

**A Survey of Macrofungal Diversity in the Ayodhya Region, Uttar Pradesh, India**Balwant Singh<sup>1\*</sup>, Vinay Kumar Singh<sup>1</sup> and Shailendra Kumar<sup>2</sup><sup>1</sup>*Mycology and Plant Pathology Laboratory, Department of Botany, K. S. Saket P.G. College Ayodhya, Uttar Pradesh, India.*<sup>2</sup>*Department of Microbiology, Dr. Ram Manohar Lohia Avadh University Ayodhya, Uttar Pradesh, India.**\*Corresponding Author Email: balwantsingh1642@gmail.com*

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**ABSTRACT**

**A survey of wild macrofungi of Ayodhya district, Uttar Pradesh, India, yielded specimens of 30 different species representing 17 genera and 9 families. During the field work, we collected several fruiting bodies of macrofungi from their wild growing habitat and owing to their macroscopic and microscopic characteristic features. Major specimen components including the pileus, stipe, gills, and spore are expressed and concentrated from the fruiting body. A seasonal variation noted herein with nature and edibility. This is the first report of the macrofungal wealth from this holy place of the Ayodhya region in the Uttar Pradesh, India. Collected specimens certainly provide evidence of the high level of macrofungal diversity of study area.**

**Keywords:** Ayodhya, Diversity, Macrofungi, Mushroom, Mycoflora.

**INTRODUCTION**

Although extensive areas of the Uttar Pradesh state in the north-eastern root of Himalaya of India. There have been less taxonomic publications (Singh *et al.*, 2016; 2019; Singh and Singh, 2022; 2023a; 2023b) on the macrofungal diversity in wild ecosystems in India, which is covered in forests and home to a large number of rivers. Many regions are still unexplored for their enormous richness of macrofungi. Rich regional forests cover the entire state, and the network of rivers and their wild make-up change depending on the varying climates from the lowlands to the Ganga River Plain. Fungal diversity, especially macrofungi is one of the most important and necessary for the healthy environments (Sultana & Quresh, 2007). There is a considerable research gap in our knowledge of macrofungi as much of the diversity is yet to be explored. The study may become a pioneer to fulfil the research gap and expose a possibility of new research area.

Ayodhya is well known and widely famous as the birthplace of Godes Rama which was the king of Ancient Avadh Kingdom. Ayodhya is a district of Uttar Pradesh state with 2522 km<sup>2</sup> area and 2470996 population (Census 2011). Ayodhya is situated on the bank of river Sarayu with rich vegetations. Climate can be described as having three distinct seasons: high summer, significant precipitation, and severely cold. The seasonal climatic changes along with temperature, relative humidity and precipitation are responsible for a rich diversity of vegetations and an association of high level macrofungal diversity. The existence of urban, rural with very vast agricultural land and forest areas that explore composite and variable varieties of macrofungi.

Fungi refers to Kingdom Mycota, which has been broadly divided into two categories, i.e., macrofungi and microfungi (Singh and Singh, 2023a). Likewise, all macrofungi are referred to as mushrooms and have fruiting bodies (Singh and Singh, 2022). They are completely heterotypic organisms and the second-largest diverse group on Earth, after insects (Singh and Singh, 2023b). About 1.5 million fungal species are thought to exist in nature, although only about 50% of them have been identified to date (Manoharachary *et al.* 2005). Around 41,000 types of mushrooms have been recorded worldwide, with 850 of those species coming from India. (Deshmukh 2004). Macrofungi share a large species richness and plays key role in ecosystem processes (Andrew *et al.*, 2013). It comprises well known group in their community and they described by popular terms like cup fungi, bracket fungi, gilled fungi, puffballs and truffles. These terms are express their morphological diversity (Singh *et al.*, 2019; Singh and Singh, 2022).

Ecologically, macrofungi can be categorized into three groups: saprophytic, parasitic, and symbiotic (Singh *et al.*, 2019). Most of macrofungi are terrestrial and they are saprobic or mycorrhizal symbiont. Whereas some macrofungi develops on woody substrate of plant and they are usually saprobes or plant pathogens (Mueller *et al.*, 2007). Due to their parasitic, symbiotic, and saprophytic activities, macrofungi play a significant role in ecosystems. (Kuffer *et al.*, 2004). They include scavenging activities that play a significant part in the ecological system and biogeochemical cycles (Paliwal *et al.*, 2013). They actively contribute to the biodegradation of organic materials such as leaves, straws, litter, and dead and decaying wood etc. (Sultana & Quresh, 2007). By the activities of macrofungi, dead and decayed materials release

nutrient back into the ecosystem. Due to the important role for environment, macrofungal study have long been interested by scientist and researchers. Whereas, macrofungi have played a crucial role in economies as a food source for generations.

The economic importance of macrofungi known for food, medicine, biocontrol agents, producers of bioactive compounds (Stojchev *et al.*, 1998; Singh and Singh, 2023b). The secondary metabolites of macrofungi like terpenes, polyphenols, steroids etc. exhibits bioactive properties which play important roles in securing the health of consumers (Singh and Singh, 2023b). Nutritionally, mushrooms are the rich source of protein and also known for different medicinal properties *viz.* antioxidant, anticancerous, antimicrobial, antifungal, antiallergic, antidiabetic, antiviral and many more (Ramesh and Pattar, 2010; Keles *et al.*, 2011; Singh, 2023). The diversity of macrofungi (mushroom) expose the availability of specialized natural resource at any place.

