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Practice of Entomophagy and Entomotherapy in Bangladesh

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Practice of Entomophagy and Entomotherapy in Bangladesh

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Abstract

The different aspects of entomophagy and entomotherapy used by ethnic people in Bangladesh were documented. A comprehensive survey was conducted on the entomophagy practice of the ethnic communities in Bangladesh as only ethnic people consume insects in Bangladesh. From the 9 largest ethnic groups, 6 groups i.e. Garo, Chakma, Tanchangya, Marma, Mro, and Tripura consume insects. A total of 36 insect species from 19 families and 8 orders were consumed by the six ethnic groups of Bangladesh. In terms of insect orders, Coleoptera ranked the highest in number (14 species) followed by Hymenoptera (7 species), Orthoptera (5 species), Hemiptera (5 species) and Dictyoptera (2 species) while only 1 species was consumed from Ephemeroptera, Odonata and Isoptera. In terms of preference, field cricket (*Brachytrupes* sp.), short horned grasshopper (*Oxya* sp.) and giant water bug (*Lethocerus indicus*) were the top three insect species consumed by 84%, 83%, and 79% of the total ethnic respondents, respectively. Individual survey indicated that the Chakma, Marma, Mro, Tanchangya, Tripura and Garo ethnic people consumed 32, 22, 29, 21, 26 and 14 species of edible insects, respectively. Nine insect species are used for medicinal purposes against cough, fever, nocturnal emission, burning and gastroenteritis. Generally ethnic peoples collect insects from their natural habitat, consumed mostly as snacks, and complete meal. Availability of edible insects is highly dependent on seasons. Despite the consumer demand, insect consumption is decreasing gradually, mainly due to the unavailability of insects resulting from random application of pesticides and fertilizers in the fields. Top three entomophagic constraints of the respondents included lack of knowledge about modern insect rearing, insect harvesting and storage facilities of insects. Our study concluded that Bangladesh has large entomophagic ethnic communities with a diverse group of edible insect species.

Key words: Entomophagy, entomotherapy, ethnic communities, socio-economic status, Bangladesh.

1. Introduction

According to the United Nations' projection, the global population is estimated to reach 9 billion people by the year 2050. It will impose severe pressure on food and feed production capacity, and consequently, pose a serious threat to the food security (van Huis *et al*., 2013). To improve the food security and reduce the environmental impact of food supply for the future global community, several strategies have been proposed by researchers (Burchi and De Muro, 2016). Among those various strategies, Food and Agriculture Organization (FAO) has proposed the promotion of insects as a viable food source in order to feed both the humans and animals (van Huis *et al*., 2013). Edible insects are rich in nutrients. The protein content of insects may vary (21-65%) depending on the life stages of insects, the season and the geographical area (Ghosh *et al*., 2017; Braide *et al*., 2010; Ebenebe *et al*., 2007; Ssepuuya *et al*., 2019). Edible insects are also rich in lipid contents (10-32% on dry basis) (Paul *et al.*, 2017)**,** minerals like iron (Fe), zinc (Zn), magnesium (Mg), manganese (Mn) are found in insect body (Ghosh *et al*., 2017). Igwe *et al.* (2011) reported that the vitamin content in insects is higher than in conventional animal sources. Studies also showed that insects could play a vital role for the treatment of baldness, osteomyelitis, inflammation, pain, and asthma (Kampmeier and Irwin, 2009), also to treat traumatic and infected wounds and burns (van Huis, 2003). Traditionally edible insects have played an important role as part of human nutrition in many regions around the world among which large parts of Africa, Asia and Latin America (Aletor, 1995; Kelemu *et al.*, 2015; Yi *et al.*, 2010). However, in a number of regions in these continents and in the western societies, entomophagy is not common.

Worldwide the number of edible insect species is considered to be about 2000 which cover the western, tropical and the temperate regions (Jongema, 2015). There are 524 species consumed in Africa, 349 in Asia, 679 in America, 41 in Europe and 152 in Australia (Ramos-Elorduy, 2005). Mexico has the most registered species, followed by Thailand, Congo, India, Australia, China and Zambia (Cerritos, 2009). According to Ramos-Elorduy, (2009), worldwide almost 2100 species of insect are consumed by overall 3071 ethnic groups. Globally, the most commonly eaten insects are beetles (Coleoptera) (31%), which make up around one third of the total (van Huis *et al*., 2013). Eating caterpillars (Lepidoptera) is especially popular in sub-Saharan Africa and is estimated at 18%. Bees, wasps and ants (Hymenoptera) come in third place with 14%, and these insects are especially common in Latin America. Next come grasshoppers, locusts and crickets (Orthoptera) (13%); cicadas, leafhoppers, plant hoppers, scale insects and true bugs (Hemiptera) (10%). The consumption of other insect orders is lower than 10% (van Huis *et al.*, 2013).

