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Research Article

TRADITIONAL AND ETHNO-MEDICINAL KNOWLEDGE OF MUSHROOMS IN WEST BENGAL, INDIA

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ABSTRACT

Mushrooms are highly prized for their utilization as nutritional and medicinal foods. So, to meet the need of growing world's populations from the point of future food security, there is a recent craze among mycologists to document the nutritional and medicinal properties of mushrooms around the globe. However, in the Indian context, the attempts to unveil local folk use of mushrooms were meager. Therefore, the aim of this study was to assess the traditional knowledge of mushrooms among some local and indigenous communities (Tribals) of eight districts of the state of West Bengal, India. A 5 years (2008-2012) extensive survey explored altogether 34 macrofungi, among which 31 are used as food and the remaining for medicinal purposes in addition with some species, which are used for both the purposes. The regional investigation showed that mushrooms being a non-timber forest product also provide a much-needed alternative source of income for rural households. Some species of *Amanita*, *Astraeus*, *Russula*, *Termitomyces*, *Armillaria*, *Auricularia*, *Fistulina*, *Grifola*, *Hericeum*, *Coprinus*, *Pholiota*, *Meripilus*, *Pleurotus*, *Calocybe*, *Lentinus*, *Tricholoma* and *Volvariella* are consumed as food. Species of *Cordyceps*, *Ganoderma*, *Schizophyllum*, *Termitomyces* etc. are used for medicinal purposes with various preparations. Powdered fruit bodies of *Daldinia concentrica* and *Pisolithus arhizus* are applied to the skin for relief from burning, itching and healing minor skin infections after mixing with coconut (*Cocos nucifera*) oil.

Keywords: India, Medicinal foods, Mushroom utilization, Tribal communities.

INTRODUCTION

Mushrooms can be defined as macrofungi having hypogeous or epigeous distinctive fruiting bodies, which can be seen with the unaided eye and to be picked by hand [1]. According to Hawksworth [2], at present there are approximate 3 million fungi of which only 140,000 species produce fruiting bodies of sufficient size and suitable structure to be considered as mushrooms. Literature review implies that till date, we know only 14,000 described mushroom species which by far accounts 10% of the total estimated mushroom diversity [3]. Among these species, near about 50% (7000 species) possess varying degrees of edibility, and more than 3000 species from 31 genera are regarded as prime edible mushrooms. The number of poisonous mushrooms is usually reported to be relatively less (approximately 1%), but an estimate reveals that approximately 10% may have poisonous attributes and of these around 30 species are considered to be lethal [4].

Mycophily was customary in the human society from the prehistoric times. Traditional knowledge regarding beneficial aspects of mushrooms has been transmitted orally from one generation to the next across the globe. The traditional knowledge of mushrooms utilization has been mentioned and appreciated worldwide in ancient texts like "Vedas." Roman and Chinese beliefs suggest mushrooms to have strength and life force providing capacity. According to Sharma [5], ancient people used to consider mushrooms as the gifts of god Osiris and the people belonging to ancient China, India and Iran used mushrooms in their ritualistic performances [6].

Mushrooms are not only prized for their splendid tasteful flavor; they also serve as a good healthy supplement. In addition to proteins, sugars, glycogen, lipid, vitamins, amino acids and crude fiber, mushrooms possess some essential mineral nutrients which are considered as key factors for the normal functioning of the body [7,8]. In recent years detailed scientific investigations using modern techniques and sophisticated instrumental facilities reveal that the mushroom neutraceuticals could be utilized for the treatment of cancer [9], heart ailments [10], diabetes [11], inflammation [12], hepatic damage [13,14], ulcer [15], microbial pathogens [16,17] etc.

West Bengal is the only state in India, which is topographically extended from Himalayas in the north to the Bay of Bengal in the south, and climatically varies from subalpine in the north, sub-tropical sub-humid in the central-southwestern and tropical savannah in the south. These wide ranges of topography, hydrological regimes, types of soils and substrata, etc. makes the state ideal for hosting and flourishing rich biodiversity including those of macrofungi. Inventories in state of West Bengal by author's group during the last decade have helped to reveal the richness of the macrofungal diversity of the state [18,19]. However, during the process of exploring macrofungal wealth of the state, a thorough documentation were gathered related to the traditional and ethno-medicinal uses of those mushrooms by counseling the locals and tribal communities (from 8 to 72 age groups) of various districts across the state. Hence, here an attempt has been made to assemble all of the information related to the traditional and ethno-medicinal knowledge of mushrooms from the state West Bengal, India aiming to conserve those indigenous knowledge through documentation.