The primary purpose of this article is to draw attention to the rural and remote areas of the Ayodhya region of Uttar Pradesh for their macrofungal wealth. Whereas, some reports of macrofungi from this region for their nutritional value are available (Singh and Singh, 2023a; Singh and Singh, 2023b), this study will also provide reference in future research.

## MATERIAL AND METHODS

Holy Ayodhya district were the study area of this current research and situated at the bank of river Saryu. It was located at between 26°47'N and 82°13'E with elevations of 93 meters at sea level (Mobile GPS App- Geographical Information System). The study area has 5 tahsils and 11 blocks. Whereas study site randomly selected from every block. A regular (weekend) survey was conducted between the years of 2021-2023 for the collection of macrofungi and the collection date of all specimens listed herein. Photographs were taken to document the natural habitat and morphological characteristics of the collected macrofungi. Collected macrofungal sample were brought to the laboratory for further microscopic examination and preserved accordingly in the dry and wet conditions (Ainsworth, 1971). Macroscopic (pileus, stipe, gills, ring etc.) and microscopic (spore's shape, size and colour) identification of macrofungal samples were done by using relevant literatures and confirmed by myco-keys (www.mushroomexpert.com, www.messiah.edu, www.inaturalist.org, www.mycobank.org and www.myckeys.com). Whereas all the preserved specimens were deposited in college laboratory collections.

## RESULT

A total of 30 macrofungal species were identified, belonging to 17 genera and 9 families (**Table-1**). The Agaricaceae family dominated with 14 species of macrofungi, followed by Amanitaceae, Bolbitiaceae, and Marasmiaceae with 3 species each, while Phallaceae had 2 reported species. The families Hygrophoraceae, Lyophyllaceae, Psathyrellaceae, and Russulaceae were each represented by a single identified macrofungus. Description of collected macrofungal species given below-

### 1. *Agaricus bernardii* (Quel.) Sacc.

*Sample ID:* Saket024 (Fig.1 A)

*Family:* Agaricaceae

*Description:* **Pileus** 5-9 cm. diameter, convex to flattened, surface dry and smooth, buff colour with brownish spots; **Stipe** 3-7.5 cm. long, 2-3 cm. thick, solid, rubbery with ring, white coloured; **Gills** free, closed together, greyish-pink to reddish brown coloured; **Spores** 6.3-7.5 × 2.5-3.2 μm., elliptical, smooth; Spore print brown (Fig.3 A).

*Nature:* Saprobic; Edible.

*Collection Date:* 25.07.2021

*Collection Site:* Village-Adhiyari, Block-Milkipur, Tahsil-Milkipur

*Verified from:* Didukh *et al.*, 2005; Vishwakarma and Tripathi, 2019

### 2. *Agaricus blazei* Murrill

*Sample ID:* Saket031 (Fig.1 B)

*Family:* Agaricaceae

*Description:* **Pileus** 5-14.5 cm. diameter, hemispherical, convex, surface covered by fibers or scales, white to greyish or dull reddish-brown coloured; **Stipe** 5-13 cm. long, 1-2.3 cm. thick, bulbous at base, ringed, smooth, scaly at base, whitish coloured; **Gills** free, narrow, crowded, whitish to brownish coloured; **Spores** 5.2-7 × 3.8-5 μm., ellipsoid, smooth, dark purple to brown coloured; Spore print brown (Fig.3 B).

*Nature:* Saprobic; Edible in choice.

*Collection Date:* 12.06.2021

*Collection Site:* Village-Datauli, Block-Purabazar, Tahsil-Sadar

*Verified from:* Murrill, 1922; Kerrigan, 2005

### 3. *Agaricus campestris* L.

*Sample ID:* Saket113 (Fig.1 C)

*Family:* Agaricaceae

*Description:* **Pileus** 4.5-8 cm. diameter, convex, incurved margins, surface dry and smooth, covered by fibers or scales, white to grey coloured; **Stipe** 5-7.6 cm. long, 1-2.5 cm. thick, tapering to pointed base, ringed, smooth, whitish coloured; **Gills** closed, free, pink to blackish brownish coloured;

**Spores** 5.7-6.5 × 3-4.2 μm., elliptical, smooth, thick walled, dark brown coloured; Spore print brown (Fig.3 C).

*Nature:* Saprobic; Edible in choice.

*Collection Date:* 04.03.2023

*Collection Site:* Village-Gopinathpur, Block-Sohawal, Tahsil-Sohawal

*Verified from:* Singh *et al.*, 2016

#### 4. *Amanita bisporigera* G.F.Atk.

*Sample ID:* Saket017 (Fig.1 D)

*Family:* Amanitaceae

*Description:* **Pileus** 2.5-10 cm. diameter, oval, convex to bell shaped, slightly sticky, white to ivory coloured; **Stipe** 5-14 cm. long, 0.5-2.5 cm. thick, tapering to apex and flaring to enlarged base, whitish coloured; **Gills** free, crowded, white coloured; **Spores** 7-9.2 × 5.7-8 μm., globus or ellipsoid, smooth, whitish coloured; Spore print white (Fig.3 D).

*Nature:* Mycorrhizal; Inedible (Deadly).

*Collection Date:* 09.10.2021

*Collection Site:* Village-Dwarikapuri, Block-Purabazar, Tahsil-Sadar

*Verified from:* Lewis, 1906; Mc Knight *et al.*, 2010

#### 5. *Amanita pelioma* Bas.

*Sample ID:* Saket085 (Fig.1 E)

*Family:* Amanitaceae

*Description:* **Pileus** 3-8.5 cm. diameter, convex, covered with powdery material, slightly sticky, white to greyish coloured; **Stipe** 6-14 cm. long, 1-2 cm. thick, tapering to apex, whitish-grey coloured; **Gills** free, close, crowded, creamy to brownish coloured; **Spores** 7-10 × 5.7-8 μm., ellipsoid, amyloid, smooth, whitish coloured; Spore print white.

