

# First report of *Hygrophorus pudorinus* (A wild edible Mushroom) from India with macro- and micro-morphology

Dyutiparna Chakraborty<sup>1</sup>, Sobhan Kumar Mukherjee<sup>2</sup> and Kanad Das<sup>1</sup>✉

<sup>1</sup>Cryptogamic Unit, Botanical Survey of India, P.O. Botanic Garden, Howrah - 711103, India

<sup>2</sup>Department of Botany, University of Kalyani, Kalyani - 741235, Nadia, India

✉Corresponding author: daskanadbsi@gmail.com

## भारत से हाइग्रोफोरस पुडोरिनस (वन्य खाद्य मशरूम) के बृहद एवं सूक्ष्माकारिकी के साथ प्रथम अभिलेख

दयूतिपर्णा चक्रवर्ती, सोभन कुमार मुखर्जी एवं कनाद दास

### सारांश

हाइग्रोफोरस पुडोरिनस जिसे सिक्किम के उप उच्च हिमालयी क्षेत्र से संग्रहित किया गया है, को प्रथम बार भारत के लिये अभिलेखित कर वर्णित एवं चित्रित किया गया है। इस शोध पत्र में इस जाति की सबद्ध जातियों के साथ इसका तुलनात्मक अध्ययन भी दिया गया है।

### ABSTRACT

*Hygrophorus pudorinus* which is collected from subalpine Himalaya of Sikkim is described and illustrated for the first time from India. Comparisons with the allied taxa are also provided.

**Keywords:** Hygrophoraceae, Macrofungi, Sikkim, Taxonomy

### INTRODUCTION

Members of the genus *Hygrophorus* Fr. are mainly characterised by their waxy nature of pileus and lamellae, elongated basidia, smooth spores, bilateral hymenophoral trama, and occurrence of ectomycorrhizal associates of higher plants. In India, along with other members of the family Hygrophoraceae, this genus was also not explored thoroughly and only few sporadic reports were made by Berkeley (1856, 1882), Sharma & Munjal (1977). During a recent macrofungal foray to

different parts of East district of Sikkim (a small Himalayan state) in 2015 one of us (DC) encountered an edible member of Hygrophoraceae. Detailed macro- and micro-morphological studies followed by literature survey revealed its conspecificity with *Hygrophorus pudorinus* (Fr.) Fr., a species originally reported from North America. In this manuscript *H. pudorinus* is reported for the first time from India with macro- and micro-morphological illustrations and comparisons with allied taxa.

## METHODS

Macromorphological characters, macrochemical colour tests (with the application of 10% KOH, FeSO<sub>4</sub> and Guaiacol) and habitat details were recorded from fresh basidiomata in the basecamp or field. Specimens were dried with a portable field dryer. Photographs of fresh basidiomata and microphotographs were captured with a Canon SX 120 and Nikon-DS-Ri1 (dedicated to Nikon Eclipse Ni compound microscope) cameras respectively. Color codes and terms mostly follow Methuen Handbook of Color (Kornherup & Wanscher 1978). Subsequently micromorphological features were recorded with the aid of a compound microscope (Nikon Eclipse Ni-U) from free-hand sections of dry basidiomata mounted in 5% KOH, or stained in a mixture of 5% KOH and phloxin and mounted in 30% glycerol or distilled water. Drawings were made with a drawing tube (attached to Nikon-DS-Ri1) at 1000× magnification. Basidium length excludes length of sterigmata. Spore-measurements were recorded in profile view from thirty basidiospores. Spore-size measurements and length/width ratios (Q) are given as: minimum–mean–maximum. Herbarium acronym follows Holmgren & al. (1990).

*Hygrophorus pudorinus* (Fr.) Fr., Anteckn. Sver. Ätl. Svamp.: 46 (1836).

*Agaricus pudorinus* Fr., Syst. mycol. (Lundae) 1: 33 (1821). *Hygrophorus pudorinus* f. *pallidus* (A.H. Sm. & Hesler) Hesler & A.H. Sm. North American Species of *Hygrophorus*: 337 (1963). *Hygrophorus pudorinus* var. *pallidus* (A.H. Sm. & Hesler) Bon, Docums Mycol. 7(nos 27–28): 37 (1977). *Hygrophorus pudorinus* var. *subcinereus* (A.H. Sm. & Hesler) Hesler & A.H. Sm., North American Species of *Hygrophorus*: 338 (1963).

