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First report on five hitherto unreported macro fungi from Rajouri district of Jammu & Kashmir (J&K), India

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ABSTRACT

The present study was undertaken within a year from January 2012 to December 2012 in different localities of coniferous forests of Rajouri Dist. of J&K, India to collect the samples of macro fungi. The vegetation and climatic conditions of state Jammu and Kashmir in India possessed a prime location in the world for the hot spot and biodiversity of macro-fungi. Although this region is still unexplored due to unawareness and less attention towards this subject. The study was therefore done to explore the variable and diverse species of macrofungi which have socio-economic and medicinal importance. The present study is describing the systemic position and taxonomic identification of five new genera of macrofungi which were not explored previously. The five new species of macrofungi that were explored and taxonomically identified are Scleroderma citrinum, Psilocybe subtropicalis, Ganoderma applanatum, Cyptotrama asprata and Entoloma serrulatum. The voucher specimens after taxonomic identification were deposited in NCFT, New Delhi, India and were assigned axccession numbers.

Key words: Macrofungi, J&K districts, taxonomic identification, medicinal importance.

INTRODUCTION

The mountainous range of Western Himalaya possesses rich forest biodiversity owing to the wide variation in agro-climatic conditions, altitude, plant species etc. The State of Jammu & Kashmir falls in the mountainous range of Western Himalaya and has abundant temperate forests, mostly dominated by conifers. These coniferous forests presumably possess great diversity not only in plant species but also in macro fungi. Only some selected pockets of these forests have been surveyed that too in unsystematic manner. However, the dwindling forest cover due to anthropogenic activities across the State has unnoticeably led to the loss of many rare fungal species. In J&K State no base-line data about the macro fungal diversity is available, except some stray reporting of hitherto unrecorded macro fungi [1-7]. The ability of conifers to grow over a wide range of habitats and over long periods is linked with the high level of ectomycorrhizal fungal diversity. Ectomycorrhizal fungi, with a few exceptions, belong to either ascomycota or basidiomycota, and most species produce macroscopic sporocarps in the form of mushrooms, truffles, etc. Besides, many macrofungi observed in these forests are either edible or medicinal mushrooms or wood rotting fungi. These fungal species vary in their abundance and phenology of fruiting as well as in nutritional value of their sporocarps [8, 9]. Various biotic and abiotic factors influence the sporocarp production of macrofungi [10]. Sporocarps are non-uniform in distribution varying from a few scattered fruiting bodies to concentrated clusters of numerous fruit bodies [11]. The documentation of existing fruiting patterns is critical to the interpretation of changes that may result from several manipulations. The practical way to compare the relative functional importance of species of macrofungi, especially ectomycorrhizal ones, in an ecosystem is by estimating the sporocarp production. Most of the macrofungal species producing hypogeous/epigeal sporocarp are thought to be ectomycorrhizal [12-14]. Seasonal distribution of hypogeous sporocarps quantitatively through sporocarp dry weight, number for individual species and population was determined [15]. Sporocarp formation varies both in space and time, and depends on a

range of external factors. The aim of present investigation was to generate base-line information on prevailing macrofungi, including ectomycorrhiza, of Western Himalayan forests and to study the seasonal variation in epigeal fruiting pattern/production/distribution in Rajouri Dist. of Jammu & Kashmir, India. Mushroom is regarded as a macrofungus with a distinctive fruiting body that can be either epigeous or hypogeous and large enough to be seen with the naked eye and to be picked by hand [16]. Mushrooms belong to the kingdom fungi, which constitutes the most diverse group of organisms after insects on this biosphere. Defining the exact number of fungi on the earth has always been a point of discussion and several studies have been focussed on enumerating the world's fungal diversity [17]. Current studies estimate that out of 1.5 million species of fungi existing on this biosphere, 140,000 species may be considered as mushrooms, but only 14,000 species are known to man, which accounts for 10% of the estimated mushroom species [16]. Only a fraction of total fungal biodiversity has been subjected to scientific scrutiny and mycologists continue to unravel the unexplored, hidden and fascinating fungal biodiversity as many macro-fungi are becoming extinct or facing threat of extinction because of habitat destruction and global climate change [18]. There are about 7750 macrofungal species known to have ectomycorrhizal nature. The genus *Amanita* contains about 500 species; including some of the most toxic known mushrooms found worldwide while some of the species are having medicinal and pharmaceutical importance according to their antioxidant values [19, 20]. This genus is responsible for approximately 95% of the fatalities resulting from mushroom poisoning, with death cap accounting for about 50% on its own.