*Nature:* Mycorrhizal; Inedible (poisonous).

*Collection Date:* 21.01.2023

*Collection Site:* Village-Ahiraui, Block-Tarun, Tahsil-Bikapur

*Verified from:* Kuo and Methven, 2010; Kuo and Methven, 2014.

#### 6. *Amanita vaginata* (Bull.) Lam.

*Sample ID:* Saket063 (Fig.1 F)

*Family:* Amanitaceae

*Description:* **Pileus** 3-9.7 cm. diameter, convex to flattened, grey to greyish-brown coloured; **Stipe** 6-17 cm. long, 1-2 cm. thick, volva, rig absent, bulbous at base, whitish to grey coloured; **Gills** free, crowded, creamy to white coloured; **Spores** 7-10.5 × 5-7 μm., roughly spherical, thin walled, non-amyloid, smooth, whitish coloured; Spore print white (Fig.3 E).

*Nature:* Mycorrhizal; Edible in choice.

*Collection Date:* 18.06.2022

*Collection Site:* Village-Bhelsar, Block-Rudaui, Tahsil-Rudaui

*Verified from:* Arora, 1986

#### 7. *Bovista plumbea* Pers.

*Sample ID:* Saket018 (Fig.1 G)

*Family:* Agaricaceae

*Description:* **Pileus** 2-4.5 cm. diameter, spherical to compressed, white to grey coloured; **Stipe** absent, cap attached to substrate with tuft of mycelium, bulbous; **Spores** 5-5.7 × 4-5 μm., ovoid, thick walled, slightly smooth, yellowish to dark brown coloured; Spore print brown (Fig.3 F).

*Nature:* Saprobic; Edible.

*Collection Date:* 17.07.2021

*Collection Site:* Village-Ganeshpur, Block-Mawai, Tahsil-Rudaui

*Verified from:* Arora, 1986

#### 8. *Conocybe apala* (Fr.) Arnolds

*Sample ID:* Saket097 (Fig.1 H)

*Family:* Bolbitiaceae

*Description:* **Pileus** 1.5-3.5 cm. diameter, conical to bell shaped, incurved margins, surface dry, white to creamy buff coloured; **Stipe** 5-9 cm. long, 1-2.5 mm. thick, hollow, whitish to yellowish coloured; **Gills** closed or crowded, short, attached, brown to dark brown coloured; **Spores** 8.5-12 × 5-7.5 μm., ellipsoid, smooth, thick walled, brown coloured; Spore print brown (Fig.3 G).

*Nature:* Saprobic; Inedible.

*Collection Date:* 24.09.2022

*Collection Site:* Village-Akbara, Block-Purabazar, Tahsil-Sadar

*Verified from:* Davis *et al.*, 2012

#### 9. *Chlorophyllum molybdites* (G. Mey.) Massee

*Sample ID:* Saket026 (Fig.1 I)

*Family:* Agaricaceae

*Description:* **Pileus** 7.5-14 cm. diameter, convex to conical and flat, dry and smooth, brown to pinkish brown coloured; **Stipe** 6-17 cm. long, 0.5-1.5 cm. thick, cylindrical, ringed, smooth, whitish to light brown coloured; **Gills** free, close, white to grey brownish coloured; **Spores** 8-10 × 7-8.5 μm., elliptical, smooth, dark greenish coloured; Spore prints greenish (Fig.3 H).

*Nature:* Saprobic; Inedible.

*Collection Date:* 03.07.2021

*Collection Site:* Village-Bhelsar, Block-Rudaui, Tahsil-Rudaui

*Verified from:* Vishwakarma and Tripathi, 2019

**10. *Collybia butyracea*** (Bull.; Fr.) Quelet

*Sample ID:* Saket034 (Fig.1 J)

*Family:* Marasmiaceae

*Description:* **Pileus** 2.5-9 cm. diameter, convex or flat, smooth, moist, white-brown to reddish-brown coloured; **Stipe** 8-10 cm. long, 1-2 cm. thick, club shaped, moist or dry, white coloured; **Gills** free or nearly attached, crowded, creamy to white coloured; **Spores** 7-10 × 4-6 µm., ellipsoid, smooth, yellowish to whitish coloured; Spore print cream to buff (Fig.3 I).

*Nature:* Saprobic; Edible.

*Collection Date:* 23.07.2022

*Collection Site:* Village-Janaura, Block-Masodha, Tahsil-Sadar

*Verified from:* Trudell and Ammirati, 2009.

**11. *Collybia erythropus*** (Press.: Fr.) Kummer

*Sample ID:* Saket042 (Fig.1 K)

*Family:* Marosmiaceae

*Description:* **Pileus** 5-6 cm. diameter, convex or flat, smooth, dry, white-brown to reddish-brown coloured; **Stipe** 5-8 cm. long, 1-1.5 cm. thick, ring absent, dark reddish-brown coloured towards base; **Gills** free, crowded, white coloured; **Spores** 4.5-6 × 2-4 µm., ellipsoid, smooth, yellowish to whitish coloured; Spore print cream to buff.

*Nature:* Saprobic; Edible in choice.