Pileus 16–70 mm. diam.; convex to sub pyramidal or pyramidal; surface scaly, glutinous, pitted or scrobiculate, in combination of pale orange to light orange (5A3–4), brownish orange or greyish red (7C5–4 or 8C5) or darker, centre darker than the rest. Lamellae narrowly adnate to subdecurrent, close (10/cm at pileus-margin), often forked, greyish orange (5B4); lamellulae present, in 2 series. Stipe 40–70 × 12–43 mm, central, white, slowly becoming concolorous with pileus; surface slightly floccose, white at apex; with minute striations throughout that frequently anastomose surrounding pits, especially towards base. Context solid in pileus and stipe. Spore print not found.

Basidiospores 7.2–8.2–9.6 × 4.4–4.8–5.4 µm (n = 20, Q = 1.50–1.67–2.08), ellipsoid to elongate; smooth. Basidia 45–65 × 8–10 µm, 4-spored, narrowly clavate to

subcylindric. Pleurocystidia and cheilocystidia absent. Lamellae-edge fertile, concolorous. Hymenophoral trama divergent. Pileipellis 150–320 µm thick, ixotrichoderm to ixocutis; hyphae septate, clamped, terminal cells cylindrical, subfusoid with mostly rounded apex. Stipitipellis up to 130 µm thick, trichoderm with erect, septate, clamped hyphae; terminal cells 5.3–7.5 µm wide, mostly cylindrical with subfusoid to appendiculate rounded apex.

*Habitat*: Scattered to gregarious under coniferous tree of subalpine mixed (broad leaf and conifer) forest

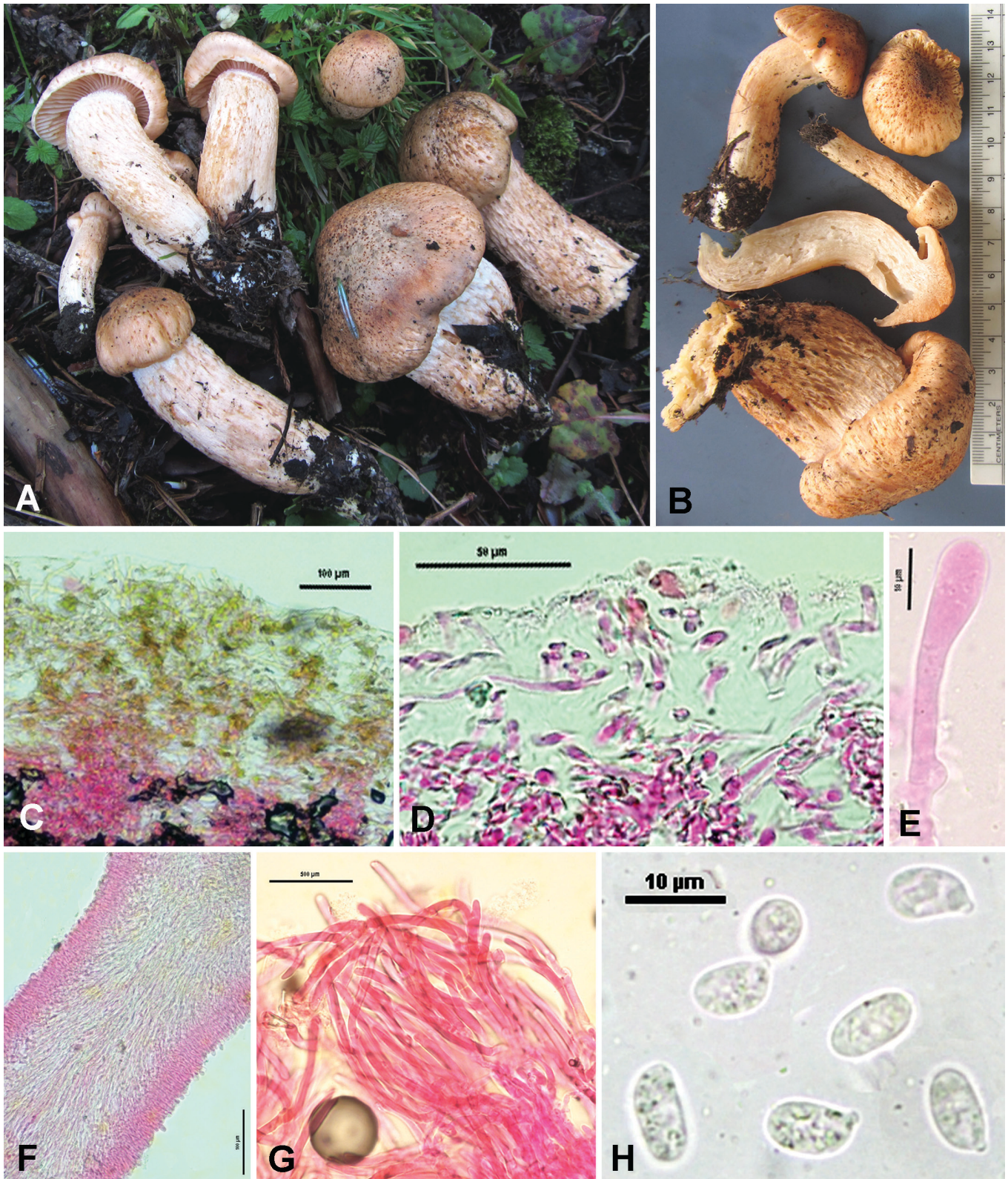
*Distribution*: North East America, Europe, India.

