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# A study on nutritional status & therapeutic uses of some palatable insect of North East India: A review

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**Abstract**
The North East India is a hotspot of biodiversity & ethnic inclusiveness which provide it a unique identity from the mainland India. Owing to the multiculturalism, entomophagy is one of the most popular practice among the tribal people across the region. The current study documented the macronutrient content i.e. protein, carbohydrate & fat content of total 18 popular edible insect species of the region. On comparison of the macronutrient content among the 18 species, the highest protein content is found to be in the giant water bug comprising 21.6% of its fresh weight whereas the wax moth revealed the highest amount of fat content comprising 22.1% of its fresh weight & the highest carbohydrate content is found to be in the insect house cricket containing 5.8% of the fresh weight. The study report also encompasses the name of 100 popular edible insect species across the region & listed the traditional therapeutic uses of various insects among the ethnic tribe of the region.

**Keywords:** edible insects, North East India, protein, carbohydrate, fat, entomophagy

## Introduction
The world's population is projected to reach eleven billion by the end of the century. Feeding them would be a challenge and it is further complicated by the impact of climate change on agriculture. To grow nutritious sustainable foods that support healthy and productive lives with far fewer resources available is a huge backbreaker task. Therefore an unusual way to boost the food supply and feed the people sustainably is by eating insects. If water scarcity has been already recognized as global crisis, access to food would no doubt be a serious issue both for the developed and the developing countries. Entomophagy describes the practise of eating insects by human and non-human species. The egg larva, pupa and adults of certain insects have been eaten by human from prehistoric times to the present day.
Insect comprises the largest phylum of animal kingdom "Arthopoda". They are very specialized group having high adaptability to diverse habitat and high reproductive capacity. According to Food and Agricultural Organization of United Nations (2013), the insect posess very high nutritional value and the cultivation of insect is ecofriendly as compared to other animal protein sources. Being nutritious and tasty, insect are the common dietary component among the ethnic people of North East India. The North East India harbours its unique cultural identity and diverse traditional food habits and the people of North East have a prototype culture of entomophagy. These people consume palatable insects for its nutritional benefit, medicinal value and as a part of culture. A recent report states that entomophagy is not only practiced in North East India but is a common Phenomena for the people all over the world & the number of insect species use for this purpose is approximately 2141 (1). Insects are considered as both friend and foe as it is one of the major crop destroyer and transmit various diseases as well. However not all insects are pests, there are many which are harmless and constitute an important portion of human diet (2).
The low amount of protein and calories being one of the major reasons of death for approximately five billion children yearly. Insects protein prepared into a good to go therapeutic food is found to be a relatively inexpensive to malnutrition. This review article emphasizes the significance of nutrients derived from insect to meet the demand of food scarcity in near future and try to demonstrate the health benefits of palatable insect consumption.

## Distribution of Edible Insect in North East India
The distribution of edible insect across the north east varies with the practice of entomophagy. A study enumerated that the ethnic people of Arunachal Pradesh consume around 158 species of insect. The choice of species varies with respect to different tribes (3). Another study states that the total number of edible insect in Assam and Meghalaya is 67 & 16 respectively (4, 5, 6, 7). Particularly Dhemaji district of Assam, a total of 16 palatable insects are consumed belonging to different orders namely Lepidoptera, Orthoptera , Hymenoptera, Isoptera, Blattodea and Hemiptera (8). In Manipur a total of 69 species are reported as esculent insects having high nutritional value. The number of palatable insects in Nagaland includes 82 species and termites are found to be consumed by the ethnic people of Meghalaya and a few tribal communities of Mizoram and Tripura (3). In North East the distribution of edible insects belongingng to various order such as coleopteran, orthoptera, hemiptera, hymenoptera, odonata, lepidoptera, isoptera and ephimeroptera are 34%,24%,17%,10%,8%,4%, 2% and 1% respectively (9). Two survey reports namely Ronghang and Ahmed, 2010 and Chakravorty et al., 2011, states that the most preferred insect order used for human consumption is coleopteran order (9, 10). In Assam 36.6% edible insect belong to coleoptera, 23.3% belong to hymenoptera and order isoptera contribute 3.3% of all edible insects (10). According to Devi et al, the order hymenoptera contribute maximum no. of species i.e., 14 edible insect among 31 aquatic edible insect in Manipur (11).

