



## Two species of *Inocybe* from Trans–Himalayan Ladakh (J&K), India

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Yangdol R, Kumar S, Lalotra P, Sharma YP 2016 – Two species of *Inocybe* from Trans–Himalayan Ladakh (J&K), India. Current Research in Environmental & Applied Mycology 6 (4): 305–311, Doi 10.5943/cream/6/4/9

### Abstract

This paper provides an account of two *Inocybe* species, namely *I. curvipes* P. Karst. and *I. sororia* Kauffman belonging to family Inocybaceae of order Agaricales, these two larger fungi have been recorded for the first time from Ladakh and constitute new addition to Indian macrofungi. Morphological and anatomical features of both the species are described, discussed and illustrated along with camera lucida drawings.

**Key words** – *Inocybe* – Jammu and Kashmir – Ladakh – New record – Taxonomy

### Introduction

*Inocybe* (Fr.) Fr. is one of the diverse genera in the order Agaricales (Agaricomycotina, Basidiomycota). The genus was placed in the family Cortinariaceae by Singer (1986) but Hawksworth et al. (1995) and Kirk et al. (2008) included it under Inocybaceae. Worldwide 500 species are known so far (Kirk et al. 2008). Index Fungorum (2016) has mentioned 1807 records under this taxon. The genus is recognized by fibrillose to squamulose cap which is often umbonate and seldom viscid. Microscopically, basidiospores are either smooth, nodulose to angular or with thick spines and metuloid cystidia are formed frequently (Arora 1986, Larsson et al. 2009, Ryberg 2009). Ecologically, many members are known to form mycorrhizal association with *Quercus*, *Pinus* and *Salix* (Dunstan et al. 1998, Dar et al. 2009, Bougher et al. 2011). Although more than 34 species of *Inocybe* are known from various locations in India (Bilgrami et al. 1979, Jamaluddin et al. 2001, Dar et al. 2009, Beig et al. 2011, Farook et al. 2013, Gogoi & Parkash 2015, Pradeep et al. 2016), only two species namely *Inocybe rimosa* (Bull.) P. Kumm. and *I. fastigiata* (Schaff.) Quel. have been recorded from Jammu and Kashmir so far (Dar et al. 2009, Beig et al. 2011). In the present communication, two species of genus *Inocybe* have been described along with their macro- and microscopic details. Both these species constitute new records for India.

### Materials & Methods

Sporocarps of *Inocybe* were collected from Phey village of Leh district of Ladakh (32°15'–36°N latitude and 75°15'–80°15'E longitude with an altitude of 2300– 5000m above the sea level) during July–September, 2014. Field records for macroscopic features of the sporocarps and their habitat were made. Micro morphological characters were recorded from dried sample, after rehydrating in 3% KOH solution, and then staining with 1% aqueous Congo red. Line drawings of microscopic details were drawn with the aid of Camera lucida and measurements were recorded for each character for description of average dimensions. Microphotography of internal details was done using a Sony N50

camera attached to an Olympus CH 20i binocular microscope. The examined samples were deposited in the Herbarium of Botany Department, University of Jammu (HBJU) with accession numbers. Facesoffungi numbers are also added (Jayasiri et al. 2015).

## Results & Discussion

*Inocybe curvipes* P. Karst.

Figs. 1–2

*Faces of fungi number:* FoF02679

Synonymy: *Inocybe rickenii* var. *ionipes* (Boud.) R. Heim, (1931)

*Inocybe globocystis* Velen., Ceske Houby 2: 368 (1920) var. *globocystis*

*Inocybe globocystis* var. *turgens* R. Heim & Romagn, Bull. trimest, Soc. Mycol. Fr. 50: 167 (1934)

