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Research Article

ENTOMOPHAGY PRACTICES AMONG THE ETHNIC COMMUNITIES OF MANIPUR, NORTH-EAST INDIA

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ABSTRACT

The different features of entomophagy practiced by the 30 different ethnic communities inhabited in Manipur were documented. Surveys were done by personal interview and questionnaire based method from 105 informants. A total of 41 insect species belonging to 8 orders under 24 families and 36 genera are recorded as food items. The order Hemiptera has the maximum number of edible species (10) and the least number (1) in Dictyoptera and Isoptera. Meitei, Tarao, Tangkhul, Chothe and Thadou consumed higher number of species (28-30) in comparison to other ethnic groups. Use value was calculated to determine the extent of utilization of each species. Bamboo worm species, *Omphisa fuscidentalis* and honey bee species, *Apis mellifera*, *A. cerana indica* and *A. dorsata* were found to have the highest use value of 0.78. The edible insects are prepared as curry, roasted, fried and raw form. Seven insect groups formed prominent items of commerce in the state in which bees have highest price ($10.42-16.67/4x4 x2cm^3) among them. It is indicated that edible insect can be comparable with other conventional food products by integrating scientific validation to the traditional wisdom.

KEYWORDS: Documentation; Entomophagy; Ethnic communities; Use value.

INTRODUCTION

Entomophagy is the term used to describe the practice of consumption of insects as food by native human populations. Edible insects are nutritious in terms of protein (40–75 g/100g dry weight) and minerals. Their protein is of high quality and has a high digestibility (77–98%) with good concentration of essential amino acids (46–96% of the nutritional profile) [1]. Some of the important edible insects include grasshoppers, caterpillars, beetle grubs, adult winged termites, bees, wasps, winged ants, cicadas and a variety of aquatic insects. These insects hold the promise of exploitation of non-conventional food resources and represent a genuine food category [2]. Over 1500 species of edible insects have been recorded in 300 ethnic groups from 113 countries [3]. It is popular in countries like South Africa [4], Angola [5], China [6], Zaire [7], India [8], Thailand [9], Mexico [10], New Zealand, Korea, Japan [11], Australia and USA [12]. The inevitable relationship with human civilization and edible insects has also been clearly emphasized recently by Itterbeeck and Huis [13]. Nevertheless, relevant informations on this practice are scattered far and wide. There might be many more countries in the world that are yet to be explored for possible entomophagy practices.

Manipur, being a distinctive part of the Indo-Burma biodiversity hotspot region, enjoys a very rich and fascinating diversity of insect fauna. Insects have been using in varied ways such as for edible, medicinal, industrial and cultural purposes [14]. Of these, entomophagy is the most familiar practice. The state has 30 different ethnic communities with distinct identity, culture and food habit. Such a rich diversity of community has gifted the state with advantage for evolving innumerous knowledge on entomophagy. There is a serious threat for the erosion and even complete loss of this valuable knowledge forever unless certain effective measures are taken up. Therefore, the present paper aims to record the edible insect fauna and document the different features of entomophagy practices prevalent among ethnic communities of Manipur, North-east India.

MATERIALS AND METHODS

The state of Manipur forms a distinctive part of the Indo-Burma biodiversity hotspot. There are 30 recognized ethnic communities in Manipur namely Meitei, Aimol, Anal, Chiru, Chothe, Gangte, Hmar, Kabui, Kacha naga, Koireng, Poumai, Kom, Lamkang, Mao, Maram, Maring, Mizo, Monsang, Moyon, Paite, Purum, Kharam, Tarao, Kuki, Simte, Sukte, Tangkhul, Thadou, Vaiphei and Zou [15]. The Meitei who live primarily in the state's valley region, form the primary ethnic group. The hill region of the state is exclusively occupied by the tribes. Surveys were conducted in 25 villages inhibited by these ethnic groups during January, 2008 to March, 2011. Data were obtained by performing questionnaire based personal interview from 105 persons of the age 20 and above. Information was collected from 3-4 targeted informants mainly comprising of village heads, traditional knowledge holder, educated youth and homemakers in each ethnic group. The questionnaire contained enquiries on insect species used as food, mode of consumption/utilization, form of preparations, life stages of insects consumed, association with other ingredients, culture related to insects, method of collection and any other uses. To record the marketability, the purposive sampling method [16] was adopted in which only insect sellers (three insect sellers from each market) were interviewed. Insect species collected during the survey were preserved following the standard methods [17] and identified up to family level by following the standard taxonomic keys [18]. For the identification of the insects upto the species level, samples were sent out to authentic institutes like USDA, ZSI, IARI etc.

