



## **WILD INDEGENOUS MUSHROOMS AS A SOURCE OF FOOD FROM DIFFERENT FOREST DIVISIONS OF ODISHA**

**Sushri Shant Tripathy, Ashutosh Rajoriya and Nibha Gupta\***

Division of Microbiology and Plant pathology, Regional Plant Resource Centre, Nayapalli, Bhubaneswar, 751015, Odisha, India.

### **ABSTRACT**

As mushrooms are important constituent of forest ecosystem growing on the most abundant biomolecules of our biosphere i.e. cellulose. Now mushrooms including both edible and non edible are regarded as macro fungus with a distinctive fruiting body which can be epigeous or hypogeous and are large enough to be seen through naked eyes. Along with their contribution on nutritional and medicinal aspects, it has been a source of food for tribal poor and mycorrhizal partner with the forest trees. This paper sums up the occurrence, biodiversity of wild edible mushrooms in five forest divisions of Odisha including one biosphere reserve (Similipal Biosphere reserve) and two sanctuaries (Karlapat & Kotagarh). The soil parameters (pH, Organic C, N, P & K) of sampling sites were also analyzed for creating a better scope for in situ conservation of wild edible and medicinally important macro fungi. 12 popular wild edible mushrooms were highlighted which are collected by the tribal people as a food and as well as for their livelihood. As there are no reports of the survey earlier carried out in Odisha for determining the varieties of wild edible mushrooms being consumed by the tribal people, we made an approach to study the market price of different edible mushrooms and their local preferences.

**Keywords:** Macrofungi, Biodiversity, Bioactivity.

### **INTRODUCTION**

Mushrooms are considered as source of proteins, vitamins, fats, carbohydrates, amino acids and minerals [1]. Mushrooms are used as food supplement in various cultures and known for their edibility and delicacy for which they are collected from wild and also cultivated. Nutritionally, edible mushrooms provide essential nutrients and contribute significantly to human diet. Mushrooms are not only sources of nutrients but also have been reported as therapeutic foods, useful in preventing diseases such as hypertension, hypercholesterolemia and cancer. All the essential amino acids minerals are present in mushrooms [2]. They are source of vitamins like riboflavin, biotin and thiamine [3]. These functional characteristics are mainly due to the presence of dietary fiber and in particular chitin and beta glucans. Mushrooms contain about 56.8% carbohydrate, 25.0% protein, 5.7% fat, 12.5% ash on dry weight basis. Several studies have shown that nutrient contents can significantly differ in mushrooms even within the same

genus as evidenced in a study conducted by Kansci *et al* [4]. Mushrooms are valued as an important source of food and income in both developing and developed countries [5]. Edible mushrooms in particular attract much attention as a functional food and as a source of physiologically beneficial medicines while being devoid of side effects [6]. Several mushroom species have been reported for their antioxidant activity [7]. Studies have also shown antitumor, antiviral, antithrombotic and immunomodulating effects of mushrooms. The phenols, organic acid, alkaloid contents of mushroom contributing to the antioxidant and free radical scavenging properties of mushrooms have been reported in few wild mushrooms [8-10]. Mushrooms are reported to have antidiabetic, cardiovascular and immune-modulating effect in addition to preventing the risk of cancer and help control blood sugar level [11].

Of interests are the wild edible ones those consumed

Corresponding Author:- **Nibha Gupta** Email:- nguc2003@yahoo.co.in

by local and tribal communities in particular which could impact the health and nutrition as because it contains significant protein, flavonoid, carotene, lycopene etc. Few selected species have been worked out to estimate antioxidant components such as phenols, flavonoid, carotenoids etc including its antioxidant properties [12,13] and a number of such valuable wild species awaiting evaluation.

Truffles are popular in Europe as well as in South America for their flavor and delicacy. *Tuber rufum* has been reported to be abundantly present in Odisha, Jharkhand, Chhattisgarh, Bihar and most parts of western India. *Termitomyces heimii* is widely edible in Tanzania, Uganda, South east and west India. Ayodele *et al* [14] reported about edibility, sociocultural, ethno mycological and medicinal uses of mushrooms of Igala land in Nigeria.

There are many species of edible and medicinal mushrooms in different parts of Nigeria. Most of these edible and medicinal mushrooms are usually collected from the wild during their growing season. Studies regarding description, cultivation and nutritional status of many of the Nigerian edible mushrooms have been carried out [15-20]. People of different cultures and region recognize the edibility and medicinal importance of mushrooms within their local area of Nigeria. However, indigenous knowledge about edible and medicinal mushrooms has not been given significant attention among the different tribes in Nigeria. Oso [21] also reported few species of edible and medicinal mushrooms among the Yoruba people. In other countries in Africa, few reports are available. Similar reports include In Tanzania Harkonen *et al* [22], Chang and Mshigeni [23] on two tribes in the rain forest region of Southern Cameroon.

