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Six hitherto unreported Basidiomycetic macrofungi from Kashmir Himalayas

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Abstract. *Pala SA, Wani AH, Bhat MY. 2011. Six hitherto unreported Basidiomycetic macrofungi from Kashmir Himalayas. Nusantara Bioscience 3: 92-97.* The Kashmir valley located in the northern extreme of India lies between $33^0$20' and $34^0$54' N latitude and 73^0 55' and $75^0$35' E longitude. The forests constituting more than 20% of the geographical area harbors diverse macrofungal species due to their wide variability in climate altitude and nature of species constituting them. The mushroom flora of the Kashmir Valley has not been documented completely until now. In this backdrop, a systematic survey for exploration and inventorization of macrofungal species of Western Kashmir Himalaya was undertaken during the year 2009-2010. During the study six species viz. *Agrocybe molesta*, C*oprinus plicatilis, Inonotus hispidus, Paxillus involutus, Psathyrella candolleana,* and *Russula fragilis* were identified the first time from the Kashmir.

Keywords: Kashmir Himalayas, wild macrofungi, edible, medicinal.

Abstrak. *Pala SA, Wani AH, Bhat MY. 2011. Enam makrofungi Basidiomycetes yang sampai sekarang belum dilaporkan dari Kashmir Himalaya. Nusantara Bioscience 3: 92-97.* Lembah Kashmir terletak di ujung utara India, antara 33º20' dan 34º54' LU, serta 73º55' dan 75º35' BT. Hutan di kawasan ini mencakup lebih dari 20% luas wilayah geografis, menjadi tempat tinggal beragam spesies makrofungi karena sangat beragamnya iklim di ketinggian dan sifat alamiah dari spesies-spesies penusunnya. Flora jamur di Lembah Kashmir belum pernah didokumentasikan secara lengkap sampai sekarang. Oleh karena itu, sebuah survei sistematika untuk mengeksplorasi dan menginventarisasi spesies macrofungi dari bagian barat Kashmir Himalaya dilakukan selama tahun 2009-2010. Selama penelitian, enam spesies yaitu: *Agrocybe molesta*, C*oprinus plicatilis*, *Inonotus hispidus, Paxillus involutus, Psathyrella candolleana* dan *Russula fragilis* diidentifikasi untuk pertama kalinya dari Kashmir.

Kata kunci: Kashmir Himalaya, macrofungi liar, dimakan, obat.

INTRODUCTION

Mushrooms have been a fascinating man due to their unusual characters like sudden appearance in isolated places in groups, rings and different geometrical shapes since the time immemorial. Mushrooms have been existing on earth prior to humans and have been used as food by man since the hunting and gathering period of human history (Cook 1977).

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 focused on enumerating the world's fungal diversity (Crous 2006). The number of existing fungi Worldwide has been estimated to 1.5 million species (Hawksworth 2004) and about 15,000 of them are mushrooms of which about 7,000 are known to possess varying degrees of edibility and more than 3,000 species may be considered prime edible, and 2,000 species have been suggested having medicinal importance (Chang and Miles 2004). Only a fraction of total fungal wealth has been subjected to scientific scrutiny and mycologists continue to unravel the unexplored and hidden wealth, as many macro-fungi are becoming extinct or facing threat of extinction because of habitat destruction and global climate change (Swapana et al. 2008).

Jammu and Kashmir, possess a prime place in the variety and galaxy of macro-fungi due to wide agro-climatic variations, diverse physiography and undulating topography, but understanding of the macro-fungal flora of the Kashmir is still in an exploratory or pioneer stage and undoubtfully there are many more species to be recorded (Watling and Abrahim 1992). Watling and Gregony (1980) recorded 119 taxa of macro-fungi from Kashmir. The list has been extended to 145 species (Beigh et al. 2008), 150 species (Dar et al. 2009a) from Kashmir and 250 from whole Jammu and Kashmir state (Dar et al. 2009b). Four new species viz. *Russula aurea*, *Russula atropurpurea*, *Suiillus variegates* and *Boletus rhodoxanthus* has been added to the list (Dar et al. 2010). Wani et al. (2010) reported nine species of morels and pseudomorels from Southern Kashmir Himalayas. The present communication describes the general distribution, brief morphological description, macro and microscopic details and edibility of

six newly reported species of macro-fungi from Kashmir Himalayas.