*Collection Date:* 14.08.2021

*Collection Site:* Village-Sarraiya, Block-Mayabazar, Tahsil-Bikapur

*Verified from:* Singh *et al.*, 2019

**12. *Collybia fuscopurpurea*** (Pers.) P. Kumm

*Sample ID:* Saket038 (Fig.1 L)

*Family:* Marosmiaceae

*Description:* **Pileus** 1-3 cm. diameter, convex, flat, smooth, dry, buff coloured; **Stipe** 1-3.5 cm. long, 0.2-0.5 cm. thick, ring absent, brownish coloured; **Gills** free, crowded, white coloured; **Spores** 4.5-6 × 1.5-2 µm., ellipsoid, smooth, whitish coloured; Spore print white.

*Nature:* Saprobic; Inedible.

*Collection Date:* 31.07.2021

*Collection Site:* Village-Ganeshpur, Block-Mawai, Tahsil-Rudauli

*Verified from:* Singh *et al.*, 2019

**13. *Coprinus comatus*** Mull.

*Sample ID:* Saket076 (Fig.1 M)

*Family:* Agaricaceae

*Description:* **Pileus** 2.5-3.2 cm. diameter, ovoid, convex, scaly, white coloured, yellow-brownish scale cap; **Stipe** 5-6 cm. long, 1.5-2.5 cm. thick,

bulbous base, hollow, smooth, whitish coloured; **Gills** free, crowded, narrow, white and become black coloured from margin; **Spores** 9.7-12.5 × 6-8.2 µm., ellipsoid, smooth, thick walled, dark brown to black coloured; Spore print black (Fig.3 J).

*Nature:* Saprobic; Edible in choice at young; Mature inedible.

*Collection Date:* 28.08.2021

*Collection Site:* Village-Mawai, Block-Milkipur, Tahsil-Milkipur

*Verified from:* Singh *et al.*, 2016; Paul *et al.*, 2019

**14. *Coprinus domesticus*** (Botton) Gray

*Sample ID:* Saket036 (Fig.1 N)

*Family:* Agaricaceae

*Description:* **Pileus** 3-7 cm. diameter, ovoid, convex, scaly, margin lined, white to grey coloured; **Stipe** 5-9 cm. long, 0.5-1.5 cm. thick, bulbous base, hollow, smooth, without ring, whitish coloured; **Gills** free, crowded, creamy white to black coloured; **Spores** 6-9 × 3.5-5 µm., ellipsoid, smooth, thick walled, brown coloured; Spore print brown to black (Fig.3 K).

*Nature:* Saprobic; Inedible.

*Collection Date:* 25.09.2021

*Collection Site:* Village-Shanawa, Block-Poorabazar, Tahsil-Sadar

*Verified from:* Readhead *et al.*, 2001; Singh *et al.*, 2016

**15. *Coprinus lagopus*** (Fries) Redhead

*Sample ID:* Saket077 (Fig.1 O)

*Family:* Agaricaceae

*Description:* **Pileus** 3-6.5 cm. diameter, obtuse-conic, umbonate, scaly, margin lined and curved in age, white to grey coloured; **Stipe** 5-9 cm. long, 0.3-1 cm. thick, hollow, smooth, surface dry, hollow, without ring, whitish coloured; **Gills** free, close, narrow, greyish-white to black coloured; **Spores** 9.5-11 × 5-7 µm., elliptical, smooth, dark brown coloured; Spore print brown to black.

*Nature:* Saprobic; Edibility unknown.

*Collection Date:* 17.12.2022

*Collection Site:* Village-Gaura, Block-Sohawal, Tahsil-Sohawal

*Verified from:* Keirle *et al.*, 2004; Kuo, 2008

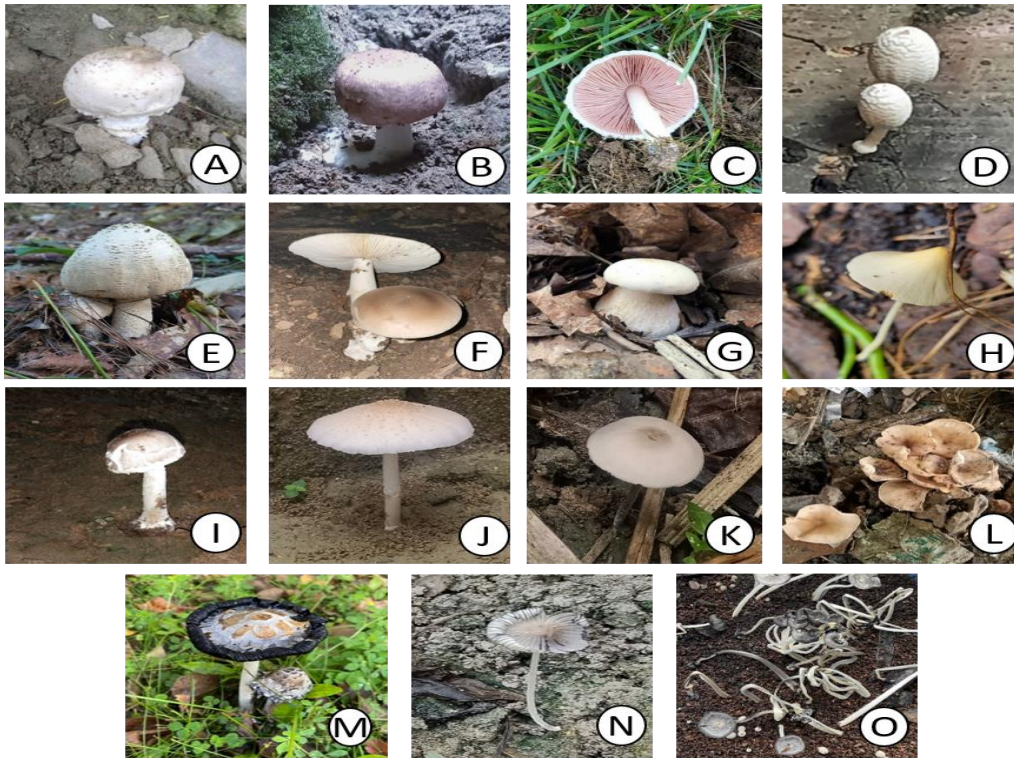
**16. *Hygrocybe eburneus*** (Bull.) Fr.

