

Original Research Article

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## Macrofungal Diversity of North-Eastern Part of Uttar Pradesh (India)

Ravinder Pal Singh<sup>1\*</sup>, Abihjeet S. Kashyap<sup>2</sup>, Aradhana Pal<sup>1</sup>,  
Pooja Singh<sup>1</sup> and N.N. Tripathi<sup>1</sup>

<sup>1</sup>Bacteriology and Natural Pesticide Laboratory, Department of Botany,  
DDU Gorakhpur University, Gorakhpur-273009, (U.P.), India

<sup>2</sup>ICAR-NBAIM Mau (U.P.), India

\*Corresponding author

### ABSTRACT

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Present study was done in North-Eastern part of Uttar Pradesh (India) which is home to diverse form of macrofungal species, some of which are highly edible and generally used by local peoples as food and other medicinal purpose. Species composition and species diversity of macrofungi were examined in 7 Tehsils of Gorakhpur district. The fruiting bodies of macrofungi were collected between 2014-2016 during different seasons, but maximum occurrence of macrofungi was found in rainy season. During extensive field survey 30 macrofungal samples were collected and identified which belonging to 23 genera and 16 families on the basis of their morphological and microscopic study. These macrofungi were observed in humid, calcareous, sandy soil and on wood log, wood, leaf litter, leaf heaps, troops of rotten wood, decaying wood log as well as on termite nests. The collected macrofungi were well photographed, preserved in dry as well as in wet condition for the further study. Present study indicates that the variation in climatic condition of Gorakhpur made it possible for the prosperity and unevenness of macrofungi in this area.

### Introduction

Fungi are a group of heterotrophic organisms that consist of a thallus, an assemblage of vegetative cells not forming tissue in the functional sense, and therefore not having differentiated organs. They are one of the most diverse groups of organisms on earth, and constitute a significant part of terrestrial ecosystems. They form a large share of the species richness and are key-players in ecosystem processes (Senn-Irlet *et al.*, 2007,

Andrew *et al.*, 2013). Macrofungi studies have long been of interest to scientists as well as the public due to their important roles in human life, such as their beneficial and harmful effects on forests, their use in the pharmacology industry, and the mass production of cultivated fungi in the food industry, as well as their vital role in biodegradation (Stojchev *et al.*, 1998). Mushrooms are economically important since they serve as food, medicine, biocontrol agents, chemical producers of bioactive

compounds used in the pharmaceutical and many other industries.

Macrofungi are useful in the bioremediation of industrial waste and the accumulation of heavy metals from the environment (Demirbas 2000). Lignicolous macrofungi also have secondary metabolites which expressed significant effects such as antibacterial activity (Kalyoncu *et al.*, 2010). They can also be grown and used as a cash crop.

Macrofungi include well-known groups that have been described by popular terms such as 'gilled fungi', 'cup fungi', 'bracket fungi', 'puffballs', and 'truffles'. These terms reflect the morphological diversity that is encountered within the macrofungi. Ecologically, macrofungi can be classified into three groups: the saprophytes, the parasites and the symbiotic (mycorrhizal) species. Most terrestrial macrofungi are saprobes or mycorrhizal symbionts, but some are pathogens of plants or fungi. Macrofungi fruiting on woody substrata are usually either saprobes or plant pathogens (Mueller *et al.*, 2007).

Mushrooms are widespread in nature and they remain the earliest form of fungi known to mankind. Mushrooms appear to be collected and consumed during almost the entire year, but most fungi are collected during the rainy seasons, suggesting the importance of rainfall patterns in fungal phenology. The goal of this paper is to turn the attention on the occurrence of several saprotrophic terrestrial agarics confined to naked humose soil observed in Gorakhpur district.

## **Materials and Methods**

### **Collection of macrofungi**

Exhaustive surveys in 7 Tehsils viz., Bansaon, Chauri-Chaura, Campierganj,

Gola, Khajni, Sadar and Sahjanwa of Gorakhpur district were conducted between 2014-2016 for the collection of macrofungi. Regular field trips were made for collection of macrofungi but it was more frequent during (June to September) monsoon season. Collected macrofungi samples were photographed in their natural habitat and their morphological characters were noted. The habitats including ecological parameters viz., vegetation composition, soil type, humidity, temperatures and time with macroscopic characters of the specimens were also noted.