MATERIALS AND METHODS

Regular field trips were carried to different places/sites of Western Kashmir Himalayas of Jammu and Kashmir State, India, namely: Uri, Gulmarg (Baramula district), Yusmarg, Doodhpathri, Chadoora (Budgam district) and Kellar (Pulwama district) forests representing different habitats like coniferous forests, deciduous forests, and grasslands (Figure 1). These field trips were organized according to the method given by Halling (1996). The sporocarps were carefully uprooted by digging them out from the soil with the help of a fork and were individually wrapped in aluminum foil and brought to the laboratory for further studies.

Standard method of collection, preservation, macro, and microscopic studies were followed (Kumar et al. 1990; Atri et al. 2003) and the shape, size, and color of fresh

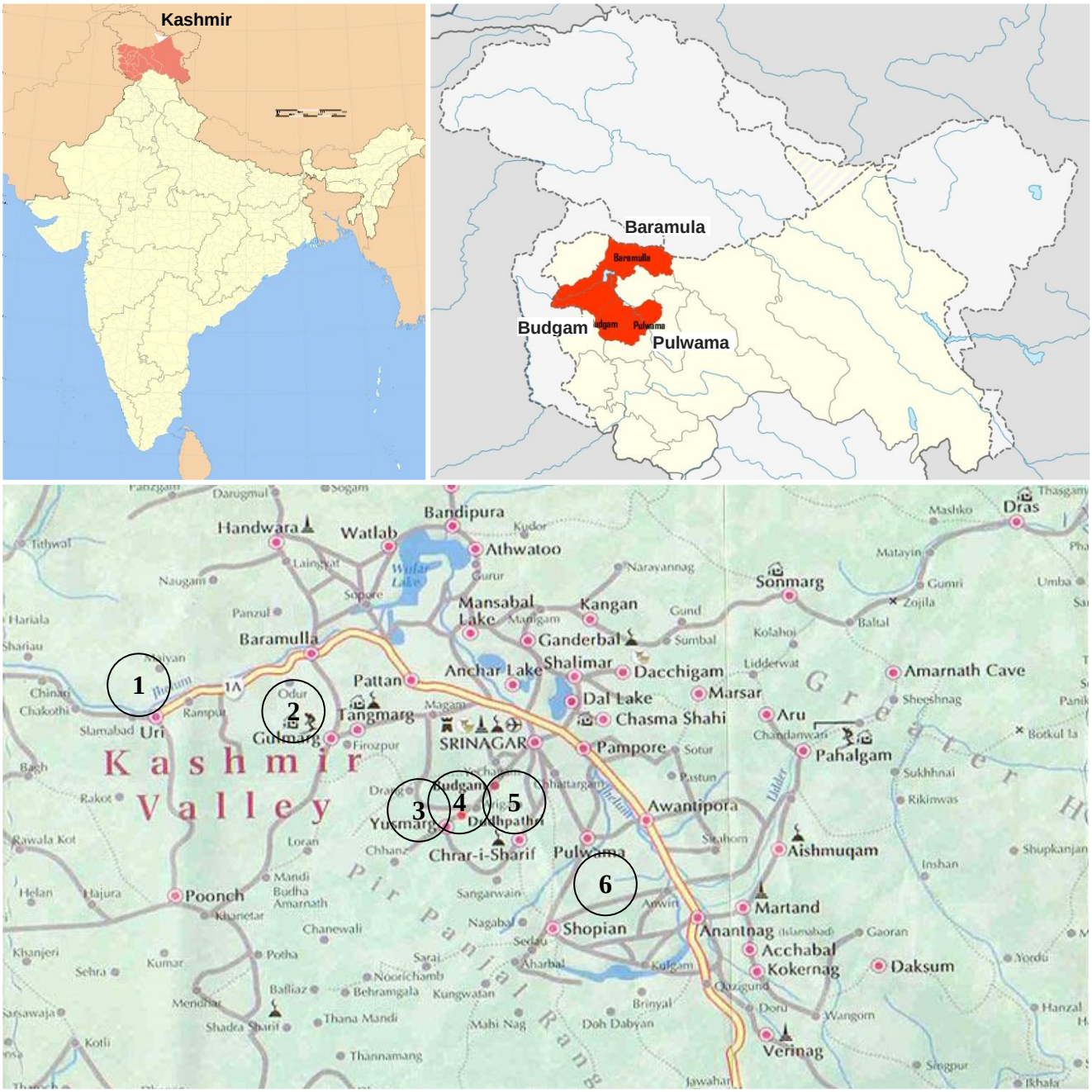

Figure 1. Research sites in Western Kashmir Himalayas of Jammu and Kashmir State, India. 1. Uri, 2. Gulmarg (Baramula district), 3. Yusmarg (Osemarg), 4. Doodhpathri (Dudhpathri), 5. Chadoora (Budgam district) and 6. Kellar (Pulwama district)

specimen were recorded before collection and preservation. The spore prints were taken according to the guidelines given by Kuo (2001). The morphology of spores such as shape and size of spores were recorded under the microscope. Reagents used for preparation of spore slides were 3% KOH, cotton blue, lactophenol, and Melzer's reagent. Photographs were taken in field using Cyber shot Sony 10.1 megapixel camera. The fungal specimens were also preserved in formalin for herbarium purposes and deposited in fungal collection of KASH Herbarium of Plant Taxonomy, Division of Botany, Faculty of Biological Sciences, University of Kashmir, India. The identification of the specimens was carried out by making use of taxonomic keys, field manuals (Lakhanpal 1996, 1997; Atri et al. 2000, 2003) and taking the help of mushroom experts like Prof. N.S Atri, Prof. T.N Lakhanpal, and Dr. R.C Upadhya (Indian Council of Agriculture Research, Himachal Pradesh, India).

RESULTS AND DISCUSSION