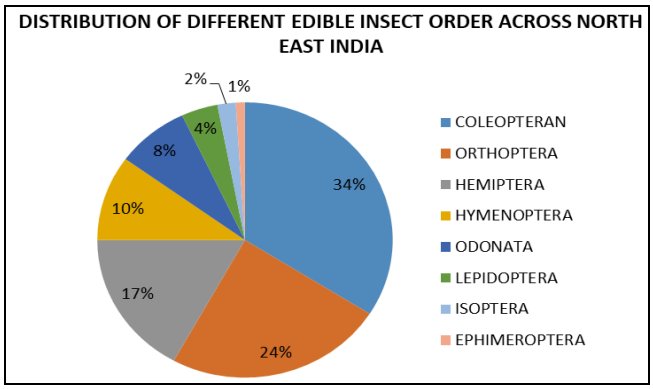


**Fig 1:** The pie chart shows the distribution of different insect order across the North East India (the data are collected from Chakravarty et al., 2011).

## Nutritional Profile of Some Popular Edible Insects

In general, edible insects are vital source of protein, amino acid, lipid, carbohydrate & vitamins & trace elements (12). On average, the range of protein content in most of the consumable insect particularly on its dry weight lies between 35%-60% and on calculation of its fresh weight it lies between 10%-25(13). It is found that consumption of insect provide higher amount of protein content as compared to some plant protein sources like lentils and cereals etc.(14).

Insect are also rich source of lipid or fats and its available content depend on insect species, sex, stage of development, season, diet etc. . A recent research data revealed that the average fat content present in different insect orders namely orthoptera , coleoptera, lepidoptera, isoptera, hemiptera and blattodea are 13.14%, 33.40%, 27.66%, 32.74%, 30.26% and 29.90% respectively (15). Insect are also source of carbohydrate, on an average, the range of carbohydrate content of insect varies from 6.71%-15.98% (16). According to FAO (United Nations Food and Agricultural Organization) report, 2004, maggots of many edible insect act as a rich source of vitamin B , Potassium , Calcium, Magnesium, Zinc, Iron etc.(17) A recent study report suggest that insect consumption also provide carotene, thiamine (vitamin B1), riboflavin (vitamin B2), pyridoxine (vitamin B6), ascorbic acid (vitamin C), cholecalciferol, vitamin E and K to our body (16). Many Researchers have found significant amount of iron, copper, calcium, zinc, phosphorus and manganese content in the grasshoppers, mealworms, crickets and termites (16, 18). The iron content of some comestible insects are found to be same as that of iron content in beef (14). The table 1 shows the nutritional status of some common insects which are utilized as food across north eastern region. The data in the table manifest mainly protein, carbohydrate and fat content of these edible insects which furnish the reasonableness to consume these palatable insects as an alternate source of food for a better health.

**Table 1:** Nutritional status of various edible insects of North east India.

| Serial No. | Common name of insect (scientific name) | Order | Carbohydrate content (%) | Protein content (%) | Fat content (%) |
|---|---|---|---|---|---|
| 1 | Eri silk worm (*Samia Cynthia ricini* ) | Lepidoptera | 35.00 3.5 | 20.88 | 7.3 |
| 2 | Winged termite (*Odontotermes* sp.) | Blattodea | 2 | 14.56 | 18.60 |
| 3 | Mole cricket (*Brachytrupes orientalis*) | Orthoptera | 4.5 | 16.9 | 6.5 |
| 4 | House cricket ( *Acheta domesticus* ) | Orthoptera | 5.8 | 19.8 | 6.9 |
| 5 | Giant water bug (*Lethocerus indicus*) | Hemiptera | N/A | 21.6 | 13.3 |
| 6 | Rice grasshopper (*Oxya hyla hyla*) | Orthoptera | 2.817 | 6.467 | 2.18 |
| 7 | Short horned grasshopper (*Oedaleus abruptus*) | Orthoptera | 3 | 6 | 1.5 |
| 8 | Stink bug (*Aspongopus nepalensis*) | Hemiptera | NA N/A | 1.06 | 3.8 |
| 9 | Scarlet skimmer (*Crocothermis servilia*) | Odonata | 1.18 | 7.048 | 0.493 |
| 10 | Red ants (*Oecophylla smaragdina*) | Hymenoptera | 2.90 | 13.90 | 3.5 |
| 11 | Giant water bettle (*Hydrophilus triangularis)* | Hemiptera | 2.10 | 19.80 | 8.30 |
| 12 | Small grasshopper (*Tetrix sp.)* | Orthoptera | 3.90 | 20.6 | 6.10 |
| 13 | Large grasshopper (*Katydid sp.)* | Orthoptera | 2.2 | 14.30 | 3.30 |
| 14 | Caterpillars | Lepidoptera | N/A | 6.70 | N/A |
| 15 | June beetle (*Phyllophaga sp.)* | Coleoptera | 2.90 | 13.40 | 1.40 |
| 16 | Wax moth (*Galleria mellonella)* | Lepidoptera | N/A | 15.5 | 22.1 |
| 17 | Dung beetle (*Scarabaeus sp.)* | Coleptera | 2.0 | 17.2 | 4.3 |
| 18 | Mealworms (*Tenebrio* sp.) | Coleptera | N/A | 20.2 | 12.7 |

