

Volvariella of West Bengal, India I.Arun Kumar Dutta¹, Prakash Pradhan¹, Anirban Roy², Krishnendu Acharya^{1*}^{1*}Molecular and Applied Mycology and Plant Pathology Laboratory, Department of Botany, University of Calcutta, Kolkata, West Bengal, - 700019, India.²West Bengal Biodiversity Board, Paribesh Bhawan, Salt Lake City, Kolkata, West Bengal, - 700098, India.Email: krish_paper@yahoo.com**Abstract:** Different species of *Volvariella*, under the family Pluteaceae was collected from different places of West Bengal and was found to be predominant in this state. A detailed macro and microscopic features of those species were presented in this paper.[Dutta AK, Pradhan P, Roy A, Acharya K. *Volvariella* of West Bengal, India I. *Researcher*. 2011;3(6):13-17]. (ISSN: 1553-9865). <http://www.sciencepub.net>.**Key words:** India, Macrofungi, *Volvariella gloiocephala*, *Volvariella pusilla*, *Volvariella volvacea*, West Bengal**1. Introduction**

India is a treasure house of fungal diversity. Compilation of Indian fungal occurrence suggests more than 27000 species of fungi which forms the largest biotic community after insects (Sarbhoy *et al.* 1996). But this number depicts only a fraction of total fungal wealth that has been subjected to scientific scrutiny (Swapna *et al.* 2008). Taxonomic studies of Indian macrofungi have recently been reported to be in decline (Hyde 2003) and this is a rising cause of concern among macrofungal conservationists and enthusiasts especially when so little is known and much is waiting to be explored. Inventories in state of West Bengal by author's group during last decade have helped to reveal the richness of macrofungal diversity of the state (Acharya and Acharya 2001; Acharya and Bhutia 2003; Acharya *et al.* 2003, 2004a, 2004b, 2004c, 2005, 2009a, 2009b, 2010a, 2010b; Rai *et al.* 2005) which is mainly attributed to the milieu of ecological domains with variable combination of altitudinal (coastal-subalpine), climatic and edaphic factors. The genus *Volvariella* is a sharply circumscribed group of agaric species which is characterized macroscopically by having pink colour spores, free lamellae, an exannulate stipe and volvate base. The genus is widely distributed; species have been reported from tropical, subtropical, and temperate regions of both the eastern and the western hemispheres. More than one hundred species, subspecies, and varieties, which today would be considered to belong in *Volvariella*, have been described from throughout the world (Shaffer 1957). There are report of 15 species of *Volvariella* from India. State of West Bengal has reports of five species of *Volvariella* like *V. castanea* (Masse) Roth., *V. delicatula* Masee., *V. diplasia* Berk & Br., *V. thwaitesii* (Hooker) Roth. and *V. terastria* (Berk. & Br.) Singer. In this communication we are reporting *Volvariella gloiocephala* (DC.) Boekhout & Enderle, *Volvariella pusilla* (Pers.) Singer and *Volvariella*

volvacea (Bull.) Singer from the state of West Bengal, India.**2. Materials and methods**

The study materials were collected during the field trip of different regions of South 24 Pargana district of West Bengal, India. The morphological and ecological features were noted and colour photographs were taken in the field. Latitude/ Longitude and elevation of the place was noted with Garmin etrex GPS machine. The specimens were brought to the laboratory and microscopic features were determined by using Carl Zeiss AX10 Imager A1 phase contrast microscope. The specimens were identified according to Shaffer, 1957 and Seok, *et al.*, 2002.

