17% of the bug species were used in the larval or nymph stage, whilst about 8% were used in the cocoon or pupal stage, whilst about 8% were used in the cocoon or pupal stage. Remarkably, 7 percent of the insect species were used when they were in the egg stage.



**Fig 3:** Showing different parts of insects used during their applications

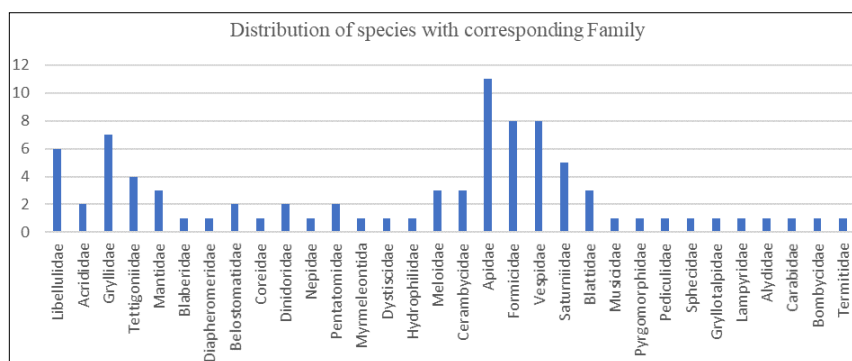
**Insect-Based Products in Ethnomedicine**

Aside from insects, several traditional therapeutic remedies comprised insect-derived products such as honey, bee wax, bee nests, and materials for hive entrances. These results highlight the resourcefulness and adaptability of ethnomedicine practices in indigenous groups,

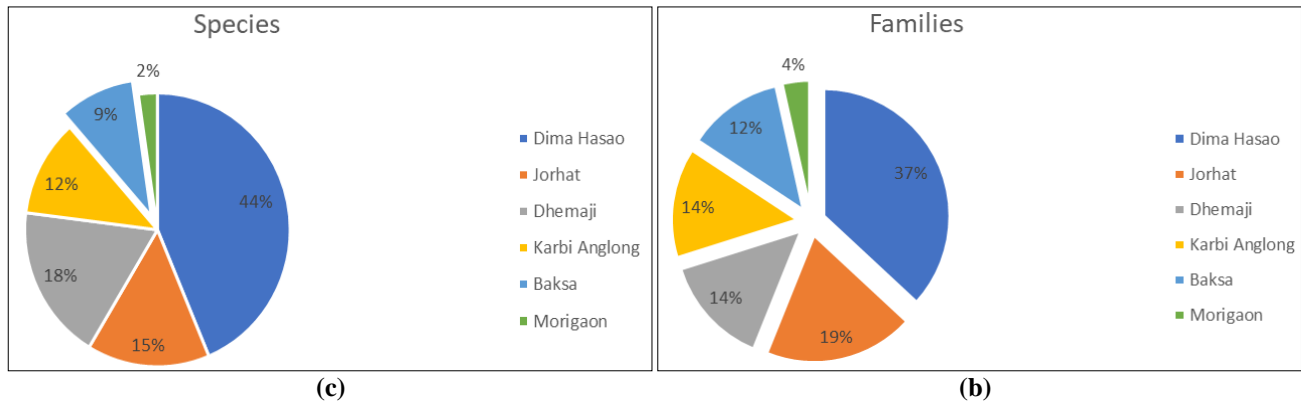
demonstrating a comprehensive approach to treatment that makes use of the various natural resources at hand. The natural products obtained from insects have marvelous pharmacological potential in comparison to other groups of animals (Kumar and Shahid, 2020) [12]. To increase their effectiveness, these products are frequently blended with water or other natural substances, such as turmeric and garlic powder. According to some reports, apitherapy is used to treat cardiovascular, gastrointestinal, and hepatic diseases as well as hasten the wounds' healing process (Abdulrhman *et al.*, 2010) [1]. Besides having high nutritive value, there are numerous health benefits of honey due to its antibacterial, wound-healing, antidepressant, anticonvulsant, and anti-anxiety properties and even anti-diabetic and anti-cancer properties (Simon *et al.*, 2009; Kassim *et al.*, 2010) [10, 15]