The macrofungal samples were brought to the laboratory for further microscopic examination and preserved in the wet and dry condition (Singh *et al.*, 2016). In dry preservation the collected samples were well dried and packed in wax-paper bags wrapped with aluminum foil to prevent external infection and intermixing of the spores and labeled. Collected macrofungi were identified on the basis of their morphological and microscopic characters and confirmed by using the relevant literatures (Jordan, 1995; Vishwakarma *et al.*, 2011; Zheng and Lui, 2008; Kumar and Sharma 2009). All the macrofungal specimens were deposited to the herbarium of Department of Botany, DDU Gorakhpur University, Gorakhpur, (U.P.) India.

## **Results and Discussion**

During present investigation a total of 30 macrofungi samples were collected which belonging to 23 genera and 16 families. The most dominant families were Polyporaceae and Tricholomataceae having 5 species each followed by Fomitopsidaceae having 4 species; Cantharellaceae, Ganodermataceae and Hygrophoraceae having 2 species each while Cordycipitaceae, Xylariaceae, Pezizaceae, Pyrenomataceae, Hyphodermataceae, Strophariaceae,

Albaratrellaceae, Sparassidiaceae, Meruliaceae and Hymenochaetaceae having one species each. Out of 30 identified macrofungi 7 were found to be edible, 22 were inedible while one was poisonous.

The information regarding the species name, family, edibility and date of collection of macrofungi are given in Table 1 (Fig. 1 and 2).

### **Description of collected macrofungi given below with their photographs**

#### ***Cordyceps canadensis* Ellis & Everhart**

Description: Fruit body 3-10 cm high, the fertile head is oval to subglobose, chestnut brown to blackish, set on a tough yellow-olivaceous stalk up to 1cm thick. Spores 20-50 X 3-5  $\mu\text{m}$ , smooth, hyaline, ellipsoid. Habitat mainly in decay wood or cow dung, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Khorabar block, Kushmi jungle. Ravinder Pal Singh, DDUNPL-272.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Ginns 1988.

#### ***Xylaria carpophila* (Pers.: Fr.) Fr.**

Description: Fruiting body 0.2-0.3 cm in diameter and 2-5 cm tall, upper stromal surface whitish becoming black-tipped at maturity, lower sterile parts black and downy, antler-shaped, compressed, perithecia black, sub-spherical, fully embedded in the stromal tissue and arranged in a single dense layer just beneath the surface towards the apex. Flesh white and hard. Spores 11-14 X 5-6  $\mu\text{m}$ , chocolate, smooth, reniform, with distinct cleft on one side, non-septate, uniseriate, 1-2 droplets, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Khajni Tehsil, Khajni block, Belipaar village. Ravinder Pal Singh, DDUNPL-276.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Koyani *et al.*, (2016).

#### ***Peziza ampliata* Pers.: Fr.**

Description: Fruit body 1-3 cm in diameter and 1-2 cm tall, apothecial upper (hymenial) surface cinnamon brown, smooth, outer (lower) surface more pallid with darker mealy dots, at first almost vesicular, becoming more cup-shaped with a denticulate margin, sessile. Flesh brown, brittle and thin. Spores 18-20 X 10-22  $\mu\text{m}$ , hyaline, reticulate, ellipsoid, non-septate, uniseriate, 2 droplets, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Veer Bahadur Singh Park. Ravinder Pal Singh, DDUNPL-279.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

#### ***Cheilymenia stercorea* (F H Wigg.: Fr.) Boud**

Description: Fruiting body cup shaped 0.2-0.3 cm across, upper surface reddish orange, fading to yellowish; undersurface similarly colored or paler, with bristle-like hairs ranging from brownish to yellowish, flesh thin and insubstantial. Saprobic on the dung of domestic animals (primarily horses and cows) and occasionally reported on the dung of wild animals; growing alone or gregariously, spring through fall, or in winter in warmer climates. Spores 14-18 X 8-10  $\mu\text{m}$ , elliptical, smooth, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Khorabar block, Kushmi jungle. Ravinder Pal Singh, DDUNPL-280.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