Observation**Taxonomy*******Volvariella gloiocephala* (DC.) Boekhout & Enderle, *Beitr. Kenntn. Pilze Mitteleur.* 2: 78 (1986)****Synonyms*****Agaricus gloiocephalus* DC., in de Candolle & Lamarck, *Fl. franç.*, Edn 3 (Paris) 5/6: 52 (1815)*Agaricus speciosus* Fr., *Observ. mycol.* (Havniae) 2: 1 (1818)*Amanita speciosa* Fr., *Observ. mycol.* (Havniae) 2: 1 (1818)*Pluteus speciosus* (Fr.) Fr., *Anteckn. Sver. Ätl. Svamp.*: 34 (1836)*Volvaria gloiocephala* (Fr.) Gillet, *Hyménomycètes* (Alençon): 388 (1876)*Volvaria speciosa* (Fr.) P. Kumm., *Führ. Pilzk.* (Zwickau): 99 (1871)*Volvaria speciosa* f. *gloiocephala* (DC.) Konrad & Maubl., *Icon. Select. Fung.* 6: 52 (1924)*Volvaria speciosa* (Fr.) P. Kumm., *Führ. Pilzk.* (Zwickau): 99 (1871) f. *speciosa**Volvaria speciosa* var. *gloiocephala* (DC.) R. Heim,

Revue Mycol., Paris 1(Suppl.): 89 (1936)
Volvariella gloiocephala (DC.) Wasser, *Ukr. bot. Zh.* 45(6): 78 (1988)
Volvariella gloiocephala (DC.) Boekhout & Enderle, *Beitr. Kenntn. Pilze Mitteleur.* 2: 78 (1986) var. *gloiocephala*
Volvariella gloiocephala var. *speciosa* (Fr.) Bon, *Docums Mycol.* 22(no. 88): 40 (1993)
Volvariella speciosa (Fr.) Singer, *Lilloa* 22: 401 (1951) [1949]
Volvariella speciosa f. *gloiocephala* (DC.) Courtec., *Bull. Sem. Soc. Mycol. Nord* 34: 16 (1984)
Volvariella speciosa (Fr.) Singer, *Lilloa* 22: 401 (1951) [1949] f. *speciosa*
Volvariella speciosa var. *gloiocephala* (DC.) Singer, *Lilloa* 22: 401 (1951) [1949]
Volvariella speciosa (Fr.) Singer, *Lilloa* 22: 401 (1951) [1949] var. *speciosa*
Volvariopsis gloiocephala (DC.) Murrill, *N. Amer. Fl.* (New York) 10(2) (1917)
Volvariopsis speciosa (Fr.) Murrill, *N. Amer. Fl.* (New York) 10(2) (1918)

Position in classification: Fungi, Basidiomycota, Agaricomycotina, Agaricomycetes, Agaricomycetidae, Agaricales, Pluteaceae, *Volvariella*, *Volvariella gloiocephala*

**<http://www.speciesfungorum.org/Names/SynSpecies.asp?RecordID=103897> (accessed on: 11/05/2011)

Description of the specimen: Pileus 6 cm broad (Fig. 1A), ovoid, expanding to convex or plane, more or less umbonate, viscid, glabrous, margin slightly striate, white to light avellaneous or light brownish gray, often darker on the disc, flesh moderately thick in center, thin towards the margin, soft, white, maculose absent. Lamellae close to crowded, broad, ventricose, free, with uneven to erose edges, white, becoming deep flesh color. Stipe 5.7 × 0.4 cm in diameter, equal or enlarging to base, terete, hollow, minutely pubescent, base tomentose, 0.5 cm thick, white to cream, base mycelial pad. Annulus absent. Volva shallow, margin free and nearly even, lacerate, or lobed, white to light gray. Basidiospores (Fig. 1D) (11.03–)11.82–14.58(–15.76) (av. 12.63) × 7.88–8.27–9.06 μm (av. 8.12), oval to ovoid, occasionally obovoid, $Q_{av} = 1.56$. Basidia 35.46–38.61 × 15.76–16.94 μm (Fig. 1B), clavate, tetrasterigmatic, 4 spored. Pleurocystidia (Fig. 1E) 25.61–39.4 × 19.7–25.61 μm in diameter, subcylindrical to fusoid, fusoid–ventricose, lanceoloid to oblanceoloid, clavate, ovoid, or obovoid, common. Cheilocystidia (Fig. 1C) 17.73–25.61 × 11.82–15.76 μm, fusoid, with or without a projection, fusoid–ventricose, obtusely lanceoloid with or without a knob or nipple at the apex, clavate, or ovoid, abundant. Hymenium trama composed of cellular, 19.7–20.09 μm broad, subglobose, hyaline cells, wall 0.39 μm thick. Pileipellis composed