**Regional variation in insect utilization**

The study looked into the ethnomedicine practices of 11 tribes spread across six districts in Assam, India, and found a richness of traditional medical knowledge inextricably linked to local biodiversity. Each district had distinct tribes and related ethnomedicinal traditions, reflecting the region's diverse cultural landscape. In the culturally diverse Dima Hasao district, four tribes Zeme, Semsá, Dimasa, and Biáte preserved ancient healing skills. Within the study location, a remarkable total of 66 insect species from 32 families were identified for therapeutic potential depicted in Figure 2 (Kemprai, *et al.*, 2022) [11]. Meanwhile, in the Baksa region, the Bodo Community demonstrated their use of 8 insect species from 7 families for therapeutic purposes. Morigaon district, home to the Karbi tribe and the Nath Community, had a more restricted use, with only 2 insect species from 2 families used in ethnomedicine. Similarly, the Mising tribe inhabiting the Dhemaji district, where 16 species from 8 families were used medicinally. In all the districts studied, Figure 2(a) illustrates the number of species belonging to each family, Figure 2(b) depicts the percentage distribution of families and Figure 2(c) shows the species percentage distribution across the districts. Jorhat district's Ahom, Chutiya, Koch-Rajbongshi tribes, and Kalita Community used 13 insect species from 11 families to practice ethnomedicine. Finally, the Karbi Anglong district demonstrated a moderate use of insect-based medicines, with 10 species from 8 families identified for therapeutic uses. These findings highlight the complex relationships between cultural practices, biodiversity, and healthcare systems, emphasizing the necessity of preserving traditional ecological knowledge for long-term health outcomes in indigenous communities.



**(a)**



**Fig 2:** (a) Showing the number of species against their Family, (b) Showing the family percentage corresponding to the districts, (c) Showing the species percentage corresponding to the districts

**Healing applications and ailments treated by insect remedies**

The use of insects and their components emphasizes their importance in traditional healing procedures among varied indigenous societies. Across the tribes studied a diverse range of insect parts and products were employed in ethnomedicine practices, as detailed in Table 1. For medical purposes, certain tribes employed the entire body of insect species, whether it was an adult, larval, or nymphal stage, while others emphasized using portions of the body like the head, wings, legs, or alimentary canal. Indigenous communities have an intricate knowledge of the

diversity of available insects and the nuances of therapeutic approaches, as evidenced by the different ways that insect-based ethnomedicines are administered based on the type of insect used and the nature of the ailment. These treatments are usually taken orally or applied externally, though fumes or insect-based smoke are also used in some applications. Numerous species of insects have been used in different forms, such as alive, cooked, ground, infusions, plasters, salves, and ointments, both in curative and defensive medicine and in magico-religious rituals, depending upon the custom of the different communities. (Costa-Neto, 2005; 2002).