### ***Hyphodontia sambuci* (Pers.) Erikss**

Description: Fruit body variable in diameter and 0.05-0.1 cm thick. Fruiting body white, resupinate, with irregular margin, the hymenial surface having a chalky consistency, flesh white and extremely thin. Spores hyaline, smooth, ellipsoid, non-amyloid, 5-7 X 4-5  $\mu$ m, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sahjanwan Tehsil, Sahjanwa block, Ranipaar village. Ravinder Pal Singh, DDUNPL-283.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

### ***Pholiota adiposa* (Fr.) Kummer**

Description: Pileus 5-12 cm in diameter, golden-yellow covered with rust, flattened, gelatinous scales, convex, becoming expanded, very viscid. Flesh pallid yellow and firm. Stipe 2-5 cm tall and 0.5-1 cm thick, at first concolorous with cap, becoming more rust, smooth above ring, with bands of rust scales below, more or less equal, typically curved, very viscid. Ring fragile and ephemeral, sub-apical. Flesh yellow, full and tough. Gills yellow, becoming rust at maturity, adnate, crowded. Spores 5-6 X 3-4  $\mu$ m, rust or reddish-brown, smooth, ellipsoid, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Chauri Chaura Tehsil,

Sardar Nagar block, Saraya village. Ravinder Pal Singh, DDUNPL-284.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

### ***Albatrellus flettii* Mores ex Pouzar**

Description: Pileus 6-7 cm across; more or less circular in outline; loosely convex, flat or irregular, occasionally fused, dry, smooth, finely velvety, or with tiny scales in patches, blue, gray or grayish blue, becoming brown, brownish. Stipe 2.5-7 cm long; up to 2 cm wide, sometimes a little off-center; blue, discoloring to grayish or brownish with age; smooth or rugged. Pores descending the stipe, pale blue or gray, becoming grayish or brownish, 2-3 angular pores per mm, tubes 4 to 5 mm deep. Spores 4-6 X 3-5  $\mu$ m, smooth; broadly elliptical or subglobose, inamyloid. Gloeoplerous hyphae absent. Choicely edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Chauri Chaura Tehsil, Sardar Nagar block, Saraya village. Ravinder Pal Singh, DDUNPL-285.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Zheng and Liu (2008).

### ***Cantharellus cibarius* Fr.**

Description: Pileus 4-5 cm in diameter, usually funnel shaped, has a irregular margin. Colour varies from light yellow to deep egg-yolk yellow, but some times a fine white bloom masks the background colour. Stipe 2-2.5 cm long and 0.3-0.5 cm thick, merging into the cap, colour paler than the cap. When growing in clumps, as is often the case, the stem of chanterelles are often curved and occasionally joined together near the base. Not strictly gills at all, the wrinkled

veins on the underside of the cap. The veins are very thick and decurrent, extending well down the stem; they are straight near to the stem but forked and more sinuous towards the edge of the cap. Spores 7-11 X 4-6  $\mu\text{m}$ , ellipsoid, smooth, inamyloid, hyaline, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Chargawan block, Maniram village. Ravinder Pal Singh, DDUNPL-288.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Vishwakarma *et al.*, (2011).

### ***C. subalbidus* Smith & Morse**

Description: Pileus 7-10 cm dia., broadly convex to flat, develops central depression and becoming irregularly shaped with age, margin become uplifted, wavy and lobed, bald or nearly felty when young, dry, whitish, bruising and discolouring yellowish with age. Stipe 3-4 cm long, 1-2 cm thick, tapering toward base, solid, whitish, bruising and discolouring yellowish with age.

Undersurface with false gills that run down the stem, often with cross veins, white, bruising and discolouring yellowish with age. Spores 8-9 X 4.5-5  $\mu\text{m}$ , smooth, ellipsoid, inamyloid. Spore print white. Flesh white, discolouring yellowish with age. Edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Chargawan block, Maniram village. Ravinder Pal Singh, DDUNPL-287.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

### ***Sparassis crispa* (Wulf) Fr.**

Description: Fruiting body 10-40 cm in diameter, cremish to yellowish in color, sub spherical comprising large number of flattened wavy lobes arising from thin and short rooting stem. Stipe brown in color, branched, woody.