of cellular, 17.73–19.7 μm broad, globose to subglobose, hyaline, wall 0.39 μm thick. Stipitipellis composed of parallel, septate, hyaline hyphae, 59.1–11.82 μm broad. Stipe context consists of 7.09–7.88 μm broad hyphae, hyaline, septate, intermixed with oliferous hyphae, 9.85–11.82 μm broad, branched sometimes, frequently present. Volva composed of interwoven, septate, 3.94–5.91 μm broad yellowish brown hyphae, intermixed with subglobose to irregularly shaped, hyaline and smooth walled cells, 13.79–43.34 × 11.82–23.64 μm. clamp–connexions absent.

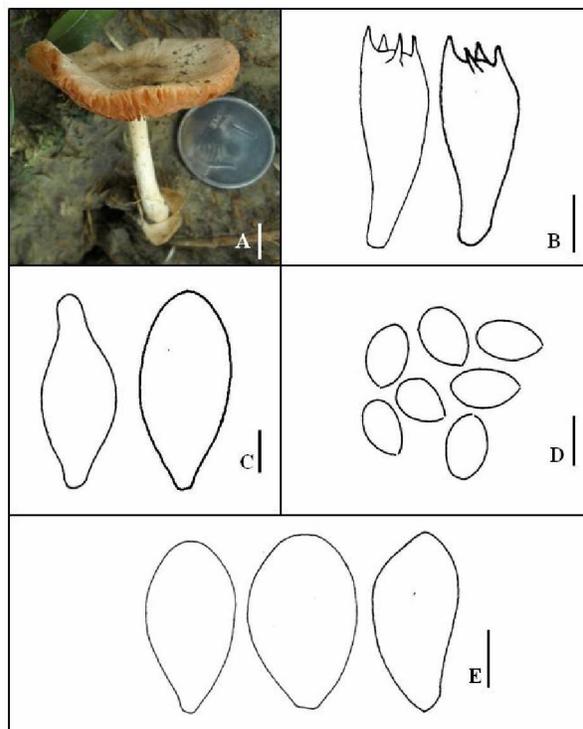


Figure 1. *Volvariella gloiocephala*. A. Basidiocarps, B. Basidium, C. Cheilocystidia, D. Basidiospores, E. Pleurocystidia (A, bar=1 cm; B, bar=10 μm; C, bar = 5 μm, D, bar = 10 μm; E, bar=10 μm).

Habitat: Growing mostly solitary upon cow dung admixed with decaying paddy straw or compost heaps.

Edibility: Edible, but mediocre (Arora, 1986).

Remarks: This material was identified according to Shaffer, 1957 as *Volvariella speciosa* var. *speciosa* (Fr. ex Fr.) Sing. However, Boekhout & Enderle in 1986 rearranged *Volvariella speciosa* var. *gloiocephala* (DC.) R. Heim and var. *speciosa* as the synonyms under the newly constructed *Volvariella gloiocephala* (DC.) Boekhout & Enderle.

Material examined: Kultali (22°04.585 N, 088°36.769 E; 18 ft amsl); 24th July, 2010; K. Acharya and P.

Pradhan; (AMH 164); Kultali Block, South 24 Pargana, West Bengal, India.

***Volvariella pusilla* (Pers.) Singer, *Lilloa* 22: 401 (1951) [1949].**

Synonyms:

Agaricus parvulus Weinm., *Gallicum*: 238 (1836)
Agaricus pusillus (Pers.) DC., (1805)
Amanita pusilla Pers., *Observ. mycol.* (Lipsiae) 2: 36 (1800) [1799]
Volvaria parvula (Weinm.) P. Kumm., *Führ. Pilzk.* (Zwickau): 99 (1871)
Volvaria pusilla (Pers.) Lloyd
Volvariella parvula (Weinm.) Speg., *Boln Acad. nac. Cienc.* 28: 309 (1926)
Volvariella parvula var. *biloba* Massee
Volvariella parvula (Weinm.) Speg., *Boln Acad. nac. Cienc.* 28: 309 (1926) var. *parvula*
Volvariella pusilla (Pers.) Singer, *Lilloa* 22: 401 (1951) [1949] var. *pusilla*