**Table 1:** Use of insects and their parts for different ailments by the tribes from respected Districts of Assam

| District/ Area        | Tribe/ Community    | Scientific name                       | Family                | Body parts used  | Ailments                           | Prescription  | Reference                    |
|-----------------------|---------------------|---------------------------------------|-----------------------|--|------------------------------------|---|------------------------------|
| Dima Hasao            | Zeme, semsa, Dimasa | <i>Crocothemis servilia servilia</i>  | Libellulidae          | Nymph (whole body)   | Headache, vision                   | Boiled and eaten  | (Kemprai, et al., 2022) [11] |
|                       |                     | <i>Diplocodes trivialis</i>           | Libellulidae          | Whole body   | Joint pain                         | Externally applied raw body.  |                              |
|                       |                     | <i>Neurothemis fulvia</i>             | Libellulidae          | Whole body   | Body ache                          | Soup nourishes the body   |                              |
|                       |                     | <i>Orthetrum pruinosum neglectrum</i> | Libellulidae          | Head   | Vision                             | Inhaling vapors from boiling manually every day for a week                            |                              |
|                       |                     | <i>Pantala flavescens</i>             | Libellulidae          | Whole body   | Conjunctivitis                     | Fumes of boiled are permitted to enter the eyes three times every day for seven days. |                              |
|                       |                     | <i>Potamarcha congener</i>            | Libellulidae          | -  | Arthritis                          | Externally applied after boiling.   |                              |
|                       |                     | <i>Melanoplus</i> sp.                 | Acrididae             | Whole body   | Hiccups                            | Consumed roasted body.  |                              |
|                       |                     | <i>Tarbinskiellus portentosus</i>     | Gryllidae             | Adult (Whole body)   | Indigestion                        | Roasted & whole body is consumed  |                              |
|                       |                     | <i>Gryllus</i> spp.                   | Gryllidae             | Adult (Whole body)   | Headache, Loose motion and malaria | Boil or roasted are consumed for early recovery                                       |                              |
|                       |                     | <i>Acheta domesticus</i> Linn         | Gryllidae             | Adult (Whole body)   | Reflux of food, indigestion        | Whole roasted insects are consumed on an empty stomach                                |                              |
|                       |                     | <i>Teleogryllus</i> spp.              | Gryllidae             | Adult (Whole body)   | Headache, vomiting                 | Roasted and grinded parts are consumed in an empty stomach along with water.          |                              |
|                       |                     | <i>Pseudophyllus titan</i>            | Tettigoniidae         | Adult (Whole body)   | Fever, Dysentery                   | Orally administered roasted body to young children.                                   |                              |
|                       |                     | <i>Mecopoda nipponensis</i>           | Tettigoniidae         | Adult (Whole body)   | Weight loss and constipation       | Boiled and eaten  |                              |
| <i>Tettigonia</i> sp. | Tettigoniidae       | Adult (Whole body)                    | Body ache, joint pain | Roasted whole body are eaten and externally applied after grinded. |                                    |   |                              |

|  |       |                                  |                 |                                   |   |  |
|--|-------|----------------------------------|-----------------|-----------------------------------|---|--|
|  |       | <i>Tenodera sinensis</i>         | Mantidae        | Adult (Whole body)                | Warts, Fracture   | Whole body is used on warts  |
|  |       | <i>Hierodula coarctata</i>       | Mantidae        | Adult (Whole body)                | Enuresis, kidney stone  | Roasted whole body is orally administered to young children and it has been prescribed to drink the grinded whole body for kidney stone. |
|  |       | <i>Epilampra</i> sp.             | Blaberidae      | Adult (Whole body)                | Appetizer   | Consumed in raw state.   |
|  |       |                                  |                 |                                   | Bloating  | Roasted body is rubbed on abdomen.   |
|  |       | <i>Carausius</i> sp.             | Diapheromeridae | Adult (Whole body)                | Calluses  | Paste is made and externally applied   |
|  |       |                                  |                 |                                   | Prickling spines  | Adult stick insects are rubbed on the skin for removal.  |
|  |       | <i>Lethocerus indicus</i>        | Belostomatidae  | Adult (Whole body)                | Dry cough   | Soup is orally administered twice daily.   |
|  |       |                                  |                 |                                   | Rheumatoid arthritis  | Fumes of boiled insects are taken for quick recovery   |
|  |       | <i>Notobitus meleagris</i>       | Coreidae        | Adult (Whole body)                | Stomach ache  | Roasted insects are taken.   |
|  |       | <i>Aspongopus nepalensis</i>     | Dinidoridae     | Adult (Whole body)                | Jaundice  | Boiled insects are consumed thrice a day for a week.   |
|  |       | <i>Coridius singalanus</i>       | Dinidoridae     | Adult (Whole body)                | Malaria, viral fever  | Cooked stink bugs are eaten daily for a duration of two weeks.   |
|  |       | <i>Laccotrephes ruber</i>        | Nepidae         | Adult (Whole body)                | Blood purifier  | Boiled nymph is orally administered daily for a week   |
|  |       |                                  |                 |                                   | Indigestion   | Boiled Soup of the bug is orally taken for rapid recovery.   |
|  |       | <i>Udonga montana</i>            | Pentatomidae    | Adult (Whole body)                | Analgesic, coughs   | Boiled bugs are eaten for rapid healing.   |
|  |       | <i>Myrmeleon</i> spp.            | Myrmeleontidae  | Larva                             | Diabetes  | Boiled insects are consumed to maintain blood sugar level.   |
|  |       | <i>Cybister limbatus</i>         | Dytiscidae      | Adult                             | Diarrhea  | Boiled insects are consumed for quick recovery.  |
|  |       | <i>Hydrophilus caschmirensis</i> | Hydrophilidae   | Adult                             | Boils, warts  | After cooking insects, the cooked water is eaten for quick recovery.   |
|  |       | <i>Mylabris</i> sp.              | Meloidae        | Adult                             | Gastritis, head ache  | Soup of boiled insect is taken once daily for a week.  |
|  |       | <i>Batocera rubus</i>            | Cerambycidae    | larva                             | Analgesic, diarrhoea  | Decoction of boiled larva are orally administered  |
|  |       | <i>Batocera parryi</i>           | Cerambycidae    | larva                             | Aphrodisiac, malaria, typhoid   | Soup of boiled are orally administered   |
|  |       | <i>Orthosoma brunneum</i>        | Cerambycidae    | larva                             | Asthma, coughs  | Roasted insects are eaten  |
|  |       | <i>Apis cerana indica</i>        | Apidae          | Honey                             | Blood pressure, cholera, cold coughs.   | One tea spoonful of honey is mixed in warm water and consumed for quick recovery.  |
|  | Honey |                                  |                 | Asthma sinusitis                  | One tablespoonful of honey is mixed in a cup of warm water and taken for quick recovery.                                |  |
|  | Honey |                                  |                 | Common illness, cancer, gastritis | One or two teaspoonsful of honey is mixed in a cup of warm water with garlic powder and orally administered once daily. |  |
|  | Honey |                                  |                 | Pneumonia                         | Honey is mixed with   |  |