The eastern ghats are isolated hill ranges in Peninsular India (Andhra Pradesh, Odisha, Tamil Nadu, Karnataka) harbors primarily tropical moist deciduous vegetation which represents species of high economic , timber , medicinal potential, Lies in 11 30' to 21 0' N Latitudes and 77.22' to 85 20' E Longitudes. The Eastern Ghats in Orissa starts from North of Similipal in Mayurbhanj districts and run through Malkangiri. Seventeen districts of Orissa comes under the eastern Ghats including 14 protected areas (13 wild Life Sanctuaries, one Biosphere reserve, One national park, two tiger reserve and one ramser wetland).

According to champion and seth, the vegetation of the hill is basically tropical moist deciduous type with many riparian evergreen elements. The average annual rainfall is 1485mm. The maximum temperature goes upto 42 degrees and the minimum temperature falls upto 5 degrees. The relative humidity is normally high during the monsoon and post monsoon months. Sometimes being more than 85 % which favors the growth of mushrooms. Many of the hill streams originated from the top of the

most of the hill that provide multiple habitat to enhance the macro fungal diversity .Wild mushrooms are becoming more and more important in our diet for their nutritional and pharmacological characteristics. The high protein and low fat /energy content of wild edible mushrooms reported by many researchers make them excellent food for use in low caloric diet.

## MATERIALS & METHODS

An approach has been made for the first time to explore (Similipal, Karlapat, Koraput, Baliguda & Banei) forest divisions of Odisha and to document different varieties of the wild edible mushrooms collected by the tribal people of Odisha and to study their dependency for it as livelihood.

### Survey Studies in Forest & Tribal Market

The study was undertaken from August to November in 2010 & 2011. Keeping in view the period of seasonal monsoon, the sampling was conducted every month in regular intervals. The sites selected were the major forest divisions of Orissa including Koraput Forest division (KRP), Similipal Tiger Biosphere Reserve (SIM), Karlapat Sanctuary (KP), Baliguda forest division (BG) and Banei Forest Division (BN). The major Forest divisions are tropical moist deciduous forests except Karlapat sanctuary (Dry deciduous Forest) & Similipal biosphere reserve (semigreen forest).

Macroscopic & microscopic details of collected mushrooms fruiting body were noted in the field and identification was done by following the identification chart and literature available. All the mushrooms were stored in dried as well as in formaldehyde solution, in the Mushroom Herbarium of, Microbiology division in Regional Plant Resource Centre , Bhubaneswar In the cases where fungi were not Identified up to the species level, numbers were given to the specimens the species belonging to the same genera. Tribal weekly markets were visited inside the protected sanctuaries and forests for gathering the ethno botanical uses, prices and their dependence on the seasonal collection of mushrooms. Information was also gathered from the tribal people for their way of traditional cooking and preservation methods of mushrooms.

Identification of macrofungi specimens were carried out basing on their macroscopic characteristics i.e. Habitat, occurrence, Association, Pileus diameter, context, colour, texture, odour, Stipe length, context, attachment, Gill colour, context, sets of lamellae, Ring position, Veil characteristics, Volva shape. Microscopic characteristics include Dermatocystidia, cuticle, epicutis, Hyphae characteristics, Gill trama, Basidiospores characteristics with different stains etc.

## RESULTS

### Collection of mushrooms

Collection of edible mushrooms is somehow associated with the different festivals of Odisha. The occurrence of different mushrooms in different festivals has made it easier for the collectors and tribal people to estimate the occurrence of mushrooms in their specific time. The seasonal monsoon starts in Odisha from Early June to Late September. While August is the peak time for the tribal people to collect and sale mushroom. You can see people selling heap of wild mushrooms along with vegetables in tribal markets called hatta. People often prefer to take collected mushrooms directly to their home if the collection is scanty. The collection and selling happens in early morning.

**Preservation and sale of mushroom for livelihood**

Some mushroom like *Lentinus fusipes* and *Russula vesca* are sun dried and stored for a long term use. The tribal's of Similipal used to keep the dried mushrooms in powder form and apply it as a seasoning in their vegetable curry. The mushrooms collected are sold in the weekly markets called hatta. In the seasonal monsoon each tribe conduct Hata once in a week comprising all types of tribal and herbal products include mushrooms. Early morning is the best time to go to the

weekly market to purchase mushroom as it gets sold out very quickly. The mushrooms are being collected by the tribal collectors in bamboo container.