Position in classification: Fungi, Basidiomycota, Agaricomycotina, Agaricomycetes, Agaricomycetidae, Agaricales, Pluteaceae, *Volvariella*, *Volvariella pusilla*
 **<http://www.speciesfungorum.org/Names/SynSpecies.asp?RecordID=307797> (accessed on: 11/05/2011)

Description of the specimen: Pileus 23 mm broad (Fig. 2A), campanulate–convex to nearly plane, umbonate, dry, with the margin becoming striate, white, with gray tinge especially on the disc, flesh thin, white to pink tinged, sterile appendiculate veil absent. Lamellae close to subdistant, up to 4 mm broad, free, with entire edges, white, becoming salmon pink, lamellulae none to 1 tiered. Stipe central, 3.3cm × 1–5 mm in diameter, equal, slightly curved, solid, becoming hollow, minutely pubescent to innately fibrillose, white, base volvate with mycelial pad, Volva cupulate, 3 mm long, white, becoming grayish with age. Annulus absent. Basidiospores (Fig. 2D) (5.52–) 5.91–7.49 (–7.88) μm (av. 7.49 μm) × (4.33–) 4.73–5.91 (–6.30) μm (av. 5.46 μm), $Q_{av} = 1.37$, ovoid to ellipsoid, having a germ pore, wall 0.39 μm, smooth, inamyloid. Basidia (Fig. 2B) 13.79–15.76 × 7.88–10.63 μm, clavate, tetrasterigmatic, 4 spored. Pleurocystidia (Fig. 2C) 26.79–74.86 × 8.67–19.7 μm, clavate–elongate, fusoid–ventricose to ovoid, with granular contents, wall 0.39 μm thick, common. Cheilocystidia 19.31–21.67 × 7.88–9.85 μm, fusoid to subfusoid, wall 0.39 μm, hyaline, common. Hymenium tramal cells 5.91–10.64 μm broad, hyaline to granular in content, septate, branched, with 4.33–6.70 μm broad and branched oliferous hyphae. Pileipellis of 5.91–11.82 μm broad repent hyphae, granular in content, septate, variously enlarged and constricted along their length, with 0.39–0.78 μm thick walls, clamp

connexions absent. Pileal context of 23.64–35.46 μm broad hyphae, hyaline, inflated, with 7.88–8.67 μm broad oliferous hyphae. Stipitipellis composed of parallel, septate, light yellowish brown hyphae, 3.94–8.67 μm broad. Stipe context of 17.73–23.64 μm broad hyphae, hyaline, septate. Volva composed of interwoven, septate, 3.94–5.91 μm broad yellowish brown hyphae, intermixed with subglobose to irregularly shaped, hyaline and smooth walled cells, 13.79–43.34 × 11.82–23.64 μm.

