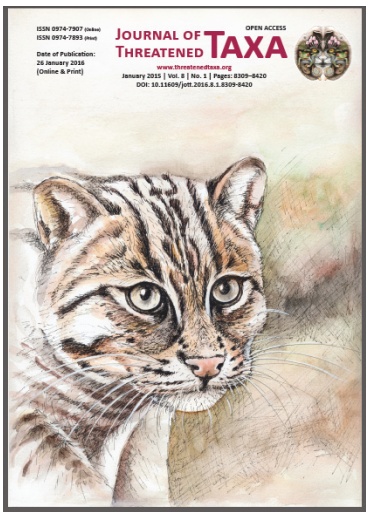

Journal of Threatened Taxa

The international journal of conservation and taxonomy

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

Short Communication

Three species of *Phallus* (Basidiomycota: Agaricomycetes: Phallaceae) from Jammu & Kashmir, India

Harpreet Kour, Rigzin Yangdol, Sanjeev Kumar & Yash Pal Sharma

26 January 2016 | Vol. 8 | No. 1 | Pp. 8403–8409
10.11609/jott.2173.8.1.8403-8409

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 January 2016 | 8(1): 8403–8409

Three species of *Phallus* (Basidiomycota: Agaricomycetes: Phallaceae) from Jammu & Kashmir, India

Harpreet Kour [1], Rigzin Yangdol [2], Sanjeev Kumar [3] & Yash Pal Sharma [4]

[1,2,3,4] Department of Botany, University of Jammu, Jammu 180006, India
[1] harpreet.mushrooms@gmail.com, [2] rigzinmushroom7145@gmail.com, [3] sanjeevkoul222@gmail.com,
[4] yashdbm3@yahoo.co.in (corresponding author)

ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

OPEN ACCESS

Abstract: In this paper, three species of *Phallus* viz., *P. macrosporus, P. rubicundus* and *P. hadriani* are described, illustrated and discussed along with habitat photographs and line drawings of microscopic features. Out of these, *P. macrosporus* is new to India. *P. rubicundus* is new to Jammu & Kashmir whereas *P. hadriani* constitutes a new report of its occurrence from the Jammu Province. A key to the investigated species is also provided.

Keywords: Ladakh, new record, Phallaceae, Poonch, stinkhorn, taxonomy.

Phallus is a well-known gasteroid genus within the family Phallaceae with 18 species distributed worldwide (Kirk et al. 2008). Index Fungorum accounts for 175 records for this genus. Characteristically, these stinkhorns develop from round to oval egg that has an inner gelatinous layer, unbranched and upright fruiting bodies and a foul smelling gleba (Arora 1986). Predominantly occupying the tropical and subtropical habitat, some species occur in temperate areas as well (Lee 1957; Li et al. 2002; Barrett & Stuckey 2008; Hemmes & Desjardin 2009; Dash et al. 2010; Mohanan 2011). In India, a number of *Phallus* species have been widely reported from various locations (Bhagwat et al. 2005; Bakshi & Mandal 2006; Swapna et al. 2008; Dash et al. 2010; Mohanan 2011; Dutta et al. 2012; Sridhar & Karun 2013; Tiwari et al. 2013). This communication deals with three species of *Phallus* collected from two highly diversified terrains of Jammu & Kashmir State, which differ with respect to altitudinal and latitudinal zonations and edaphic factors.

Study Area

Jammu & Kashmir has very rich biological wealth and cultural heritage and because of its unique geography and diverse climatic conditions it is an abode to a large number of macro-fungi. The present study was carried out on the specimens collected from two different districts of Jammu & Kashmir: Poonch and Leh (Fig. 1).