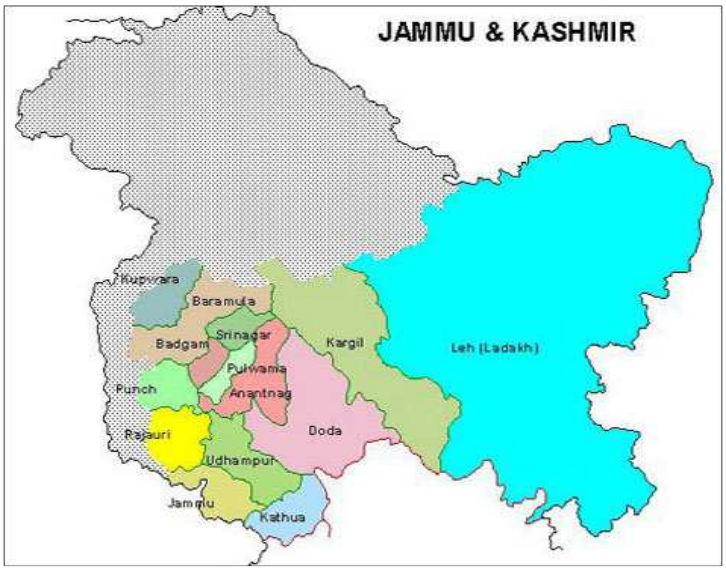

Image 1: Map showing districts boundaries in J&K, India

Image 2: Map showing different districts of Jammu & Kashmir, India

The state Jammu and Kashmir is rich in macrofungal diversity due to wide agro-climatic variations, diverse physiographic conditions and undulating topography, but understanding of the macro-fungal flora of the Kashmir is still in an exploratory stage and undoubtfully there are many more species to be recorded [21]. Jammu and Kashmir State is stretched between 32°17'-37°03' N latitude and 72°03'-80°20' E longitude, and covers a total area of 222,235

km², with an average annual rainfall between 60-80 cm. It is bordered to the north and east by the main Himalayan ranges and Punjab plains to the south. The state exhibits varied climatic and topographic conditions and provide pleasant environment for the lavish growth of diverse group of plants. However, information on the species of wild mushrooms from this state is limited. In this backdrop, a systematic study of wild mushroom diversity from various locations of Jammu and Kashmir was undertaken. Previous studies were performed [22] on collection and taxonomic identification of some of the other varieties of macrofungi from Kashmir region. The present communication describes the brief morphological description, macro and microscopic details, seasonal occurrence and edibility of the 05 new species of macro fungi (not reported previously) belonging to different genus collected from Rajouri Dist. of Jammu & Kashmir (J&K), India.

MATERIALS AND METHODS

The regular field trips were undertaken within a year from January 2012 to December 2012 in different localities of coniferous forests of Rajouri Dist. of J&K, India to collect the samples of macro fungi. During collection of mushroom fungi extensive care has been taken to avoid any damage to the base and fragile parts of the samples. Macroscopic characters such as shape, size, colour, colour difference with age, taste, odour, spore deposition of fresh specimens [23, 24] and its natural habitat was recorded with the season of appearance of their fruiting body. The specimens were kept in separate paper bags to avoid mixing. The photography was accomplished using digital camera (Sony C.S- DSC-W320). Each specimen was collected and labelled, indicating number, date of collection, locality and uses, and then brought to the laboratory for macro and micro investigations after that necessary micro chemical reactions were carried out to satisfy some probability factors. Collected specimens were dried, preserved in paper or polythene bags or in shape of herbarium sheets [25-27]. Identification was made on the basis of critical observations of the specimens and by the use of relevant literature under the guidance of experts.