Spore bearing surface ochraceous. Spore 5-6 X 4-4.5  $\mu\text{m}$ , ellipsoid, non amyloid, hyaline. Spore print whitish. Flesh crispy, elastic and ochraceous. Edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Bansaon Tehsil, Gagha block, Rampur village. Ravinder Pal Singh, DDUNPL-289.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Kumar and Sharma (2009).

### ***Fomitopsis pinicola* (Sw.) P. Karst.**

Description: Fruiting body 15-16 cm wide, semicircular, convex to hoof shaped, hard, tough, woody, smooth, wrinkles with age, cap surface usually red to reddish brown with a white or yellow margin. Stem absent. Pore surface cream colored and it does not bruise brown, 3-5 pores per mm.

Spores 6-8 X 4-4.5  $\mu\text{m}$ , cylindrical, inamyloid and smooth. Spore print yellowish. Flesh white and leathery to woody, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Khajni Tehsil, Khajni block, Belipaar village. Ravinder Pal Singh, DDUNPL-290.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Flores *et al.*, (2014).

***Laetiporus sulphureus* (Bull.) Murrill**

Description: Fruiting body 5-30 cm across and up to 20 cm deep and 3 cm thick; fan-shaped to semicircular or irregular; more or less planoconvex; smooth to finely wrinkled; bright yellow to bright orange when young, frequently fading in maturity and with direct sunlight. Flesh thick; soft and watery when young, becoming tough, eventually crumbling away; white to pale yellow. Stipe absent; Pores yellow; with 2-4 circular to angular pores per mm; tubes 4 to 5 mm deep. Spores 5.5-7 X 3.5-5 µm; smooth, elliptical to ovoid, inamyloid. Edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-291.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Chandulal *et al.*, (2013).

***Postia caesia* (Schard.: Fr.) Karst.**

Description: Fruiting body 1-6 cm in diameter and 0.2-1 cm thick, at first whitish, becoming increasingly blue with age, occasionally with brownish tinge, upper surface finely hairy, with slight concentric zonation and radial wrinkling, margin somewhat wavy, sessile narrowly attached. Flesh whitish, elastic and tough. Pores whitish, small, at first rounded or slightly angular, lacerate on vertical surface, 4-6 per mm. tubes concolorous, 4-6 mm deep. Spores 4-5 X 1.5-2 µm, hyaline, smooth, cylindrical-ellipsoid or allantoid, amyloid with droplets, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-293.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Tiberius and Cătălin (2012).

***P. stiptica* (Pers.) Jülich**

Description: Fruiting body 2-8 cm in diameter, 1-3 cm thick, white, upper surface sometimes bristly tomentose, with slight concentric zonation and radial wrinkling, margin somewhat wavy, sessile, broadly attached, flesh white, fibrous, soft. Pores white, small, at first rounded or slightly angular on vertical surfaces, 3-4 per mm, tubes concolorous, 5-8 mm deep. Spores 3.2-4 X 2-2.5 µm, ellipsoid, smooth, hyaline, non amyloid. Spore print whitish, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Khajni Tehsil, Khajni block, Madan Pura village. Ravinder Pal Singh, DDUNPL-292.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Tiberius and Cătălin (2012).

***Phlebia cornea* (Bourd. & Galz.) Parm.**

Description: Fruiting body variable in diameter and 0.05-0.2 cm thick, cream with grey and ochraceous tinges, resupinate, irregular patches with distinct margins, the hymenial surface irregularly warty. Flesh cream, when damp, faintly thin, waxy and soft, when dry, membranous and tough. Spores 7.5-12 X 3.5-5.5 µm, hyaline, smooth, ellipsoid-cylindrical, non-amyloid, with numerous of droplets, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sahjanwan Tehsil, Sahjanwa block, Ranipaar village. Ravinder Pal Singh, DDUNPL-295.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

***Funalia trogii* (Berk.) Bondartsev & Singer**

Description: Fruiting body 5-14 cm dia, annual, effused-reflexed to rarely resupinate, tough, corky, upper surface coarsely hispid, creamish colour, faintly zonate, margin sharp, annual. Stem absent. Pore 1-2 per mm, angular, creamish, spore 6-11 X 2.5-3 µm, cylindrical, hyaline, non amyloid. Flesh soft, spongy when young and harder at maturity. Spore print light brownish, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Khorabar block, Kushmi Jungle. Ravinder Pal Singh, DDUNPL-297.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