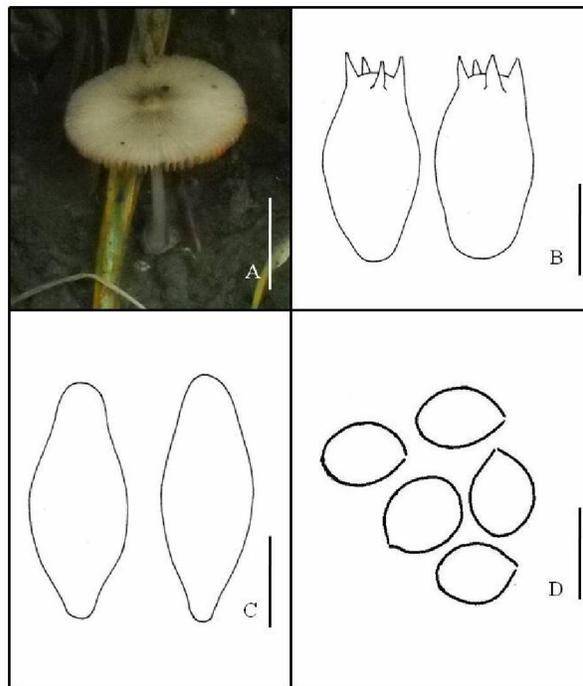


Figure 2. *Volvariella pusilla*. A. Basidiocarps, B. Basidium, C. Pleurocystidia, D. Basidiospores (A, bar=2 cm; B, bar=10 μm; C, bar = 5 μm, D, bar = 5 μm).

Habitat: Growing solitary, in shade upon humus soil among grasses.

Edibility: Unknown

Remarks: This species is similar to *Volvariella hypopithys* (Fr.) Shaffer in gross shape, but distinguished from it by having the smooth surface on stipe and the hyphae of the pileipellis longer than those in *V. hypopithys*.

Material examined: Kultali (22°05.014 N, 088°36.371 E; 18 ft amsl); 24th June, 2010; K. Acharya and P. Pradhan; (AMH 163); Kultali Block, South 24 Pargana, West Bengal, India.

***Volvariella volvacea* (Bull.) Singer, in Wasser, Lilloa 22: 401 (1951) [1949]**

Synonyms**

Agaricus volvaceus Bull., *Herb. Fr.* 6: tab. 262 (1786)

Agaricus volvaceus Bull., *Herb. Fr.* 6: tab. 262 (1786)
var. *volvaceus*

Amanita virgata Pers., *Tent. disp. meth. fung.* (Lipsiae): 18 (1797)

Vaginata virgata (Pers.) Gray, *Nat. Arr. Brit. Pl.* (London) 1: 601 (1821)

Volvaria volvacea (Bull.) P. Kumm., *Führ. Pilzk.* (Zwickau): 23, 99 (1871)

Volvariopsis volvacea (Bull.) Murrill, *N. Amer. Fl.* (New York) 10(2): 144 (1917)

Position in classification: Fungi, Basidiomycota, Agaricomycotina, Agaricomycetes, Agaricomycetidae, Agaricales, Pluteaceae, *Volvariella*, *Volvariella volvacea*
**<http://www.speciesfungorum.org/Names/SynSpecies.asp?RecordID=307802> (accessed on: 11/05/2011)

Description of the specimen: Pileus 4 cm in diameter (Fig. 3A), broadly parabolic to convex or hemispheric, broad, umbo, surface colour, paler towards the margin, moist to subviscid, smooth, margin striate, maculose absent, flesh thickness 0.5–2 mm. Lamellae free, regular, even, concolorous, pinkish brown, 7 mm in width, crowded, with lamellulae of several lengths. Stipe central, curved, 5.2 cm × 19 mm, slightly tapered at base, solid, fleshy fibrous, surface whitish, smooth, glabrous, stipe base mycelial pad. Annulus absent. Volva saccate, membranous–fleshy, 2 mm thick, grayish brown, concolorous with the pileal surface above but whitish below. Context 4 mm thick at the disk, gradually thin towards the margin. Pileal trama consists of hyphal cells, hyphae 37.43–84.71 × 22.46–24.82 μm in diameter, wall 0.39 μm thick, septate, septa 1.58 μm thick, clamp–connexions absent. Basidiospores (Fig. 3D) 5.52–(5.91)–(6.30)–7.09 × 4.33–4.73 μm in diameter, $Q_{av} = 1.37$, ellipsoid, ochraceous salmon, smooth, wall 0.591 μm thick. Basidia (Fig. 3B) 21.67–23.64 × 9.85–11.03 μm in diameter, clavate, granules and Oliferous cells absent, tetrasterigmatic, sterigmata 3.94–4.73 × 1.97 μm in diameter. Lamella–edge sterile. Cheilocystidia (Fig. 3C) 23.64–51.22 × 11.82–16.55 μm in diameter, lageniform, wall 0.39 μm thick. Pleurocystidia (Fig. 3E) 23.64–38.61 × 10.64–25.61 μm in diameter, hyaline, wall 0.39 μm thick. Stipe consists of hyphal cells, 5.91–12.61 μm in width. Volva consists of mycelial cells, 4.73–5.91 μm width, rarely septate, consists of granules, 4.33 × 3.15–3.94 μm in diameter. Epicuticulis consists of mycelial cells, 70.92–82.74 × 23.64–27.58 μm in diameter, wall 0.39 μm thick, septate, septa 2.36 μm thick, consists of vacuolar contents, 8.27–9.06 × 4.33–7.88 μm in diameter.