The mushrooms are being sold in a specific unit locally known as “bhaga” approximately containing 200 g to 250g of fruiting bodies. Some mushrooms like *Amanita sp* and *Termitomyces sp* are being preferred by the local customers in bud conditions. The collectors bear some loss as the completely opened caps of amanita are not being preferred by some people.

**Preparation and cooking of mushrooms**

Mushrooms having different genus are being processed before cooking in different ways. The tribals mostly prefer to soak the mushrooms in turmeric water solution for few hours before cooking, as it helps to clear the insects and termites associated in the gills of mushrooms. The tribal people prefer to eat the fried mushrooms with onion and a locally made wine by fermenting the rice with water and some root ingredients called Handia. Different ways of preparation of wild edible mushrooms are shown in the following table (Table 2).

**Table 1. Representing macroscopic characteristic, habitat and distribution of wild edible mushrooms in world and in Odisha.**

| Sl.No. | Species name                  | Macroscopic characteristics   | Habitat   | Distribution   |
|--------|-------------------------------|---|---|--|
| 1.     | <i>Termitomyces clypeatus</i> | Tuberculate striate shaped pileus, medium sized, av 10cm dia. Brownish in colour, with white margin having reflexed roll. Fibrillose scales, but half peeling cuticle. No change in colour on bruising or handling. White to deep brown centrally attached stipe, fibrous surfaced, stuffed. No ring, volva, or veil. Basal association mycelial. Gill white, but turns light brownish on maturity; densely crowded; free attachment. Smooth edged.       | On grassland, solitary association grows in slopes. In tropical moist deciduous grassland.  | Europe, South America and Brazil. In India, reported from Himachal Pradesh, Tamilnadu, Punjab, Maharashtra. In Odisha collected from Koraput, Baripada, Sundergarh, Bargarh, Kalahandi and Baliguda forests. |
| 2.     | <i>T. eurrhizus</i>           | Mature specimen white, but greyish in center when young. Pileus fleshy medium sized, diameter 4 cm (av) margin roll inflexed. Scales fibrillose, covering entire surface. Cuticle half peeling. No discoloration on bruising or handling. Centrally attached stipe, fibrous surface, broad on top and tapering in end, base pseudorrhiza. Annulus fugacious, veil present without volva. Crowded, separable and smooth edged gill having free attachment. | On termite infested soil, mostly seen in lateritic soil mounds and termite comb. Open grassland or in tropical moist deciduous forests, also grows in association with thick woody shrub. | Distributed in Eastern Ghats of India. Occurrence is seasonal from mid monsoon to early winter. In Odisha, recorded from Chandaka, Similipal, Baliguda and Bonai forests.                                    |
| 3.     | <i>T. heimii</i>              | Pileus: 6 cm (av), White. Shape: Convex, Inflexed, Moist, Hygrophanous, Fibrillose, Half peeling. Stipe:- Central, 8 cm, Broad in top & tapering in end, Psudorrhiza, Smooth, Fibrous, Stuffed,   | It is mostly found in termite infested soil. The emergence of the fungus has also been noticed from   | Widely edible in most parts of south India and Goa. Also reported from Punjab and Himachal pradesh. Recorded in  |