- Here N/A indicates not analyzed. Sources:- references-2,19,20,21,22,23

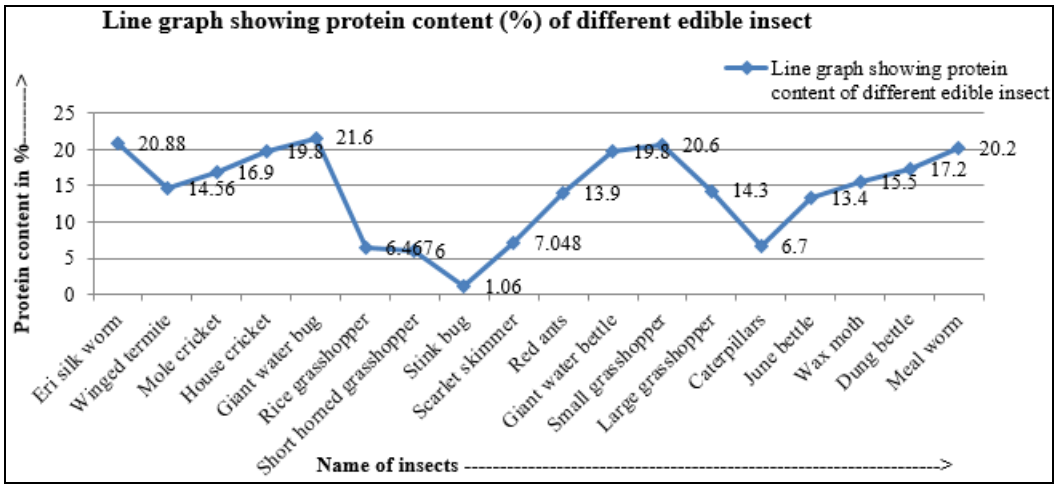


**Fig 2:** Represent line graph of protein content of some insects which are utilized as food across the North Eastern Region