MATERIALS AND METHODS

Study area

The study region includes eight districts of the state West Bengal, India (Fig. 1), lies in between 21°38'-27°10' N latitude and 85°50'-89°50' E longitude, covering an area of approximately 88,752 km^2. Vegetation of Himalayan hill region (HHR) comprising of Darjeeling and adjoining districts includes the *Castanopsis* sp. (locally called "Katus" by the Nepalese), *Quercus* sp., *Alnus* sp. (locally popular as "Utish" by the Nepalese) and the dominant exotic species of *Cryptomeria japonica* D. Don (popularly known as "Dhupi" among Nepalese). The soil is characterized by sandy to sandy loam in texture with a pH ranging from 4 to 6. Lateritic region (LR) comprises of the districts of Birbhum, Murshidabad, Burdwan, Bankura and West Midnapur. Here, the soil is nutrient poor lateritic with sandy loam to clay loam characteristics and pH range of 5.4-6.6. The vegetation is dominated by dry deciduous

Sal trees (*Shorea robusta* Gaertn. f.; Dipterocarpaceae). Besides that planted forests of *Eucalyptus globulus* Labill. and *Acacia auriculiformis* A. Cunn. Ex Benth are also common. Coastal region (CR) comprises of the districts of South 24 parganas and East Midnapur. Here, soil is alluvial and partially saline with sporadic patches of saline alkali and degraded alkali soils with pH range of 7.0-8.5. The district South 24 parganas covers some area of the Indian part of Sundarbans ("World Heritage Site") where forest is mainly of mangrove type. In addition, the villages have dominance of *Areca catechu* L., *Phoenix dactylifera* L., *Cocos nucifera* L., *Bambusa* spp. etc. among others.

Ethnobotanical survey

A 5 years (2008-2012) survey among 8 districts of the state viz. Birbhum, Bankura, Murshidabad, Burdwan, South 24 Parganas, Purba Midnapur, Paschim Midnapur and Darjeeling revealed that, quite a number of macrofungal species are consumed by the locals and tribal communities of the study site for the purpose of food and ethno-medicine. During the survey, respondents from 8 to 72 age groups were investigated with local names of the mushrooms, meaning of the local names, uses and mode of preparations, beliefs, etc.

Macrofungal specimens were collected, photographed in the sampling site and then preserved using standard preservation techniques. Types of mushrooms growing among different types of regions were also investigated. The collected macrofungal samples were examined critically in the laboratory for their proper identification and edibility with the help of standard literatures [20-23] and finally the voucher specimens has been deposited with the accession code AMF in the Calcutta University Herbarium, Kolkata, West Bengal, India. The collected relevant information regarding mushroom utilizations among the regions were verified by cross-questioning key informants such as village elders, herbalists and studying all local mycological books and journals [22,24-26]. Local markets of each of the regions were visited to find out the variation of demands among clientele.

