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Entomophagy practices among the primitive tribes inhabiting the Nilgiris district of Western Ghats, Tamil Nadu, South India

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Insects have been a traditional food among the people of various countries including India. The Nilgiris district of Western Ghats, Tamil Nadu a recognised biodiversity hotspot in South India, has six different inhabitant primitive tribes namely *Todas, Kotas, Kurumbas, Irulas, Paniyas* and *Kattunayakans*, whose insect eating habit and their traditional knowledge on collection, processing and cooking of edible insects have been documented in this study. Eight species of insects *viz*., *Apis dorsata, Apis cerana, Apis florea*, *Trigona* sp., *Oecophylla smaragdina*, *Vespa affinis* and *Odontotermes* sp. belonging to five families under two orders (Hymenoptera and Isoptera) have been recorded to be used as food. The use value of insects have been calculated and inferred that honey bee broods were widely eaten. Their entomophagy habit varies geographically where the members of Kurumba and Kattunayakan tribes residing in the Gudalur and Pandalur taluks were found to consume more insect species than the other tribes. Insects were eaten raw or roasted or cooked with the vegetables. The respondents are also aware of the therapeutic values and health benefits of insects they consume, however various factors including modernization and availability of alternate foods causes decline of insect foods.

Keywords: Edible insects, Health benefits, The Nilgiris, Primitive tribes, Traditional knowledge

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The association of man with insects (the most successful living organism) is of great significance and apart from being harmful some insects are beneficial to human, therefore eventually turns edible. Insect foods are common since ancient times and widely accepted in Indian culture. The use of insect as food is termed as entomophagy and nowadays it is gaining more attention as alternate food source to overcome food insecurity. Insects are eaten as traditional food among various parts of the world where they are consumed not as an alternative but as a part of regular diet and India is certainly no exception. Entomological society of America, says that termites, grasshoppers, caterpillars, weevils by weight are best sources of protein than cattle, chicken, pork or lamb[1]. Insects contain high nutrients and require less land and water thus could solve protein shortages and can contribute to food security[2].

The indigenous tribes in India choose their food insects according to their traditional beliefs, taste, regional and seasonal availability; also different developmental stages of various insects are consumed[2]. About 41 species of insects under 36 genera belonging to 24 families of 8 orders were reported to be edible among the ethnic communities of Manipur[3]. Members of the Nyishi and Galo tribes of Arunachal Pradesh eat 81 species of local insects[4]; 12 species of insects were reported to be eaten by Galo tribes[5] and Chowdhury *et al*.,[6] has highlighted the traditional insect foods prepared by the different ethnic communities and tribes inhabited in Eastern Himalayas. More than 11 species of edible insects were recorded among the Ao tribe of mokokchung district, Nagaland[7]; the indigenous people of Nagaland widely consume the carpenter worm, *Cossus* spp., whose larval stages are cooked as traditional food during their festivals[8] and the ethnic people of Phek, Dimapur and Kohima districts of the same state eat grasshoppers, crickets, red ants and larvae of mulberry silkworms[1]. An edible pentatomid bug (*Ochrophora montana*) had earlier been mentioned as a delicacy for inhabitants of the Mizo Hills in Northeast India[9].

Many researches on entomophagy have been conducted in Assam and a wide variety of edible

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insects has been reported where, the Bodos of Udalguri district eat 23 species of edible insects as their traditional food[2]; the ethnic tribes of Dimoria Development Block use 18 species of insects for food[10]; 5 species of insects were found to be eaten by the Rabha folk of Assam[11]; 30 species of edible insects were recorded by the local inhabitants of Baksa District as their ethnic food[12] and the eggs and larvae of red ants *Myrmica rubra* are consumed by the members of karbi community of Assam[13]. Tribes of Kandhamal, Koraput, Sundergarh, Keojihar and Mayurbhanj district of Orissa eat roasted insects as snacks or with rice[14]. The villagers of Pithra village of Simdega district of Jharkhand eat eggs of red ants found on trees[15].

Many tribes in Tamil Nadu have been using *Odontotermes formosanus* as food and medicine[16-18]. In some parts of South India including Karnataka, the raw queen termites are fed to the children who are weak[19,20]. Singh and Padmalatha[21] investigated on the therapeutic values of insects in Tirunelveli district, Tamil Nadu and revealed that 11 species of insects has been used by traditional healers in preparing medicines to heal ailments. Insects like *Acrida cineri, Bombyx mori*, *Photinus carolinus, Hierodella ocellata, Blatta orientalis, Mutilla occidentalis, Laccifera lacca, Periplanata americana, Musca domestica, Cimex* sp., *Apis* sp., and *Coccinella septempunctata* has good therapeutic values and are used by indigenous tribes to treat different ailments[22-25].