For each species of edible insect use value, $UV=\sum U/n$ was determined where, U is the number of citations per species and n is the number of informants [19] (Philips et al. 1994). It is a functional parameter to evaluate the relative importance of each species based on its use among informants. Use value of each species is therefore based objectively on the importance attributed by the informants and does not depend on the opinion of the researcher.

RESULTS

A total of 41 insect species belonging to 8 orders under 24 families and 36 genera were recorded as accepted food items. The particular stages in which they are eaten are also recorded along with their seasonal availability periods (Table 1). The species composition in different orders comprise of 1 species each in Dictyoptera and Isoptera, 4 species each in Lepidoptera and Orthoptera, 8 species in Coleoptera, 6 species in Odonata, 7 species in Hymenoptera, and 10 species in Hemiptera. The differences in the habit of consumption of insects among the 30 different ethnic communities are presented in Fig 1. It is found that five ethnic groups namely. Meitei, Tarao, Tangkhul, Chothe and Thadou consumed 28-30 species in comparison to 9-26 species consumed by other ethnic groups.

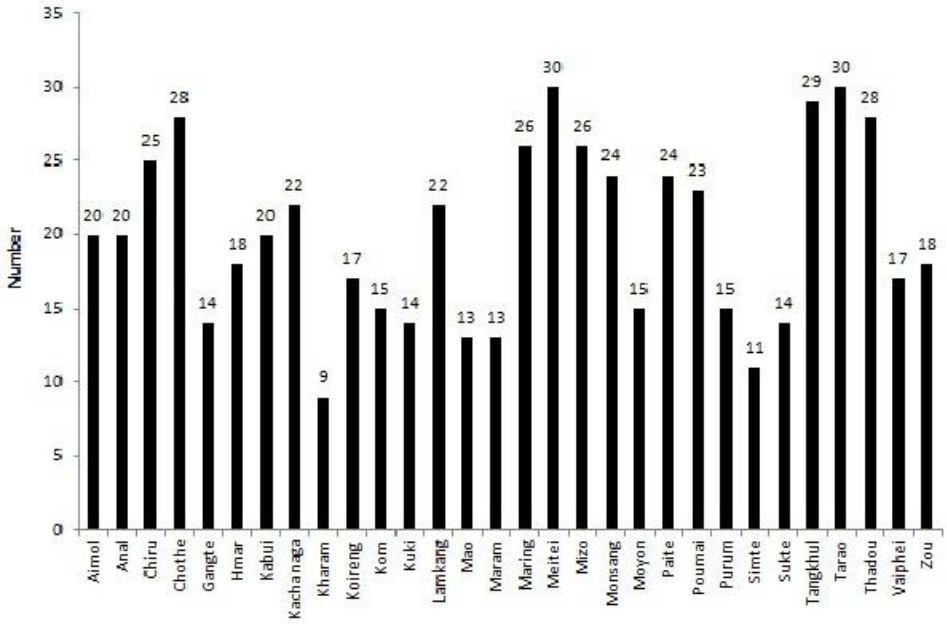

Fig.1: Number of insect species eaten by different ethnic groups of Manipur

Table1: List of insect species utilized as edible in Manipur.