Though wild harvesting is still very widespread among the countries for both subsistence and commercial purposes (Yen, 2015), the edible insect consumption is growing rapidly as they are getting acceptance by the world people. Many countries of the world have already established their insect industries as great source of income by marketing insects and insect-based food items. The global edible insect market is expected to grow from 406 million USD in 2018 to over 1.18 billion USD by 2023 (Shahbandeh, 2019). In addition, it is worth noting that not only especially in Africa, but also in Asia, there exist a very large informal market which is not included in this market value.

The entomophagy practice is common in many Asian countries. According to Ramos-Elorduy (2005), 349 insect species are eaten in 29 Asian countries. In Bangladesh, however, entomophagy is a rare phenomenon. There are no published data on entomophagy in Bangladesh although insects are consumed by some ethnic groups. In Bangladesh there are many large and small ethnic groups living in the Chattogram, Sylhet, Mymensingh and Rajshahi divisions. The majority of them are living in the three hilly districts of Chattogram

division. The largest ethnic groups are Chakma, Marma, Khasia, Khasi, Saontal, Garo, Hajong, Tripura, Manipuri, Tanchangya, Mro, Jaintia (Mai, 2007). The total population of the indigenous ethnic people in Bangladesh is estimated to be around 3 million. Bangladeshi ethnic people consume insects by collecting them from the wild environment. These insects are also used for the therapeutic purposes by some of the ethnic people. The entomophagic nature of the Bangladeshi ethnic groups may be a basement for establishment of the future insect industry in Bangladesh. Eventually these insects can contribute to improve the nutritional status not only for ethnic groups but also for other people in Bangladesh. Because there are at present no specific data regarding the edible insects available in Bangladesh, the present study aims to investigate the edible insect species and entomophagic natures in selected ethnic groups of Bangladesh.

2. Materials and methods

Ethnic group and study site

An oral pre-survey was conducted to get an idea about the entomophagy and entomotherapeutic nature of the nine largest Bangladeshi ethnic groups from four major divisions where they are living historically. From this oral pre-survey it was ensured that six out of nine ethnic groups have the habit of consuming insects. In Chattogram division (southeastern part of the country), 5 ethnic groups i.e. Chakma, Tanchangya from Rangamati district, Marma, Mro from Bandarban district, Tripura from Khagrachari district and also the Garo ethnic group from Sherpur district in northern Mymensingh division were included in this survey (figure 1). It is important to note that there is no information about other (smaller) ethnic groups who consume insects. It was, however, not possible to include them into this research because of their small community size and of the difficulties to approach them.

Respondent selection

A cross-sectional survey was conducted in 6 ethnic groups from 2 divisions. A multi-stage random sampling was applied within each ethnic group. In the first stage, one village was randomly selected from individual district of the respective division of the selected ethnic group. In the second stage, 25 households in each village were selected and from each household, one respondent was included, either male or female person. In this way a total of 150 respondents (25 respondents from each of the six ethnic groups) were asked about their entomophagic nature. Recommendation by the local leader of that village (locally called ‘headman’ or ‘Karbari’) was needed to enter the individual ethnic regions.

Preparation of the questionnaire and insect photographs

A structured questionnaire was prepared to collect all types of data to fulfill the study objectives. The questionnaire consisted of three parts:

1. We asked about their preference and likeliness to insect consumption?
2. What constraints they faced for insect consumption? and
3. Does photographs of common insects help to identify insects by ethnic group?

The questionnaire included the name of the edible insect species they consume along with socio-economic characteristics of the interviewees, vernacular names of the edible insects, mode of intake, portion of consumption, source of the insects, level of consumption, occasion in which insects are consumed, trend in consumption, reasons for decreased/increased consumption, availability, acceptability, last edible insect harvesting and buying time, use of insects as medicine, method of preparation etc. Based on the pre-survey a list of seven entomophagy related constraints was compiled to identify the main barriers for an increased consumption of insects and thus the future prospect of an insect-based food chain in Bangladesh. Each constraint was scored on a four-level scale (high, medium, low, not

important). Based on this scoring, a constraint facing index (CFI) was computed using this formula (Pandit and Basak, 2013):

$$CFI = (C_h \times 3) + (C_m \times 2) + (C_l \times 1) + (C_n \times 0)$$

In which,

C_h = Percentages of respondents indicating high importance

C_m = Percentages of respondents indicating medium importance;

C_l = Percentages of respondents indicating low importance;

C_n = Percentages of respondents indicating no constraint (not important)

As a third part of the research, printed laminated photographs of 65 species of insects were prepared based on some South Asian literature (Chakravorty *et al.,* 2013; Barennes *et. al*., 2015) and surveyed for information from the ethnic communities.

Data collection

The survey was based on an oral interview by the interviewers and reporting in the questionnaire. Interview was taken with the help of a local ethnic interpreter as many of the ethnic people can speak only their local language. At first, most of the respondents were reluctant to answer about their insect consumption habit. To create a congenial environment, positive attitude towards insect consumption along with their benefits were discussed prior to the interview. The edible insect species were identified with the help of the photographs and the insect names in their ethnic language were recorded. The other relevant entomophagy practices were surveyed by using the questionnaire.