**Pileus** conical to campanulate, 0.6–2.1 cm in diameter, brownish –cinnamon, surface dry, margin incurved when young, later decurved, fibrillose to squamulose, context thin, cream **Lamellae** adnexed, unequal, sub–distant, yellowish brown with some lilaceous tint **Stipe** 2.3–2.5 × 0.2–0.3 cm, central, slightly bulbous at base, pale brown, solid, fibrillose **Annulus** Absent **Spore print** cinnamon brown **Odour** not distinct **Basidia** clavate, 27.2–30.4 × 9.6–13.6 µm, hyaline, thin walled, sterigmata four (1.6–4.8 µm in length), multiguttulate, basal clamps present **Basidiospores** irregularly angular– broadly ellipsoidal, 9.6–11.2 × 6.4–8.8 µm,  $a_vL= 10.4$ ,  $a_vW= 7.6$ ,  $Q= 1.5–1.3$ , small nodules, pale yellow to brownish (Congo red), thick walled, mono–multiguttulate **Pleurocystidia** fusiform, 40.0–81.6 × 12.0–18.4 µm, hyaline, metuloidal, thick walled, prominent **Cheilocystidia** not observed **Pileus hyphae** 4.0–16.0 µm, hyaline, frequently septate, unbranched, thin walled, clamp connection present **Stipe hyphae** 8.0–18.0 µm, hyaline, thin walled, frequently septate, unbranched, clamp connection present.

Collection examined – India, Jammu and Kashmir, Leh, Phey village, scattered, on soil under *Salix alba* tree, R. Yangdol and Y. P. Sharma, 30<sup>th</sup> August 2014, HBJU- 493.

Distribution – The species is widely distributed in Europe, North America, South America, Eastern Ukraine and Brazil (Singer & Digilio 1951, Esteve–Raventos & Moreno 1987, Nishida 1989, Stijve & de Meijer 1993, Prylutskyi 2015).

Edibility – Not eaten in the study area

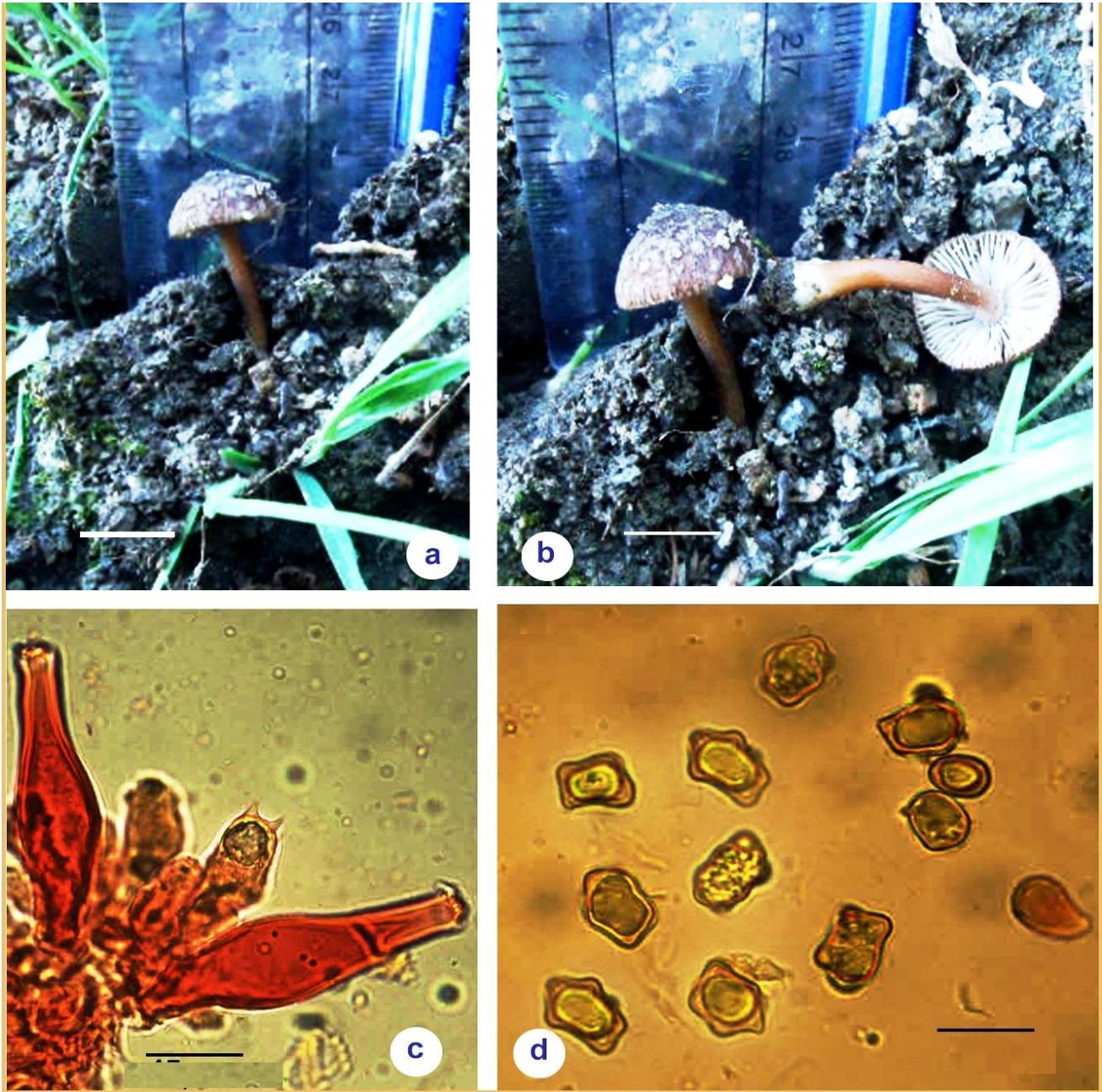
Remarks – The present specimen corroborates well with the description given by Bougher & Matheny (2011) except for some minor variation in the width of pleurocystidia, which was broader (19.0–27.0 µm) in Australian species than our examined specimen (12.0–18.4 µm). Further cheilocystidia was mentioned in previous examined species but it was not observed in Ladakh collection. It constitutes a new report for India.