|    |                       |   |   |  |
|----|-----------------------|---|---|--|
|    |                       | Annulus Present, double, fugacious, superior, Veil Present, Universal, Gill Length: 3 cm, equal, fleshy, Crowded, Free, Non separable, Normal, Edge: Smooth.  | termite comb. Found mainly in shady moist places. Epigeous in nature, scattered occurrence.   | many parts of Odisha.  |
| 4. | <i>T. microcarpus</i> | PILEUS:- Diameter: 1.5 cm (av), Colour:- When young in centre: Deep brown, In Margin: White, Mature Specimen: Brown. Shape: Convex. Pileus margin roll: Inflexed, Pileus surface on Touch: Moist, Hygrophanous, Scales: Fibrillose, Cover the entire surface, Cuticle:- Fully peeling, Pileus consistency:- Fleshy, Flesh colour: White, No change in colour on bruising or handling . STIPE:- Attachment: Central, White to Light brown, Size: 4 cm, Thickness at top: Equal throughout, Stipe Shape: Equal in diameter, Stipe base: blunt, Texture: Smooth, Consistency: Fibrous, Stipe Surface: Smooth, Stipe context : hollow, Trama color : White . RING: Annulus absent, VEIL: Absent, VOLVA: Absent, Basal Association: Mycelial . - LAMELLAE:- Gill Length: 0.75 cm, equal, No of Sets of Lamellae: 1, Gill Colour: White, On Maturity:- White, Consistency: fleshy, Densely crowded, Gill Attachment: adnexed, Gill Separation: Non Separable, Gill nature: Forking, Gill Shape: Normal, Edge: Smooth. | On leaf litter, scattered association. Found in hill slopes mostly on red soil of tropical moist deciduous forests. Seen in grassland and wooded shrub forests.   | In Odisha collected from Baliguda, Kalahandi, and Koraput forest areas and also in many costal districts. But sold in small quantities in the weekly markets ( <i>haat</i> ), as primarily consumed by collectors. |
| 5. | <i>R. nigricans</i>   | The young cap is grayish white, but swiftly turns brown, and then black on maturity. It measures 5–20 cm in diameter. There usually is a large depression in the centre of mature caps, which are three quarter peeling. The stem is white; firm; straight, and thick, and it too blackens with age. The gills are off-white initially; very widely spaced, and are adnate. These turn red; then grey, and finally black, when bruised. The flesh, which has a fruity smell, when cut turns pale Indian red, and becoming black within 20 minutes. The spore print is white.  | It appears in late summer and autumn in both deciduous and coniferous woodland across Britain, Northern Europe, and east coast of North America. Jashipur forests of Mayurbhanj district and along hill slopes of Kalinga of Keonjhar district. | On leaf litter, scattered, grows on hill top; black decomposed Forest snails: Tropical moist deciduous, grass land and shrubs.   |
| 6. | <i>R. brevipes</i>    | Hazel-brown to pale ochraceous brown colour cap, mature specimen turning white. Pileus diameter 6 cm (av) margin roll inflexed. Scaly surface, cuticle half peeling. No change in colour on bruising or handling. Stipe attachment central; concolorous with pileus; stipe base myceloid. Annulus, veil, volva absent. Gill 3 cm long, fleshy, moderately crowded, attachment shortly decurrent and   | An ectomycorrhizal fungus; epigeous, scattered; Present in slopes, laterite soil, on leaf litter.   | Belgarh, Kotagarh sanctuary of Baliguda forest division, Jashipur, Badampahad area, Bisoi and Bangiriposi of Mayurbhanj district.  |

|     |                         |  |  |  |
|-----|-------------------------|--|--|--|
|     |                         | smooth edged.  |  |  |
| 7.  | <i>R. lepida</i>        | Fruiting bodies initially egg shaped, 15-30 mm, white base attached to a white cord like rhizomorph. Stalk 2.5-3 cm; hollow upper half wrinkled, tapered to a narrow apex. Reddish orange to deep red; gelatinous olive green volva; sac like gelatinous eggs. Strongly fetid odour of the fruiting body carrying spores. Has a distinct and abrupt demarcation between red coloured upper half of the fruiting body which is covered by gleba and white to pinkish lower half   | An ectomycorrhizal fungus, living in root symbiosis with trees, deriving photosynthesized nutrients from it and providing soil nutrients in return.                                      | The panther cap is an uncommon mushroom, found in both deciduous, especially beech and, less frequently, coniferous woodland and rarely meadows throughout Europe, western Asia. Also recorded from South Africa.  |
| 9.  | <i>R. virescens</i>     | Cap 5-15 cm; round to convex when young, becoming broadly convex to flat to uplifted with a shallow depression; dry; velvety; the surface soon cracking up into small patches. Green to yellowish green; the margin not lined to very slightly lined; the skin peeling about halfway to the center. Gills attached to the stem or nearly free from it at maturity; close or crowded; white to cream. Stem: 3-9 cm long; 2-4 cm thick; brittle; dry; smooth; white; discoloring brownish with age. Flesh white; brittle; thick; not changing when sliced.   | Solitary, found in moist deciduous forest of Odisha. Forms ectomycorrhizal symbiotic relationship with varieties of trees.   | North America, Germany, most parts of Europe. In India, distributed in Tamilnadu, Himachal, Punjab, Maharastra, Madhya Pradesh. In Odisha, collected from Banamunda, Jashipur forest area in Mayurbhanj district.  |
| 10. | <i>L. fusipes</i>       | The caps are quite large and can be upto 160 mm in diameter. Being concave on the surface, they often hold rain water. The fungus may not be long lasting and can fall in a couple days, while others can last for ages. They start to deteriorate quickly. Cap dia 8 cm (av) white both in centre and margin. Moderately indented, rolled cap margin, surface on touch moist. Fibrillose scale; half peeling cuticle; fleshy. Stipe attachment essentric, concolorous with pileus, 5 cm, equal dia throughout. Stipe stuffed; base blunt, smooth texture, consistency cartilaginous, Distinct gill 4 cm; equal; fleshy; moderately crowded. Gill attachment, shortly decurrent; normal, smooth edged. | Mostly popular among Kanni tribe of Kanyakumari district. In Odisha it's major distribution is seen in bamboo clumps of many forests of Karlapat sanctuary, Banei, Belghar and Kotagarh. | A fairly common fungus of the rainforests and appears above ground after a good rain. It can often be seen in troops along fallen logs and on dead trees. Grows in tropical moist deciduous forests of Odisha.   |
| 11. | <i>Amanita caeserea</i> | Cap is orange coloured convex shape. The surface is smoothy, margins striated, inflexed pileus margin; fibrillose scales. Cuticle half peeling, no change in colour on bruishing or handling. Stipe broad on top and tapering at end with smooth texture. Ring double, fungacious, superior in nature. The base of the stipe is thicker than the top and is seated in a light greyish to white cup like volva, which is remnant of universal veil. Non separable gill, pale to golden yellow, about 3 cm along,  | Epigeous, on slopes of hills. In Odisha it is seen mostly in tropical moist deciduous and semi evergreen forests.  | Native to southern Europe and North Africa. Similar orange- capped species occur in North and India. It was consumed and valued by the Ancient Romans, who called it Boleynus; a name now applied to a very different type of fungus. In South India, Goa, Northern parts of India. In Odisha, |