Statistical analysis

Descriptive statistics such as variance were used for analyzing socio-economic profile, list of edible insects and entomophagy related profile of the respondents in study areas. All the recorded data were analyzed by descriptive statistics using SPSS (Version 20, IBM Corporation, Armonk, New York)

3. Results and discussion

Socioeconomic profile of the ethnic respondents

Among the 150 respondents from six ethnic groups, male and female respondents were 59% and 41%, respectively (Supplementary Table 1). The majority of the respondents (65%) could read and write while the illiteracy percentage was 20%. In terms of profession, most participants (33%) were engaged as farmer, followed by housewife (17%) and student (13%). The religious status of the respondents showed mainly Buddhists (67%) with 17% respondents from Hindu and Christian religion each. There were no Muslims in the present study.

Characteristics of the edible insect's consumption

Consumption of insect species varied among the six studied ethnic groups of Bangladesh. From the 65 insect species that were included in this study with their photograph, 36 species were mentioned at least once by the studied ethnic group. These 36 species of insects belonged to 8 orders and 19 families (Figure 2). Among these species, the orders with the highest number of species were Coleoptera (14 species), Hymenoptera (7 species), Orthoptera (5 species) and Hemiptera (4 species). For 4 other orders, only 1 or 2 insect species were mentioned (Dictyoptera, Odonata, Isoptera, and Ephemeroptera) (Supplementary Tables 2 to 9). Jongema (2015) also reported that worldwide the majority of the edible insects were from Coleoptera (31%), Hymenoptera (15%), Orthoptera (13%) and Hemiptera (10%). Alamu *et al*., (2013) found that major edible insects of Nigeria were belonging to the Lepidoptera

(27%), Coleoptera (27%), Orthoptera (23%) and Isoptera (14%). Our study shows that entomophagy in the ethnic communities of Bangladesh is in accordance with the consumption pattern of insect orders that are known worldwide.

Number of edible insects in individual ethnic group

When looking to individual insects, the present study revealed that field cricket (*Brachytrupes* sp.), short-horned grasshopper (*Oxya* sp.) and giant water bug (*Lethocerus indicus*) were the top three mostly consumed insects with a consumption by 84%, 83% and 79% of the total respondents, respectively (Table 1**)**. Moreover, the *Lethocerus deyrollei* and *Oryctes rhinoceros* were consumed by more than 50% of all respondents.

The consumed insect species varied among the six ethnic groups. The Chakma, Mro, Tripura, Marma and Tanchangya ethnic groups from the Chattogram division consume 32, 29, 26, 22 and 21 insect species, respectively, while the respondents from the Garo ethnic group (Mymensingh division) consume 14 insect species (Table 2).

In terms of insect order, Coleopteran insect consumption positioned top among all ethnic groups due to their high abundance in the studied area. However, in terms of favourite species, insects from Orthoptera (*Brachytrupes* sp., *Oxya* sp.) and Hemiptera (*Lethocerus indicus* and *L. deyrollei*) combinedly top ranked among all ethnic groups from the Chattagram division due to their attractive shape and palatability. The top three insect species consumed among the Garo ethnic group were from Hemiptera, Odonata and Isoptera orders, respectively (Figure 2; Table 2).

Our study suggests that geographical location and topography highly influence insect consumption among different ethnic groups. The ethnic groups from the Chattagram division (i.e. Chakma, Mro, Tripura, Marma and Tanchangya) show a wide variation of consumed insect species. They live in the hilly forest areas with higher insect diversity. To the contrary, the Garo people live in the plain land of Mymensingh division with relatively less forest and insect diversity. Note, for instance, that the two giant water bug species (*L. indicus* and *L. deyrollei*) that are popular in the Chattogram division, were not consumed by the respondents from the Garo ethnic group. When relating insect consumption to the socioeconomic profile of the respondents (Supplementary Table 1), there were no significant effect of age, literacy, occupational status or religion.

The survey performed by Chakravorty *et al.* (2013) about entomophagy in six Indian tribes also showed a wide variation in consumed insect species (with 20 different species as the highest number of insects consumed by the Wancho tribe). A part of the Chakma ethnic group live also in adjacent Indian territory, and Chakravorty *et al.* (2013) reported the consumption of 15 species by this ethnic group. More recent research also revealed that Adi and Apatani tribes from India consume 53 and 49 species of insects, respectively (Chakravorty *et. al.*, 2019). Manditsera *et al.*, (2018) reported that the availability of edible insects has a large influence on the edible insect consumption. According to them, rural people consumed more insects than the urban people mainly due to choose of taste and perception towards insect consumption, among others.

The pattern of insect consumption is mainly controlled by the time of availability in a year. The majority of the insect species are harvested by the ethnic groups during the cool and dry winter season, for example the field cricket (*Brachytrupes* sp.). Some aquatic insects (e.g. the giant water bug, *Lethocerus indicus*) are harvested during the hot and humid rainy season.

However, short-horned grasshopper (*Oxya* sp.) is harvested through-out the year. The Garo ethnic group mentioned that, they generally do not harvest *Oxya* sp. from the rice fields during the summer due to the use of large amounts of pesticides in agricultural practice.