*Inocybe sororia* Kauffman, *N. Amer. Fl.* (New York) 10(4): 259 (1924)

Figs. 3–4

*Faces of fungi number:* FoF02681

**Pileus** bell shaped or conical umbonate when young, often expanding in age, 2.0–2.5 cm in diameter, pale yellowish brown, radially fibrillose, surface dry, obtuse umbo, margin slightly uplifted and splitted in age **Lamellae** adnate, pale brown, sub- distant, unequal **Stipe** equal to slightly bulbous at base, 3.5–7.6 × 0.5–0.6 cm, central, surface dry, fibrillose, concolorous with the pileus **Annulus** absent **Spore print** brown **Basidia** clavate, 24.0–28.8 × 8.8–11.2 µm, hyaline, thick walled, basal clamps present, guttulate, sterigmata two– four (2.4–4.8 µm in length) **Basidiospores** ellipsoidal, 8.8–11.2 × 5.6–8.0 µm,  $a_vL= 10.0$ ,  $a_vW= 6.8$ ,  $Q= 1.6–1.4$ , thick walled, smooth, olive green (in Congo red), mono–guttulate **Cystidia** narrowly clavate, 35.2–54.4 × 12.0–20.8 µm, hyaline, thick walled **Pileus cuticle hyphae** 6.0–8.0 µm, hyaline, thick walled, septate, branched, clamp connections present **Pileus context hyphae** 14.0–34.0 µm wide, hyaline, thick walled, septate, unbranched, clamp connections present **Stipe hyphae** 8.0–16.0 µm, hyaline, thin walled, septate, unbranched, clamp connections present.