The district Poonch, cradled in the peaks of the Pir Panjal Himalayan ranges, lies between 73°58'–74°35'E & 33°25'–34°01'N. It is bounded by the Kashmir Valley in the northeast, district Rajouri in the south and Pakistan occupied Kashmir in the west. The area experiences sub-tropical to temperate climate regime. Average temperature during the summer months is around 30°C while in the winter months it is as low as 8–10 °C. The annual rainfall ranges from 1,635–1,796 mm, the bulk of which is received during the monsoon period (July to

DOI: http://dx.doi.org/10.11609/jott.2173.8.1.8403-8409

Editor: R.K. Verma, Tropical Forest Research Institute, Jabalpur, India. **Date of publication:** 26 January 2016 (online & print)

Manuscript details: Ms # 2173 | Received 21 July 2015 | Final received 06 January 2016 | Finally accepted 11 January 2016

Citation: Kour, H., R. Yangdol, S. Kumar & Y.P. Sharma (2016). Three species of *Phallus* (Basidiomycota: Agaricomycetes: Phallaceae) from Jammu & Kashmir, India. *Journal of Threatened Taxa* 8(1): 8403–8409; http://dx.doi.org/10.11609/jott.2173.8.1.8403-8409

Funding: University Grants Commission, New Delhi UGC-SAP Grant No. F.3-14/2011 (SAP-II)- dated 19/03/2015; and RGNF: F1-17.1/2013-14/RGNF-2013-14-ST-JAM-37362 Feb. 2014.

Conflict of Interest: The authors declare no competing interests.

Acknowledgements: The authors wish to thank the Head, Department of Botany, University of Jammu and UGC-SAP for providing laboratory facilities and financial assistance. The second author (an RGNF fellow) also acknowledges the financial support received as a Senior Research Fellowship from the University Grants Commission, New Delhi.

September). Silty loam and alluvial soil are the major soil types of Poonch.

On the other hand, Leh District, one of the coldest and most elevated places in the world, is situated in the Ladakh region in Indian Trans-Himalaya. It is located between 32°15'–36°00' & 75°15'–80°15'E with an altitude ranging from 2,900–5,900 m. The area is characterized by extreme heat and cold, extreme bareness and dryness, low oxygen and atmospheric pressure. The temperature fluctuates between 35°C during summer to a minimum of -35°C during extreme winter. The annual precipitation is very little i.e., 80–300 mm and thus the absence of rainfall over the greater part of the year has resulted in xerophytic vegetation. The soil is predominantly sandy to sandy loam and pure clay with low nutrient content.

Methods

The specimens examined were collected from the study area during 2014–2015. Habitat details and field characters such as habit, odour, colour, and size of the pileus (cap), pseudostipe and volva, presence or absence of indusium or veil were observed from the fresh material. The microscopic details were studied from dried specimen, revived in 5% KOH, and stained in 1% Congo red. Microscopic line drawings were made with the aid of a camera lucida. Microscopic characters were photographed using a Sony N50 camera attached to an Olympus CH 20i binocular microscope and measurements were recorded for each character for description of average dimensions. The mean quotient (Q) of the spore length divided by spore width was calculated from a measurement of 20 mature basidiospores. The examined samples were deposited in the Herbarium of Botany Department, University of Jammu (HBJU).

Results and Discussion

1. *Phallus macrosporus* B. Liu, Z.Y. Li & Du (1980)

Material examined: HBJU 402, 03.viii.2014, Phey Village, Leh, Jammu & Kashmir, India, solitary, humicolous, in a cultivated field of barley (Toh), coll. R. Yangdol and Y.P. Sharma.

Expanded basidiomata: 14.0cm high, solitary. Receptacle: convex, surface deeply reticulate with perforated apex. Gleba: Olive brown, mucilaginous. Pseudostipe: cylindrical, 8.5 × 2.2 cm, spongy, hollow, white when fresh, light yellow when dried. Volva: saccate, 3.5 x 2.6 cm, membranous, reddish tinted to purple. Odour: pungent. Basidiospores: ellipsoidal, 6.4–8.0 × 4.0–4.8 µm, a_vL = 7.2, a_vW = 4.4, Q = 1.6–1.7, subhyaline to light greenish, smooth. Basidia: not observed. Pileus hyphae: septate, hyaline, thin walled, branched, clamp connections present, 1.6–3.2 µm wide. Pseudostipe: composed of hyaline hyphae, 1.6–4.8µm