***Lenzites sepiaria* (Wulfen) Fr.**

Description: Fruiting body 2-10 cm dia., 0.1 cm thick, fan shaped, annual, dark brown in colour, upper surface rust brown with concentric maroon tinged zones with more pallid margin, darkening with age, under surface brownish in colour, sessile. Pores maze or gill like in radial arrangement, at first ochraceous becoming brownish at maturity. Spores 7.5-9.5 X 2.5-4 µm, cylindrical, smooth, hyaline, non amyloid. Spore print white, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-298.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

***Polyporus brumalis* (Pers.) Fr.**

Description: Fruiting body 3-8 cm across, circular in outline, convex with sunken central depression, dry, smooth, yellowish brown in colour, margin inrolled. Stem 2-2.5 cm long, 2-4 mm wide, central, smooth, white, tough. Pores 2-3 circular pores per mm, whitish, running down the stem. Spore 4-6 X 1-2 µm, smooth, cylindrical. Spore print white. Flesh white, thin, tough, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Khorabar block, Kushmi Jungle. Ravinder Pal Singh, DDUNPL-299.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Dai (1996).

***Trametes hirsutus* (Wulfen) Pat.**

Description: Fruiting body 3-8 cm dia., 2-3 cm wide, semicircular, often fuse laterally with other caps, hairy radially furrowed, concentric zones of furrow, whitish in colour with brownish margin. Stem absent. Pores whitish, 3-4 circular pores per mm. Spores 5-7 X 1.5-3 µm, smooth, cylindric, inamyloid. Spore print white. Flesh whitish, tough and corky, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Khorabar block, Kushmi jungle. Ravinder Pal Singh, DDUNPL-301.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Tiberius and Cătălin (2012).

***T. suaveolens* (L.: Fr.) Fr.**

Description: Fruiting body 6-12 cm in diameter and 1.5-3.5 cm thick, upper surface

whitish, zoned grayish with age, sometimes with green tinge, finely downy, margin sharp, slightly undulating, sessile. Flesh white and tough. Pores white, becoming cream or buff with age, angular or elongated slot-like. Tubes concolorous, 10-15 mm deep. Spores 7-11 X 3-4  $\mu\text{m}$ , hyaline, smooth, cylindrical or slightly allantoids, non-amyloid, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sadar Tehsil, Khorabar block, Kushmi jungle. Ravinder Pal Singh, DDUNPL-300.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Tiberius and Cătălin (2012).

### ***Ganoderma applanatum* (Pers.) Pat.**

Description: Fruiting body 3-16 cm broad, more or less fan shaped, semicircular, brownish, upper surface furrowed, rough with zones of various colours. Stem absent. Pore 4-7 circular pores per mm, whitish to brownish at maturity. Spore 5-10 X 4-7  $\mu\text{m}$ , elliptical, smooth, inamyloid. Spore print reddish brown. Flesh brownish and hard, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Chauri Chaura Tehsil, Sardar Nagar block, Bilaari Mithiyan village. Ravinder Pal Singh, DDUNPL-303.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Bhosle *et al.*, (2010).

### ***G. praelongum* Murrill**

Description: Fruiting body 14-20 cm broad, upper surface glabrous, sulcate, laccate, bay to brownish, more or less fan shaped, semicircular, brownish, rough with zones of various colours. Margin thin, sterile, cream to

ochraceous, acute to sulcate, rarely blunt. Pore: 5 per mm. Stem absent. Pore 4-7 circular pores per mm, whitish to brownish at maturity. Spore 8-10 X 6-7  $\mu\text{m}$ , elliptical, smooth, inamyloid. Spore print reddish brown. Flesh brownish and hard, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Chauri Chaura Tehsil, Sardar Nagar block, Bilaari Mithiyan village. Ravinder Pal Singh, DDUNPL-305.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Bhosle *et al.*, (2010).