*Sample ID:* Saket074 (Fig.2 A)

*Family:* Hygrophoraceae

*Description:* **Pileus** 4-6 cm. diameter, convex, smooth, scaly, margin inrolled, pinkish-white coloured; **Stipe** 4-5.5 cm. long, 0.8-1.2 cm. thick, smooth, hollow, without ring, whitish coloured;





**Figure 1:** A, *Agaricus bernardii*; B, *Agaricus blazei*; C, *Agaricus campestris*; D, *Amanita bisporigera*; E, *Amanita pelioma*; F, *Amanita vaginata*; G, *Bovista plumbea*; H, *Canocybe apala*; I, *Chlorophyllum molybdites*; J, *Collybia butyracea*; K, *Collybia erythropus*; L, *Collybia fuscopurpurea*; M, *Coprinus comatus*; N, *Coprinus domesticus*; O, *Coprinus lagopus*



**Figure 2:** A, *Hygrocybe eburneus*; B, *Lactarius quietus*; C, *Lepiota aspera*; D, *Leucoagaricus americanus*; E, *Leucoagaricus leucothites*; F, *Leucocoprinus cepistipes*; G, *Lycoperdon perlatum*; H, *Lycophyllum connatum*; I, *Macrolepiota procera*; J, *Panaeolus antillarum*; K, *Panaeolus papilionaceus*; L, *Parasola conopilea*; M, *Phallus indusiatus*; N, *Phallus multicolour*; O, *Pleuteus salicinus*

**Gills** decurrent, waxy, white coloured; **Spores** 5.5-6.8 × 3-4 µm., elliptical, whitish coloured. Spore print white.

*Nature*: Saprobic; Edible.

*Collection Date*: 17.09.2022

*Collection Site*: Village-Sidhau, Block-Rudauli, Tahsil-Rudauli

*Verified from*: Vishwakarma and Tripathi, 2019

### 17. *Lactarius quietus* Fr.

*Sample ID*: Saket090 (Fig.2 B)

*Family*: Russulaceae

*Description*: **Pileus** 4-8.5 cm. diameter, convex, dark concentric zone, yellow-brown to reddish-brown coloured; **Stipe** 4-7.5 cm. long, 5-10 mm. thick, hollow, without ring, yellow-brown to reddish-brown coloured; **Gills** decurrent, crowded, creamy-brown coloured; **Spores** 7.5-10 × 5-7 µm., elliptical, creamy-whitish coloured; Spore print cream-white.

*Nature*: Mycorrhizal; Edibility unknown.

*Collection Date*: 07.01.2023

*Collection Site*: Village-Adhiyari, Block-Milkipur, Tahsil-Milkipur

*Verified from*: Courtya *et al.*, 2006; Kuo, 2005

### 18. *Lepiota aspera* (Pers.) Quell.

*Sample ID*: Saket022 (Fig.2 C)

*Family*: Agaricaceae

*Description*: **Pileus** 2-5.5 cm. diameter, convex to flat with maturity, scaly, white to brown coloured; **Stipe** 5-8 cm. long, 0.5-1.5 cm. thick, smooth, hollow, without ring, brownish coloured; **Gills** free, crowded, closed, white coloured; **Spores** 6-9 × 2.5-3 µm., ellipsoid, smooth, whitish coloured; Spore print white (Fig.3 L).

*Nature*: Saprobic; Edible with care.

*Collection Date*: 26.09.2021

*Collection Site*: Village-Chandpur, Block-Bikapur, Tahsil-Bikapur

*Verified from*: Vishwakarma and Tripathi, 2019

### 19. *Leucoagaricus americanus* (Peck) Vellinga

*Sample ID*: Saket028 (Fig.2 D)

*Family*: Agaricaceae

*Description*: **Pileus** 4.5-8 cm. diameter, oval, convex to flat, dry and smooth, scaly, white to reddish-brown coloured; **Stipe** 8-10 cm. long, 1-3 cm. thick, tapering towards base, white to reddish-brown coloured; **Gills** free, crowded, closed, white coloured; **Spores** 8-9 × 4-6.5 µm., ellipsoid, smooth, whitish to cream coloured; Spore print white.

*Nature*: Saprobic; Edible.

*Collection Date*: 28.08.2021

*Collection Site*: Village-Shanawa, Block-Poorabazar, Tahsil-Sadar

*Verified from*: Singh *et al.*, 2016

### 20. *Leucoagaricus leucothites* (Vitt.) Wasser

*Sample ID*: Saket079 (Fig.2 E)

*Family*: Agaricaceae

*Description*: **Pileus** 5-8 cm. diameter, oval, convex to flat, smooth and silky, flesh or creamy-yellow coloured; **Stipe** 9-11 cm. long, 1-2.5 cm. thick, narrow, ringed, concolorous; **Gills** free, closed, white to flesh coloured; **Spores** 7-8.5 × 4.2-5.5 µm., ovoid, smooth, whitish coloured in mass; Spore print dark brown (Fig.3 M).

*Nature*: Saprobic; Edible.