Traditional knowledges are acquired by only by practical hearing, training and observation, which are orally transmitted among generations[26], entomophagy is one such art and disappearing fast among the younger generation due to various factors. Therefore more studies are required in this field to document the indigenous traditional knowledge and effective measures to be taken to prevent their complete loss, as currently they are in a verge of extinction[3]. In this study we have documented the entomophagy practices among the ethnic tribes in the Nilgiris, Western Ghats, Tamil Nadu, which is one of the biosphere reserves in India having a rich floral and faunal diversity.

Materials and Methods

The study has been conducted among the primitive tribes viz., Todas, Kotas, Kurumbas, Irulas, Paniyas and Kattunayakans inhabiting various regions of the Nilgiris district (11° 29' 29.7744" N, 76° 44' 1.1400" E), Tamil Nadu. The Nilgiris is a hilly region with 1,800 m elevation where the Western Ghats and Eastern Ghats meet in Tamil Nadu, thus acts as a biodiversity hotspot. The primary data had been collected using a structured questionnaire, where 100 respondents (both men and women) of different age groups, from 25 – 80 years had been randomly selected and surveyed. The tribal leaders, traditional healers, home makers, honey collectors, estate workers, youngsters and educated members of all six tribes from 12 tribal villages (including Archidin, Ellanalli, Kunjapanai, Pudhukotagiri, Nelakottai, Thorapally *etc*.) in all six taluks (Udhagamandalam, Kundah, Coonoor, Kotagiri, Gudalur and Pandalur) (Fig. 1.) of the district were enquired about the edible insect species, method and site of its collection, its life stages preferred for eating, mode of consumption, their cooking recipes and the benefits of eating them. The edible insect species mentioned to be eaten were collected using nets, handpicking and traps as described by Ghosh & Sengupta[27], then preserved in 70% alcohol and brought to laboratory for taxonomic identification. The insect samples were submitted to various institutions like Zoological Survey of India (ZSI), Entomological Research Institute (ERI) for authentic species confirmation. The obtained data were statistically analysed to find their utility rate. For each species of edible insects recorded, their use values are calculated using the formula, Use value (UV) =Σ U / n where, U is the number of citations per species and n is the number of respondents enquired[28]. The use value of respective insects denotes their utility as food source among the Nilgiri tribes.

Results

Various life stages of 8 species of insects belonging to 5 families under 2 insect orders (Hymenoptera and Isoptera) have been found to be eaten by the primitive tribes of Nilgiri hills (Table 1). All the tribal groups use or used edible insects in their ethnic diet and at

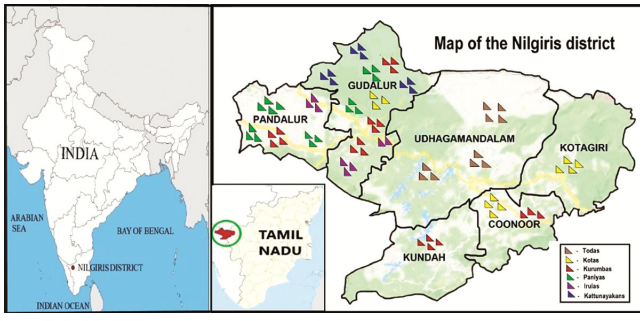

Fig. 1 — The map of Nilgiris district representing the distribution of respondents

Table 1 — List of edible insects eaten by tribes of Nilgiris district

S. No	BINOMIAL NAME	VERNACULAR NAME	STAGES AND MODE OF EATING	COLLECTING METHOD	SEASON
			Hymenoptera		
1	*Apis dorsata* Indian rock bee (Apidae)	*Thaen rot, rod, korr, thaen mari, thuda, thaen kunju*	Larva & pupa eaten Raw, boiled, steam baked, roasted & cooked as curry	Smoking & scraping of the hive	Mar to Jul
2	*Apis cerana* Asian honey bee (Apidae)	*Thaen rot, rod, korr, thaen mari, thuda, thaen kunju*	Larva & pupa eaten Raw, boiled, steam baked, roasted & cooked as curry	Smoking & scraping of the hive	
3	*Apis florae* Dwarf honey bee (Apidae)	*Thaen rot, rod, korr, thaen mari, thuda, thaen kunju*	Larva & pupa eaten Raw, boiled, steam baked, roasted & cooked as curry	Smoking & scraping of the hive	
4	*Trigona* sp. Stingless bee (Apidae)	*Kosutheni*, nejar	Larva & pupa eaten Raw	Smoking & scraping of the hive	Year round
5	*Vespa affinis* Greater banded hornet (Vespidae)	*Kadanjaal, kadanthaal*	Larva & pupa eaten Raw, steam baked & cooked as curry	Smoking & setting fire to the hive	
6	*Oecophylla smaragdina* Weaver ant (Formicidae)	*Butnipee, Aettaca*	Larva & pupa eaten Raw, roasted & cooked as curry	Smoking & setting fire to the hive	
			Isoptera		
7	*Odontotermes* sp. Fungus growing termite (Termitidae)	*Isgini, Gaaralulu*	Adults were Fried & roasted	Handpicking & light trap	Sep to Nov