|     |  |   |  |   |
|-----|--|---|--|---|
|     |  | fleshy, crowded with free attachment.   |  | collected from forests of Kandhamal and at Banamunda Mayurbhanj district.   |
| 12. | <i>Amanita loosii</i>                    | Cap convex, 8–25cm across, it stays in the button stage for a long time and is hemispherical at first. Stem 100- 150 x 50mm, scaly with delicate mealy white scales and ending in a bulbous rooting base, the volval is sack like creamy white to ochraceous in age; the ring is white and of a delicate mealy texture, soon breaking up. Flesh white, gills free, crowded and white. Spore print white.  | In mixed woodland, on calcareous soils. Grows on ground, fields and lawns or on roadsides.                             | Wide distribution in Europe. In India it is distributed in Eastern Ghats and North India. In Odisha it is distributed in major parts of Similipal Biosphere Reserve of Mayurbhanj district & some parts of North Kalahandi district.  |
| 13. | <i>L. tuberigium</i>                     | Moderately indented white colored cap, 8 cm dia (avg.). Pileus fleshy; surface on touch moist. Fibrillose scale covering the surface; half peeling cuticle. No change in colour on bruising or handling. Eccentric attached, stuffed stem, 5cm long; equally thick from end to end; blunt base, concolorous with pileus. The stem surface is fibrous appearing as cartilage. Trama color is white. Fleshy, moderately crowded separable gills; smooth edged.  | On decaying wood; gregarious. Present on slopes in moist deciduous forests.  | Kotagarh forests of Odisha.   |
| 14. | <i>V. volvaceae</i>                      | Hairy, light grey or brownish cap; the cap turning yellowish in center on maturity. Mature gills and spores are pinkish. Fairly large cap with silky fibres and unlined margin. Stem 6-20 cm long; 1-2 cm thick; more or less equal, but usually tapering somewhat to apex; often curved in order to set the cap "straight" on wood; flesh dry; white; smooth; without a ring; the base encased in a thick, white to yellowish or brownish, sack-like volva. Gills free from the stem; reddish brown; crowded, fleshy, forking and about 7 cm long. | Forest type: Tropical moist deciduous, mostly on grassland or on decaying straw heaps.                                 | Distributed in North America, Europe, Japan, China and most south Asian countries. In India, recorded from Bihar, Odisha, Chattisgarh, Punjab. It's distribution outside India is reported to be commonly on woods but in Odisha it frequently occurs in moist paddy straws. It is sold in weekly rural market (hat) of Mayurbhanj, Koraput, Angul districts in Odisha. |
| 15. | <i>T. rufum</i>                          | Hypogeous, subglobose or irregular in form, sometimes with a basal depression, 1-4 cm cap, reddish brown, yellow brown, blackish, areolate. Warts minute, pyramidal, flattened. <i>Gleba</i> hard, solid, whitish at first, becoming light-brown, dark-brown at maturity, marbled, smoked sometimes garlicky strong odor.   | Widespread, associated with moist deciduous trees and conifers, ripening in late autumn and winter, scattered.         | United Kingdom, Europe, America and South-East Asia. In Odisha collected from Koraput, Baliguda, Banei and Similipal forest areas.  |
| 16. | <i>Calvatia utriformis</i> (Bull.) Jaap. | Fruit body 6–12cm across, squat and pear-shaped when mature tapering towards the base, white to pale grey-brown, outer wall consisting of scurfy warts and soon breaking up into hexagonal patches leaving the fragile inner wall to flake off irregularly at the top. <i>Gleba</i> when young white in centre, turning to light pinkish  | The macrofungus is edible and consumed by tribals in Odisha. Reported to have antibacterial and antifungal properties. | Europe, Asia, Japan, North America, Mexico, and South Africa. It has also been collected in Chile, and New Zealand. In Forest of Odisha.  |