Figure 1. Study area - Jammu and Kashmir

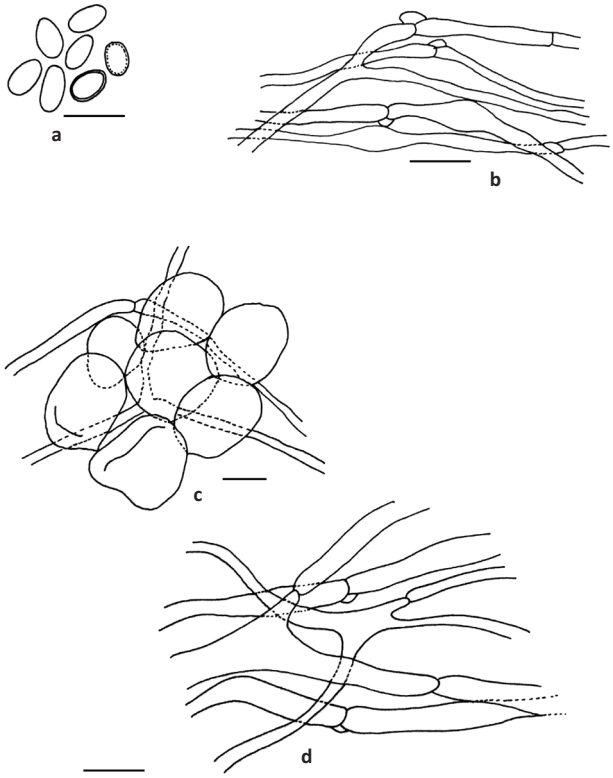

Figure 2. *Phallus macrosporus*. Camera lucida drawings: (a) Basidiospores; (b) Pileus hyphae; (c) Stipe hyphae and cells; (d) Volval hyphae. Scale bars a,b,d= 15µm, c= 20µm. © Rigzin Yangdol