Based on our study and the available literature, we assume that the variation of edible insect species among the ethnic communities is due to the environment, availability and the ethno-entomological knowledge of the ethnic communities.

Medicinally used edible insects

The present study showed that in total nine edible insect species belonging to 6 orders were found to have various medicinal uses in all the ethnic groups except the Tanchangya ethnic group (Table 3). The insects were mainly used to cure cough, nocturnal emission and fever. We found that 21% of the total 150 respondents used insects as medicine for recovering different diseases. Chakravorty *et al*. (2013) reported therapeutic uses of 4 species of edible insects among different ethnic groups in India, among them *Apis (cerana) indica* and *Apis mellifera* are commonly used for medicinal purposes by the different studied tribe. In India, medicinal use of 6 insect species in Assam with *Apis mellifera indica* that was used for cold and cough (Ronghang and Ahmed, 2010). Barennes *et al*., (2015) mentioned that 10% of the studied respondents have mentioned about the use of insects in their traditional medicine in Laos.

From harvesting to insect consumption

In Bangladesh the ethnic community harvest edible insects in several ways among them 72% respondents reported to harvest edible insect by their hand, while 21% used spade. The Garo ethnic people used only their hand to harvest edible insects. On the other hand, the use of a net was mentioned by 24% of the respondents from the Chakma people, whereas no other ethnic groups mentioned. Almost half of the respondents (49%) collect insects from their natural habitat, but 33% respondents collected edible insects both from the natural habitat and local market. Up to 72% of the Marma ethnic people stated that they collect field crickets and giant water bugs from the local market. During our survey, it was found that field cricket and giant water bugs were found to be sold with great demand by the local ethnic Marma women in Bandarban district (Supplementary Figure 1). These two insects have a high local demand due to their size and shape. 24% of the Chakma ethnic people buy edible insects directly from the harvester.

Depending on the insect species, different life stages i.e. from egg to larvae or grub and the adult were consumed (Supplementary Tables 2 to 9). Insects were always prepared by frying or roasting. Where necessary, insects were consumed after discarding the wings. 42% of the respondents consumed insects only as snacks, while 43% consumed insects both as a complete meal (combined with rice) and as a snack. There also exist differences between the ethnic groups. 48% of the Tripura ethnic people consume insects as a complete meal, while 32% of the Garo and 28% of the Marma people also mentioned consumption of insects along with mixed vegetables and with local edible leaves. These results confirm the work of Yhoung-Aree *et al.* (1997) who reported that in rural areas of Thailand, edible insects were used as main dish or with staple food. They also discard wings of insect before processing.

The studied ethnic groups consumed insects not on regular basis, the majority takes it occasionally. Only 20% of both the Tripura and Chakma people, and 16% of the Mro people responded to consume insects on a comparatively frequent basis (several times in two to three months). Generally, the respondents like to consume edible insects in a mass gathering (48%)

with their family and friends. Ramos-Elorduy (2006) stated that the indigenous peoples of Mexico gather edible insects for consumption with their families and sell the extra insects to the market.

Seventy nine percent of the respondents mentioned a decreasing trend of insect consumption, while 19% stated an unchanged trend of consumption. Unavailability of edible insects, increased standard of living, changes in environmental conditions, use of pesticides and fertilizers in fields were the major key factors for the decreasing edible insect consumption in the ethnic communities in Bangladesh. However, most of the respondents stated that they are interested to consume insects and would consume if they were available. Overall 83% respondents stated that availability of the edible insects depends on seasons. On the other hand, 32% Marma people, 28% Garo people and 20% Tripura people also responded that availability sometimes depends on harvesters who collect those edible insects.

Constraints faced by the respondents regarding entomophagy

The decreasing trend in entomophagy is further examined by scoring the different constraints to consumption and calculating Constraint Facing Index (CFI). Overall, it can be stated that the low availability of the insects is the main constraint to insect consumption. The lack of knowledge about insect rearing and modern harvesting techniques are ranked as the 2 major problems (Table 4). In addition, lack of storage facilities of the insects also hampers the consumption throughout the year. The majority of the respondents collect insects in the winter or spring season (November to April) when the environment is dry and cool and less humid, while only few aquatic insects are available in the rainy season (July to September). Therefore. availability through-out the year also potential constraints those particular area. Furthermore, the price of the insects is also higher in the urban areas compared to villages due to the difficult transportation system and year-round unavailability.

In general, to reduce the seasonal barrier and increase the availability, many respondents are interested to mass rear the edible insects (Durst and Hanboonsong, 2015). We also found a similar pattern from our surveyed ethnic group. In addition, insect rearing could also contribute to the income of many families. Besides rearing, knowledge about modern insect harvesting could also benefit entomophagy. Bangladeshi ethnic peoples generally harvest insects from the wild environment by hand, with a spade or a net. However, harvesting insects from the environment is also considered as a threat to the ecological balance. Ramos-Elorduy (2006) revealed that the edible insect population in a Mexican town has declined due to the over harvesting by non-qualified independent workers. This highlights the importance of sustainable harvesting (Mbata *et. al*., 2002), as human and the wildlife are directly competing for the edible insects.