RESULTS

The present investigation thus leads to the identification of 05 new species of macro fungi which were not explored previously. All collections have been deposited in the herbarium of NCFT and were assigned accession numbers viz. *Scleroderma citrinum* (NCFT5674.12); *Psilocybe subtropicalis* (NCFT5611.12)*; Ganoderma applanatum* (NCFT5671.12); *Cyptotrama asprata* (NCFT5237.12) and *Entoloma serrulatum* (NCFT4571.12)

Study on the collected species of macrofungi:
1. *Scleroderma citrinum* (NCFT5674.12) (Collected from Bhetara Teh. Kalakote) Systemic position:
Kingdom: Fungi
Division: Basidiomycota
Class: Agaricomycetes
Order: Boletales
Family: Sclerodermataceae
Genus: *Scleroderma*
Species: *citrinum*

Figure 1 (a): Fruiting bodies of Scleroderma *citrinum* (NCFT5674.12)

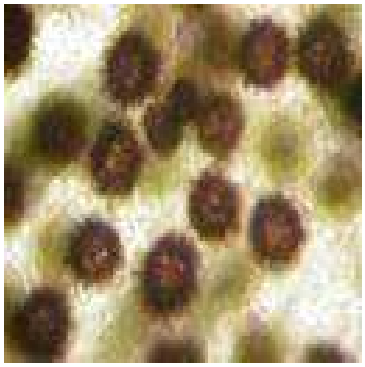

Figure 1 (b): Microscopic slide of spores of *Scleroderma citrinum* (NCFT5674.12)

Description:
Habitat: this species was found in mycorrhizal condition with hardwoods and conifers; often found in mossy areas, especially on sandy soils; growing alone, scattered, or gregariously; widely distributed; found in the month of July to early December. *Scleroderma citrinum*, the Common Earthball, is a poisonous fungus similar in appearance to a warty potato. The rounded fruitbody was attached to the ground by white mycelial threads, visible in the picture. The tough thick skin of the earthball was initially white, cream or yellow and turned brown or green as it ages; it is covered by a web of rough scales. Fruit body was 2-13 cm in diameter; roughly spherical in shape; the surface was hard and scaly, yellowish to yellow-brown, often cracked; the peridium was whitish when sliced but have pinkish tinch;. In maturity, the peridium breaks open to release the spores. Gleba was thick and white later turns purple-black from the center towards periphery. Spore Mass consisted of thick and white spores at first, becoming purple to purple-black from the center outwards; eventually blackish to brownish and appeared dust-like brown. They were globose, reticulate in shape with spines up to 1.4 µm long; 7-12 µm diameter. On chemical treatment with KOH the surface becomes dark reddish in color. This mushroom is inedible and can be poisonous if eaten.

2. *Psilocybe subtropicalis* (NCFT5611.12) (Collected from Daghera village Teh. Sunderbani)
Systemic position:
Kingdom: Fungi
Division: Basidiomycota
Class: Agaricomycetes
Order: Agaricales
Family: Strophariaceae
Genus: Psilocybe
Species: Subtropicalis

Figure 2 (a): Fruiting bodies of *Psilocybe subtropicalis* (NCFT5611.12)

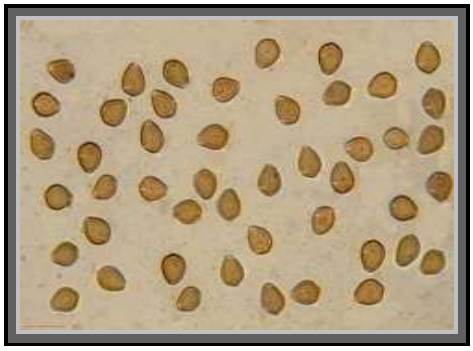

Figure 2 (b): Microscopic slide of spores of *Psilocybe subtropicalis* (NCFT5611.12)