During the year 2009-2010, an extensive survey was carried out to different places/sites of Western Kashmir Himalaya to unravel the macrofungal wealth. In the survey a large number of macrofungi belonging to different taxa were witnessed, but six species were first time seen in the Kashmir. The macroscopic and microscopic studies along with photographs of these six species are given below:

***Agrocybe molesta* (Lasch) Singer**

Synonym(s): *Pholiota dura* (Bolt. ex Fr.) Kummer, *Agrocybe dura* (Bolt. ex Fr.) Sing.

English name: Bearded field cap

Local name: Maedan haddur

Description: Cap: 3-7 cm across, convex expanding to almost flat, creamy white to yellowish brown, sometimes developing cracks in age and often with whitish partial veil remnants on the margin. Gills: Adnate, pale at first latter becoming brown to dark brown or purple-brown. Stipe: 4-7 cm in length, 5-1 cm thick, cylindrical, smooth to finely hairy; white; with a thin ring (but the ring often disappears). Flesh: Thick, firm, whitish. Spores: Ovoid-ellipsoid, smooth, 9-12 x 6-8 um^2; Spore print choclate brown.

Habitat and habit: Saprobic, growing singly in grass at roadsides or in meadows.

Season: Early spring to summer, occasional.

Edibility: Inedible

Site of collection: Kellar, Yusmarg

Accession number: SH.KASH-28788

C*oprinus plicatilis* (Curt. & Fr.) Fr.

Synonym(s): *Parasola plicatilis* (Curtis) Redhead, Vilgalys & Hopple

English name: Fragile brittlegill

Local name: Vangan haddur

Description: Cap: 2-4 cm in diameter, initially ovoid but latter on flattens and appears like a small umbrella. The upper surface of the cap is characteristically sulcate (characteristic grooves on the upper surface), and a depression in the center. Color changes from grey brown to silver blue. Gills: Free, initially clay pink then grey, finally black, hardly deliquescing. Stipe: 2-5 cm in length, 0.2-0.3 cm thick, cylindrical, hollow internally and white in color. Spores: Elliptical, smooth, 7-10 x 5-6 um^2; Spore print black.

Habit and habitat: Saprobe, growing solitary in grass lawns.