4. Conclusion

The present study is the first comprehensive survey on entomophagy in Bangladesh context. The report revealed that at least 36 edible insects from 8 different orders are consumed by six ethnic groups (Chakma, Marma, Mro, Tanchangya, Tripura and Garo) in Bangladesh. In addition, these ethnic groups also use 9 insect species for medicinal purposes. Among the six ethnic groups, Chakma people from the hilly Chattogram division consumed the highest number of edible insect and the lowest number were recorded by the Garo ethnic group from the plain land Mymensingh division. The study also revealed that age, literacy and religion had no effect on entomophagy nature of the ethnic people of Bangladesh. The respondents were interested to consume insects more frequently. The major constraints faced by the respondents regarding entomophagy are the lack of knowledge about insect rearing, modern

insect harvesting and storage facilities of insect. Mitigation of these constraints by education may help to develop insect farms and improved harvesting techniques. Besides an increased availability of edible insects throughout the year, insect consumption will also contribute to income generation for the ethnic communities in Bangladesh. The increased availability of insects might also have an impact on the food consumption pattern of the ethnic people, thereby improving their food security as well.

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Conflict of interest

The authors declare that they have no conflict of interest.

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Tables

Table 1. Topmost five edible insects in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all respondents (n=150)	% Intake per ethnic group (n=25)
Brachytrupes sp.	Gryllidae	Field cricket	Adult	Fried or roasted with vegetables	84.0%	Chakma-88% Marma-92% Mro-92% Tanchangya-100% Tripura-92% Garo-40%
Oxya sp.	Acrididae	Short-horned grasshopper	Adult	Fried or roasted	83.3%	Chakma-96% Marma-68% Mro-88% Tanchangya -80% Tripura-68% Garo-100%
Lethoceru indicus	Belastomatidae	Giant water bug	Adult	Fried or roasted	79.3%	Chakma-100% Marma-100% Mro-88% Tanchangya -100% Tripura-84% Garo-0%
Lethocerus deyrollei	Belastomatidae	Giant water bug	Adult	Fried or roasted	54.0%	Chakma-76% Marma-96% Mro-24% Tanchangya -72% Tripura-56% Garo-0%
Oryctes rhinoceros	Scarabaeidae	Asiatic rhinoceros beetle	Grub, Adult	Fried or roasted	54.0%	Chakma- 68% Marma- 92% Mro- 40% Tanchangya - 64% Tripura- 44% Garo- 16%

Table 2. Ethnic group wise number of consumed edible insect species

Ethnic group	No. of consumed insect species	No. of insect families	No of insect orders	Topmost consumed insect and% intake by respondents (n=25)
Chakma	32	16	7	*Lethocerus indicus* (Giant water bug) 100% *Oxya* sp. *(*Short-horned grasshopper) 96% *Brachytrupes* sp. *(*Field cricket) 88%
Marma	22	9	5	*Lethocerus indicus* (Giant water bug) 100% *Lethocerus deyrollei*(Giant water bug) 96% *Brachytrupes* sp.(Field cricket) 92%
Mro	29	15	6	*Brachytrupes* sp.(Field cricket) 92% *Oxya* sp. *(*Short-horned grasshopper) 88% *Lethocerus indicus* (Giant water bug) 88%

Tanchangya	21	12	6	*Brachytrupes* sp.(Field cricket) 100% *Lethocerus indicus* (Giant water bug) 100% *Oxya* sp. *(*Short-horned grasshopper) 80%
Tripura	26	13	7	*Brachytrupes* sp.(Field cricket) 92% *Lethocerus indicus* (Giant water bug) 84% *Oxya* sp. *(*Short-horned grasshopper) 68%
Garo	14	11	5	*Oxya* sp *(*Short-horned grasshopper) 100% *Anisoptera sp.* (Dragonfly) 68% *Odontotermes obesus* (Termite) 56%

Table 3. Medicinally used edible insects in Bangladesh

Scientific Name	**Order**	**Family**	**English Name**	**Used to cure**	**Used by the ethnic group(s)**
Unidentified sp.	Coleoptera	Scarabaeidae	Long-armed scarab beetle	Cough, nocturnal emission	Marma, Tripura
Propomacrus sp.	Coleoptera	Scarabaeidae	Scarab beetle	Cough, nocturnal emission	Marma, Tripura
Apis (cerana)indica	Hymenoptera	Apidae	Indian honeybee	Cough, fever	Chakma
Unidentified sp.	Hymenoptera	Vespidae	Eumenes wasp	Cough, fever	Chakma
Anisoptera sp.	Odonata	Aeshnidae	Dragonfly	Nocturnal emission	Garo, Tripura
Oxya sp.	Orthoptera	Acrididae	Short-horned grasshopper	Nocturnal emission	Garo
Periplaneta americana	Dictyoptera	Blattidae	Cockroach	Burning, gastroenteritis	Chakma
Lethoceru indicus	Hemiptera	Belastomatidae	Giant water bug	Nocturnal emission	Chakma, Mro
Unidentified sp.	Hemiptera	Cicadidae	Cicada	Nocturnal emission	Garo