### ***Inonotus cuticularis* (Bull.) P. Karst.**

Description: Fruiting body 10-22 X 2-4 cm, large, velvety, reddish-ochre, felty or downy, bristle with age, undulating. Stem absent. Pores yellowish brown, angular, 2-3 pores per mm. Spores 6-7 X 4-5.5  $\mu\text{m}$ , smooth, ellipsoid. Spore print brownish. Flesh pallid brown, thick, soft and spongy when young, woody when mature, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-306.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Nejhad and Kotrianta (2008).

### ***Hygrocybe acutopunicea* Haller**

Description: Pileus 3-10 cm in diameter, domed or broadly umbonate caps with irregular downturned margins and dark blood red with usually a yellowish margin. The caps fade gradually, often in patches from the centre outwards, to become yellowish buff. Stipe 5-15 cm long and 1.3-2 cm thick, with a

somewhat rooting base, ring absent, coarsely fibrillose, yellow flushed with red in its upper section, shading into orange and then white towards the base. Gills initially yellow, but reddening gradually as the fruitbody ages, the gills are adnexed or free, they are moderately distant. Spores 8-11 X 4.5-5.5  $\mu\text{m}$ , ellipsoid to cylindrical, smooth, inamyloid. Poisonous.

Collection examined: Uttar Pradesh, Gorakhpur district, Gola Tehsil, Gola block, Ranipur village. Ravinder Pal Singh, DDUNPL-308.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

### ***H. miniata* (Fr.) Kummer**

Description: Pileus 1-3 cm across, convex, becoming broadly convex or nearly flat, often developing a broad central depression, dry or slightly moist in humid or wet weather; innately, finely, radially scurfy or fibrillose, especially with age, scarlet to reddish orange when young and fresh, fading to orange or yellow, the margin sometimes becoming thinly lined. Stipe 2-7 cm long and 0.2-0.5 cm thick, equal or tapering to base, dry, bald, yellow near the apex, elsewhere colored more or less like the cap but fading more slowly, base white.

Gills broadly attached to the stem or beginning to run down it, nearly distant, thick, pale yellow at first, becoming yellow to orange; short-gills frequent. Spores 5-8 x 3-4  $\mu\text{m}$ , smooth, ellipsoid or not infrequently, somewhat constricted and subpyriform, hyaline. Edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Gola Tehsil, Gola block, Ranipur village. Ravinder Pal Singh, DDUNPL-309.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Borkar *et al.*, (2015).

### ***Clitocybe discolor* (Pers.: Fr.) Kummer**

Description: Pileus 2-5 cm across, whitish, smooth, at first convex or bun-shaped, later shallowly infundibuliform or umbilicate, with slightly inrolled margin. Flesh white and thick. Stipe 4-5 cm tall and 0.7-1 cm in diameter, concolorous, shiny, with white hairs at the base.

Ring absent, flesh white, cartilaginous, full, becoming stuffed. Gills white, adnate-decurrent, fairly broad, crowded. Spores hyaline, smooth, ellipsoid, non-amyloid, droplets absent, 4-5 X 3-3.5  $\mu\text{m}$ , inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sahjanwan Tehsil, Sahjanwa block, Ranipaar village. Ravinder Pal Singh, DDUNPL-310.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

### ***C. phyllophila* (Fr.) Kummer**

Description: Pileus 4-10 cm across, convex, flattening with a wavy margin, usually developing a shallow central depression and retaining a small umbo, smooth and silky when dry, white with a fine bloom, developing buff or ochre spots mostly near the centre. Stipe 4-8 cm long and 0.7-1.5 cm thick, smooth, white, downy at the base, ring absent. Gills decurrent, crowded, white, turning cream with age. Spores ellipsoidal to subglobose, smooth, 4-5 X 3-3.5  $\mu\text{m}$ . Spore print pale pinkish. Edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Sahjanwan Campierganj

Tehsil, Campierganj block, Veer Bahadur Singh Park. Ravinder Pal Singh, DDUNPL-311.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

***Collybia erythropus* (Pers.: Fr.) Kummer**

Description: Pileus 5-7 cm in diameter, reddish-brown, hygrophanous, drying pallid tan, convex, becoming expanded, bluntly umbonate with wavy margin, slightly viscid or smooth. Flesh whitish tinged cap colour and thin. Stipe 5-8 cm tall and 0.7-1.5 cm thick, darkening reddish-brown towards base, typically fusiform with a rooting base which often fuses with others, twisted and grooved. Ring absent. Flesh whitish, tough and more or less full. Gills at first whitish, free or emarginated, broad, crowded. Spores hyaline, smooth, ellipsoid or pipe-shaped non-amylid, occasionally with droplets, 4-6 X 2-4  $\mu$ m. Edible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-313.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