*Specimens examined*: India: Sikkim, East District, Memainchu, 3601m, N 27°21'00.6" E 88°49'30.9", 06.07.2015, D. Chakraborty, DC 15-018 (CAL); Kyangnosla, 3352 m, N 27°22'21.0" E 88°46'31.1", 07.07.2015, D. Chakraborty, DC 15-024 (CAL).

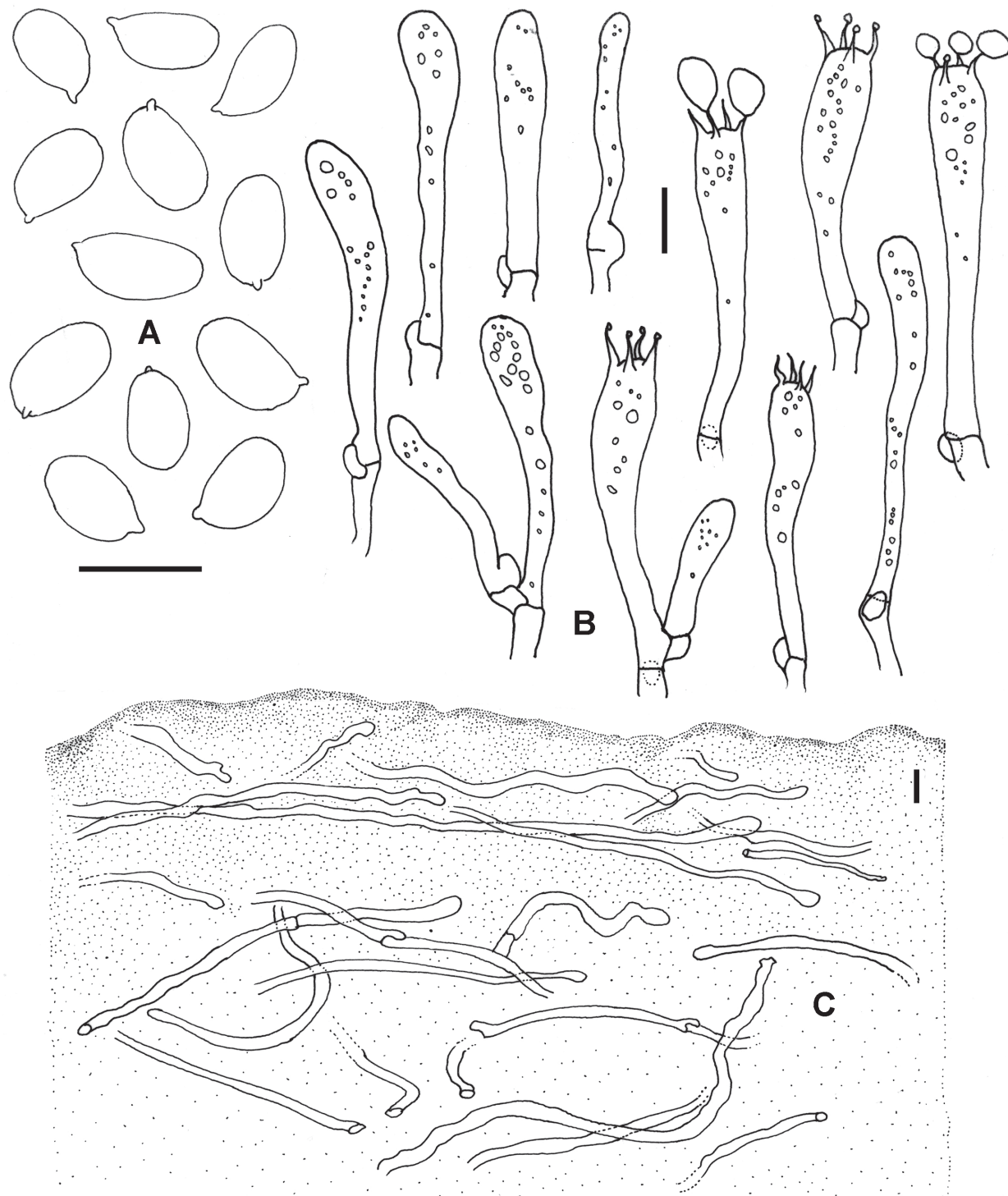
*Note*: *Hygrophorus pudorinus* (Fr.) Fr. is well distributed in North East America (Hesler and Smith 1963, Bessette & al. 2012) and Europe (Knudsen & Vesterholt 2012, Breitenbach & Kränzlin 1991) where they commonly known as “Blushing *Hygrophorus*” or “Turpentine Waxcap”. Its existence was merely known from Himachal Pradesh without any morphological description or illustration (Kumar & al. 1990). Repeated macrofungal forays undertaken by Botanical Survey of India in recent years uncovered this mushroom species which is highly appreciated by the local people of Sikkim and taken with delicacy.