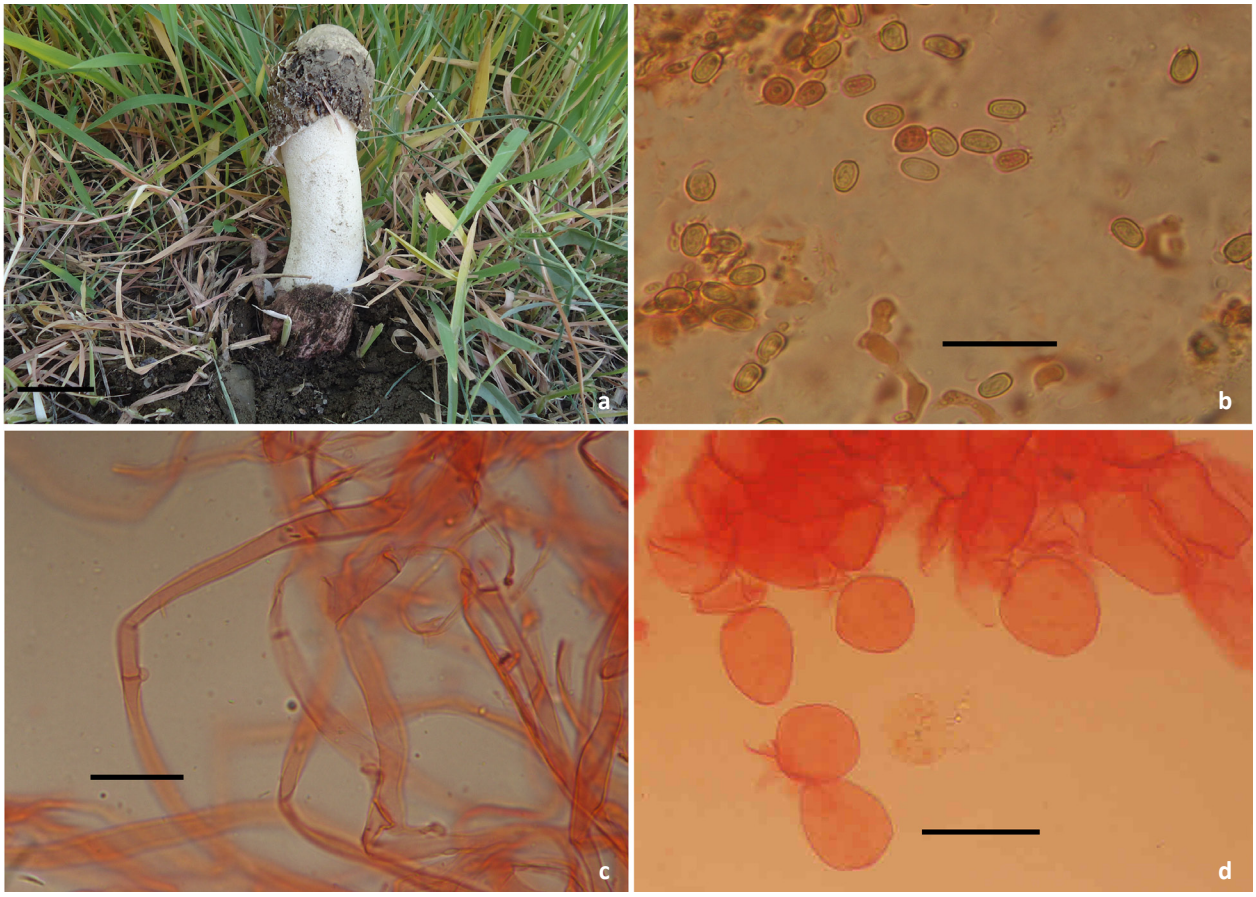

Image 1. *Phallus macrosporus*: (a) Expanded basidiomata in natural habitat; (b) Basidiospores in Congo red; (c) Pileus hyphae showing clamp connections; (d) Stipe elements. Scale bars a= 2cm, b-d= 15µm. © Rigzin Yangdol

wide and sub-globose cells measuring 18.0–48.0× 14.0–44.0 µm. Volva: composed of septate, branched, hyaline, thick walled hyphae, 2.4–16.0 µm wide, clamp connections present (Image 1, Fig. 2).

Taxonomic remarks: The present specimen of *P. macrosporus* is similar to the description given by Calonge (2005), with reticulate receptacle, reddish to purple volva and large sized basidiospores. The overall morphology of the basidiomata resembles *P. hadriani* but the presence of large sized basidiospores clearly differentiates it from the latter. This is a new report for India.

Distribution: Earlier reported from China (Liu et al. 1980)

2. *Phallus rubicundus* (Bosc) Fr., Syst. mycol. (Lundae) 2(2): 284 (1823)

Synonymy: *Satyrus rubicundus* Bosc, Mag. Gesell. naturf. Freunde, Berlin 5: 86 (1811) *Phallus rubicundus* (Bosc) Fr., Syst. mycol. (Lundae) 2(2): 284 (1823) var. *rubicundus Ithyphallus rubicundus* (Bosc) E. Fisch., Syll. fung. (Abellini) 5: 11 (1888) var. *rubicundus Phallus rubicundus* var. *gracillimus* Dring & R.W. Rayner, (1967)

Material examined: HBJU 403, 10.viii.2014, Khorinar, Poonch, Jammu & Kashmir, India, solitary, humicolous, in a cultivated field, coll. H. Kour and Y.P. Sharma.

Eggs: ovate, white, smooth, 2.0–3.0 cm wide, mycelial strands attached to the base. Mature basidiocarp: 14.0–19.0 cm long. Pseudostipe: decurved, peach coloured, spongiose, tapering towards the apex, deeply reticulate. Receptacle: conical, with a flat tip with conspicuous pore at the apex. Gleba: olivaceous, covering the whole length of the receptacle. Volva saccate, 14.0–17.0 cm, creamish-white. Odour: pungent. Basidiospores: elliptical, 3.2–4.8 × 1.6–2.4 µm, a_vL = 4.0 a_vW = 2.0, Q = 2.0, hyaline, smooth, greenish tinted in KOH. Pileus hyphae: septate, hyaline, branched, 1.6–3.2 µm wide. Stipe cells: sub-globose, hyaline, 28.0–60.0 × 28.0–52.0 µm. Volva: composed of septate hyphae, 3.2–4.8 µm wide. Rhizomorph hyphae: hyaline, septate, 1.6–3.2 µm wide (Image 2, Fig. 3).