Season: Spring and rainy summer.

Edibility: Edible

Site of collection: Gulmarg, Kellar

Accession number: SH.KASH-28781

***Inonotus hispidus* (Bull.) P. Karst.**

Synonym(s): Boletus velutinus With. Inonotus hirsutus (Scop.) Murrill, Polyporus hispidus (Bull.) Fr., *Phaeoporus hispidus* (Bull.) J. Schröt.

English name: Pleated inkcap

Local name: Neeji haddur

Description: Fruiting body: 7-22 cm across, 4-8 cm thick, bracket or semicircle or kidney shaped, upper surface hairy, rust redish yellow in color, when mature an iron rust color, and when finally old and dead it becomes black. Pores: Circular to angular, small, 2-3 per mm, olive colored. Water drops coming out of the pores when fruiting body is young. Flesh: Thick, woody, reddish brown

Spores: Subglobose, smooth, 9-12 x 7-10 um^2; Spores print brown.

Habit and habitat: Parasitic on apple and walnut trees; growing usually alone but occasionally fusing with others into overlapping groups. Infection occurs at a branch stub or pruning wound

Season: Summer

Edibility: Edible

Site of collection: Chadoora, Doodhpathri

Accession number: SH.KASH-28792

***Paxillus involutus* (Batsch) Fr.**

Synonym(s): *Agaricus adscendibus* Bolton, *Agaricus contiguus* Bull., *Agaricus involutus* Batsch, *Omphalia involuta* (Batsch) Gray

English name: Shaggy bracket

Local name: Chunth lashe

Description: Cap: 5-11 cm wide, convex with a depression in the center, inrolled margins, olive-brown in color, smooth, and sticky when wet. Gills: Decurrent, close, narrow, brownish yellow, darkens when bruised. Gills can be peeled easily from the cap. Stipe: 2-6 cm long, 1-2 cm thick, equal or tapers towards the base, smooth, cap colored. Flesh: Thick, yellowish brown darkens when bruised. Spores: Ellipsoid, smooth, 7-8 x 6-7 um^2; Spore print brown

Habit and habitat: Mycorrhizal, growing alone or scattered in hardwoods

Season: Summer

Edibility: Inedible

Site of collection: Kellar

Accession number: SH.KASH-28799

Figure 1. Basidiomycetic macrofungi collected from wild in Western Kashmir. A. *Agrocybe molesta*, B. *Coprinus plicatilis*, C. *Inonotus hispidus*, D. *Paxillus involutus*, E. *Psathyrella candolleana*, F. *Russula fragilis*

***Psathyrella candolleana* (Fr.) Maire**

Synonym(s): *Agaricus appendiculatus* Bull., *Agaricus candolleanus* Fr., *Hypholoma candolleanum* (Fr.) Quél., *Psathyra candolleana* (Fr.) G. Bertrand, *Psathyrella microlepidota* Orton

English name: Poison pax

Local name: Zaher haddur

Description: Cap: 3-7 cm diameter, rounded-conical when young, but broadly convex to flat at maturity, light brown initially with scattered small white scales, when young margin adorned with hanging veil remnants. Margins often split at maturity. Gills: Adenate to nearly free, crowded, whitish at first, later grayish or grayish purple and finally dark brown. Stipe: 4-11 cm long, 2-6 mm thick, equal, hollow, fragile, white, without any ring. Flesh: White, vrey thin, fragile Spore: Ellipsoid to ovoid, smooth, nonamloid, with an apical germ pore, 6-9 x 4-5 um^2; Spore print dark brown.

Habit and habitat: Saprobic; growing scattered or gregariously in lawns or pastures, on recently dead hardwood trees, their roots, stumps or debris.

Season: Late spring and early autumn.

Edibility: Edible.