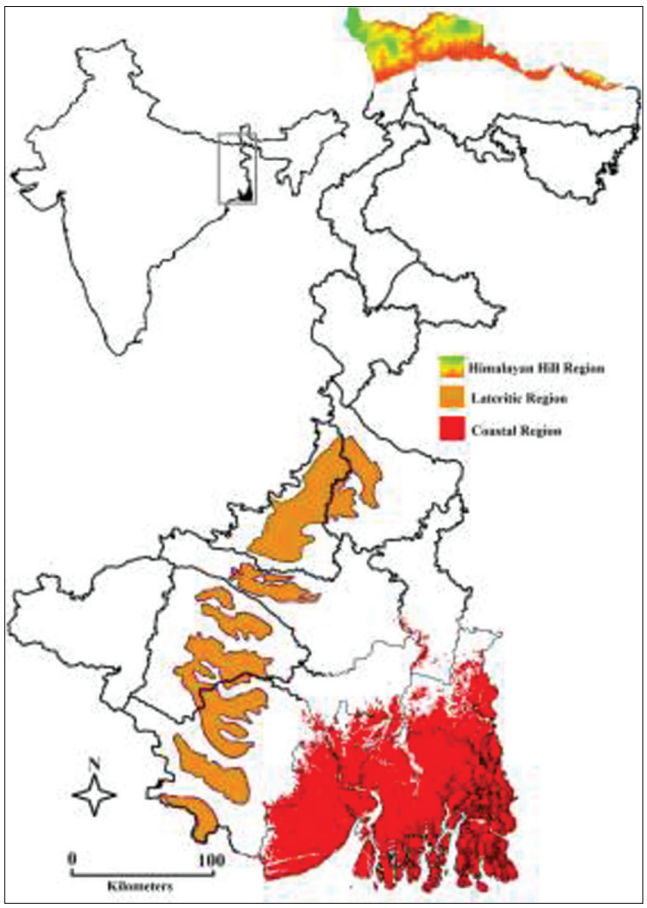

Fig. 1: Three types of eco-regions within the state of West Bengal where study was conducted

RESULTS AND DISCUSSION

The present study demonstrated that people of the various districts of the state collect and consume different types of mushrooms as food and use them for treatment of several diseases. Such positive social disposition of locals towards mushrooms can be scientifically translated as mycophilia [22]. Majority of the regional ethnic population have mycophilic inclination and during the monsoon season, mushrooms play a significant role in sustaining their livelihood. Altogether 34 macrofungal species were found to be consumed or used by the locals and tribals of the regions among which 31 mushroom species were found to be edible, and 5 were used for medicinal purposes, while some species were valued for both the purposes (Fig. 2). The studied eight districts of the state comprises of three types of eco-regions i.e., lateritic, Himalayan hills and coastal. The identified edible species from the LRs were *Amanita hemibapha*, *A. vaginata*, *A. vaginata* var. *alba*, *Astraeus hygrometricus*, *Russula albonigra*, *R. brevipes*, *R. cyanoxantha*, *Russula* sp. (White cap colour; locally called 'Sada Patra'), *R. senecis*, *R. lepida*, *Termitomyces clypeatus*, *T. heimii* and *T. microcarpus*. People of the hilly regions prefer to consume *Armillaria mellea*, *Auricularia auricula*, *Fistulina hepatica*, *Grifola frondosa*, *Hericeum* sp., *Coprinus comatus*, *Pholiota squarrosa*, *Meripilus giganteus* and *Pleurotus* sp. while people of the CRs prefer to chomp through *Calocybe indica*, *Lentinus squarrosulus*, *Pleurotus ostreatus*, *M. gigantea*, *Macrocybe lobayensis* and *Volvariella volvacea* (Table 1).

Fig. 2: Some of the edible and medicinally important mushrooms of West Bengal (a) *Auricularia auricula* (b) *Schizophyllum commune* (c) *Termitomyces heimii* (d) *Macrocybe crassa* (e) *Russula senesis* (f) *Volvariella volvacea* (g) *Lentinus squarrosulus* (h) *Daldenia concentrica*

Table 1: List of macrofungi which are utilized as food in the state of West Bengal, along with their local name, reason behind the local name and preparations