|  |                       |                                 |                |                           |   |  |                              |
|--|-----------------------|---------------------------------|----------------|---------------------------|---|--|------------------------------|
|  |                       |                                 |                |                           |   | turmeric powder and externally applied on the belly.   |                              |
|  |                       | <i>Apis laboriosa</i>           | Apidae         | Honey                     | Appetizer, Common illness, cholera, cold coughs, vertigo, diarrhoea     | One teaspoonful of honey is mixed in a cup of warm water and garlic powder and orally administered once daily. |                              |
|  |                       |                                 |                | Bee comb                  | Appetizer, Common illness diarrhoea coughs, vertigo                     | A small piece of bee comb is dissolved in a cup of warm water and orally administered.                         |                              |
|  |                       | <i>Lepidotrigona arcifera</i> L | Apidae         | Honey/bee comb            | Analgesic, blood pressure, cancer, chest pain, gastritis, heart disease | A small piece of bee comb is dissolved in a cup of warm water and orally administered                          |                              |
|  |                       | <i>Lophotrigona canifrons</i>   | Apidae         | Nest entrance             | Diarrhoea, dog bite, snake bite, mouth ulcers                           | A small pieces of nest entrance is dissolved in a cup of warm water and orally administered.                   |                              |
|  |                       | <i>Oecophylla smaragdina</i>    | Formicidae     | Whole body                | Analgesic, fever, headache  | Cocked ants with tulusi leaf and administered orally for quick recovery  |                              |
|  |                       |                                 |                |                           | Malaria, typhoid, sinusitis   | Decoction of boiled ants is orally administered daily for two weeks.   |                              |
|  |                       | <i>Provespa barthelemyi</i>     | Vespidae       | Adult (Whole body)        | Analgesic, insomnia, oedema   | Soup of boiled wasps is orally administered  |                              |
| Dhemaji                                | Mishing Tribe         | <i>Samia Cynthia ricini</i>     | Saturniidae    | Pupae, Cocoon, cocoon ash | Liver protection  | -  | (Doley & Kalita 2012)        |
|  |                       | <i>Apis indica</i>              | Apidae         | Honey                     | Cough, cold, fever  | -  |                              |
|  |                       | <i>Vespa orientalis</i>         | Vespidae       | Whole insect              | Cough, cold, stomach problem  | -  |                              |
|  |                       | <i>Dorylus orientalis</i>       | Formicidae     | Eggs, adults              | Small pox, chicken pox, dysentery, stomachache.                         | -  |                              |
|  |                       | <i>Schistocera gregaria</i>     | Acrididae      | Whole body, body oil      | Lip protection  | -  |                              |
|  |                       | <i>Eumenes petiolatus</i>       | Vespidae       | Eggs, larvae              | Headache  | -  |                              |
| Karbi Anglong                          | -                     | <i>Apis mellifera</i>           | Apidae         | Honey                     | Asthma, flu, coughs   | Consumed honey in raw state  | (Verma et al., 2014) [19]    |
|  |                       | <i>Periplaneta americana</i>    | Blattidae      | Whole body                | Asthma  | Insect is fried and consumed   |                              |
|  |                       | <i>Achaeta sp.</i>              | Gryllidae      | Hind legs                 | Diuretic  | Insect is burned and eaten   |                              |
|  |                       | <i>Psudacanthotermis sp.</i>    | Pentatomidae   | Whole body                | Asthma  | Insect is fried and eaten  |                              |
|  |                       | <i>Musca domestica</i>          | Muscidae       | Whole body                | Baldness  | Insect is roasted and consumed   |                              |
|  |                       | <i>Poeciloceruspictus</i>       | Pyrgomorphidae | Whole insect              | Lung infection  | Insect is fried and eaten  |                              |
|  |                       | <i>Trigona spinipes</i>         | Apidae         | Honey                     | Throat inflammation   | Honey consumed   |                              |
|  |                       | <i>Lytta vesicatoria</i>        | Meloidae       | Whole body                | Anticancer  | Crushed and dissolved in water and orally consumed   |                              |
|  |                       | <i>Mylabris cichorii</i>        | Meloidae       | Whole body                | Anticancer, rabies, warts   | Crushed and dissolved in water and orally consumed   |                              |
|  |                       | <i>Pediculus sp.</i>            | Pediculidae    | Whole body                | Clears urinary tract  | Consumed alive   |                              |
| Morigaon (Pobitora wildlife sanctuary) | Nath community, Karbi | <i>Sceliphron sp.</i>           | Sphecidae      | Whole insect              | Pneumonia   | Insect along with cinnamon, clove, honey, and black pepper boiled together and prescribed to eat.              | (Borah and Prasad, 2016) [5] |
|  |                       | <i>Apis indica</i>              | Apidae         | Honey                     | Cough   | The combination of honey and <i>Ocimum sanctum</i>   |                              |