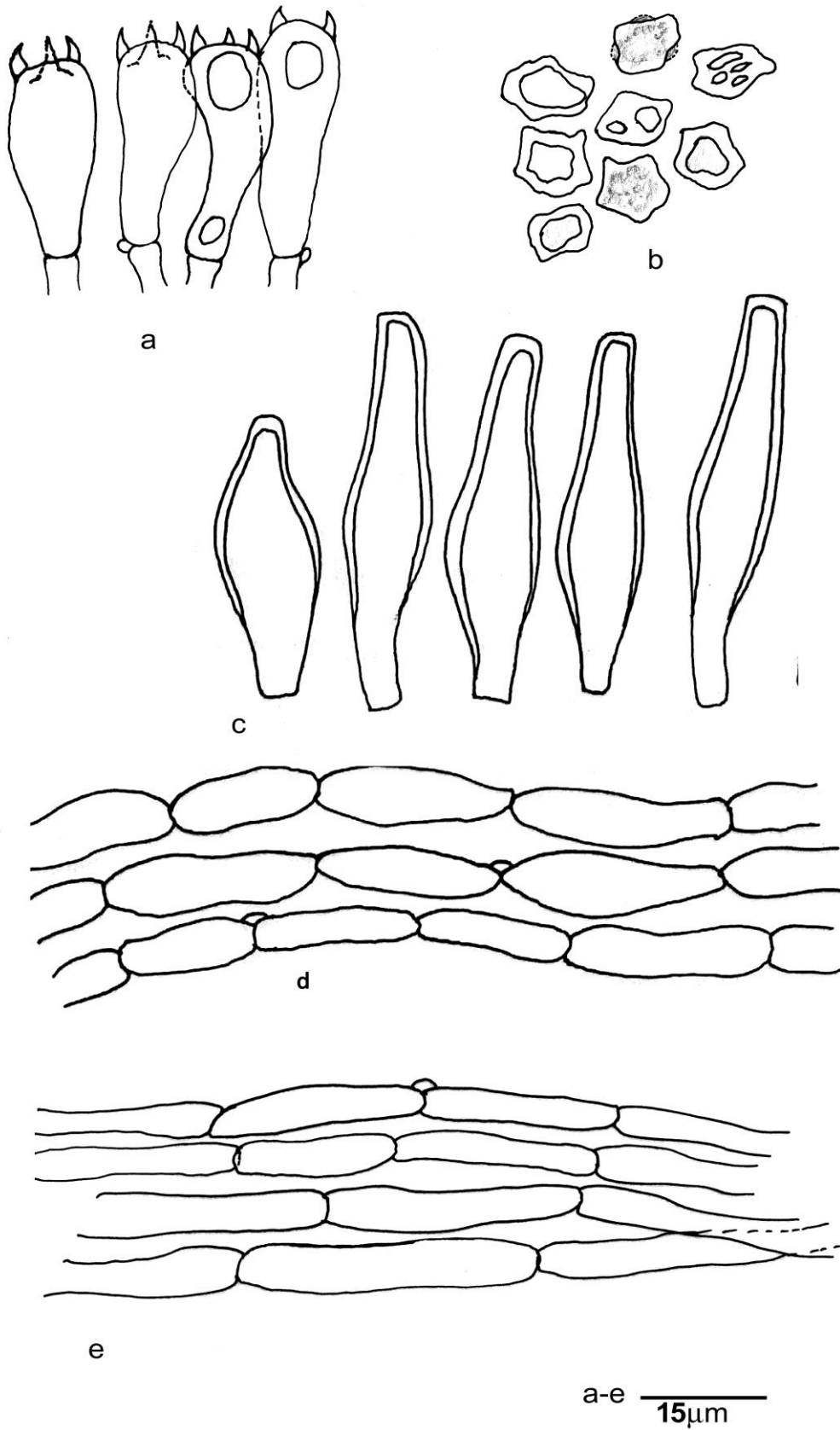
**Fig. 1** – *Inocybe curvipes*. **a,b**. Sporophore in their natural habitat. **c**. Pleurocystidia and basidia **d**. Basidiospores. Scale bars a,b = 1 cm, c = 15µm, d = 10µm.

Collection examined – India, Jammu and Kashmir, Leh, Phey village, humicolous, scattered, under *Salix alba* tree, R. Yangdol and Y. P. Sharma, 3<sup>rd</sup> September 2014, HBJU- 494.

Distribution – Earlier reported from North America (Murrill, 1924; Arora, 1986).