Table 4. Constraints faced by the respondents regarding entomophagy

Constraints	Extent of constraints faced by the respondents (n=150)				Constraint Facing Index (CFI)
	High (3)	Medium (2)	Low (1)	Not at all (0)	
Lack of knowledge about insect rearing	137	13	0	0	291
Lack of knowledge about modern insect harvesting	123	23	4	0	279
Lack of storage facilities of insect	78	35	11	26	210
Lack of adequate insect species	55	43	15	37	177
High price of insect	52	37	20	41	167
Lack of transportation and communication facilities	0	32	35	83	66
Cultural barriers	0	0	23	127	15

Table S1. Socioeconomic profile of the respondents related to edible insect consumption in Bangladesh

Categories	No. of respondents	Percentage of the respondents (%)
Sex distribution		
Male	88	58.7
Female	62	41.3
Literacy		
Can't read and write	31	20.3
Can sign only	21	14.0
Can read and write	98	65.3
Occupational status		
Farmer	50	33.3
Agricultural labor	2	1.3
Housewife	26	17.3
Driver	4	2.7
Jobless	7	4.7
Household helper	8	5.3
Teacher	8	5.3
Student	20	13.3
Businessman	10	6.7
Mason	1	0.7
Govt./Non govt. employee	12	8.0
Others	2	1.3
Land possessing conditions		
Self	104	69.3
Leased	29	19.3
Temporary leased	2	1.3
Not applicable (N/A)	15	10
Category of age		
Children	16	10.7
Economically active	121	80.7
Dependent	13	8.7
Religion		
Hindu	25	16.7
Buddha	100	66.7
Christian	25	16.7

Table S2. Coleopteran edible insects consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Lepidiota sp.	Scarabaeidae	Sugarcane white grub	Grub,adult	Fried	32.67%	Chakma- Borohobang Marma- Beibo Mro- Mipcha

						Tanchangya- Mulipok Tripura- Wagmokhol
Lepidiota sp.	Scarabaeidae	Sugarcane white grub	Grub, adult	Fried	46.67%	Chakma- Hobang Marma- Beibo Mro- Cico Tanchangya- Shimpuk Tripura- Wagmokhol
Anomala sp.	Scarabaeidae	Scarab beetle	Grub, Adult	Fried or roasted	12.0%	Chakma- Pok Marma-Po Mro- Sobchung Tanchangya- Khuyapok Tripura- Yongpoma Garo- Jongmen
Unidentified sp.	Scarabaeidae	Green june beetle	Adult	Fried or roasted	22.67%	Chakma- Hekkomari Marma- Cicama Mro-Kitong Tripura- Purunmokol
Unidentified sp.	Scarabaeidae	Dune Chafer	Adult	Roasted	4.0%	Chakma- Hobang Marma- Cicama Mro- Cico Tanchangya- Pok
Unidentified sp.	Scarabaeidae	White grub	Grub	Fried	11.33%	Chakma- Darbopok Marma- Chobulo Mro- Dong Tanchangya- Goborpok Tripura- Yongpoma Garo- Jongmen
Unidentified sp.	Scarabaeidae	Long-armed scarab beetle	Adult	Fried or roasted	14.67%	Chakma-Guropok Marma-Chobo Mro-Cico Tanchangya-Chechnapok Tripura-Musukhiniyong
Propomacru sp.	Scarabaeidae	Scarab beetle	Adult	Fried or roasted	10.67%	Marma-Chobo Mro-Cico Tripura- Musukhiniyong
Oryctes rhinoceros	Scarabaeidae	Asiatic rhinoceros beetle	Grub, Adult	Fried or roasted	54.0%	Chakma-Shimpuk Marma-Shebo Mro- Kitong Tanchangya- Khuyapok Tripura- Cirkoma Garo- Jongmen
Allomyrina dichotoma	Scarabaeidae	Japanese rhinoceros beetle	Grub, Adult	Roasted	34.0%	Chakma-Homrengpok Marma-Banggiyengbo Mro- Cico Tanchangya- Shimpuk Tripura- Cirkoma
Xylotrupe gideon	Scarabaeidae	Brown rhinoceros beetle	Grub, Adult	Fried or roasted	41.33%	Chakma-Shimpuk Marma- Banggiyengbo Mro-Kitong Tanchangya- Shimpuk Tripura- Cirkoma

Sternocera sp.	Buprestidae	Giant jewel beetle	Adult	Fried	28.67%	Chakma-Hekkomori Mro-Kloma Tanchangya- Khampoka Tripura-Yongsaraisa Garo-Allang
Bactocera roylei	Cerambycidae	Long-horned beetle	Adult	Fried or roasted	16.67%	Chakma-Shimpuk Marma-Naifebo Mro- Kicchet Tanchangya- Cerepoka Tripura- Pok Garo- Gettash
Lucanu laminifer	Lucanidae	Stag beetle	Adult	Fried or roasted	49.33%	Chakma-Shimpuk Marma-Banggiyengbo Mro- Dhakep Tanchangya- Shimpuk Tripura- Cirkoma