***C. fuscopurpurea* (Pers.) P. Kumm**

Description: Pileus 0.5-3 cm dia., wide, convex, flat, smooth, radially fibrillose, dry,

buff, thin, delicate. Stipe 1.3-2 cm long, 0.2-0.5 cm thick, cylindrical, more or less equal, delicate, soft, fragile, brownish. Gills free, white, parallel, crowded. Spores 5-6 X 1.5-2.5  $\mu$ m, ellipsoid, cylindrical, smooth. Spore print white. Flesh thin, soft, delicate, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-312.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Pushpa and Purushothama (2012).

***Omphalina ericetorum* (Pers.) M. Lange**

Description: Fruiting body 0.5-2 cm dia., yellowish buff agarics with funnel shaped cap, at first more or less convex, becoming depressed, infundibuliform, margin incurved, smooth, sulcate at margin. Stipe 0.5-1.5 cm long, 0.2-0.4 cm thick, concolorous, equal, finely downy and darker at the base, ring absent. Gills decurrent, pallid, creamy yellow, broad, distant. Spores 8-9 X 4-5  $\mu$ m, hyaline, smooth, ellipsoid, non amyloid. Flesh whitish ochre, thin. Spore print yellowish, inedible.

Collection examined: Uttar Pradesh, Gorakhpur district, Campierganj Tehsil, Campierganj block, Campierganj Jungle. Ravinder Pal Singh, DDUNPL-314.

Specimen examined: Macroscopic and microscopic features agree well with the description given by Jordan (1995).

**Table.1** Species, family, edibility and date of collection of macrofungi

<b>Macrofungi</b>	<b>Family</b>	<b>Edibility</b>	<b>Date of collection</b>
<i>Albatrellus flettii</i>	Albaratrellaceae	Edible	29/08/16
<i>Cantharellus cibarius</i>	Cantharellaceae	Inedible	13/08/14
<i>Cantharellus subalbidus</i>	Cantharellaceae	Edible	9/08/14
<i>Cheilymenia stercorea</i>	Pyronemataceae	Inedible	5/01/15
<i>Clitocybe phyllophila</i>	Tricholomataceae	Edible	13/08/14
<i>Clitocybe discolor</i>	Tricholomataceae	Inedible	12/08/14
<i>Collybia fuscopurpurea</i>	Tricholomataceae	Inedible	16/07/15
<i>Collybia erythropus</i>	Tricholomataceae	Edible	6/08/15
<i>Cordyceps canadensis</i>	Cordycipitaceae	Inedible	19/08/14
<i>Fomitopsis pinicola</i>	Fomitopsidaceae	Inedible	29/08/15
<i>Funalia trogii</i>	Polyporaceae	Inedible	5/04/15
<i>Ganoderma applanatum</i>	Ganodermataceae	Inedible	5/01/15
<i>Ganoderma praelongum</i>	Ganodermataceae	Inedible	23/04/15
<i>Hygrocybe miniata</i>	Hygrophoraceae	Edible	29/08/15
<i>Hygrocybe acutopunicea</i>	Hygrophoraceae	Poisonous	29/08/15
<i>Hyphodontia sambuci</i>	Hyphodermataceae	Inedible	15/07/16
<i>Inonotus cuticularis</i>	Hymenochaetaceae	Inedible	12/08/14
<i>Laetiporus sulphureus</i>	Fomitopsidaceae	Edible	22/07/14
<i>Lenzite sepiaria</i>	Polyporaceae	Inedible	22/08/15
<i>Omphalina ericetorum</i>	Tricholomataceae	Inedible	22/08/15
<i>Peziza ampliata</i>	Pezizaceae	Inedible	13/07/16
<i>Phlebia cornea</i>	Meruliaceae	Inedible	12/07/15
<i>Pholiota adipose</i>	Strophariaceae	Inedible	11/08/14
<i>Polyporus brumalis</i>	Polyporaceae	Inedible	5/07/15
<i>Postia caesia</i>	Fomitopsidaceae	Inedible	6/08/15
<i>Postia stiptica</i>	Fomitopsidaceae	Inedible	29/08/15
<i>Sparassis crispa</i>	Sparassidiaceae	Edible	06/08/15
<i>Trametes hirsutus</i>	Polyporaceae	Inedible	5/03/15
<i>Trametes suaveolens</i>	Polyporaceae	Inedible	5/04/15
<i>Xylaria carpophyla</i>	Xylariaceae	Inedible	25/08/15