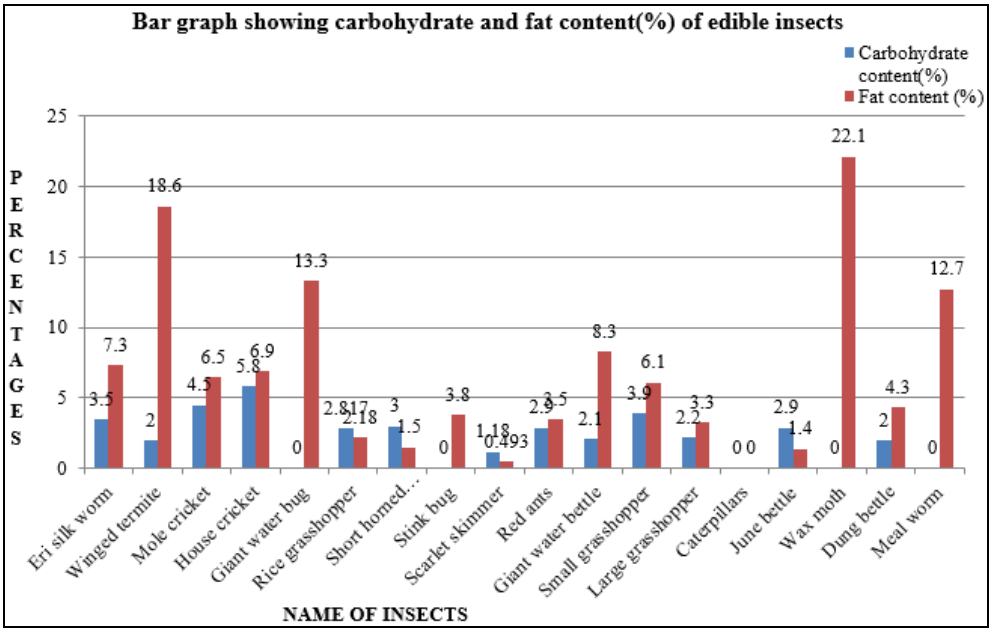


**Fig 3:** Represent bar graph of protein & fat content of different edible insects of North East India

On comparing the protein content% of these 18 edible insects in figure2, the highest value lies in giant water bug which is about 21.6% of its fresh weight followed by eri silkworm containing20.88% of its fresh weight. The third highest value regarding protein content value lies in stink bug comprising 1.06% of its fresh weight. The figure 3 clearly exhibit the carbohydrate and fat content % of these edible insects where maximum amount of carbohydrate & fat content is found to be in house cricket (5.8% of its fresh weight) and wax moth (22.1% of its fresh weight) respectively. On the graph represented by figure3, it is identifiable that the insect species are rich in fat composition as compared to carbohydrate content. The nutrient analyses of majority of edible insect species are yet to be done.

The names of some insect species whose nutrient profile is not well known but are very popular in entomophagy purpose across the North East region of India are ---- 1). *Dytiscus marginalis* 2)*Hydrochera ricksecker*i 3)*Cybis sp.* 4)*Eurytrachelus titan* 5)*Odontolabis cuvera* 6)*Analeptes trifasciata* 7)*Lepidiota mansueta* 8)*Batocera horsefieldi* 9)*Batocera rufomaculata* 10)*Dihammus cervinus* 11)*Rhynchophorus ferrugineus* 12) *Ochrophora Montana* 13)*Lacotrephes ruber* 14)*Pomponia imperatoria* 15)*Okangana sp*. 16)*Pelocoris femoratus* 17*) Polistes sp*. 18)*Apis cerana* 19)*Apis mellifera* 20)*Apis florea* 21)*Vespa affinis* 22)*Dorylus orientalis* 23)*Atta sp.* 24)*Myrmica rubra* 25) *Formica indica* 26)*Chondacris rosea* 27)*Phlaeoba infumata* 28)*Melanoplus sp*. 29)*Oxya fuscovittata* 30)*Cyrtacanthacris aeruginosus* 31)*Heiroglyphus banian* 32)*Schistocerca gregaria* 33)*Eupreponotus inflatus* 34)*Schizodactyllus monstrosa* 35)*Acheta sp*. 36)*Mecopooda elongata* 37)*Ruspolia baileyi* 38)*Neurothermis fluctuans* 39)*Philosomia ricini* 40)*Cirinaforde sp.* 41)*Anaphe infracta* 42) *Bombyx mori* 43)*Aeshna mixta* 44)*Antheraea assamensis* 45)*Anaphe venata* 46)*Mantis religiosa* 47*)Macrotermes natalensis* 48)*Macrotermes bellicosus* 49*) Reticulitermes flavipes* 50)*Zonocerus variegatus* 51)*Melanoplus sp.* 52)*Udonga Montana* 53) *Notobitus meleagris* 54)*Apis laboriosa* 55)*Tarbinskielleus portentosus* 56) *Diplacodes trivialis* 57)*Orotherum pruinosum neglectum* 58)*Lepidotrigona arcifera* 59)*Pantala flevescens* 60) *Potamarcha congener* 61)*Orthosoma brunneum* 62)*Orotherum Sabina Sabina* 63)*Cossus sp*. 64)*Acrida exaltata* 65)*Meloimorpha cincticornis* 66) *Teleogryllus sp*. 67)*Elimaea securigera* 68)*Heirodula coarctata* 69)*Tibicen pruinosa* 70)*Dalader planiventris* 71)*Pomponoia sp*. 72)*Dundubia sp.* 73)*Cordius sp*. 74)*Erthesina fullo* 75)*Cyclopelta siccifolia* 76)*Eurostus gossipes* 77) *Lucanus lamnifer* 78)*Xylotrupes Gideon* 79)*Propomacrus sp.* 80)*Sternocera sp.* 81)*Antilochus coquebertii* 82) *Eumenes sp*. 83)*Laptysma sp*. 84)*Brachytrupes portentosus* 85)*Omphisa fuscidentalis* 86)*Hydrous olivaceous* 87)Cybister sugillatus 88)Rhantus sp. 89)Limnogonus sp. 90)Acisoma panorpoides 91) *Leucorrhina sp.* 92)*Tramea basilaris* 93)*Corduliidae sp*. 94)*Prionoxystus robiniae* 95)*Erionata torus* 96)*Tipula sp*. 97)*Sympatrum sp.* 98)*Urothermis signata* 99)*Antheraea proylei* 100)*Tessaratoma javanica* (3, 4, 19, 24, 25).