least three species of insect are commonly consumed all ethnic groups. Their entomophagy behaviour, health benefits of eating insects, along with their collection, processing and cooking methods were recorded in this present study. The use values calculated for the recorded edible insects were presented in Fig. 2.

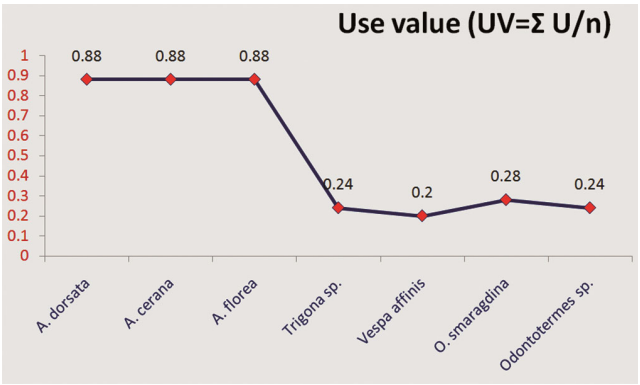

Fig. 2 — Use value of edible insects

***Apis dorsata*, *Apis cerana indica* and *Apis florea* (Hymenoptera: Apidae)**

The larva and pupa of the honey bees were abundantly available for collection during the months of March to July, which is vernacularly known in different dialects as '*Thaen rot, rod, korr, thaenmari, thuda, thaenkunju'* and were simply steam baked, boiled, roasted or eaten raw. The piece of hive along with the broods in it is crushed to obtain a milky white fluid extract, from which a curry is prepared by adding oil, shallot or onion, tomato, pepper, turmeric powder and bird's eye green chili (vernacularly known as 'kaandhari molagu'). Some of their easily available garden vegetables like beet root, beans, radish and carrot were used to cook the curry. Sometimes a bhurji kind of dish is also made with the thick consistent larval extract obtained. Also the whole larvae and pupae were used to make the curry.

***Trigona* sp. (Hymenoptera: Apidae)**

Trigona sp. is vernacularly known as '*kosutheni* or *nejar'*, whose larvae and pupae commonly eaten. They are collected by scraping their hives and the broods were eaten raw, roasted and cooked.

***Vespa affinis* (Hymenoptera: Vespidae)**

The broods of lesser banded hornet, *Vespa affinis* were eaten by few tribes in Gudalur and Pandalur

taluks of the Nilgiris district which is vernacularly known as '*Kadanjaal or kadanthaal'*. The hornet hives were obtained after chasing away the adults using fire. The obtained larvae and pupae were eaten raw, roasted and made as curry with garden vegetables.

***Oecophylla smaragdina* (Hymenoptera: Formicidae)**

The weaver ant *Oecophylla smaragdina,* vernacularly known as '*butnipee* or *aettaca or para erumbu'* is commonly found in the trees of the Nilgiris district and eaten as delicacy. The nests of weaver ants hanging in the trees have been burnt with fire to chase away the adults. The burnt nest had been brought down to obtain the larvae and pupae from it. These ant broods were cooked in the same style as that of bees and the milky extract obtained from the crushed ant broods was mixed with onions, pepper, chilly and turmeric powder to make a healthy soup.

***Odontotermes* sp. (Isoptera: Termitidae)**

The winged swarmers of subterranean termites emerging from the ground during the months of September to November were collected by handpicking and also using light trap method by the few tribes in Gudalur and Pandalur taluks. The termites are vernacularly known as '*Isgini* and *gaaralulu'*. The collected alates were washed in clean water, wings removed, sun dried or simply roasted in pan with salt and eaten.

Discussion

In comparison with the entomophagy practices of the tribes of Manipur, Arunachal Pradesh, Eastern Himalayas, Nagaland and Assam[3,4,6,7,10], no aquatic insects were found to be eaten by the ethnic tribes in the Nilgiri hills. Only hymenopteran and isopteran insects were caught for their own consumption and the inhabitant communities do not sell or market the edible insects.