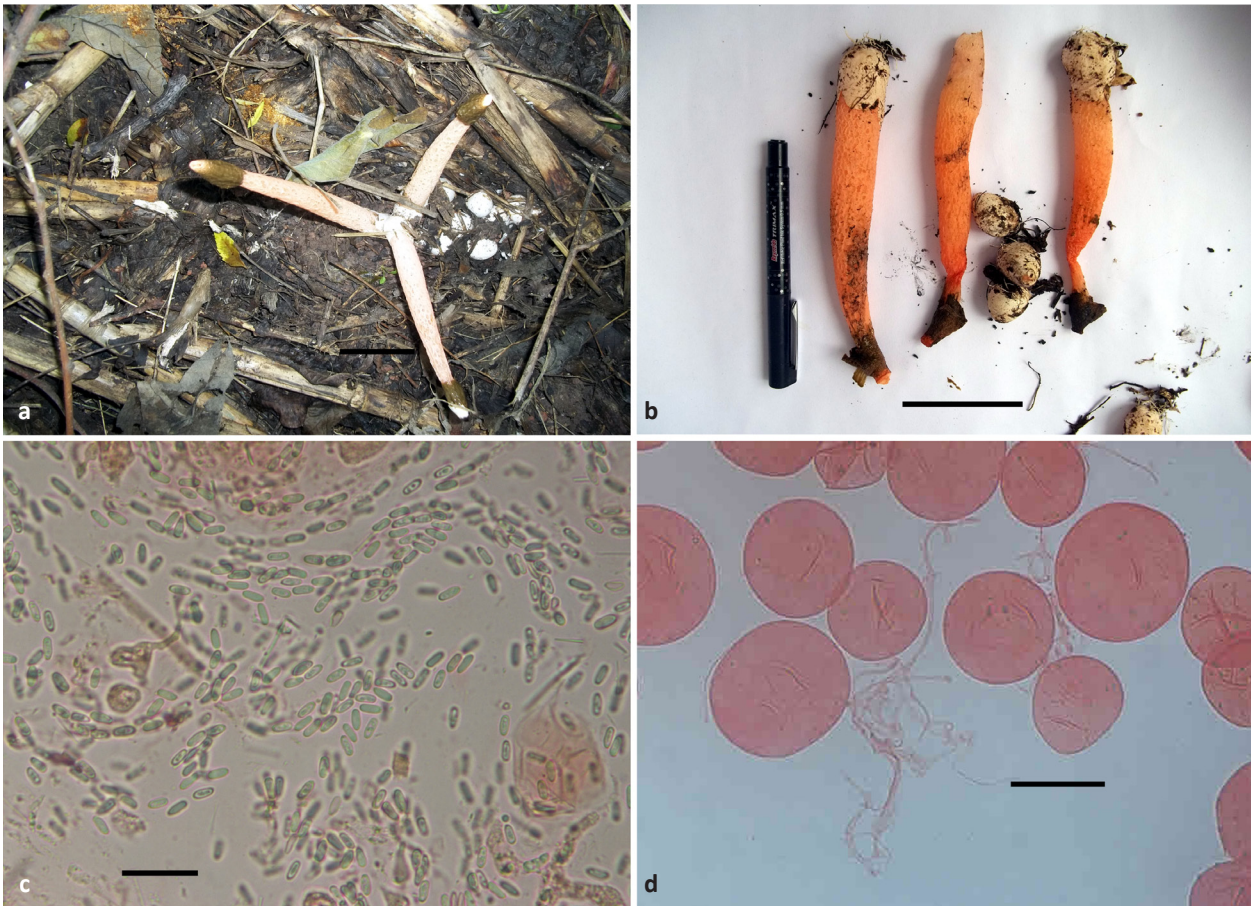

Image 2. *Phallus rubicundus*: (a) Mature Fruit bodies in natural habitat; (b) Uprooted fruit bodies and eggs; (c) Basidiospores; (d) Stipe cells. Scale bars a-b= 3cm, c= 15µm, d= 10µm. © Harpreet Kour

Taxonomic remarks: *P. rubicundus*, commonly known as Devil's stinkhorn, can easily be confused with *Mutinus elegans* but a close examination reveals that *P. rubicundus* has a clearly distinguished, separate head that holds the spore containing olive green slime whereas the species of *Mutinus* bear their slime on the upper part of a stem that lacks a clearly distinguished head. Earlier, this species was found on the ground and on dead roots of grass but our examined species was found inhabiting the litter and dead logs. It is new to Jammu & Kashmir.