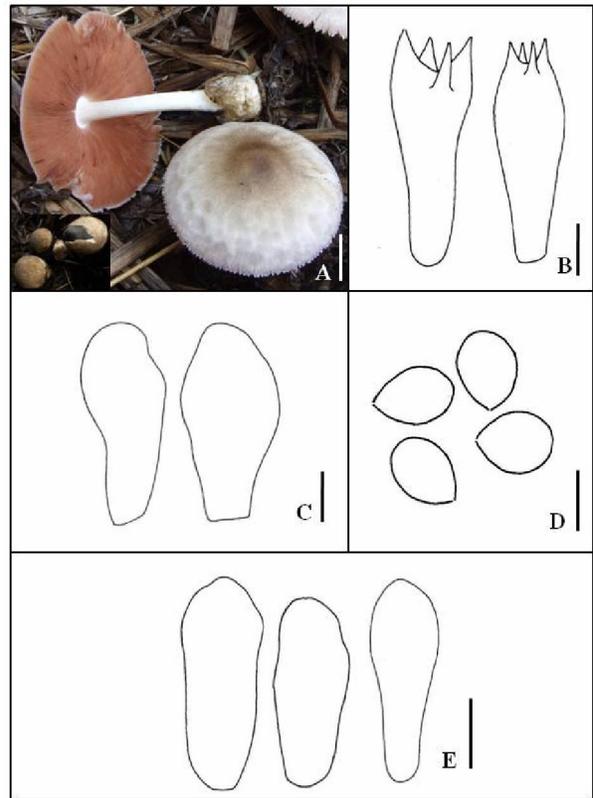


Figure 3. *Volvariella volvacea*. A. Basidiocarps, B. Basidium, C. Cheilocystidia, D. Basidiospores, E. Pleurocystidia (A, bar=1 cm; B, bar=5 μm; C, bar = 10 μm, D, bar = 5 μm; E, bar=10 μm).

Habitat: Growing solitary, or scattered upon decaying paddy straw.

Edibility: Edible (Seok *et al.*, 2002)

Remarks: Macroscopically *V. volvacea* closely resembles with *V. dunensis*, but its well-developed grey-brown coloured volva and habitat on organic rich substrate easily distinguishes it from *V. dunensis* (Justo & Castro 2010). From our survey, we have observed that this member of *Volvariella* is most frequent in occurrence and is also economically and nutritionally important in the region.

Material examined: Kumirmari Island (22°12.066 N, 088°53.297 E; 13 ft amsl); 26th June, 2010; K. Acharya and A. K. Dutta; (AMH 158) Gosaba Block, South 24 Pargana, West Bengal, India; Satjalia (22°09.889 N, 088°50.979 E; 22 ft amsl); 02nd August, 2010; K. Acharya and A. K. Dutta; (AMH 173) Gosaba Block, South 24 Pargana, West Bengal, India.

Key to species described

- 1A. Spore more than 11 µm long and 7 µm broad, pileus viscid, white or cream in colour, 5-15 cm broad; stipe stout; pleurocystidia diverse in shape, common; pileal margin not striate or only slightly so.....*Volvariella gloiocephala*
- 1B. Spores less than 11 µm long and 7 µm broad, pileus not viscid2
- 2A Pileus 5-10 cm broad, streaked with blackish fibrils; spores average 8.4-9.1 × 5.4-5.8 µm; cheilocystidia often more than 50 µm long.....*Volvariella volvacea*
- 2B Pileus 0.5-3 cm broad, white, vinaceous brown or brownish grey to brownish black, not squamulose, becoming striate on the margin; stipe 1-5 cm long, glabrous; spores less than 9 µm long.....*Volvariella pusilla*