In general, edible insects provide satisfactory amounts of energy and proteins with amino acid requirements for humans, high in monounsaturated and polyunsaturated fatty acids with rich micronutrients[29]. Among the six primitive tribes studied, members of kurmba and kattunayakan tribe use more number of insect species as food. The inhabitant tribes of Nilgiri hills have honey extraction as their major livelihood occupation. The leftover broods (larva, pupa and eggs) from the extracted hives turn edible for them, hence the hive containing juveniles inside were brought home for food. The members of the kattunayakan tribe are exclusively known for honey extraction. The etymology of the word "*Kattu-nayakan"* means '*hero of the forest'*. The traditional technique they follow for collecting the honey from forest area, made them to expertise in that field. While all of the honey collecting tribes use the smoking method to chase away the bees from their hives, Kattunayakans used to sing their traditional song and raise some rhythmic sounds to chase away the bees from the hive. Through this technique, they mean to cause less or no harm to the bees, they justify. There exist a cultural association between the members of kattunayakan tribe and the bees, which is accepted by the people of the Nilgiris and that attachment requires a deep study. As most of the Nilgiri tribes are engaged and accessible with the bee hives, they all get chances to consume the honey bees. All the three species of honey bee are widely eaten and has the highest use value of 0.88. The broods were eaten raw by many of them during the collection process and it is reported to be slightly sweeter. Sometimes the raw larva were dipped in honey and eaten for sweet enhancement. The taste of butter and vegetable oil shallow-fried broods of *Apis mellifera* were similar to walnuts, pork-cracklings, sunflower seeds and rice-crispies and found to be appetizing[30]. Tribes of Karbi Anglong district in Assam consume honey broods of *Apis dorsata* (Rock bee) and stated that as very expensive since, they are wild in nature[6]. The curry prepared of bees is one of the most delicious menu among their common dishes of the people of hilly region in Manipur where the larval and prepupal stage of *Apis cerana indica* is favourite of Tangkhul, ethnic community in Manipur and it is served to their married daughters or sisters when they come to their parent home[3]. The brood eating Nilgiri tribes said that the brood of honey bee contains all nutrients equivalent to that of honey and also stated that eating the honey brood treats cold, cough, chest pain; prevents heart attack; improves eyesight and boosts immunity. The larvae and pupae of stingless bees, *Trigona* sp. (Use value - 0.24) were also commonly consumed whose honey is said to be little bitter and sour in taste, but has abundant medicinal values. The honey of stingless bees was found to have better antioxidant, wound healing, anti-inflammatory, anti-microbial, and moisturizing properties also treats cold, cough and bronchitis[31,32]. Unlike honey bees, *Trigona* sp. is harmless (stingless) and also easily available even at their domestic areas such as houses, over the cracks in the buildings or mud walls, in the

supporting bamboos of their huts *etc*. However this insect species is not much preferred as food rather used as medicine. It is said that the broods of *Trigona* tastes slightly bitter and treats cold, cough, fever; also fights against infection and allergies. The knowledge holders stated that the broods of bees (*Apis* sp. and *Trigona* sp.) eaten, had the same health benefits and therapeutic values as that of their respective honey obtained.

There is a great variation in entomophagy practices among the tribes of the Nilgiris district distributed in areas of different altitude. The Udhagamandalam, Coonnor, Kundah and Kotagiri are taluks with high elevation whereas Gudalur and Pandalur taluks were located just below the other taluks and often considered as 'Plains' by the Nilgiri tribes. The Gudalur and Pandalur taluk are forest area covered with more trees, so the tribes residing there are accessible to wide variety of food insects, where ants, hornets and termites were recorded as edible. The geographical and climatic conditions prevailing in that area would have also favoured the insect eating interest among the inhabitants. The larvae and pupae of the weaver ant, *Oecophylla smaragdina* is widely consumed by the Kurumba and Kattunayakan tribes (Use value - 0.28) of the Gudalur and Pandalur taluks, where the nests of weaver ants could be easily spotted hanging in the Areca palm, rubber and other tall trees. *Oecophyllasma ragdina* was reported to contain 55.27% of protein, 14.99% of fat, 19.84% of carbohydrate, 93.14mg of magnesium, 150.00 mg of sodium, 710.00 mg of potassium, 15.66 mg of iron and 18.97 mg of zinc[33]. The Mishings tribe and Ahom Community of Assam use red ants (*Oecophylla smargdina*) as their traditional food on Assamese festival Bohag Bihu in the month of April and it is believed that eating red ants keeps them free from infectious diseases[6]. Also, larva of the same is being consumed by the Bodos in an ethnic festival celebrated for welcoming the spring season[10]. The people of Pithra village of Simdega district, Jharkhand eat eggs of red ants fried with salt, chilly spices and mustard oil, which is said to be good for bones[1]. Similarly, the ethnic community of Nilgiris hills says that eating ant broods prevents stroke, relieves muscle pain, gives body strength and boosts immunity.