Distribution: Previously reported from West Africa and Brazil (Dring 1964; Trierveiler-Pereira et al. 2009) and Dutta et al. (2012) reported it from West Bengal, India.

3. *Phallus hadriani* Vent. (1798)

Synonymy: *Hymenophallus hadriani* (Vent.) Nees, Syst. Pilze (Würzburg): 251 (1816)

Phallus hadriani Vent., Mém. Inst. nat. Sci. Arts 1: 517 (1798) f. *hadriani*

Phallus iosmos Berk., in Smith, Engl. Fl., Fungi (Edn 2) (London) 5(2): 227 (1836)

Phallus imperialis Schulzer, in Kalchbrenner, Icon. Sel. Hymenomyc. Hung.: 63, pl. 40, fig. 1 (1873)

Material examined: HBJU 401, 18.v.2015, Khorinar, Poonch, Jammu & Kashmir, India, solitary, humicolous, in a cultivated field among the trees of *Melia azardicta* and *Prunus domestica*, coll. H. Kour and Y.P. Sharma

Eggs: sub-globose to pyriform, 4.0–6.0 × 4.0–5.0 cm, initially white in colour, later turned pink to purple colour with scales forming reticulate pattern on the surface, partly subterranean, attached to the substrate by a mycelial cord; when cut found the stinkhorn to be enclosed in a gelatinous substance. Mature basidiomata: 20.0–25.0 cm high. Receptacle: 2.5–4.0 cm wide, strongly reticulated with a perforation at its tip. Gleba: Olive green, with the disappearance of gleba receptacle appeared pure white. Pseudostipe: cylindrical, 7.0–10.0 cm long and 1.2–2.5 cm wide, hollow, spongy, white

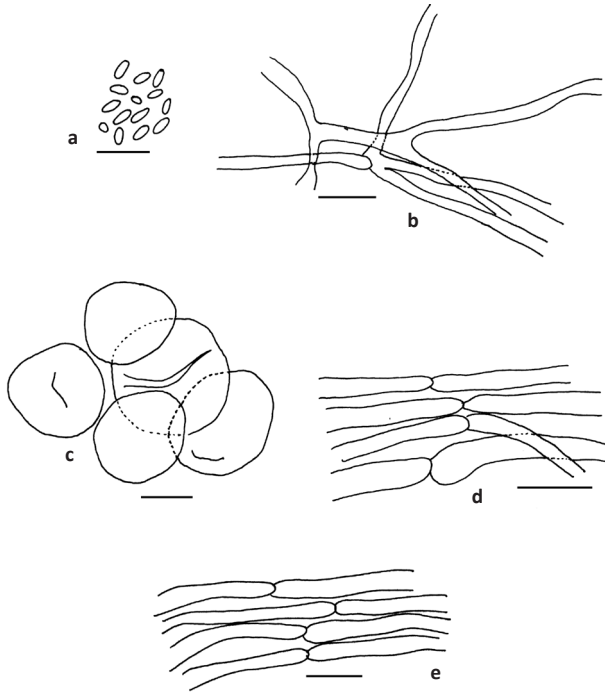

Figure 3. *Phallus rubicundus.* Camera lucida drawings: (a) Basidiospores; (b) Pileus hyphae; (c) Stipe cells; (d) Volval hyphae; (e) Rhizomorph hyphae. Scale bars a,b,d,e= 10µm, c= 15µm. © Harpreet Kour