Description:
Habitat Found on soil, in open places of subtropical conifer forests of Rajouri. Season: from june to November. The pilus was reddish brown to straw colour, 19-25 mm in diameter, shape was sub convex, and surface was dry glabrous, turned completely black when dried. Gills were pale brown to blackish violet with white margins. There attachment was adnate. Stipe was about 38-82x1-2.5mm in dimensions, whitish, fleshy in the pileus, subfleshy in the stipe, having floccose appressed white fibrils with slightly bulbous hollow base, and stained blue when cut apart. Spores are 5.5x4.5um, sub rhomboidal in face view, sub ellipsoidal from side view consisted of thick wall (1.4um),brownish yellow in colour having a wide germ pore at on end and a short appendage at its opposite end. Basidia is about 16.4-25.7x5.3-7.8 um, having four spores shape was sub cylindrical and hyaline in colour. Pleurocystidi was observed i.e hyaline in colour with ventricose subcuminate shape and having dimensions 14-20x4-7um. Cheilocystidi also reported in this specimen with subcylindric shape hyaline body having branching at the top sub hymenium formed from subglobose elements was present. Light yellowish Gill pattern regular. Clamp connections were also present.

3. *Ganoderma applanatum* (NCFT5671.12) (Collected from Nowshera Town Teh. Nowshera)
Systemic position:
Kingdom: Fungi
Division: Basidiomycota
Class: Agaricomycetes
Order: Polyporales
Family: Ganodermataceae
Genus: *Ganoderma*
Species: *applanatum*

Figure 3 (a): Fruiting bodies of *Ganoderma applanatum* (NCFT5671.12)

Figure 3 (b): Microscopic slide of *Ganoderma applanatum* (NCFT5671.12)

Description:

Have found it as Solitary or in small groups on downed logs of both hardwood and conifers, also on living trees; especially common on Morus alba. At latitude 33 09-33 52”N and longitude 74 14 21.46”E at altitude 555m.Its sporocarp was dull grey, grey-brown to brown, fan shaped, Somewhat convex, the fruiting body was perennial, sessile and hard woody in texture i.e. 5.7-6.2cm broad and 5.5-11 cm thick margins irregular often furrowed having flesh up to 6-7cm thick and was brown tough and corky in appearance. Pores: pores 4.2-5.8 per mm, white in colour, quickly turned brown on getting injury, multi-seried tubes present,3.7-14mm long, having a separation of a thin layer tissue; tubes and pores turns black on treatment with KOH .Spores were brown in deposit about elliptical, blunt at the distal end, thick-walled, ornamented with minute spines.

4. *Cyptotrama asprata* (NCFT5237.12) (Collected from Rehan Village Teh. Buddhal)

Systemic position:

Kingdom: Fungi
Division: Basidiomycota
Class: Agaricomycetes
Order: Agaricales
Family: Physalacriaceae
Genus: *Cryptotrama*
Species: *asprata*

Figure 4 (a): Fruiting bodies of *Cyptotrama asprata* (NCFT5237.12)

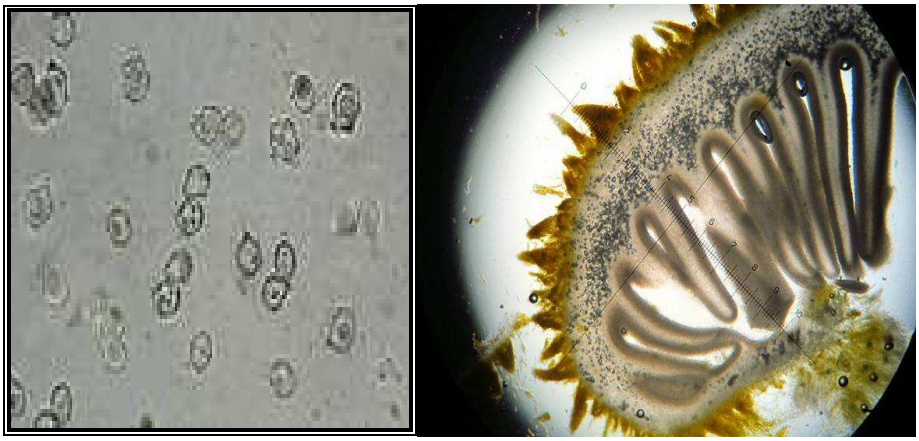

Figure 4 (b): Microscopic slides of spores of *Cyptotrama asprata* (NCFT5237.12)