Table S3. Hymenopteran edible insects consumed by the six ethnic groups in Bangladesh

Scientific Name	**Family**	**English Name**	**Consumption stage**	**Mode of Intake**	**% Intake by all ethnic respondents**	**Consumed tribe and respective vernacular name**
Oecophylla smaragdina	Formicidae	Red ant	Egg	Fried egg	3.33%	Chakma- Boda Mro- Wayachoyon
Apis mellifera	Apidae	Western honey bee	Egg, larvae, honey	Honey, fried egg/larvae	17.33%	Chakma- Moupuk Mro- Kuoyaica Tripura- Proiya
Unidentified sp.	Apidae	Bumblebee	Egg, larvae	Fried egg/larvae	12.0%	Chakma-Moupuk Marma- Piya
Apis cerana indica	Apidae	Indian honey bee	Egg, larvae, honey	Honey, fried egg/larvae	44.0%	Chakma-Moupuk Marma- Piya Tripura- Koytam Tanchangya- Pok Tripura-Bungbraima
Unidentified sp.	Apidae	Carpenter bee	Egg	Fried egg	0.67%	Chakma-Moupuk
Unidentified sp.	Vespidae	Eumenes wasp	Egg, larvae	Fried egg/larvae	1.33%	Chakma-Moupuk
Vespula vulgaris	Vespidae	Common wasp	Egg, larvae	Fried egg/larvae	34.0%	Chakma-Vingur Mro- Kuyangchaica Tanchangya- Piyung Tripura- Pok

Table S4. Orthopteran edible insects consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Microcentrum sp.	Tettigoniidae	Katydid	Adult	Fried or roasted	20.0%	Chakma-Firung Mro- Plong Tripura- Patakuiyong
Brachytrupes sp.	Gryllidae	Field cricket	Adult	Fried or roasted with vegetables	84.0%	Chakma-Gongru, Marma- Pro, Mro-Tongkher Tanchangya- Gorapoka Tripura- Khargum, Garo-Jongdol
Unidentified sp.	Tettigoniidae	Long-horned grasshopper	Adult	Fried or roasted	47.33%	Chakma-Tulofirung Marma- Heichukma Mro- Plong Tanchangya- Piyung Tripura- Kuk Garo- Gokhmadim
Oxya sp.	Acrididae	Short-horned grasshopper	Adult	Fried or roasted	83.33%	Chakma-Guiccha firing Marma-Haingrongse Mro- Plong Tanchangya- Piyung Tripura- Kuk Garo- Adrushrang
Unidentified sp.	Acrididae	Short-winged grasshopper	Adult	Fried or roasted	25.33%	Chakma-Dhan firing Marma- Hi Mro-Plong Tripura- Kuk Garo- Jongmen

Table S5. Hemipteran edible insects consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Lethocerus indicus	Belastomatidae	Giant water bug	Adult	Fried or roasted	79.33%	Chakma- Midurepok Marma- Robo ma Mro- Tuikhlongpang Tanchangya- Mulipok Tripura- Athukbocoi Garo- Jongmen
Lethocerus deyrollei	Belastomatidae	Giant water bug	Adult	Fried or roasted	54.0%	Chakma-Painnepuk Marma-Robo se Mro-Tuikhlongpang Tanchangya- Mulipok Tripura- Athukbocoi
Unidentified sp.	Cicadidae	Cicada	Adult	Roasted	11.33%	Chakma-Firung Garo- Mai jhingjhing

Dalader acuticosta	Coreidae	Coreid bugs	Adult	Fried or roasted	7.33%	Mro-Klangcha Garo- Mai jhingjhing
Unidentified sp.	Reduviidae	Thread-legged bugs	Adult	Fried or roasted	5.33%	Mro-Ritlak

Table S6. Edible insects from Dictyoptera order consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Periplaneta americana	Blattidae	Cockroach	Adult	Powdered form	2.0%	Chakma-Teillyepok
Unidentified sp.	Mantodea	Preying mantid	Adult	Roasted	19.33%	Chakma- Asfiring Mro-Plongkher Tanchangya-Piyung Tripura- Kukdangi

Table S7. Edible insects from Odonata order consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Anisoptera sp.	Aeshnidae	Dragonfly	Adult	Fried or roasted	21.33%	Chakma-Pok Marma- Pochond Tripura- Lemju Garo- Adrushrang

Table T8. Edible insects from Isoptera order consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Odontotermus sp.	Termitidae	Termite	Adult	Fried or roasted	13.33%	Chakma- Uipuk Mro- Po Tanchangya-Uipoka Garo- Hakin

Table S9. Edible insects from Ephemeroptera order consumed by the six ethnic groups in Bangladesh

Scientific Name	Family	English Name	Consumption stage	Mode of Intake	% Intake by all ethnic respondents	Consumed tribe and respective vernacular name
Unidentified sp.	Baetidae	Mayfly	Adult	Fried or roasted	3.33%	Tripura- Kuk