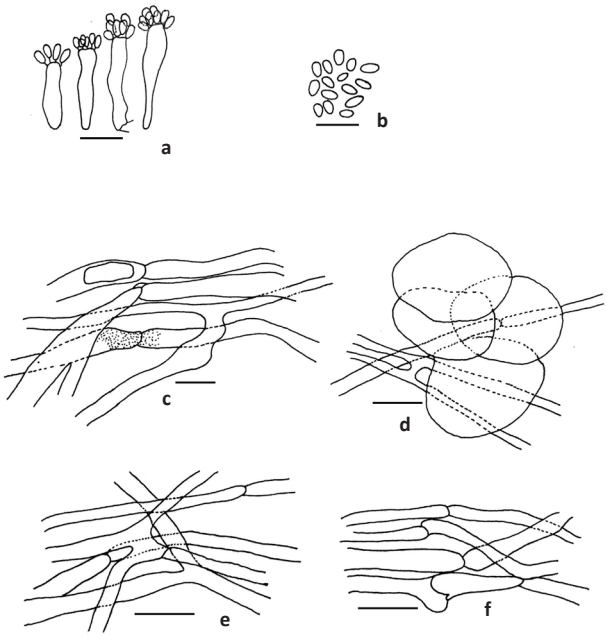

Figure 4. *Phallus hadriani*. Camera lucida drawings: (a) Basidia; (b) Basidiospores; (c) Pileus hyphae; (d) Stipe hyphae and cells; (e) Volval hyphae; (f) Rhizomorph hyphae. Scale bars a,b,c,e,f= 10µm, d= 15µm. © Harpreet Kour

when fresh, became light yellow when dried. Volva: 2.0–3.0 cm wide, light purple. Basidiospores: 2.4–3.2 (4.8) × 0.8–1.6µm, a_vL = 3.2, a_vW = 1.2, Q= 2.7, elliptical, smooth, subhyaline, greenish tinge in KOH. Basidia: elongated, cylindrical, a bit broader at centre, 14.4–16.0 × 2.4–3.2 µm, Sterigmata 8 in number. Receptacle: composed of hyaline, septate and branched hyphae and measures about 2.4–3.2 µm. Pseudostipe: comprises subglobular cells, 1.6–4.8 µm. Volval hyphae: hyaline, septate, branched, 1.6–4.8 µm (Image 3, Fig. 4).

Taxonomic remarks: Macro- and microscopic features of the present specimen corroborates well with the description given by Calonge (2005). *Phallus impudicus* is a closely related species but differs only in the colour of the volva which is white in the former and purplish in our described species. This stinkhorn species is sometimes mistaken for an old morel owing to its pitted head, somewhat similar in shape with a lack of slimy spores mass (which may be lost in old age). Although, this species had earlier been enlisted by Abraham (1991) from Kashmir but we are describing it for the first time. Thus, it constitutes a new record for Jammu province.

Distribution: Earlier reported from Turkey and Poland (Zabawski 1976; Demirel & Uzun 2004)

References

Abraham, S.P. (1991). Kashmir fungal flora - An overview. *Indian Mushroom Floristic Studies* 13-24.

Arora, D. (1986). *Mushrooms Demystified*. Ten Speed Press, Berkeley, California, USA, 936pp.

Bakshi, D. & N.C. Mandal (2006). Activities of some catabolic and anabolic enzymes of carbohydrate metabolism during developmental phases of fruit-bodies of *Dictyophora indusiata* and *Geastrum fornicatum*. *Current Science* 90: 1062–1064.

Barrett, M. & B. Stuckey (2008). *Phallus merulinus* newly reported for the top end. *Fungimap Newsletters* 36: 1–16.

Bhagwat, S.A., C.G. Kushalappa, P.H. Williams & N.D. Brown (2005). The role of informal protected areas in maintaining biodiversity in the Western Ghats of India. *Ecology and Society* 10: 1–40.

Calonge, F.D. (2005). A tentative key to identify the species of *Phallus*. Bulletino del Circolo Micrologo 29: 9–18.

Dash, P.K., D.K. Sahu, S. Sahoo & R. Das (2010). *Phallus indusiatus* Vent. & Pers. (Basidiomycetes) - a new generic record from Eastern Ghats of India. *Journal of Threatened Taxa* 2(8): 1096–1098; http://dx.doi.org/10.11609/JoTT.o2305.1096-8

Demirel, K. & Y. Uzun (2004). Two new records of *Phallales* for the mycoflora of Turkey. *Turkish Journal of Botany* 28: 213–214.