**Medicinal Application**

Traditionally edible insect & other conventional food items have the potentiality to fulfill the dietary requirement of people & play significant role in prevention of several diseases related to malnutrition and other health hazard (22**).** It is of the belief that due to the presence of therapeutic value in various insect's products they are of immense use in the prevention of various diseases (26). In Assam, red tree ant commonly known as amroli or amloi porua (*Oecophylla smargdina*) is one of the popular food item during bohag bihu which is also use in treatment of epistaxis or nasal hemmorrhages. The formic acid present in different edible insects are very potent for therapeutic treatment of pathological condition like scabies, stomach disorder, malaria, tooth ache and blood pressure anomalies etc. (4). A study suggests that ant alcohol is potent in boosting up immunity and libido (27). The enzymatic hydrolysates present in insects confer the capacity to supress the angiotensin converting enzyme & assist their antidibetic and antioxidant property.

The Table-2 demonstrates various traditional therapeutic uses of edible insects among the folkloric people of the north eastern part of India.

**Table 2:-**Demonstrating therapeutic uses of various insects found in Northeast India

| Serial no. | Scientific Name | Common Name | Therapeutic uses |
|---|---|---|---|
| 1. | *Melontha vulgaris* | May beetle | Scratches ,anaemia ,rheumatism |
| 2. | *Palembus dermestoides* | Peanut beetle | Asthma, arthritis, tuberculosis |
| 3. | *Mylabris sp.* | Blister beetle | Skin diseases |
| 4. | *Brachytrupes sp.* | Cricket | Mental development |
| 5. | *Acrida bicolor* | Grasshopper | Hypertension |
| 6. | *Apis indica* | Honeybee | Cold, fever, cough |
| 7. | *Samia ricini* | Eri silkworm | Protect the liver |
| 8. | *Odontotermes obesus* | Termite | Ulcer |
| 9. | *Oecophylla smaragdina* | Red ant | Chicken pox, small pox, dysentery |
| 10. | *Vespa orientalis* | Wasps | Cold, cough, stomach problem |
| 11. | *Musa nebulo* | Housefly | Cold, fever, eye problem |
| 12. | *Lethocerus indicus* | Giant water bug | Health tonic, protein supplement |
| 13. | *Notobitus meleagris* | Leaf footed plant bug | Gastrointestinal problem |
| 14. | *Apis laboriosa* | Himalayan honey bee | Respiratory problem |
| 15. | *Diplacodes trivialis* | Chalky percher | Gastrointestinal problem |
| 16. | *Udongona montana* | Stink bug | Dermatological problem |
| 17. | *Pantala flavescens* | Wandering glider | Respiratory problem |
| 18. | *Orthosoma brunneum* | Brown prinoid | Respiratory problem |
| 19. | *Batocera rubus* | Mango Longhorn | Gastrointestinal problem |

**Pupa of Silkworm**

**Grasshopper**

**Dragonfly**

**Eri silkworm**

**Giant water bug**

**Red ant**

| Mole cricket | Termite |
|---|---|

**Fig 4:** Some of the common edible insects found in Northeast India.

## Conclusion

Insects, being one of the most beneficiary nutritious living organisms, have the potential for human consumption. Despite having such high nutritive value most of the edible insects are still unexplored. On the other hand the world, which is diminishing in its resources but it is growing in its human population, is proceeding to encounter global food scarcity in near future where insects are very well possession to be a great source of protein as it drastically takes less land, water and less feed when being produced. By the year 2050 the world will be almost of 9 billion people and these insects can be a good alternative food for the future. As most of the insects are hand harvested and are only seasonally available so both these make inaccessible to large number of society. To stabilise the supply it is necessary to farm them. With farming and producing there can be a huge change in availability of insects to the masses. By producing more genetically stable farm, the people will easily access the insects that are selective to taste, food content etc & will be a great step towards commercialisation of insects &its product. However the major barrier is the consumer acceptance. Understanding that, besides being delicious it is of high nutritive value could might lead to wide acceptance among the people. Therefore it is very important at this time to look at protein source that is nutritious and that could feed everyone but at the same time it is extremely resource sufficient.

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