Description:

Cyptotrama asprata is a saprobic in habitat, reported from the decaying wood of deciduous trees. were typically collected between July through September from conifer forest having abudent pinus sp. tree. The cap is 0.7 to 2.6 cm in diameter, convex to cushion-shaped. Surface is rough and dry, and younger specimens are covered with characteristic spikes; and these spikes withers with age, mature specimens appeared more hairy or woolly. Older specimens typically have the surface features worn off. The cap margin tends to be rolled inwards when young, latter on becoming straight with maturity. The cap is bright or pale yellow, high intensity of colour towards the center of the cap. There found a web-like ring that soon disappears. The gills were pale yellow to white in color, were distantly spaced and have an adnate (squarely attached) or slightly decurrent attachment to the stem; felt greasy when dried and crushed. The stem is 1.2 to 6.4 centimetres long by 0.3 to 0.5 centimetre thick at the stem apex; the stem is slightly thicker towards the base, and may be covered with hyphae that appear woolly or hairy in texture. The surface of the was scaly mostly at the base and having very small granular particles. The flesh was white or pale yellow, with no characterstic taste or ordor. The spore print is white. Edibility is unknown for this fungus. The spore-bearing cells, the basidia, were reported club-shaped, two- to four-spored, and 25–29 by 5–6µm. The presence of sterile cells called pleurocystidia was uncommon; specimens contained few or abundant cheilocystidia (large sterile cells found on the gill edge) that are club-shaped, thin-walled and 37–86.3 by 8.3–15.7 µm in size.[9]Spores were hyaline thin-walled, smooth, and ellipsoidal or oval in shape. Their dimensions were typically 7.2–9.5 by 5–6µm; having a single large oil droplet inside it.

5. *Entoloma serrulatum* (NCFT4571.12) (Collected from Palam Village Teh. Rajouri)

Systemic position:

Kingdom: Fungi.
Phylum: Basidiomycota.
Class: Agaricomycetes.
Order: Agaricales.
Family: Entolomataceae
Genus: *Entoloma*
Species: *serrulatum*

Figure 5 (a): Fruiting bodies of *Entoloma serrulatum* (NCFT4571.12)

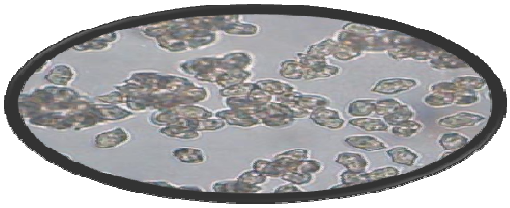

Figure 5 (b): Microscopic slide of spores of *Entoloma serrulatum* (NCFT4571.12)

Description:
Saprobic; was found growing alone and scattered in conifer forest often in moist areas; sometimes found on tree trunks covered with moss, found in the month of late September. Its cap was 1-5.3 cm; convex usually depressed in shape, silky texture and have fine scaly body, especially over the center; bluish black, fading to purplish colour; the margin finely lined with time. Flesh was thin fragile; pale or grayish in colour. Gills were attached to the stem; close; whitish or pale bluish gray at first, eventually pinkish; having black or bluish black edges.Stem was about 3-7.5. cm long; 2-3.3 mm thick; equal; silky at the apex and smooth below; hollow; colored like the cap;. Spore print is pink and spores were 8-11 x 5-8.3 µ; 5-, 6-, or 7-sided. Cheilocystidia are 41-109 x 7.5-12.2 µ in size and are clavate in shape with cuticular elements and pileocystidia present.

DISCUSSION

Since the wild fungi play an important role to maintain the health of forests besides their medicinal importance and nutritional value in most of the cases, therefore it becomes quite necessary to explore, document and conserve this natural wealth. The present communication reports the six species of macro fungus, viz. *Scleroderma citrinum*, *Psilocybe subtropicalis*, *Ganoderma applanatum*, *Cyptotrama asprata* and *Entoloma serrulatum* which are first time from the Rajouri Dist. of Jammu & Kashmir, India.

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