Order: Family	Scientific name	Common name	Stage eaten	Seasonal availability
Odonata: Libellulidae	*Pantala flavescens* (F.)	Dragon fly	nymph	Oct-July
Odonata: Libellulidae	*Acisoma panorpoides* Rambur	dragon fly		
Odonata: Libellulidae	*Crocothemis servilia* (Drury)	dragon fly		
Odonata: Libellulidae	*Orthetrum triangulare* (Selys)	dragon fly		
Odonata: Libellulidae	*Rhyothemis variegata* (L.)	dragon fly		
Odonata: Libellulidae	*Diplacodes trivialis* (Rambur)	dragon fly		
Dictyoptera: Mantidae	*Heirodula* sp.	praying mantid	nymph, adult	Sept-Jan
Orthoptera: Acrididae	*Oxya hyla hyla* Serville	rice grasshopper	nymph, adult	Aug- Dec
Orthoptera: Acrididae	*Acridium melanocorne* L.	short-horned grasshopper	larva, adult	June-Dec
Orthoptera: Acrididae	*Gryllus* sp.	field cricket	larva, adult	Oct-April
Orthoptera: Gryllotalpidae	*Gryllotalpa orientalis* Burmeister	mole cricket	larva, adult	Mar -July
Isoptera Termitidae	*Odontotermes sp.*	termite	queen, larva, adult	Feb-Aug
Hemiptera: Belostomatidae	*Lethocerus indicus* (Lep.& Serv.)	giant water bug	nymph, adult	Nov-July
Hemiptera: Belostomatidae	*Diplonychus rusticus* (F.)	water bug	nymph, adult	Sept-Dec
Hemiptera: Nepidae	*Ranatra* sp.	water scorpion bug	nymph, adult	June-July
Hemiptera: Nepidae	*Laccotrephes maculatus* Fabr.	water scorpion	nymph, adult	Sept-Mar
Hemiptera:: Dinidoridae	*Coridius* sp.	bug	nymph, adult	Oct-Dec
Hemiptera: Pentatomidae	*Udonga montana* (Distant)	stink bug	nymph, adult	Nov-April
Hemiptera: Cicadidae	*Pomponia* sp.	Cicada	nymph, adult	Mar -Aug
Hemiptera: Corixidae	*Micronecta* sp**.**	Water boatmen	nymph, adult	April-July
Hemiptera: Notonectidae	*Notonecta* sp	backswimmer	nymph, adult	April-July
Hemiptera: Hydrometridae	*Hydrometra greeni* Kirkaldi	Water measurer	nymph, adult	May-June
Lepidoptera: Bombycidae	*Bombyx mori* L.	Mulberry-silkworm	nymph, adult	May-June
Lepidoptera: Saturniidae	*Samia cynthia ricini* (Donovan)	eri-silkworm	adult	Sept-Feb
Lepidoptera: Saturniidae	*Antheraea proylei* Jolly	oak tasar silkworm	adult	Sept-Feb
Lepidoptera: Pyralidae	*Omphisa fuscidentalis* Hampson	bamboo worm	adult	Sept-Feb
Hymenoptera: Apidae	*Apis mellifera* L.	honey bee	Larva, pupa	Mar -Sept
Hymenoptera: Apidae	*Apis cerana indica* F.	honey bee	pupa	Perennial
Hymenoptera: Apidae	*Apis dorsata* F.	giant honey bee	pupa	Mar-Aug
Hymenoptera: Vespidae	*Vespa affinis* (L.)	social wasps	larva	May-July
Hymenoptera: Vespidae	*Polistes* sp.	paper wasps	egg, larva, pupa	Oct -Jan
Hymenoptera: Vespidae	*Vespula vulgaris* (L.)	yellow jacket wasps	egg, larva, pupa	Oct -Jan
Hymenoptera: Formicidae	*Solenopsis geminata* F.	ant	egg, larva, pupa	Oct -Jan
Coleoptera: Hydrophilidae	*Hydrous olivaceous* F.	true water beetle	egg, larva, pupa	Feb-May
Coleoptera: Hydrophilidae	*Hydrous indicus* Bedel	Water scavenger beetles	egg, larva, pupa	Oct-Dec

Coleoptera: Dytiscidae	*Cybister sugillatus* Erichson	true water beetle	egg, larva, pupa	Apr-Sept
Coleoptera: Dytiscidae	*Cybister tripunctatus* (Olivier)	true water beetle	egg, larva, pupa	Sept-Oct
Coleoptera: Dytiscidae	*Cybister ventralis* Sharp	true water beetle	grub, adult	June-July
Coleoptera :Curculionidae	*Cyrtotrachelus dux* Boheman	bamboo beetle	grub, adult	June- Feb
Coleoptera :Dynastidae	*Oryctes rhinoceros* L.	rhino beetle	grub, adult	Mar- July
Coleoptera:Cerambycidae	*Anoplophora glabripennis* (Motschulsky)	long horned beetle	Adult grub	April-July