Serial number	Name of the mushroom	Local name	Closest meaning of name	Consumed as	Preparations	Place where consumed
1	*Amanita hemibapha* (Berk. And Broome) Sacc.	Tarmal oat/ Sasan tarwal oat	Tarmal (Saotali) means Sword (because the volva looks like sword carrying case)	Food	Fruitbody is cooked with mustard oil and spices	LR
2	*A. vaginata* (Bull.) Lam.	Sal chhatu/ Mural chhatu/ Budhi oat	Sal=*Shorea robusta* in Bengali (grows in association with *Shorea robusta* trees)	Food	Fruitbody is cooked with mustard oil and spices	LR
3	*A. vaginata* var. *alba* (De Seynes) Gillet	Sal chhatu/ Mural chhatu/ Budhi oat	grows in association with *Shorea robusta* trees	Food	Fruitbody is cooked with mustard oil and spices	LR
4	*A. mellea* (Vahl) P. Kumm.	Chipley chiyau/ Modhu chhatu	Modhu (Bengali) means Honey (because of the honey like exutdates of the mushroom); Chhatu=mushroom	Food	Fruitbody is cooked with mustard oil and spices	HHR
5	*A. hygrometricus* (Pers.) Morgan	Putko/Kurkure Chhatu	Kurkure=crispy	Food	Fruitbody is cooked with mustard oil and spices	LR
6	*A. auricula* (L.)	Kane/Baje kane chiyaou/Kan chatka	Looks like Pinna ("Kan" in Bengali language)	Food	Fried with noodles in Darjeeling/Soup	HHR
7	*C. indica* Purkayastha and Chandra	Dhoodh chhatu	Milky white coloured	Food	Fruitbody is cooked with mustard oil and spices	LR and CR
8	*C. comatus* (O.F. Müll.) Pers.	Parchul chhatu	Cap surface covered by hairs	Food	Fruitbody is cooked with mustard oil and spices	HHR
9	*F. hepatica* (Schaeff.) With.	Kalejo chiyau	Kalejo (Nepali) means Liver (because of its appearance like is liver like)	Food	Cooked; sometimes used as salads	HHR
10	*G. frondosa* (Dicks.) Gray	Thakre chiyaou	Thak (Nepali) means stack (it has stacked appearance)	Food	Fruitbody is cooked with mustard oil and spices	HHR
11	Hericeum species	Jhari/Prabal chhatu	Jhari (Nepali) means falls; Prabal (Bengali) refers Coral	Food; roasted when young	Fruitbody is cooked with mustard oil and spices	HHR
12	*L. squarrosulus* Mont.	Kath chhatu	Kath (Bengali) refers to wood	Food; when fresh and young	Fruitbody is cooked with mustard oil and spices	LR, HHR and CR
13	*M. giganteus* (Pers.) P. Karst.	Thakre chiyaou	It has stacked appearance	Food	Fruitbody is cooked with mustard oil and spices	HHR
14	*P. squarrosa* (Oeder) P. Kumm.	Bhale chipley	Bhale (Nepali) denotes male (because of robust appearance)	Food	Fruitbody is cooked with mustard oil and spices	HHR
15	*P. ostreatus* (Jacq.) P. Kumm.	Kalche jhinuk chhatu	Kalche (Bengali) denotes blackish; Jhinuk (Bengali) refers Oyester (because of its appearance of blackish oyester)	Food	Fruitbody is cooked with mustard oil and spices	LR, HHR and CR
16	Pleurotus species	Kanne chiyaou	Kanne (Nepali)=ear like	Food	Fruitbody is cooked with mustard oil and spices	HHR
17	*R. albonigra* (Krombh.) Fr.	Kalo patra	Kalo (Bengali)=blackish (as it gradually turns blackish in colour with, bruising, exposure and age)	Food	Fruitbody is cooked with mustard oil and spices	LR
18	*R. brevipes* Peck	Jhor chhatu	Jhor (Bengali)=storm (as it is reported to grow after the incidence of storm)	Food	Fruitbody is cooked with mustard oil and spices	LR
29	*R. cyanoxantha* (Schaeff.) Fr.	Jam patra	Jam (Bengali)=black berry fruit (as it is coloured like black berry)	Food	Fruitbody is cooked with mustard oil and spices	LR
20	*Russula* species (White cap colour)	Sada patra/Jhor chhatu	Sada (Bengali) means white (fruitbody is milk white coloured)	Food	Fruitbody is cooked with mustard oil and spices	LR

(*Contd*...)

Table 1: (*Continued*...)

Serial number	Name of the mushroom	Local name	Closest meaning of name	Consumed as	Preparations	Place where consumed
21	*Russula* species (Reddish cap colour)	Murgi oat/Salle chiyau	Murgi (Bengali)=chicken (pileus is coloured like that of a rooster's comb)	Food	Fruitbody is cooked with mustard oil and spices	LR
22	*R. senecis*	Jhal chhatu	Jhal (Bengali)=spicy (taste is spicy)	Food	Fruitbody is cooked with mustard oil and spices	LR
23	*R. lepida* Fr.	Murgi chhatu/ Sim oat/ Sundori chhatu	Pileus is coloured like that of a rooster's comb	Food	Fruitbody is cooked with mustard oil and spices	LR
24	*S. commune* Fr.	Pakha chhatu	Pakha (Bengali)=fan (because of its appearance is fan like)	Food	Mixed with gram flour and fried to make pakora	CR
25	*T. clypeatus* R. Heim	Bali chhatu/ Kalunge chiyau	Bali (Bengali)=sand (because of their preferences to grow on sand)	Food	Fruitbody is cooked with mustard oil and spices	LR
26	*T. heimii* Natarajan	Sib chhatu	Sib=lingam of God Shiva of Hindu mythology (fruitbody resemble Siblingam as it arises out deep underneath the soil	Food	Fruitbody is cooked with mustard oil and spices	LR and CR
27	*T. microcarpus* (Berk. and Broome) R. Heim	Uei chhatu/ Choto karane	Uei (Bengali)=termite (prefer to grow on Termite nest)	Food	Fruitbody is cooked with mustard oil and spices	LR
28	*M. crassa* (Sacc.) Pegler and Lodge	Dhoodh chhatu	Dhoodh (Bengali)=milk (Smells like milk when dried)	Food	Fruitbody is cooked with mustard oil and spices	LR and CR
29	*M. gigantea* (Massee) Pegler and Lodge	Boro dhoodh chhatu	Smells like milk when dried	Food	Fruitbody is cooked with mustard oil and spices	LR and CR
30	*M. lobyensis* (R. Heim) Pegler and Lodge	Dhoodh chhatu	Smells like milk when dried	Food	Fruitbody is cooked with mustard oil and spices	LR and CR
31	*V. volvacea* (Bull.) Singer	Powal chhatu/ Basub oat/Khar chhatu	Powal, Khar (Bengali)=straw (because it prefers to grow upon straw)	Food	Fruitbody is cooked with mustard oil and spices	LR and CR