**Fig.1** (A) *Cordyceps canadensis* (B) *Xylaria carpophyla* (C) *Peziza ampliata* (D) *Cheilymenia stercorea* (E) *Hyphodontia sambuci* (F) *Pholiota adiposa* (G) *Albatrellus flettii* (H) *Cantharellus subalbidus* (I) *C. cibarius* (J) *Sparassis crispa* (K) *Fomitopsis pinicola* (L) *Laetiporus sulphureus* (M) *Postia stiptica* (N) *P. caesia* (O) *Phlebia cornea*



**Fig.2** (A) *Funalia trogii* (B) *Lenzite sepiaria* (C) *Polyporus brumalis* (D) *Trametes suaveolens* (E) *T. hirsutus* (F) *Ganoderma applanatum* (G) *G. praelongum* (H) *Inonotus cuticularis* (I) *Hygrocybe acutopunicea* (J) *H. miniata* (K) *Clitocybe discolor* (L) *C. phyllophila* (M) *Collybia fuscopurpurea* (N) *C. erythropus* (O) *Omphalina ericetorum*



Present investigation documented the diversity and distribution of macrofungi between 2014-2016. The survey of macrofungi were conducted in 7 Tehsils (Bansgaon, Campierganj, Gola, Khajni, Sahjanwa, Sardar nagar and Sadar) of Gorakhpur district. Species diversity of macrofungi is related to their particular habitats. The factors like geographic location, elevation, temperature, humidity, light and surrounding flora greatly influence the growth and development of macrofungi (Tapwal *et al.*, 2013).

During present survey 30 macrofungi belonging to 23 genera and 16 families were collected from different parts of Gorakhpur district. Out of these species, 7 species were found to be edible, 22 were inedible while 1 species was poisonous. From time to time different workers had studied macrofungal diversity of different parts in India. Chandrawati *et al.*, (2014) found 29 macrofungal species which belonging to 12 families from Kusumhi Forest of Gorakhpur district. Out of 29 species, 4 were excellently edible, 6 edible, 18 inedible and 1 poisonous, while Vishwakarma *et al.*, (2014) collected 12 macrofungi belonging to 8 families from Gorakhpur district. Besides Das and Das (2014) studied and identified 45 macrofungal species from Utrakhand.

Anand *et al.*, (2014) collected 120 macrofungal samples from Rajouri District (J and K) which belong to different genera. The macrofungi were identified up to species level, collected macrofungi belong to 14 orders, 31 families, 67 genera and 8 species. It is interesting to note that out of 120 mushrooms species, 50 species were found to be edible and 24 species had potent medicinal value. From North-East India Bhattacharjee *et al.*, (2015) collected 25 macrofungal samples and identified it up to species level, which belong to 9 orders, 17 families and 22 genera.

Dwivedi *et al.*, (2012) collected 50 macrofungi from Amarkantak Biosphere Reserve forest of Central India, out of which only 16 macrofungi were identified up to species level. Another worker Dwivedi *et al.*, (2015) collected and identified 37 macrofungal species belonging to 19 genera, 13 families and 10 orders from Vindhyan region of Central India.

In conclusion, India is sanctified with diverse agro climatic zones that harbor a wealth of macrofungal diversity. In India macrofungi are very diverse in nature but they are not explored completely till now. Tribal and local people are using these mushrooms as their important diet during rainy season also they are using it for treating various ailments. It is important today to explore these mushrooms and find out their important value so other peoples also utilize and take benefit from them. Beside their use as food these macrofungi are highly used as folk medicines. Some of the macrofungi are even locally marketed at high rate. This type of knowledge can open new field for researchers to work out and find new type of drug to prevent various ailments.

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