Insect collection methods/techniques are influenced by various factors such as insect species, habit and habited nature and population size. Generally, big size insects are collected simply by hands picking methods or using homemade hand net. This is the most common method adopted in collection of terrestrial insects like *C. dux, O. rhinoceros, A. glabripennis, O. fuscidentalis, G. orientalis, Heirodula* sp., *A. melanocorne, Odontotermes* sp and *Cicada* species. Smoking is done during the night time beneath the hives of bees and wasps to sedate them so that the whole hive can be collected. During the swarming period, Hemiptera bugs were collected in bulk by jerking the infested branches of the plants.

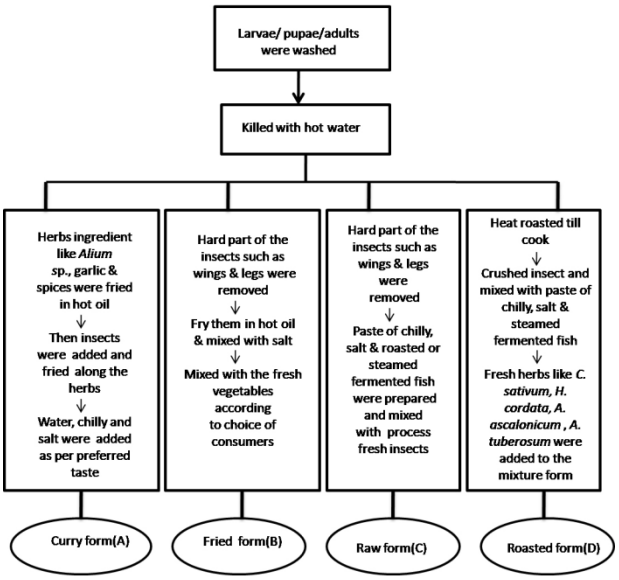

Fig. 2 Different forms of preparation of edible insect (A) curry (B) fried (C) raw (D) roasted dishes

Edible insects are prepared in four different forms viz. curry, roasted, fried or raw (Fig.3). Depending upon the type of insects and form of the consumption, these are prepared with or without other ingredients like spices and oil. Hard bodied insects are eaten in roasted or fried form whereas soft bodied insects are eaten as curry or raw. The method of preparation is mostly traditional and is handed down from generation to generation. Nymphs/grubs and adults stages are mainly eaten in Dictyoptera, Orthoptera, Hemiptera, Isoptera and Coleoptera groups. Odonates are eaten in nymph stage only but Lepidoptera are eaten in both larval and pupal stages. In Hymenoptera insects, eggs are also eaten along with other stages. *U. montana* (Distant) is found to be utilized both for edible and extraction of edible oil. Natural harvest of this insect in large quantity is done for oil extraction by the villagers during swarming.

Edible insect species which are readily available and easy to capture are usually brought to markets for sale. The insect species sold in the market are presented in Table 2. These include species of aquatic insects that are available throughout the year in ponds, lakes and ditches. These insects can be easily collected in large quantity. Prices of the bees ($10.42-16.67/4x4 x2cm^3) are usually high not only due to their taste but also for having cultural importance in tribal customs.

The use value of 41 different edible insect species is presented in Fig 2. Among other species, *Apis dorsata* F., *A.* mellifera L., *A. cerana indica* (Family: Hymenoptera) and *Omphisa fuscidentalis* (Family: Lepidoptera) have the highest use value of 0.78, due to

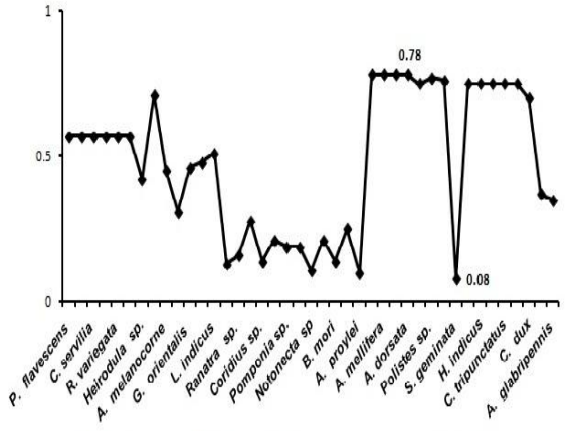

Fig 2: Use values of different edible insect species recorded in Manipur

delicacy of these species. *S. geminata* F., an ant species, has the lowest use value of 0.08 and its use is found to be limited to forest dwellers.