Edibility – Not edible in the study area

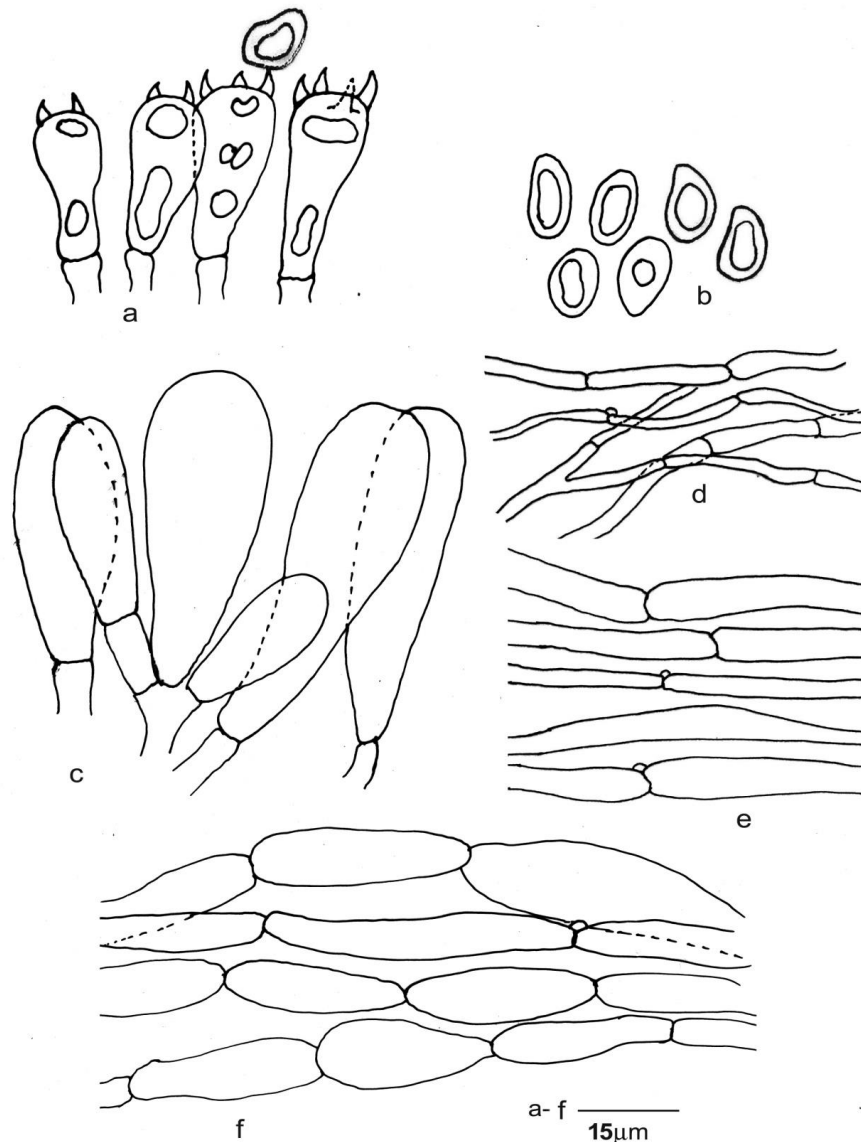
Remarks – The taxonomic details of *Inocybe sororia* are in conformity with the description given by Arora (1986) except for the size of basidiospores which are somewhat smaller than earlier described species by Arora (10.0–13.0 µm). It is a new fungal report from India.



**Fig. 2** – *Inocybe curvipes*. Camera lucida drawings: **a**. Basidia **b**. Basidiospores **c**. Pleurocystidia **d,e**. Pileus and Stipe hyphae showing clamp connections. Scales bars a–e = 15 µm.



**Fig. 3** – *Inocybe sororia*. **a.** Sporophore in the natural habitat. **b.** Ventral view of a sporophore. **c.** Basidia. **d.** Basidiospores. **e.** Cystidia. **f.** pileus hyphae showing clamp connections. Scale bars a,b = 1cm, c–f = 15  $\mu$ m.



**Fig. 4** – *Inocybe sororia*. Camera lucida drawings: **a.** Basidia. **b.** Basidiospores. **c.** cystidia. **d.** Pileus cuticle hyphae. **e.** Pileus context hyphae. **f.** Stipe hyphae. Scales bars a–f = 15 µm.

### Acknowledgements

The authors thank Head, Department of Botany (UGC–SAP DRS I) University of Jammu, Jammu for providing research facilities and UGC for providing financial assistance as Senior Research Fellowship under RGNF scheme.

### References

- Arora D. 1986 – Mushroom Demystified. A comprehensive guide to fleshy fungi. 2<sup>nd</sup> ed. Berkeley. Ten speed press, Berkeley. California. 936 p.
- Beig MA, Dar GH, Khan NA, Ganai NA. 2011 – Seasonal production of epigeal fungal sporocarps in mixed and pure fir (*Abies pindrow*) stands in Kashmir forests. Journal of Agricultural Technology **7**, 1375–1387.
- Bilgrami KS, Jamaluddin, Rizvi MA. 1979 – Fungi of India part I. List and References. Today and Tomorrow's Printers and Publishers, New Delhi 467 p.