|                                    |  |                               |                |                       |   |   |                              |
|------------------------------------|--|-------------------------------|----------------|-----------------------|---|---|------------------------------|
|                                    |  |                               |                |                       |   | (Tulsi) leaf sap is prescribed.   |                              |
| Jorhat (Gibbon Wildlife Sanctuary) | Ahom, Chutiya, Koch-Rajbongshi, Kalita | <i>Scapteriscus borellii</i>  | Gryllotalpidae | Alimentary canal      | Intestinal worm (thread worm)                     | Alimentary canal part of the insect is consumed in raw state.   | (Borah and Prasad, 2017) [4] |
|                                    |  | <i>Lampyridae</i> spp.        | Lampyridae     | Whole Body            | Cancer  | Raw insects are prescribed to eat daily   |                              |
|                                    |  | <i>Periplaneta americana</i>  | Blattidae      | Whole body            | Asthma  | Boiled the insect without their wings and prescribed to eat.  |                              |
|                                    |  | <i>Apis cerana indica</i>     | Apidae         | Whole body            | Cancer  | The insect is ground in water and prescribed to consume   |                              |
|                                    |  | <i>Vespa affinis</i>          | Vespidae       | Whole body            | Cancer  | It is grinded and mixed with water and prescribed to drink  |                              |
|                                    |  | <i>Myrmicaria brunnea</i>     | Formicidae     | Whole body            | Body pain   | Prescribed to eat in raw state  |                              |
|                                    |  | <i>Tetraponera rufonigra</i>  | Formicidae     | Whole body            | Body ache   | Prescribed to eat in raw state  |                              |
|                                    |  | <i>Oecophylla smaragdina</i>  | Formicidae     | Whole body            | Sinus<br>Cancer<br>Epistapix (Bleeding from nose) | Fried and prescribed to eat some are prescribed to eat in the raw state   |                              |
|                                    |  | <i>Leptocorisa varicornis</i> | Alydidae       | Whole body            | Fever   | Boiled and prescribed to eat  |                              |
|                                    |  | <i>Antheraea assamensis</i>   | Saturniidae    | Whole body            | -   | Consumed raw for nutrition  |                              |
|                                    |  | <i>Acheta domesticus</i>      | Gryllidae      | Whole body            | Pain<br>For better eye sight improve pancreas     | Fried and prescribed to eat   |                              |
|                                    |  | <i>Pheropsophus</i> spp.      | Carabidae      | Whole body            | Alcoholic habit                                   | Beetle is consumed in raw state   |                              |
|                                    |  | <i>Mantis religiosa</i>       | Mantidae       | Cocoon with larva     | Otorrhoea (wound in ear)                          | Cocoon and larva is burned and produced ash is mixed with coconut oil and prescribed to apply in wounded area directly with feather |                              |
| Dhemaji District                   |  | <i>Bombyx mori</i>            | Bombycidae     | Larvae, pupae & adult | Constant itching & soreness of throat             | Consumed after frying and boiling   | (Dutta et al., 2016) [6]     |
|                                    |  | <i>Antheraea assamensis</i>   | Saturniidae    | Larvae, pupae & adult | Constant itching & soreness of throat             | Consumed after frying and boiling   |                              |
|                                    |  | <i>Samia cynthia ricini</i>   | Saturniidae    | Larvae, pupae & adult | Infection of tongue & mouth                       | Consumed after frying and boiling   |                              |
|                                    |  | <i>Oecophylla smaragdina</i>  | Formicidae     | Adult                 | Nose infection, sinus & throat infection          | Insect dried, grinded and mixed with mustard seeds & inhaled.   |                              |
|                                    |  | <i>Odontotermes</i> sp.       | Termitidae     | Adult stage           | Food value  | Wings & intestine removed then fried in oil   |                              |
|                                    |  | <i>Vespa orientalis</i>       | Vespidae       | Eggs & larvae         | Stomach problems                                  | Larvae and eggs are crushed & boiled and consumed   |                              |
|                                    |  | <i>Vespa magnifica</i>        | Vespidae       | Eggs & larvae         | Stomach problems                                  | Larvae and eggs are crushed & boiled and consumed   |                              |