According to Hesler & Smith (1963) *H. pudorinus* is placed under subgen. *Hygrophorus* as its hymenophoral trama is not interwoven and basidiospores are inamyloid. Macro- and micro-morphological characters of Indian material is on conformity with its American counterpart except the pileus of Indian specimen which were slightly smaller in comparison to American specimens (Hesler & Smith 1963). Moreover, presence of the combination of characters like, dry stipe, distinct coloration (buff to salmon) of pileus, thick and soft stipe, divergent hymenophoral trama confirms its taxonomic placement under series *Pudorini* of subsection *Camarophylli* under the section *Hygrophorus* (Hesler & Smith 1963). While considering the recent phylogeny of the family Hygrophoraceae, *H. pudorinus* is now well placed under tribe Hygrophoreae of subfamily Hygrophoroidae (Lodge & al. 2014).

Morphologically and phylogenetically allied species of *H. pudorinus* are *H. poetarum* R. Heim, *H. secretanii* Henning and *H. russula* (Schaeff.) Kauffman. But, *Hygrophorus poetarum* differs from *H. pudorinus* by its



**Fig. 1:** A. & B. Fresh young and mature basidiomata; C. & D. Pileipellies; E. Basidiole with basal clamp; F. Lamellar trama; G. Stipitipellis; H. Basidiospores. Bars = C & F: 100  $\mu\text{m}$ , D: 50  $\mu\text{m}$ , E & H: 10  $\mu\text{m}$ , G: 500  $\mu\text{m}$ .



**Fig. 2:** A. Basidiospores; B. Basidia and Basidioles; C. Pileipellis. Bars = A & B: 10 µm, C: 25 µm.

occurrence in association with *Fagus* sp., presence of pileus with umbo and decurrent gills (Hesler & Smith 1963, Breitenbach & Kränzlin, 1991). *Hygrophorus rus-sula* is separated by its pruinose stipe apex, reddening of context on bruising, gills with purplish red spots,

and occurrence under *Quercus* sp. (Bessette & al. 2012). *Hygrophorus secretanii* is quite distinct by its occurrence under *Picea* sp., having bitter almond odour, distant gills and presence of 4- & 2-spored basidia (Knudsen & Vesterholt 2012).

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