- Bougher NL, Matheny PB. 2011 – Two species of *Inocybe* (fungi) introduced into Western Australia. *Nuytsia* 21, 139–148.
- Dar GH, Beig MA, Qazi NA, Ganai NA. 2009 – Hitherto unreported Agaricales from Jammu and Kashmir. *Journal of Mycology and Plant Pathology* 39, 35–38.
- Dunstan WA, Dell B, Malajczuk N. 1998 – The diversity of ectomycorrhizal fungi associated with introduced *Pinus* spp. in the southern hemisphere, with particular reference to Western Australia. *Mycorrhiza* 8, 71–79.
- Esteve-Raventos, A. F., Moreno G. 1987 – Contribution to the knowledge of the Spanish species of *Inocybe*. 1) Some species with nodulose spores. *Documents Mycologiques* 17, 13–24.
- Farook VA, Khan SS, Manimohan P. 2013 – A checklist of agarics (gilled mushrooms) of Kerala State, India. *Mycosphere* 4, 97–131.
- Gogoi G, Parkash V. 2015 – A checklist of gilled mushrooms (Basidiomycota: Agaricomycetes) with diversity analysis in Hollongapar Gibbon Wildlife Sanctuary, Assam, India. *Journal of Threatened Taxa* 7, 8272–8287.
- Hawksworth DL, Kirk PM, Suttan BC, Pegler DN. 1995 – Ainsworth and Bisby's Dictionary of Fungi. International Mycological Institute, CAB International. London. 66 p.
- Jamaluddin, Goswami MG, Ojha BM. 2001 – (1989-2001). Forest pathology division. Tropical Forest Research Institute, Jabalpur (MP) Pawan Kumar, Scientific Publishers, India. 326 p.
- Jayasiri SC, Hyde KD, Ariyawansa HA, Bhat J, Buyck B, Cai L, Dai YC, Adb-Elsalam KA, Ertz D, Hidayat I, Jeewon R, Jones EBG, Bakhkali AH, Karunarathna SC, Liu JK, Luangsa-ard JJ, Lumbsch HT, Maharachchikumbura SSN, McKenzie EHC, Moncalvo JM, Ghobad-Nejhad M, Nilsson H, Pang KL, Pereira OL, Phillips AJL, Raspe O, Rollins AW, Romero AI, Etayo J, Selcuk F, Stephenson SL, Suetrong S, Taylor JE, Tsui CKM, Vizzini A, Abdel-Wahab MA, Wen TC, Boonmee S, Dai DQ, Daranagama DA, Dissanayake AJ, Ekanayaka AH, Fryar SC, Hongnan S, Jayawardena RS, Li WJ, Perera RH, Phookamsak R, Silva NI de, Thambugala KM, Tian Q, Wijayawardene NN, Zhao RL, Zhao Q, Kang JC and Promputtha I. 2015 – The faces of fungi database: fungal names linked with morphology, phylogeny and human impacts. *Fungal Diversity* 74, 3–18.
- Kirk PM, Cannon PF, Minter DW, Stalpers JA. 2008 – Ainsworth and Bisby's Dictionary of the Fungi, 10<sup>th</sup> Ed. CAB International, Wallingford, UK 771 p.
- Larsson E, Ryberg M, Moreau PA, Mathiesen AD, Jacobsson S. 2009 – Taxonomy and evolutionary relationships within species of section *Rimosae* (*Inocybe*) based on ITS, LSU and mtSSU sequence data. *Persoonia* 23, 86–98.
- Murrill WA, Kauffman CH, Overhotts LO. 1924 – North American Flora. The New York Botanical Garden 10, 227–260.
- Nishida FH. 1989 – Key to the species of *Inocybe* in California. *Mycotaxon* 34, 181–196.
- Pradeep CK, Vrinda KB, Varghese SP, Korotkin HB, Matheny PB. 2016 – New and noteworthy species of *Inocybe* (Agaricales) from tropical India. *Mycological progress* 15, 1–25.
- Prylutskyi OV. 2015 – *Inocybe* (Agaricales, Basidiomycota) in Kharkiv forest-steppe, Eastern Ukraine. *Cream* 5, 408–417.
- Ryberg M. 2009 – An evolutionary view of the taxonomy and ecology of *Inocybe* (Agaricales). University of Gothenburg. Faculty of Science, Department of Plant and Environmental Sciences. 24 p.
- Singer R, Digilio APL. 1951 – Prodrómo de la Flora Agaricina Argentina. *Lilloa* 25, 5–462.
- Singer R. 1986 – The Agaricales in modern taxonomy, 4<sup>th</sup> Ed. Bishan Singh and Mahindra Pal Singh, Dehradun. 981p.
- Stijve T, De Meijer AAR. 1993 – Macromycetes from the State of Paraná, Brazil. 4. The psychoactive species. *Arquivos de Biologia e Tecnologia, Curitiba* 36, 313–329.
- www.index fungorum.org – 20<sup>th</sup> December 2016.