|                |                |                                   |                |                     |   |  |  |
|----------------|----------------|-----------------------------------|----------------|---------------------|---|--|--|
|                |                | <i>Eumenus sp.</i>                | Vespidae       | Nest                | Stomach problems  | Nest is mixed with local herbs and consumed                    |  |
|                |                | <i>Apis indica</i>                | Apidae         | Egg, larvae & honey | Whooping cough  | The eggs, larvae are crushed and mixed with honey and consumed |  |
|                |                | <i>Periplaneta americana</i>      | Blattidae      | Adult (Whole body)  | Asthma  | Insect is boiled/burned & consumed                             |  |
| Baksa district | Bodo community | <i>Tarbinskiellus portentosus</i> | Gryllidae      | Adult (Whole body)  | Protein supplement, to cure weakness.                           | Roasted or fried and consumed.                                 | (Hassan <i>et al.</i> , 2023) <sup>[8]</sup> |
|                |                | <i>Apis indica</i>                | Apidae         | Honey               | To cure fever, cold, cough.                                     | Honey mixed with tulsi leaves and consumed                     |  |
|                |                | <i>Samia ricini</i>               | Saturniidae    | Larvae, Pupae       | To treat weakness, as nutritious food at the time of pregnancy. | Fried, roasted or curry  |  |
|                |                | <i>Lethocerus indicus</i>         | Belostomatidae | Adult               | As protein supplement.  | Fried, roasted or smoked and consumed                          |  |
|                |                | <i>Oecophylla smaragdina</i>      | Formicidae     | Eggs                | To treat low pressure, stomachache, dysentery.                  | Fried eggs consumed  |  |
|                |                | <i>Oecophylla smaragdina</i>      | Formicidae     | Whole insect        | To treat cuts, wounds.  | Ants are crushed into paste and applied externally             |  |
|                |                | <i>Vespa sp.</i>                  | Vespidae       | Larvae              | To treat cold, cough, stomach related problems.                 | Fried or roasted larvae are consumed                           |  |
|                |                | <i>Ruspolia baileyi</i>           | Tettigoniidae  | Adult               | As protein supplement, to treat weakness.                       | Fried or roasted adult are consumed                            |  |