Raw data , not included in main text					
	USE VALUE				
P. flavescens	0.57		Total no. of edible insects		
A. panorpoides	0.57	Aimol	20		
C. servilia	0.57	Anal	20		
O. triangulare	0.57	Chiru	25		
R. variegata	0.57	Chothe	28		
D. trivialis	0.57	Gangte	14		
Heirodula sp.	0.42	Hmar	18		
O. hyla hyla	0.71	Kabui	20		
A. melanocorne	0.45	Kacha naga	22		
Gryllus sp.	0.31	Kharam	9		
G. orientalis	0.46	Koireng	17		
Odontotermes sp.	0.48	Kom	15		
L. indicus	0.51	Kuki	14		
D. rusticus	0.13	Lamkang	22		
Ranatra sp.	0.16	Mao	13		
L. maculatus	0.28	Maram	13		
Coridius sp.	0.14	Maring	26		
U. montana	0.21	Meitei	30		
Pomponia sp.	0.19	Mizo	26		
Micronecta sp.	0.19	Monsang	24		
Notonecta sp	0.11	Moyon	15		
H. greeni	0.21	Paite	24		
B. mori	0.14	Poumai	23		
S. cynthia ricini	0.25	Purum	15		
A. proylei	0.1	Simte	11		
O. fuscidentalis	0.78	Sukte	14		
A. mellifera	0.78	Tangkhul	29		
A. cerana indica	0.78	Tarao	30		
A. dorsata	0.78	Thadou	28		
V. affinis	0.75	Vaiphei	17		
Polistes sp.	0.77	Zou	18		
V. vulgaris	0.76				
S. geminata	0.08				
H. olivaceous	0.75				
H. indicus	0.75				
C. sugillatus	0.75				
C. tripunctatus	0.75				

C. ventralis	0.75				
C. dux	0.7				
O. rhinoceros	0.37				
A. glabripennis	0.35				

Table 2: List of marketed edible insects in Manipur

Scientific name	Life stage	Approx. Price (USD)	Remark
A. cerana indica	larva, prepupa	4.17-10.42 per hive of 4x4 x2cm^3	This insect is favourite of Tangkhul ethnic community; serving of this insect curry to their married daughters or sisters is compulsory when they come to their parent home.
A. dorsata	larva, prepupa	10.42-16.67 per hive of 4x4 x2cm^3	This insect is very expensive because it is wild in nature.
L. indicus	mature adult	0.35-0.52 per pieces of insect	Price of this insect varies depending upon its seasonal availability. Generally, price is high for male insects which produce aroma.
H. olivaceous	mature adult	0.63-0.83 per container (½ kg sized)	This insect is a common site in most markets.
C. confusus	mature adult	0.63-0.83 per container (½ kg sized)	This insect is sold without differentiation with *H. olivaceous.*
Different dragon fly nymphs	nymph	1.04-2.08 per 1Kl	Dragon fly nymphs are sold as cluster of different species.
C. dux	larva	0.42 per 5 insects	Sold in clips of about 5 to 10 insects.

There is asymmetry in their values even within the species belonging to same order and family. For instance *O. hyla hyla* has greater use value (0.71) than *Acridium melanocorne* (0.45) because of its common occurrence in paddy fields.