|     |   |  |   |   |
|-----|---|--|---|---|
|     |   | when mature. Hemispherical shaped fungus; moist surface, non hygrophanous. Fibrilose white colored scales covering the entire surface of fruiting body. Fleshy, change from white to pink colour on bruising. No stipe, ring or volva.   |   |   |
| 17. | <i>M. procera</i>                                     | Cap diameter 10 cm (av). Fruiting body convex shape, light brown when young with white margin turning to white once mature. Pileus margin roll inflexed; pileus surface dry on touch. Scales squarose covering the entire surface often shaggy and torn-up at maturity. Pileus consistency fleshy, flesh white to pale white. Stem 14 cm; attachment central; Concolourous with pileus. Equal thickness in diameter throughout. Base myceloid, smooth textured, surface fibrous. Superior ring. Gill 5cm, long fleshy, freely attached, forking but separable, smooth edged. | Saprobic; growing alone or scattered in woods or at the edges of woods, or in pastures, on trails, and other disturbed ground areas | Eastern and central part of Europe. Baliguda & Baripada forest divisions.   |
| 18. | <i>Langermannia gigantea</i> (Batsch ex Pers.) Llyod. | The giant puffball is easily recognized by its size and shape which is almost round. Finely velvety when young, but soon smooth; soft; interior white and fleshy, becoming yellowish; the outer surface eventually falling away in pieces. The fruiting body has cabbage like appearance. Epigeous and hygrophanous in nature, scales light pink on maturity. Gleba covers the fruiting body completely without any differentiation.   | In grass land, alone or gregarious, often at the edges of meadows.  | Common in Europe and North America. In Odisha, mainly found in Chandaka and Thakurmunda, Kendumundi forest of Koranjia forest division.   |
| 19. | <i>T. medius</i>                                      | Tuberculate, striate, small sized, av-3 cm dia, whitish in colour, with white margin, with reflexed roll, fibrillose scale, but half peeling cuticle, no change in colour in bruising or handling. Centrally attached stipe, fibrous surface, stuffed, no ring, volva or veil. Basal association mycelia, gill white but turns light brownish on maturity, densely crowded, smooth edged   | On grassland, scattered, gregariously, grows in leaf litter in tropical moist deciduous grassland.                                  | Europe, South America and Brazil. In India reported from, Himachal Pradesh, Punjab, Tamil nadu and Maharashtra. In Odisha collected from Koraput, Baripada, Sundargarh, Bargarh, Kalahandi and baliguda forest. |

**Table 2. Mushroom species with local name and edibility preferences of wild edible mushrooms**

| Sl No. | Species                         | Edibility   |
|--------|---------------------------------|---|
| 1.     | <i>Termitomyces microcarpus</i> | It is locally known as Hunka chattu in Odisha. Tribals sell these mushrooms in small quantities near road side of forest roads or in weekly tribal market called Hatta. These mushrooms are fried in mustard oil by adding Turmeric chilly powder garlic ginger and onion. Water is added in intervals and cooked for 15- 20 mins before it is ready to serve.  |
| 2.     | <i>Termitomyces heimii</i>      | It is considered highly palatable and nutritious and therefore liked by tribals and non tribals alike both in villages and in urban areas. It is widely distributed in Mayurbhanj, Kalahandi, Koraput, Baliguda, Khurda and Banei forest division of Odisha. It is known as sravana kadhi and Vadrava chattu after the name of the season, Aug- Sep. in south western parts of Odisha. As this mushroom is fleshy and stuffed |