**Ethnomedicine: A sustainable healthcare system**

Ethnobiology emphasizes Indigenous Peoples' ecological knowledge, stressing their in-depth awareness of local ecosystems and sustainable practices, which are critical for developing successful conservation measures and establishing harmonious environmental connections (Turner *et al.*, 2022) <sup>[18]</sup>. Ethnobiology's emphasis on cultural and ecological links, local knowledge, and participatory methodologies places it as an important contributor to understanding and solving the Sustainable Development Goals, particularly in contextually appropriate and culturally sensitive manners (Arrivabene *et al.*, 2024) <sup>[3]</sup>. Hence, integrating ethnomedicine into contemporary healthcare systems can improve patient care and give cost-effective treatment choices, particularly in marginalized regions.

**Conclusion**

The utilization of animals and animal products in conventional medication by indigenous communities is a very much acknowledged practice worldwide. For the people who stay in the far-off towns with restricted or no admittance to current allopathic medicines, for them the knowledge of traditional medicine is vital. Customary prescriptions are somewhat minimal expense things, and these are simpler to orchestrate and acquire compared to modern health facilities in remote villages. Proper commercialization and marketing strategies can also improve the livelihood of village dwellers (Mozhui *et al.*, 2017) <sup>[13]</sup>. Besides, it is often accepted that the conventional ways lead to a prompter cure and are without side effects (Jugli *et al.*, 2020) <sup>[9]</sup>. In very few parts of the world only, insects are used for medicinal purposes (Senthilkumar *et al.*, 2008) <sup>[14]</sup>. It is evident that the indigenous people of the Northeast have been widely using their traditional knowledge of medicine for

hundreds of years. The tribes of this region have been using several insect-based medicines to cure severe diseases from time immemorial. However, only a few scientific reports are being published on the traditional medicinal uses of animals from the NE region. Therefore, providing education on the conservation and preservation of this knowledge is very much needed (Wilsanand *et al.*, 2007) <sup>[20]</sup>. The upliftment of such traditional practices is possible only when a positive discussion is laid out between traditional people and healthcare professionals. Integration of traditional healthcare remedies into modern systems of treating diseases will ensure a holistic approach towards healthcare in general. Therefore, the part of ethnomedicine in Assam is important for studying and establishing new ways of treatment.

**Author contribution statement**

DK conceptualizes and contributes to the making of the first and final manuscript, NK prepares the first manuscript. BH and AAI analyzed the data and prepared the tabular form of the data. CB reviewed the data and RA supervised the entire manuscript.

**References**

1. Abdulrhman MA, Mekawy MA, Awadalla MM, Mohamed AH. Bee honey added to the oral rehydration solution in treatment of gastroenteritis in infants and children. *J Med Food*,2010;13:605–609. doi:10.1089/jmf.2009.0075
2. Altaf M, Abbasi AM, Umair M, Amjad MS, Irshad K, Khan AM. The use of fish and herptiles in traditional folk therapies in three districts of Chenab riverine area in Punjab, Pakistan, 2020, 1–21.
3. Arrivabene A, Lasic L, Blanco J, Carrière SM, Ladio A, Caillon S, *et al.* Ethnobiology's Contributions to