*Collection Date*: 20.08.2022

*Collection Site*: Village-Shanawa, Block-Poorabazar, Tahsil-Sadar

*Verified from*: Singh *et al.*, 2016

### 21. *Leucocoprinus cepistipes* (Sowerby) Pat.

*Sample ID*: Saket069 (Fig.2 F)

*Family*: Agaricaceae

*Description*: **Pileus** 2-5.6 cm. diameter, ovoid, conical to bell shaped, dry, scaly, white to brown coloured, darker at centre; **Stipe** 3-6 cm. long, 0.3-1 cm. thick, base swollen, smooth, ringed, yellowish to brownish coloured; **Gills** free, crowded, closed, white coloured; **Spores** 5.5-9 × 4-7 µm., elliptical, smooth, thick walled, whitish coloured; Spore print white.

*Nature*: Saprobic; Inedible.

*Collection Date*: 24.01.2021

*Collection Site*: Village-Chandpuri, Block-Masodha, Tahsil-Sadar

*Verified from*: Vishwakarma and Tripathi, 2019

### 22. *Lycoperdon perlatum* Pers.

*Sample ID*: Saket023 (Fig.2 G)

*Family*: Agaricaceae

*Description*: **Pileus** 2-6.6 cm. diameter, pear shaped, surface covered by spines, whitish-grey or brown coloured; **Stipe** 1-3 cm. long, thin, bare, short, brownish coloured; **Gills** free, crowded, closed, white coloured; **Spores** 6.5-7 × 4-5 µm., spherical, smooth, thick walled, whitish-brown coloured; Spore print greenish brown (Fig.3 N).

*Nature*: Saprobic; Inedible.

*Collection Date*: 23.10.2021

*Collection Site*: Village-Sewar, Block-Amaniganj, Tahsil-Milkipur

*Verified from*: Thind and Thind, 1982; Natarajan and Purushothama, 1987

**23. *Lycophyllum connatum*** (Schumach.) Singer

*Sample ID:* Saket086 (Fig.2 H)

*Family:* Lycophyllaceae

*Description:* **Pileus** 2-8 cm. diameter, convex, semi-flattened, wavy margin, smooth and dry, whitish coloured; **Stipe** 2-5 cm. long, 0.5-1.5 cm. thick, slightly swollen at base, ring absent, white coloured; **Gills** adnate, crowded, closed, white coloured; **Spores** 5.5-7 × 3-4.5 µm., ellipsoid, smooth, with oil drops; Spore print white.

*Nature:* Saprobic; Inedible.

*Collection Date:* 23.04.2022

*Collection Site:* Village-Rauzagaon, Block-Rudauli, Tahsil-Rudauli

*Verified from:* Alvarado *et al.*, 2015

**24. *Macrolepiota procera*** (Scop.) Singer

*Sample ID:* Saket064 (Fig.2 I)

*Family:* Agaricaceae

*Description:* **Pileus** 7-11.2 cm. diameter, ovoid or button spherical, scaly, pale buff to grey-brown coloured; **Stipe** 11-13 cm. long, 1-2.5 cm. thick, large ringed, smooth, whitish to brown coloured; **Gills** free, crowded, narrow, white coloured; **Spores** 8-8.8 × 4.2-5 µm., ovoid, smooth; Spore print white (Fig.3 O).

*Nature:* Saprobic; Edible.

*Collection Date:* 18.08.2022

*Collection Site:* Village-Shankargarh, Block-Poorabazar, Tahsil-Sadar

*Verified from:* Singh *et al.*, 2016; Paul *et al.*, 2019

**25. *Panaeolus antillarum*** (Fr.) Dennis

*Sample ID:* Saket092 (Fig.2 J)

*Family:* Bolbitiaceae

*Description:* **Pileus** 3-7 cm. diameter, bell shaped to convex, thick, smooth, white to light grey coloured; **Stipe** 5-18 cm. long, 1-2 cm. thick, solid, whitish to greyish coloured; **Gills** free, crowded, narrow, grey to black coloured; **Spores** 11-15.2 × 7.2-11 µm., ellipsoid, cylindrical, smooth; Spore print black.

*Nature:* Saprobic; Edible but not commonly eaten.

*Collection Date:* 30.07.2022

*Collection Site:* Village-Manjha, Block-Mayabazar, Tahsil-Bikapur

*Verified from:* Stamets, 1996

**26. *Panaeolus papilionaceus*** (Bull.) Quel.

*Sample ID:* Saket098 (Fig.2 K)

*Family:* Bolbitiaceae

*Description:* **Pileus** 1.5-5 cm. diameter, bell shaped to convex, thick, smooth, grey-brown coloured; **Stipe** 4-15 cm. long, 4-7 mm. thick, ring absent,

dark greyish coloured; **Gills** closed, crowded, narrow, dark brown to black coloured; **Spores** 11-15.5 × 7-11 µm., elliptical, lemon shaped, smooth; Spore print black.

*Nature:* Saprobic; Inedible.

*Collection Date:* 07.01.2023

*Collection Site:* Village-Bisnoharpur, Block-Bikapur, Tahsil-Bikapur

*Verified from:* Kuo, 2007

**27. *Parasola conopilea*** (Fr.) Orstadius and E. Larss

*Sample ID:* Saket075 (Fig.2 L)

*Family:* Psathyrellaceae

*Description:* **Pileus** 1.5-5 cm. diameter, conical to bell shaped or convex, smooth, reddish-brown coloured; **Stipe** 5-12.5 cm. long, 2-3 mm. thick, without ring, fragile, hollow, white coloured; **Gills** attached, distant close, brown to dark grey coloured; **Spores** 14-15.5 × 6-7 µm., ellipsoid, smooth; Spore print black.