Dring, D.M. (1964). Gasteromycetes of West Tropical Africa. *Mycological Papers* 98: 1–60.

Dutta, A.K., N. Chakraborty, P. Pradhan & K. Acharya (2012). Phallales of West Bengal, India. II. Phallaceae: *Phallus* and *Mutinus*. *Researcher* 4: 21–25.

Hemmes, D.E. & D.E. Desjardin (2009). Stinkhorns of the Hawaiian Islands. *Fungi* 2: 8–10.

Kirk, P.M., P.F. Cannon, D.W. Minter & J.A. Stalpers (2008). *Ainsworth and Bisby's "Dictionary of the Fungi - 10th Edition.* CAB International, Wallingford, UK, 771pp.

Lee, W.S. (1957). Two new phalloids from Taiwan. *Mycologia* 49: 156–

Image 3. *Phallus hadriani*: (a) Partially submerged egg; (b) Uprooted eggs showing colour change; (c) L.S of egg showing exoperidium, mesoperidium, endoperidium and pseudostipe; (d) Fresh basidiome with gleba and volval remnants on receptacle; (e) Fully mature basidiomata showing reticulated receptacle and conspicuous perforation at the tip; (f) Basidiospores in Congo red; (g) Basidia; (h) Pileus hyphae showing clamp connection. Scale bars a-c= 2cm, e= 5cm, f- h= 10µm. © Harpreet Kour

Key to investigated species of *Phallus*

1. Receptacle granulose or rugulose 2
1. Receptacle reticulate 3
2. Receptacle conical, pseudostipe reddish to orangish, basidiospores 3.2–4.8 × 1.6–2.4 µm, volva white .... *Phallus rubicundus* (Bosc) Fr.
3. Basidiospores size less than or equals to 5µm 4
3. Basidiospores size more than 5µm 5
4. With spores of 2.4–3.2 (4.8) × 0.8–1.6 µm, volva purple with scales ..... *Phallus hadriani* Vent.
5. With spores of 6.4–8.0 ×4.0–4.8 µm, volva pale reddish to purplish tinge ..... *Phallus macrosporus* B. Liu, B. Li & Du

158.

Li, T.R., B. Song & B. Liu (2002). Three taxa of Phallaceae in HMAS, China. *Fungal Diversity* 11: 123–127.

Liu, B., Z.Y. Li & F. Du (1980)."*Phallus macrosporus* new species". *Acta Microbiologica Sinica* (in Chinese) 20: 124–126.

Mohanan, C. (2011). *Macrofungi of Kerala*. Kerala Forest Research Institute, Kerala, India.

Sridhar, K.R. & N.C. Karun (2013). On the Basket Stinkhorn Mushroom *Phallus merulinus* (Phallaceae) in Mangalore, Karnataka, India. *Journal of Threatened Taxa* 5(5): 3985–3988; http://dx.doi.org/10.11609/JoTT.o3312.3985-8

Swapna, S., A. Syed & M. Krishnappa (2008). Diversity of macrofungi in semi-evergreen and moist deciduous forest of Shimoga District, Karnataka. *Journal of Mycology and Plant Pathology* 38: 21–26.

Tiwari, C.K., J. Parihar, R.K. Verma & U. Prakasham (2013). *Atlas of Wood Decaying Fungi of central India.* Tropical Forest Research Institute, Jabalpur, India.

Trierveiler-Pereira, L., C. Loguercio-Leite, F.D. Calonge & I.G. Baseia (2009). An emendation of *Phallus glutinolens*. *Mycological Progress* 8: 377–380; http://dx.doi.org/10.1007/s11557-009-0603-7

Zabawski, J. (1976). New localities of *Phallus hadriani*, new record in the northwest Poland. *Fragmenta Floristic et Geobotanica* 22: 623–26.

OPEN ACCESS

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

January 2016 | Vol. 8 | No. 1 | Pages: 8309–8420
Date of Publication: 26 January 2016 (Online & Print)
DOI: 10.11609/jott.2016.8.1.8309-8420
www.threatenedtaxa.org