LR: Lateritic region, HHR: Himalayan hill region, CR: Coastal region, *V. volvacea: Volvariella volvacea, M. lobyensis: Macrocybe lobyensis, M. gigantean: Macrocybe gigantean, M. crassa: Macrocybe crassa, T. microcarpus: Termitomyces microcarpus, T. heimii: Termitomyces heimii, T. clypeatus: Termitomyces clypeatus, S. commune: Schizophyllum commune, R. lepida: Russula lepida, R. senecis: Russula senecis, R. cyanoxantha: Russula cyanoxantha, R. brevipes: Russula brevipes, R. albonigra: Russula albonigra, P. ostreatus: Pleurotus ostreatus, P. squarrosa: Pholiota squarrosa, M. giganteus: Meripilus giganteus, L. squarrosulus: Lentinus squarrosulus, G. frondosa: Grifola frondosam, F. hepatica: Fistulina hepatica, C. comatus: Coprinus comatus, C. indica: Calocybe indica, A. auricular: Auricularia auricular, A. hygrometricus Astraeus hygrometricus, A. mellea: Armillaria mellea, A. vaginata: Amanita vaginata, A. hemibapha: Amanita hemibapha*

Both men and women used to gather wild edible mushrooms (WEMs), even children between 8 and 16 years of age knew as many mushrooms as adults. However, women of the study regions took active participation in collecting mushrooms along with other NTFPs like firewood, minor fruits, tubers, eggs of ants, etc. by venturing into the forests early in the morning. The quantity of WEMs in an optimal weather could weigh up to 1-2 kg/collector, but the potential quantity of the collected mushrooms was related to the species, size and frequency of the collected fruit bodies. An interesting tradition of most of the mushroom collectors was that they never harvested more than the amount required for subsistence consumption, and they left some part of the sporocarp at the collection site because they believed that the residual part would help the mushroom to grow in the subsequent favorable conditions.

WEMs made a substantial contribution to nutrition and household economy in the regions. Market survey data among the regions revealed that altogether fourteen different edible mushroom species are found to be sold, either in fresh or dried form at the roadside or weekly markets (locally called "Haat" by the regional peoples), which includes *Amanita vaginata*, *A. vaginata* var. *alba*, *A. hygrometricus*, *A. auricula*, *C. indica*, *P. ostreatus*, *Russula* sp. (White cap colour; locally called 'Sada Patra'), *Russula* sp. (Reddish cap color; locally called 'Murgi chaatu'), *Termitomyces heimii*, *T. heimii*, *T. microcarpus*, *Macrocybe crassa* (Sacc.) Pegler and Lodge, *Macrocybe gigantea* (Massee) Pegler and Lodge and *M. lobayensis* (R. Heim) Pegler and Lodge. Quality, condition and stage of fruit bodies are the key factor for determining the cost of mushrooms in the local markets. Of the total 31 edible mushrooms species, it was rare to see in market the remaining nineteen, as most were consumed by the collectors themselves. Among the mushrooms found into the market of LR, *T. heimii* fetched the highest price to the sellers (Rs. 200/kg; especially before the pileus expands); however, as soon as its pileus expanded, the price fell down to Rs. 50/kg. Dried *A. auricula* is highly prized in the Kalimpong subdivision, Darjeeling, West Bengal, and was found to be sold at Rs. 1200/kg. *T. heimii* was the costliest one (Rs. 280/kg.) at the markets of CR. A significant variation regarding the preference of mushrooms based on their edibility was observed among the regions e.g. the people of CR do not prefer to consume the species of *A. auricula* even though this species is predominant at that area, whereas, it is a delicacy for the locals of Himalayan hilly region.