*Nature:* Saprobic; Inedible.

*Collection Date:* 29.10.2022

*Collection Site:* Village-Jainabad, Block-Mawai, Tahsil-Ridauli

*Verified from:* Money, 2005; Money, 2016; Baroni, 2017

**28. *Phallus indusiatus*** Vent.

*Sample ID:* Saket020 (Fig.2 M)

*Family:* Phallaceae

*Description:* **Pileus** 6-8 cm. diameter, conical to bell shaped, smooth, reticulate, girded with net like form, light brown to white coloured; **Stipe** 2-2.5 cm. long, without ring, white coloured; **Spores** 2-3 × 1-2 µm., elliptical, smooth, thin walled, hyaline; Spore print olive. *Nature:* Saprobic; Inedible.

*Collection Date:* 03.12.2022

*Collection Site:* Village-Sarraiya, Block-Mayabazar, Tahsil-Bikapur

*Verified from:* Huang *et al.*, 2011; Paul *et al.*, 2019

**29. *Phallus multicolor*** (Berk. & Broome) Cooke

*Sample ID:* Saket045 (Fig.2 N)

*Family:* Phallaceae

*Description:* **Pileus** 3-4 cm. diameter, conical, perforated at apex, pitted as reticulate pattern, surface lemon-yellow, covered by thick layer of dark brown; **Stipe** 8-10 cm. long, 1-2 mm. thick, dry, hollow, white to yellowish-yellow coloured; **Spores** 3-4.5 × 1-2 µm., ellipsoid, cylindrical; Spore print olive.

*Nature:* Saprobic; Poisonous.

*Collection Date:* 24.12.2022



*Collection Site:* Village-Sidhaura, Block-Haringtonganj, Tahsil-Bikapur

*Verified from:* Burk and Smith, 1978; Paul *et al.*, 2019

**30. *Pleuteus salicinus*** (Pers.) P. Kumm.

*Sample ID:* Saket099 (Fig.2 O)

*Family:* Pluteaceae

*Description:* **Pileus** 2-4 cm. diameter, convex, scaly at centre, margin darker, whitish-grey to brownish-

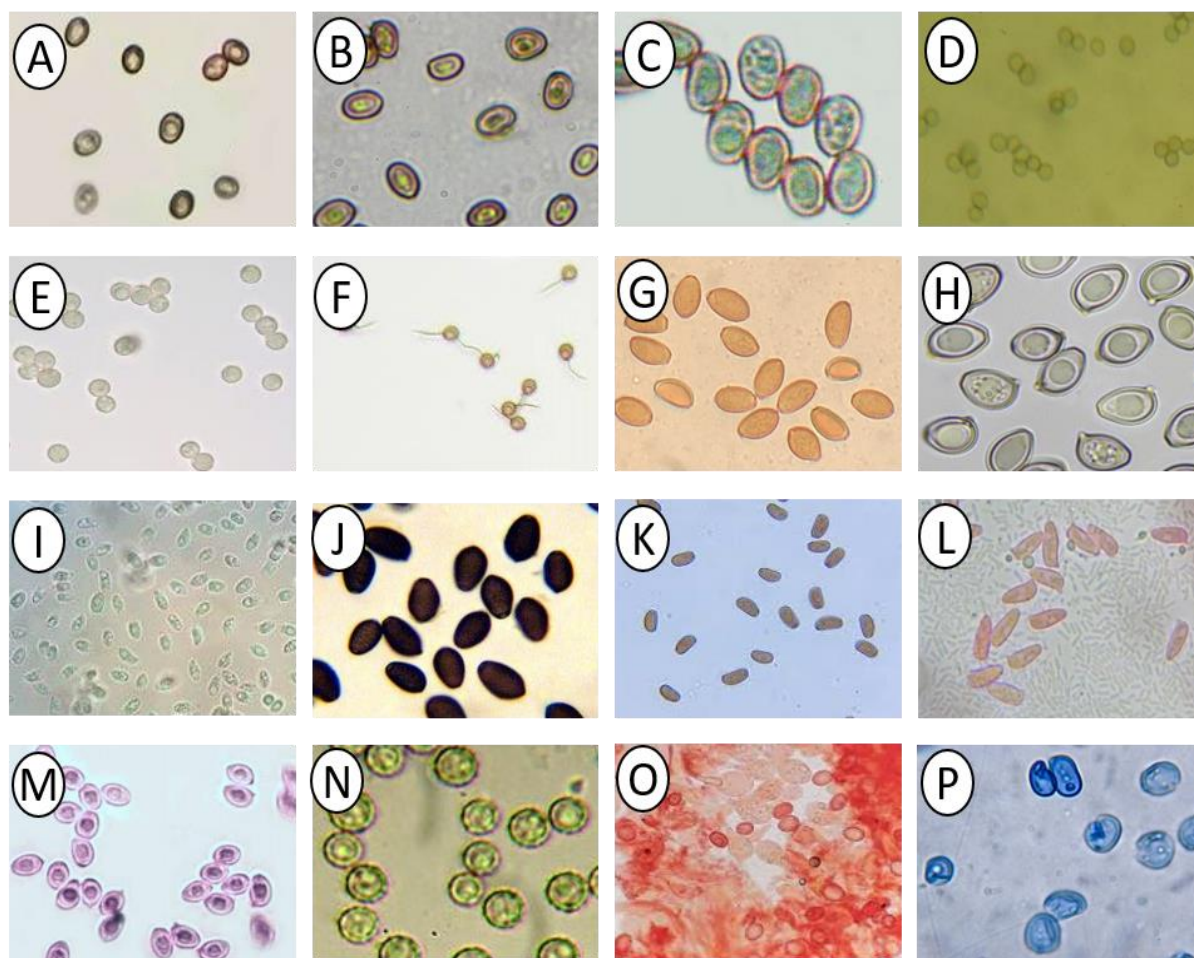
grey coloured; **Stipe** 2-5 cm. long, 0.3-0.6 cm. thick, slightly swollen at base, ring absent, white to greyish coloured; **Spores** 7-8 × 4.5-6 μm., ellipsoid, smooth, cylindrical; Spore print bluish (Fig.3 P).