|     |                               |   |
|-----|-------------------------------|---|
|     |                               | inside it is first boiled in turmeric water and then cooked using different seasonings and spices.  |
| 3.  | <i>Termitomyces eurrhizus</i> | This mushroom is almost popular in almost all part of Odisha. It is a peculiar edible mushroom having a very long stipe that remains hypogeous in soil. Due to its long stipe it is known as Nada chattu. It is boiled before cooking to remove the slimy extract present in its raw stage. According to the tribals it tastes sweet once it is cooked.   |
| 4.  | <i>Termitomyces clypeatus</i> | This mushroom is called as Bada bali chattu, Batki chattu, Bihiduni chattu in different parts of Odisha. It is similar to <i>T. medius</i> but has a large size fruiting body. As this mushroom is comparatively prone to insects it is preferred to be plucked at immature stage.  |
| 5.  | <i>Amanita caeserea</i>       | <i>A. caeserea</i> has a fully fledged nice looking fruiting body. We observed collection of mushroom from the fruit hills of Similipal Biosphere Reserve. It is a delicacy among the tribals of Mayurbhanj district. Due to its turmeric yellow colour it is called (Haladia) yellow Manda. The name Manda is attributed on accounted of its egg shaped appearance in its immature stage. Amanita mushrooms are first boiled before it is fried as boiling reduces the mucosal component in the cap and stipes.                    |
| 6.  | <i>A. loosii</i>              | It is sold in Mayurbhanj district of Odisha. It has resemblance with <i>A. caeserea</i> morphologically except its colour which is white. It is known as Dhala Manda and has a good demand in Mayurbhanj and Keonjhar district.   |
| 7.  | <i>Russula lepida</i>         | A beautiful red colour mushroom of ectomycorrhizal association growing in sal forest across the state. As it grows in leaf litter of sal forest it is also known as sal chattu in Koraput district. Also popularly known as Nali Kukuda Chattu in other areas because it resembles with the red crescent top of a fowl. It has a similar morphology with <i>R. brevipes</i> except the colour. It is sold in small quantity in tribal markets. Mostly the mushroom is handpicked and cooked at home due to its solitary occurrence. |
| 8.  | <i>R. brevipes</i>            | This mushroom is known as Kukuda Chattu because of its structure resembling to the crest of a peahen. It is mostly handpicked by forest dwellers and sold regularly in the market. It is readily infested by insects and termites so has a short shelf life. The fruiting body is therefore sun dried so that it can be consumed for few days. While cooking chopped mushroom is cooked with ginger and sugar to reduce the acrid smell of fungus.  |
| 9.  | <i>Tuber rufum</i>            | A truffle from family <i>Tuberaceae</i> . It is popular, the most coveted and priced mushroom of Odisha. The Tribals considered it as nutritious and tasty as goat meat. Due to its hypogeous nature it is collected by digging the soil. It is locally known as rutka chattu or Batti chattu. The gleba is peeled off and the tender flesh is fried in oil with garlic ginger and turmeric and other essential seasonings to make it into a delicious curry.   |
| 10. | <i>Lentinus fusipes</i>       | This mushroom is mostly found growing below bamboo clumps. It is therefore locally known as baunsa chattu. The people prefer to soak this mushroom for 2 hours in turmeric water before it is cooked to remove ant and insects from the stipe of fruiting body. It is chopped into pieces and fried with onion in mustard oil with red chilly powder. It is available in the tribal markets of Koraput, Banei and Kalahandi forest division.  |
| 11. | <i>Microporus xanthopus</i>   | It is known as atandi chattu. It is primarily consumed at its immature stage when it is tender. It is reported to be handpicked by tribal people in scanty amount in SBR region.  |

The financial assistance obtained in part from State Plan project, Dept.of Forest and Environment , Govt.of Odisha and Ministry of Environment and Forest, Govt. of India is gratefully acknowledged.

## DISCUSSION

As the extinction of wild macro fungi species have started tremendously, still it has not been brought into consideration of conservation. As many trees having mycorrhizal association with wild macro fungi are being cut down due to human interference this is leading an

unfavorable condition for the mushrooms to grow in their proper habitat. Though no information was found from the tribals for its medicinal uses. But the consumption of wild mushrooms like *Termitomyces sp* resulted increasing pain in the joints of old age tribal people having arthritis. Consumption of *Amanita sp.* by some people resulted

dysentery. Although the wild edible mushrooms creates a seasonal occupation for the tribal people comprising mostly the women workers, its presence remains as a limited knowledge for the city dwellers.

Developing the culture for cultivation of some of these wild edible mushrooms as well as popularizing the pharmacological potential and food value of these wild edible mushrooms can create a good market for the tribal people as source of seasonal income in large scale mushroom all over the state.