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References

- [1] Acharya K, Acharya R. *Cyathus* and *Geastrum* – An addition to Darjeeling mycoflora. The Indian Forester. 2001;127: 950–952.
- [2] Acharya K, Bhutia TP. Two new contributions to the Thelephoraceae of Eastern Himalaya. The Indian Forester. 2003;129:1051–1052.
- [3] Acharya K, Pradhan P, Bhoomik B. *Pluteus cervinus* (Schaeff.) P. Kumm.: An addition to the macrofungi of West Bengal, India. Journal of Environment and Sociobiology. 2009a;6(2): 119–122.
- [4] Acharya K, Pradhan P, Chakraborty N, Dutta AK, Saha S, Sarkar S, Giri S. Two species of *Lysurus* Fr. : addition to the macrofungi of West Bengal. Journal of Botanical Society of Bengal. 2010b;64(2):175-178.
- [5] Acharya K, Pradhan P, Chakraborty N. *Laccaria amethystina* Cooke: an addition to the macrofungi of West Bengal, India. Journal of Botanical Society of Bengal.

- 2009b;63(2):137–139.
- [6] Acharya K, Pradhan R, Bhattacharya M, Choudhury J, Pradhan P, Rai M. On new records of three species of Macrofungi, *Helvella* from Darjeeling hills. Journal of Environment and Sociobiology. 2005;2(1&2), 81–84.
- [7] Acharya K, Rai M, Pradhan P. Agaricales of Sikkim Himalayas: A Review. Researcher. 2010a;2(5):29–38. (<http://www.sciencepub.net>)
- [8] Acharya K, Rai M, Rai NP, Giri S. Two new records of Agaricales around Darjeeling hills. Journal of Mycopathological Research. 2003;41:113–114.
- [9] Acharya K, Rai M, Rai NP, Sen S. Three new species of *Russula*: Addition to the macrofungi of Sikkim. The Indian Forester. 2004c;130: 953–955.
- [10] Acharya K, Rai M, Sen S. *Otidia onotica* – A new record from Sikkim Himalaya. Indian Journal of Applied and Pure Biology. 2004b;19:215–217.
- [11] Acharya K, Rai M, Subba J, Gurung S. Two new species of *Lactarius* – new report from Darjeeling. Indian Journal of Applied and Pure Biology. 2004a;19:63–66.
- [12] Arora D. Mushrooms Demystified, 2nd ed. Ten Speed Press, New York. 1986;pp 259–260.
- [13] Bilgrami KS, Jamaluddin S, Rizwi MA. In: Fungi of India-list and references. 2nd edition. Today and tomorrow's printers and publishers, New Delhi, India. 1991; pp 527-528.
- [14] Hyde KD. Mycology and its future in the Asia region. Fungal Diversity. 2003;13: 59–68.
- [15] Justo A, Castro ML. An annotated checklist of *Volvariella* in the Iberian Peninsula and Balearic Islands. Mycotaxon. 2010;112:271–273.
- [16] Rai M, Sen S, Dutta BB, Acharya K. Some additions to the Coprinaceae of Sikkim Himalayan Journal of Mycopathological Research. 2005;43:101–103.
- [17] Sarbhoy AK, Agarwal DK, Varshney JL. In: Fungi of India 1982–1992, CBS Publishers and Distributors, New Delhi, 1996;pp. 350.
- [18] Seok, S.J. *et al.* Taxonomic study on *Volvariella* in Korea. Mycobiology. 2002;30(4):183-192.
- [19] Shaffer R.L. *Volvariella* in North America. Mycologia. 1957;(49)4:545-579
- [20] Swapna S, Syed A, Krishnappa M. Diversity of macrofungi in semi-evergreen and moist deciduous forest of Shimoga district-Karnataka, India. Indian Journal of Mycology and Plant Pathology. 2008; 38(1):21–26.

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