*Nature:* Saprobic; Edible.

*Collection Date:* 18.03.2023

*Collection Site:* Village-Ballipur, Block-Masodha, Tahsil-Sadar

*Verified from:* Konuk *et al.*, 2006; Justo, 2014



**Figure 3:** A, *Agaricus bernardii*; B, *Agaricus blazei*; C, *Agaricus campestris*; D, *Amanita bisporigera*; E, *Amanita vaginata*; F, *Bovista plumbea*; G, *Conocybe apala*; H, *Chlorophyllum molybdites*; I, *Collybia butyracea*; J, *Coprinus comatus*; K, *Coprinus domesticus*; L, *Lepiota aspera*; M, *Leucoagaricus leucothites*; N, *Lycoperdon perlatum*; O, *Macrolepiota procera*; P, *Pleuteus salicinus*

**DISCUSSION**

For ecosystem and environmental health, macrofungi represents a chief component and important element. Macrofungi play diverse roles ranging from mycorrhizal associations to parasitism and decomposition of various plant materials. Macrofungi hold considerable economic value for society due to their nutritional and

medicinal benefits. Some species of macrofungi can be collected for human consumption and known to be highly edible. In present study herein, 30 taxa of macrofungi belonging to 9 families and 17 genera were identified in the phylum Basidiomycota. The results were obtained from a three-year survey conducted at various sites where macrofungi were collected with overlapping occurrences.



**Table 1:** List of macrofungi with their relative habitat and edibility nature.

S.N.	Macrofungi	Family	Habitat	Edibility
1.	<i>Agaricus bernardii</i>	Agaricaceae	Saprobic	Edible
2.	<i>Agaricus blazei</i>	Agaricaceae	Saprobic	Edible in Choice
3.	<i>Agaricus campestris</i>	Agaricaceae	Saprobic	Edible in Choice
4.	<i>Amanita bisporigera</i>	Amanitaceae	Mycorrhizal	Inedible (Deadly)
5.	<i>Amanita pelioma</i>	Amanitaceae	Mycorrhizal	Inedible (Poisonous)
6.	<i>Amanita vaginata</i>	Amanitaceae	Mycorrhizal	Edible in Choice
7.	<i>Bovista plumbea</i>	Agaricaceae	Saprobic	Edible
8.	<i>Conocybe apala</i>	Bolbitiaceae	Saprobic	Inedible
9.	<i>Chlorophyllum molybdites</i>	Agaricaceae	Saprobic	Inedible
10.	<i>Collybia butyracea</i>	Marosmiaceae	Saprobic	Edible
11.	<i>Collybia erythropus</i>	Marosmiaceae	Saprobic	Edible in Choice
12.	<i>Collybia fuscopurpurea</i>	Marosmiaceae	Saprobic	Inedible
13.	<i>Coprinus comatus</i>	Agaricaceae	Saprobic	Edible in Choice
14.	<i>Coprinus domesticus</i>	Agaricaceae	Saprobic	Inedible
15.	<i>Coprinus lagopus</i>	Agaricaceae	Saprobic	Unknown
16.	<i>Hygrocybe eburneus</i>	Hygrophoraceae	Saprobic	Edible
17.	<i>Lactarius quietus</i>	Russulaceae	Mycorrhizal	Unknown
18.	<i>Lepiota aspera</i>	Agaricaceae	Saprobic	Edible with care
19.	<i>Leucoagaricus americanus</i>	Agaricaceae	Saprobic	Edible
20.	<i>Leucoagaricus leucothites</i>	Agaricaceae	Saprobic	Edible
21.	<i>Leucocoprinus cepistipes</i>	Agaricaceae	Saprobic	Inedible
22.	<i>Lycoperdon perlatum</i>	Agaricaceae	Saprobic	Inedible
23.	<i>Lycophyllum connatum</i>	Lyophyllaceae	Saprobic	Inedible
24.	<i>Macrolepiota procera</i>	Agaricaceae	Saprobic	Edible
25.	<i>Panaeolus antillarum</i>	Bolbitiaceae	Saprobic	Edible with care
26.	<i>Panaeolus papilionaceus</i>	Bolbitiaceae	Saprobic	Inedible
27.	<i>Parasola conopilea</i>	Psathyrellaceae	Saprobic	Inedible
28.	<i>Phallus indusiatus</i>	Phallaceae	Saprobic	Inedible
29.	<i>Phallus multicolor</i>	Phallaceae	Saprobic	Inedible (Poisonous)
30.	<i>Pleuteus salicinus</i>	Pluteaceae	Saprobic	Edible

## CONCLUSION

The macrofungal health reveal the wealth of ecosystem and shows a healthy biogeochemical cycling in ecological process. The present study provides a pioneer diversity report of microfungi in Ayodhya district, Uttar Pradesh, India. Collected macrofungi certainly provide evidence of the high level of macrofungal diversity of Ayodhya region, which is seriously understudied for macrofungal flora.

## CONFLICT OF INTEREST

There is no conflict of interest.

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