## REFERENCES

1. Jiskani MM. Energy potential of mushrooms. The DAWN Economic and Business Review. PIV 2001.
2. Buigut SK. Mushroom production in suitable small scale farming system-opportunities and constraints a survey of Uasin Gishu district In proceedings of the horticulture seminar on sustainable horticulture production in the tropics at Jomo Kenyatta University of Agriculture and technology. Juja Kenya 3<sup>rd</sup>-6<sup>th</sup> October 2001 Eds Wesonga JM Losenge T Ndung'u CK Fricke A Hau B Stutzel H2002, 2002, 1-5.
3. Chang ST and Bushwell JA. Mushroom nutraceuticals. *World Journal of Microbiology and Biotechnology*, 12, 1996, 473-476.
4. Kansci G, Mossebo DC, Selatsa AB and Fosto M. Nutrient content of some mushroom species of the genus *Termitomyces* consumed in Cameroon. *Nahurang*, 47, 2003, 213-216.
5. Wong JLG and Thromber KB. Resource assessment of non wood forest Products Experience and biometric principles Non Wood Forest Products Series no 13 FAO Rome, 2001.
6. Sagakami H, Aohi T, Simpson A and Tanuma S. Induction of immunopotential activity by a protein bound polysaccharide PSK. *Anticancer Research*, 11, 1991, 993-1000.
7. Kumari D, Reddy MS and Upadhyay RC. Antioxidant activity of three species of wild mushroom genus *Cantherellus* collected from north-western Himalaya India. *International Journal of Agriculture and Biology*, 133, 2011, 415-418.
8. Mau JL, Chang CN, Huang SJ and Chen CC. Antioxidant properties of methanolic extracts from *Grifola frondosa* *Morchella esculenta* and *Termitomyces albuminosus* mycelia. *Food Chemistry*, 87, 2004, 111-118.
9. Barros L, Venturini BA, Baptista P, Estevinho LM and Ferreira ICFR. Chemical composition and biological properties of portugese wild mushrooms A comprehensive study. *Journal of Agricultural and Food Chemistry*, 56, 2008, 3856-3862.
10. Adebayo EA, Oloke JK, Ayandele AA and Adegunlola CO. Phytochemical antioxidant and antimicrobial assay of mushroom metabolite from *Pleurotus pulmonarius*- LAU 09JF736658. *Journal of Microbiology and Biotechnology Research*, 22, 2012, 366-374.
11. Konuk M, Afyon A and Yagiz D. Chemical composition of some naturally growing and edible mushrooms. *Pakistan Journal of Botany*, 383, 2006, 799-804.
12. Imran MM, Raja MM, Basith JA and Asarudeen A. Determination of total phenol flavonoid and antioxidant activity edible mushrooms *Pleurotus florida* and *Pleurotus eous*. *International Food Research Journal*, 18, 2011, 221-224.
13. Ferreira ICFR, Baptista P, Boas MV and Barros L. Free radical scavenging capacity and reducing power of wild edible mushrooms from north east Portugal Individual cap and stipe activity. *Food Chemistry*, 100, 2007, 1511-1516.
14. Ayodele SM, Akpaja EO and Adamu Y. Some edible and medicinal mushrooms of Igala land in Nigeria their sociocultural and ethnomycological uses. *International Journal of Science and Nature*, 23, 2011, 473- 476.
15. Alofe FV. Amino acids and trace minerals of three edible wild mushrooms from Nigeria. *J Food Compos Analysis*, 4 1991, 167-174.
16. Ayodele SM and Okhuoya JA. Vegetative growth studies of *Psathyrella atroumbonata* Pegler an indigenous edible mushroom in Nigeria. *International Journal of Tropical Agriculture and Food Systems*, 1(2), 2007, 184-186.
17. Okhuoya JA. Mushroom cultivation, The Nigeria Experience Food processing Technology for Africa UNDO, 1997, 153-168.
18. Oso BA. Mushrooms in Yoruba Mycology and medicinal practices. *Nigerian Journal of Economic Botany*, 31, 1977, 365-371.
19. Fasidi IO and Ekvere UUS. Studies on *Pleurotus tuberregium* fries Singer Cultivation proximate composition and mineral contents of sclerotia. *Food Chemistry*, 48 1993, 255-258.
20. Akpaja EO and Begho ER. Production of Sclerotia of *Pleurotus tuber-region* Fr Sing on wastes under mature rubber *Hevea brasiliensis*. *Muell Arg Nigeria J Al Sci*, 1999, 17-121-125

## ACKNOWLEDGEMENT

Authors are highly thankful to Dr. N.S. Atri, Professor and Head, Department Of Botany, Patiala University, Punjab, Dr. Kaviyarasan, Dept of Botany CAS, Madras University for identity verification of the specimen. Financial assistance received from Forest and Environment department, Govt. of Odisha is also gratefully acknowledged. We are thankful to the Division forest office of Baliguda, Banei, South Kalahandi, Koraput and Similipal Biosphere Reserve for providing permission and logistic support in the field.

21. Oso BA. Mushrooms and Yoruba people of Nigeria. *Mycologia*, 67, 1975, 311 – 319
22. Harkonen M, Saari maki T, Nwasumbi L and Niemela T. Collection of Tanzanian mushroom Heritage as a form of development cooperation between the University of Helsinki and Daves Salem. *Aquilo Ser Bot*, 31, 1993, 99–105.
23. Chang ST and Mshigene KE. Mushrooms and Human Health, their growing significance as potent dietary sulements. The University of Namimbia Press, 2001, 79.