DISCUSSION

Brief accounts of the edible insects in north east India were recorded by various workers [20, 21, 22]. From other parts of India, reports on entomophagy are found in states like Tamil Nadu [23], Orissa and Jharkhand [24]. Meyer-Rochow [25] reported ten species of edible insects from the orders Odonata, Isoptera, Orthoptera, Hemiptera, Coleoptera and Hymenoptera consumed by the Meitei community only. Higher numbers of insect species are used as food by the Meitei and Tangkhul. This might be because of their large size of population from the other groups. Thadou, Tangkhul and its descendent tribe, Tarao are mainly forest dwellers and eat maximum numbers of forest insects like species of bees, wasps and bugs. Insects like rice grasshopper, bees, bamboo worm and aquatic beetles are commonly consumed by most of the ethnic groups. Ethnic-based practices of entomophagy have also been reported in Galo and Nyishi tribes of Arunachal Pradesh [21]. The use and exploitation of the ecosystem varies according to the regions where humans settle [26].

Consumption of the nymph stage of dragonfly is similar to other ethnic communities of China and elsewhere in India [27]. Three species of the family Lebullidae (order: Odonata), *Acisoma panorpoides* Rambur, *Crocothemis servilia* (Drury) and *Diplacodes trivialis* (Rambur) are found to be common with the species reported from Nagaland, Arunachal Pradesh and China. Exopterygote insects (Orthoptera, Isoptera, and Hemiptera) are eaten in their nymph and adult stages whereas majority of the endopterygote insects are eaten in larval and pupal stages [28]. The extraction and the use of edible oil from *U. montana* from Manipur is a rare

phenomenon [29] described the methods of collection and oil extraction from this insect by Mizo tribes. Larvae of *O. fuscidentalis* (Lepidoptera: Pyralidae), which is reported as the most common edible insect among the informants was also cited as a notable edible insect in China [27] and Thailand [30]. Earlier study in China has reported a yield of 0.3-.05 kilogram of this insect from one bamboo plant [31]. Consumption of silkworm larvae and pupae was also found to be a common practice in Nagaland [25], China [31] and Africa [32]. During survey, it was noted that people collect bee and wasp-hives from forests or nursery and take out broods to use as food similar to the ethnic tribes of Mizoram [29]. People of the hill districts in Manipur considered the curry preparation of bees as the top most delicious item among their dishes. Aquatic beetles are also popular in Manipur and other parts of north east India [33].

The mode of harvest of edible insect showed that different collection techniques was found to be employed depending on the prevailing situations of the insect's habit and habited at a particular period. The availability of edible insect is unpredictable, both in time and location [34]. Most edible insects are harvested from wild [32]. Same species like *Cybister* species was collected by using light trap or scooping gear. [35] also described utilization of various devices and techniques like baskets, cloth nets or manually in collection of aquatic insects. For the collection of wasps and bees, smoking method is commonly practiced. Likewise, Nonaka [36] depicted that when the entrance to the nest of *vespula* sp. is discovered, smoke is used to sedate the wasps inside.

Selection of species as food item is found to be dependent on their taste, favour and availability in the natural habitats [37] and, therefore, different insects have different uses. This result was also depicted by the use value of each species. Preparation and cooking methods vary with the ethnic group [38].

On the other hand, pupae and larvae of bee and wasp are eaten as raw in some parts of north east India [29] whereas queen termites are fed raw to weak children in some villages of Karnataka state [39]. Similar forms of preparation were also described for giant water bugs and pentatomid bugs with Arunachal Pradesh [21] and Manipur. Some tribal also consumed the giant water bug in a different way in that they push dry rice inside the body and boiled then roasted [29].

Twelve different species of edible insects are found to be marketed items among the food commodities. There are reports of sale of grasshoppers and pine caterpillar @ USD 0.55-0.84/Kg and @ USD 0.84-1.02/Kg, respectively in different markets of north east India [29] and in south India [39]. Johnson [40] reported that in Asia and Pacific regions, public research has paid little attention to the subject of marketing and commercialization of edible forest insects. Absence of economic data represents a serious constraint to the commercial development of edible insects as commodity of trade between countries.

CONCLUSION

The acceptance of 41edible insect species by different ethnic communities in Manipur indicated the significance of the insect as a respectable food item and also its role in promoting noticeable economic input. Documenting the significance of food insect becomes the foremost requirement in bringing linkage between people's livelihoods and assesses their sustainable use. Thus, further studies on insects as food should include key factors like ecology, management and conservation implications, industrialization and marketing of edible insects in order to promote their sustainable development.

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