- Sustainability Science. *J Ethnobiol*,2024;44:207–220. doi:10.1177/02780771241261221
4. Borah MP, Prasad SB. Ethnozoological study of animals-based medicine used by traditional healers and indigenous inhabitants in the adjoining areas of Gibbon Wildlife Sanctuary, Assam, India. *J Ethnobiol Ethnomed*,2017;13:1–13. doi:10.1186/s13002-017-0167-6
  5. Borah MP, Prasad SB. Ethnozoological remedial uses by the indigenous inhabitants in adjoining areas of Pobitora Wildlife Sanctuary, Assam, India. *Int J Pharm Pharm Sci*,2016;8:90–96.
  6. Dutta L, Ghosh SS, Deka P, Deka K. Terrestrial edible insects and their therapeutic value in Moridhal Panchayat of Dhemaji district, Assam,2016;3:11–14.
  7. Estelle L, Loko Y, Fagla SM, Orobiyi A, Glinma B, Toffa J. Traditional knowledge of invertebrates used for medicine and magical-religious purposes by traditional healers and indigenous populations in the Plateau Department, Republic of Benin, 2019, 1–21.
  8. Hassan M, Haq SM, Amjad MS, Ahmad R, Bussmann RW, Manuel J, De P. Invertebrates and herptiles for livelihoods—ethnozoological use among different ethnic communities in Jammu and Kashmir (Indian Himalayas), 2023. doi:10.3389/fphar.2022.1043155
  9. Jugli S, Chakravorty J, Meyer-Rochow VB. Zootherapeutic uses of animals and their parts: an important element of the traditional knowledge of the Tangsa. *Environment, Development and Sustainability*, 2020. doi:10.1007/s10668-019-00404-6
  10. Kassim M, Achoui M, Mansor M, Yusoff KM. The inhibitory effects of Gelam honey and its extracts on nitric oxide and prostaglandin E2 in inflammatory tissues. *Fitoterapia*,2010;81(8):1196–1201.
  11. Kemprai SR, Tamuli DAK, Teron DR. Entomotherapy: a study of medicinal insects of three ethnic groups in Semkhor Area, Dima Hasao District, Assam. *Int J Sci Res Eng Manag*,2022;06:1–26. doi:10.55041/ijrsrem11486
  12. Kumar D, Shahid M. Natural materials and products from insects: Chemistry and applications. *Natural Materials and Products from Insects: Chemistry and Applications*, 2020. doi:10.1007/978-3-030-36610-0
  13. Mozhui L, Kakati L, Changkija S. A Study on the Use of Insects as Food in Seven Tribal Communities in Nagaland, Northeast India, 2017. doi:10.1080/09709274.2017.1399632
  14. Senthilkumar N, Breeding T, Barthakur N. Bioprospecting with reference to Medicinal Insects and tribes in India, 2008.
  15. Simon A, Traynor K, Santos K, Blaser G, Bode U, Molan P. Medical honey for wound care—still the latest resort. *Evidence-based Complement Altern Med*,2009;6:165–173. doi:10.1093/ecam/nem175
  16. Solanki GS, Chutia P. Studies on ethno-medicinal aspects and zoo-therapy in tribal communities in Arunachal Pradesh, India. *Int J Ecol Environ Sci*,2009;35:67–76.
  17. Thangjam R, Ningthoujam K, Kadam V, Sorokhaibam M. A review on edible insects and their utilization in Northeastern Himalaya. *J Entomol Zool Stud*,2020;8:1309–1318.
  18. Turner NJ, Cuerrier A, Joseph L. Well grounded: Indigenous Peoples' knowledge, ethnobiology and sustainability. *People Nat*,2022;4:627–651. doi:10.1002/pan3.10321
  19. Verma AK, Prasad SB, Rongpi T, Arjun J. Traditional healing with animals (zoo-therapy) by the major ethnic group of Karbi Anglong district of Assam, India. *Int J Pharm Pharm Sci*,2014;6:593–600.
  20. Wilsanand V, Varghese P, Rajitha P. Therapeutics of insects and insect products in South Indian traditional medicine,2007;6:563–568.