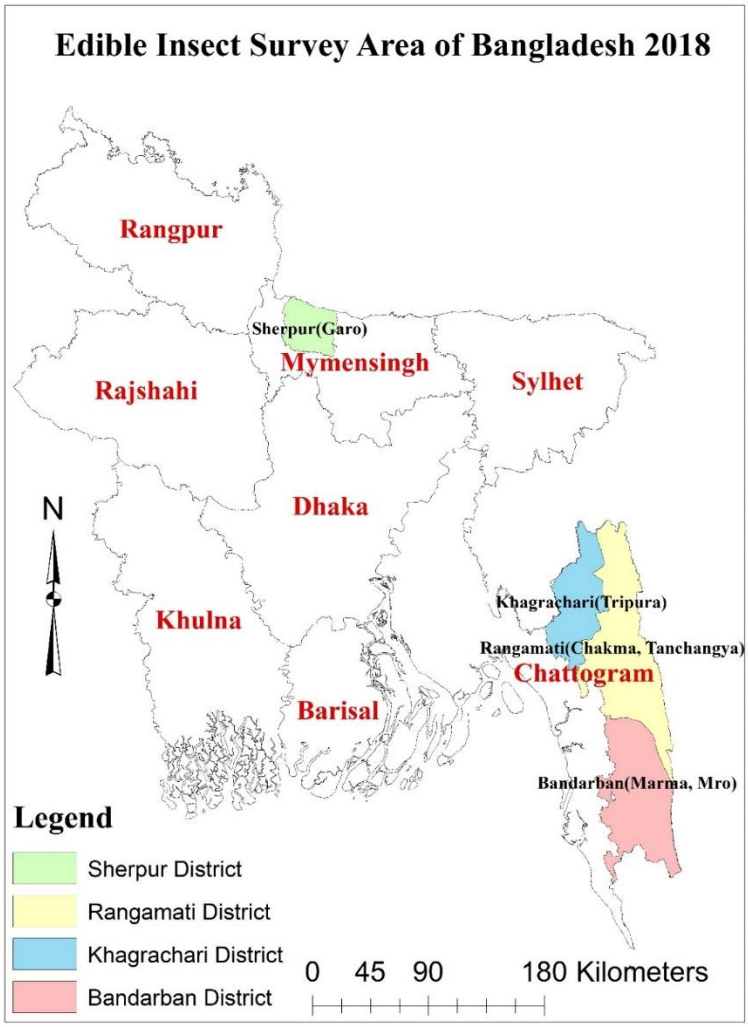

Figure 1. Entomophagy and entomotherapy practices areas in Bangladesh. Five ethnic groups i.e. Chakma, Tanchangya from Rangamati district, Marma, Mro from Bandarban district, Tripura from Khagrachari district belong to the Chattogram division and the Garo ethnic group from Sherpur district belong to the Mymensingh division of Bangladesh consume and use insect for medicinal purposes

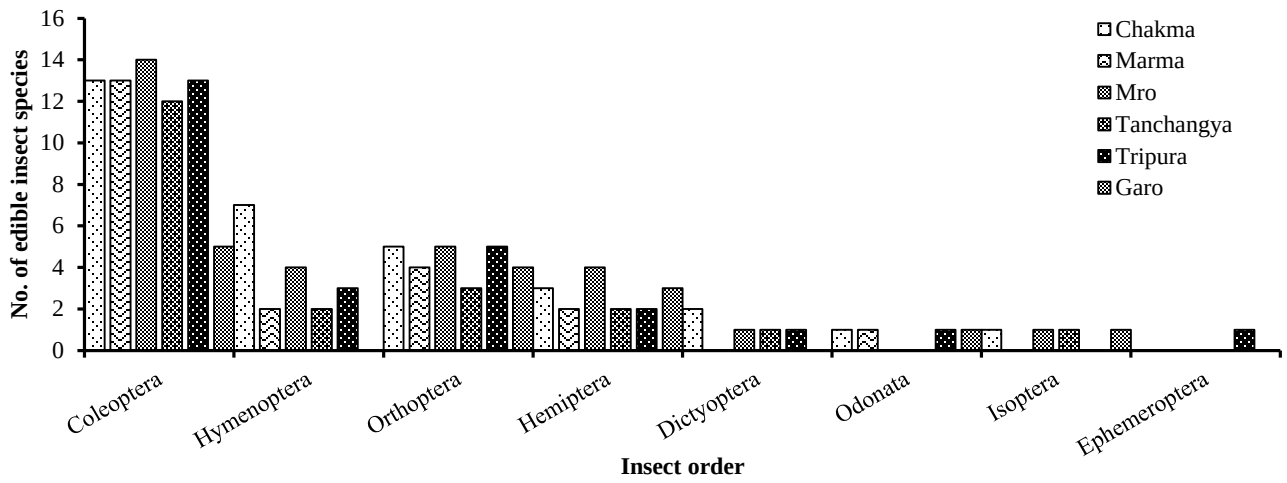

Figure 2. Order wise consumption of edible insects by Chakma, Marma, Mro, Tanchangya, Tripura and Garo ethnic groups in Bangladesh

Figure S1. The local ethnic Marma women selling edible insects in the local market of Bandarban district, Bangladesh