The people of Nilgiris were scared of the occurrence of foraging hornets at their surroundings and they all focus to find its nest to destroy it. When enquired about hornets, the forest tribes commented that four to five consecutive stings of *Vespa affinis* make an adult man fatal. Only the kurumba and kattunayakan tribes consume the broods of lesser banded hornet, *Vespa affinis* (Use value - 0.20) to treat hip pain, asthma and to increase body strength. Once the hornet nest in the tree is sighted, they set fire beneath the nest to harvest the broods for food. Some people use smoke at the entrance of *Vespula* nest sedates the wasp inside[34]. The bodos of Udalguri district, Assam eat *Vespa affinis*[2]; the ethnic groups of Arunachal Pradesh consume about six species of wasps belonging to the group vespidae[4] and in South India, *Vespa orientalis* is ground with mustard oil/ honey with salt and eaten to treat inflammation, leucoderma and skin infections[24].

Termites are valuable source of protein, fat and essential amino acids in the human diet[16] and it is the only winged adult insect eaten whereas only the immature stages of rest of the insects are consumed as it is reported that exopterygote insects (Orthoptera, Isoptera and Hemiptera) are eaten in their nymphal and adult stages whereas majority of the endopterygote insects are eaten in larval and pupal stages[35]. Termites known as '*Eesal'* in tamil, is eaten by many ethnic groups in the state of Tamil Nadu: Tribes of Bodi hills and sathyamangalam forest[36]; Irulas of Gingee hils, Villupuram district[18]; the same of Chengalpattu district in Tamil Nadu[37] and the 'Kannikaran', 'Paniyan', 'Palliyan', 'Sholaga', 'Irular' and 'Kota' tribes[38]. In the Nilgiris, only the Kurumba and Kattunayakan tribes in the Gudalur and Pandalur taluks eat termites (Use value - 0.24) says that they are good for health and improves eyesight, while the others in high altitude region strictly do not consume. In general, Irulas in Tami Nadu are expert in collection, processing and also selling of termites. Those of Gingee hills sell processed termites in the market, which provides them their livelihood opportunity[18]. Surprisingly, the irulas of the Nilgiris does not consume termites and they expressed their weirdness when enquired about that but most of the irula respondents, accepted that their own relatives and communities residing in the other district plains of Tamil Nadu eat termites as their traditional food. This shows the variation in their food preferences among the distributed communities which may be due to their environmental conditions. Generally termites are rich in fat and constitute about 47.31% of total body weight[39]. Excess fat content of the insect and the

climatic factors prevailing in high altitude areas would have caused the inhabitants to neglect termites for food. However, some people of the district collect subterranean termites emerging from the ground for using them as fish baits.

Throughout the study, it was observed that only the respondents of above 60 yrs of age (elder people) have given more information about their insect eating habit. Almost all of them stated that, insect foods are not eaten nowadays and also added that their younger generation are unaware of that. Some of the elderly aged respondents admitted that they used wide variety of insects as their traditional food during their childhood times and unfortunately they forgotten most of the insects eaten. This clearly indicates the interruption of knowledge transmission among generations and loss of ethnic foods. Most of the tribes admit that insects were their major food during olden days, when they were inaccessible to vegetables, rice, dhal, wheat, chicken *etc*. Availability of alternate foods and the risk factors of collecting food insects from forest areas along with modernisation caused the decline in interest for insect foods among the tribes of the Nilgiris district.

Conclusions

The primitive tribes of Nilgiris use 8 species of hymenopteran and isopteran insects as their traditional food which gives them good health and strength. They also possess wide traditional knowledge on the therapeutic values of edible insects. Factors such as food insecurity, arising health issues in man, search of alternative food sources had made the world to turn back on the traditional foods, though modernization occurs. When their present lifestyle is assessed, a great decline in interest for the insect foods is observed among the Nilgiri tribes due to various reasons. The valuable traditional knowledge and practices of ethnic tribes must be documented for conservation.

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Conflict of Interest

The authors declare no conflict of interest among them.

Author's Contributions

BAD designed the whole methodology and framed the outline of the study. VLK did the field work for obtaining data and insect sample collection. JJ helped in statistical analysis. MGR co-ordinated the entire work.

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