Near about five species of mushrooms had medicinal and cultural uses that complement economic values among the people of the study regions. In some places of CRs, powdered fruit bodies of *Daldinia concentrica* and *Pisolithus arhizus* were mixed with coconut (*Cocos nucifera*) oil and applied to the skin for getting relief from burning, itching and healing minor skin infections. Several other mushrooms

Table 2: List of ethno-medicinally useful macrofungi along with their local name, preparations etc

Serial number	Name of the mushroom	Local name	Closest meaning of name	Used as	Preparations	Place where used
1	*D. concentrica* (Bolton) Ces. and De Not	Kath chhatu	Kath=wood in Bengali (mainly grows upon wood)	Getting relief from burning, itching and healing minor skin infections	Powdered fruitbody is mixed with coconut oil and applied to skin	LR and CR
2	*S. commune* Fr.	Pakha chhatu	Pakha=fan in Bengali (because of its appearance is fan like)	As tonic	Fruitbody is pasted and mixed with water to make soup	CR
3	*T. clypeatus* R. Heim	Bali chhatu/ Kalunge chiyau	Bali=sand in Bengali (because of their preferences to grow on sand)	Medicine; treatment of pox	Fruitbody is pasted and applied to the affected area	LR
4	*C. sinensis* (Berk.) Sacc.	Yarsagumba/ Jeeban booti	Yarsagumba (in Tibetan)=plant (fungal part) grows upon the insect (hypogeal) in summer and only during winter the parasitized insects are visible above ground; Jeeban=life in Bengali (because of the medicinal property of the mushroom for saving life), Booti=fungal part in Bengali	Medicine; used as aphrodisiac, invigorative, revitaliser, anti-aging	Powdered fruitbody is taken in tea or soups	HHR
5	*P. arhizus* (Scop.) Rauschert	Sonajhuri chhatu/ Bomb chhatu	Prefer to grow in association with *A. auriculiformis* (Sonajhuri plant)/the roundish morphological appearance of the mushrooms looks like bomb (grenade with smooth surface), so called "Bomb chhatu" by the Bengalis	Getting relief from burning, itching and healing minor skin infections	Powdered fruitbody is mixed with coconut oil and applied to skin	LR and CR

LR: Lateritic region; HHR: Himalayan hill region; CR: Coastal region, *D. concentrica: Daldinia concentrica, S. commune: Schizophyllum commune, T. clypeatus: Termitomyces clypeatus, C. sinensis: Cordyceps sinensis, P. arhizus: Pisolithus arhizus, A. auriculiformis: Acacia auriculiformis*

such as fruitbody of *T. clypeatus* were pasted and applied to the skin for the treatment of pox, whereas powdered fruitbody of *Cordyceps sinensis* is consumed mixing up with tea or in the form of soup as aphrodisiac, invigorative etc. (Table 2).

Some regional beliefs include their hunting of edible mushrooms mainly during the full moon ("Purnima" by the Bengalis and "Purne" by the Nepalese community) and aunsii days (popularly known as "Amaboshya" by the Bengali community). Our investigation also revealed that previously there were certain cases of mushroom poisoning within the peoples of HHR due to *Scleroderma* spp. However, according to their opinion during culinary preparation of WEMs, more garlic and ginger were needed to be added in order to counter the adverse effects of poisonous substances secreted or excreted by wild organisms like insects.

CONCLUSIONS

The present study had shown that the local and indigenous people of the state of West Bengal, India possesses a quite a number of traditional knowledge regarding mushroom utilization, which are yet to be fully documented. It is interesting to note that within the same state, some ethno-mycological perceptions differed across regions while some perceptions were widely accepted. The findings could serve as the foundation for further research on the domestication of some of the common WEMs of the region. The impact of changing climatic pattern, monsoon, swelling population and the consequent threat of intensive collection upon growth and availability of mushrooms needs to be studied. The traditional knowledge of mushrooms described here could preferably attract researchers and corporates to indulge their interest for the exploration of underlying scientific, economic and biological prospects.

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