Site of collection: Kellar, Uri

Accession number: SH.KASH-28784

***Russula fragilis* (Pers.) Fr.**

Synonym(s): *Agaricus fragilis* L., *Bolbitius vitellinus* (L.) J. Favre

English name: Pale brittlestem

Local name: Veri haddur

Description: Cap: 3-7 cm in diameter, initially convex but becomes flat with a depression in the center at maturity, color purplish with a dark center but sometimes color fades with rain. The cuticle can be easily peeled and the margins of the cap split at maturity. Gills: Annexed, moderately spaced, white in color but changes color on bruising. Stipe: 4-6 in length, 0.7-1.5 cm thick, cylindrical or club shaped centrally attached with cap, fragile and white in color. Flesh: white and fragile. Spores: Spherical but echinate with 7.5-9 x 6-8 um^2 in size; Spore print is white.

Habit and habitat: Ectomycorrhizal, generally scattered in both coniferous and broad leaved trees.

Season: Summer

Edibility: Inedible

Site of collection: Chadoora, Chrarishrief

Accession number: SH.KASH-28801

Discussion

Several authors have described the taxonomy of mushrooms from various regions of the world but analysis reveals that 60% of the newly described fungi are from tropics including mushrooms and up to 55% of the mushroom species have proved to be undescribed (Hawksworth 2001). Except a dozen of species cultivated on large scale, all the macrofungal species grow in natural habitat and their harvest is being undertaken for the benefit in different countries including India. Nowadays anthropogenic activity has made countries all over the world to show serious concern about the dwindling biodiversity being last at the rate never known before. The 1991 red list for the former republic of Germany, for instance, lists 1,037 species of threatened large fungi constituting 35% of the all the larger fungi (Cherfas 1991). Therefore, exploration, systematics, and conservation of wild mushrooms have received more attention in the present day world.

Different researchers have contributed to the study of mushroom flora of Himalayas and have reported more than 250 species from the Himalayan state Jammu and Kashmir (Abrahim and Kaul 1985, 1988; Abrahim and Kachroo 1989; Watling and Abrahim 1986, 1992; Lakhanpal 1996, 1997; Atri et al. 2000; Beigh 2008; Dar et al. 2009a,b, 2010; Wani et al. 2010). However, the ecological data available on some of the genera is still not enough. Watling and Abrahim (1992) reported 77 mycorrhizal mushroom species containing many species of *Russula* genus from different regions of the Kashmir. Dar et al. (2009a,b, 2010) reported many species of genus *Russula* from Kashmir.

The six species of macrofungi mentioned above has been already reported from other parts of the world and are known to possess varying degrees of nutritional and medicinal values. *Agocybe molesta* an edible species of macrofungi is widely distributed in U.S.A and other parts of the world (Kuo 2006) and is known to have valuable antioxidant potential. *Coprinus plicatilis* an edible mushroom commonly growing in America, Europe, and Asia is also known to possess medicinal importance (Boa 2004). *P. candolleana* possessantibacterial activity against various gram positive bacteria like *Bacillus cereus*, *Bacillus subtilis*, *Staphylococcus aureus*, *Salmonella typhimurium* and *Candida albicans* (Coletto et al. 1999) and also posses antitumor properties (Ohtsuka et al. 1973). Although *Innonotus ispidus*, *Paxillus involutus*, and *R. fragilis* are inedible but possess varying degrees of medicinal properties. Antivral, antibacterial, cytotoxic and anticancer propertyies has been observed in *I. ispidus* (Ali et al. 2003; Al-Fatimi 2005; Zan et al. 2011). *P. involutus* forming ectomycorrhizal relationships with a number of coniferous and deciduous tree species and has been found markedly increasing the resistance of the host plants to pathogenic strains of the *Fusarium oxysporum* (Duchesne et al. 1988). *R. fragilis* forms mycorrhizal relationship with a wide variety of plants is common in temperate zones of Asia, Europe and north America (Phillips 2006). It has been proved that *R. fragilis* had proteins with inherent antimicrobial properties against a number of pathogens (Hearst et al. 2010).

CONCLUSION

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 macrofungus, viz. *Agrocybe molesta* (Lasch) Singer, C*oprinus plicatilis* (Curt. & Fr.) Fr., *Innonotus*

hispidus (Bull.) P. Karst., *Paxillus involutus* (Batsch) Fr., *Psathyrella candolleana* (Fr.) Maire and *Russula fragilis* (Pers.) Fr**.,** which are first time from the Kashmir.

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