

First Record of a Sky-Blue Pinkgill Mushroom (*Entoloma* spp.) collected from Chaiyaphum province, Northeast Thailand

Taweesak Malimas¹, Tanakwan Budsabun², Janwit Phuttikul³, Anchalee Praphothithang⁴, Manussawee Dechkla², Somboon Tanasupawat^{5*}

¹Microbial Laboratory Biosafety Level-1, 46 M, 9 Nongphua, Muangsuang, Roi-Et 45220, Thailand

²Department of Industrial Microbiology, Faculty of Science and Technology, Suan Sunandha Rajabhat University, Bangkok 10300, Thailand.

³Forest Biodiversity Division, Fores Research Development office, Royal Forest Department, Bangkok 10900, Thailand.

⁴Forestry Technical Officer, Royal Forest Department, Haruethai Rd., Nai Muang, Chaiyaphum, 36000, Thailand.

⁵Department of Biochemistry and Microbiology, Faculty of Pharmaceutical Sciences, Chulalongkorn University, Bangkok 10330, Thailand.

DOI: <https://doi.org/10.5281/zenodo.20643822>

Published Date: 11-June-2026

Abstract: A sky-blue basidiomycete belonging to the genus *Entoloma* was collected from Phupeng-Phuromthip mountains, Nong bua daeng District, Chaiyaphum province, Northeast Thailand. The specimen was characterized by a vivid blue pileus, pinkish spore print, and angular basidiospores. Morphological examination suggested affinity with members of the blue *Entoloma* group. Molecular analyses were not available at the time of study. This report provides the first documented occurrence of a sky-blue *Entoloma*-like fungus from the surveyed locality.

Keywords: sky-blue basidiomycete, genus *Entoloma*, Agaricomycotina, micromorphology, pinkish basidiospores, Entolomataceae.

I. INTRODUCTION

The genus *Entoloma* was Agaricomycotina (Basidiomycota, Agaricales, Entolomataceae) is one of the most diverse and taxonomically challenging group of pink-spore agarics, comprising more than 1,500 described species worldwide (Morozova and Noordeloos, 2010, Ediriweera et al., 2017; He et al., 2019; Alves et al., 2012; Chen et al., 2025; Liu et al., 2025). Most species of *Entoloma* were reported to the poison mushroom and saprotrophic fungi, not many species were edible mushroom (Chen et al., 2025; Liu et al., 2025). Member of the genus are characterized by pinkish basidiospores, typically angular or polyhedral in shape, and by a wide range of macromorphological forms including myceloid, tricholomatoid, collybioid, and rhodophylloid morphotypes. Most species of *Entoloma* are saprotrophic, but some species are mycorrhizal and weakly parasitic microorganism, inhabit variety of ecosystems, from tropical forest to temperate woodlands and grassland, often forming ecological associations with soil, leaf litter, or decaying wood (Morozova and Noordeloos, 2010, Ediriweera et al., 2017; Anil Raj and K.N., Manimohan., 2016, 2017; He et al., 2019; Alves et al., 2012; Liu et al., 2025; Chen et al., 2025)

Member of the genus exhibit remarkable morphological diversity, yet species with blue pigmentation remain uncommon and taxonomically significant. Blue-colored species of *Entoloma* have drawn scientific attention due to their unique chromatic compounds, restricted ecological niches, and their value in understanding phylogenetic relationship within the genus.

Historically, sky-blue pinkgill mushroom or blue *Entoloma* species were rarely reported, blue-colored fungi are among the most visually striking components of fungal biodiversity and have attracted considerable scientific and public interest

worldwide. Within the genus *Entoloma*, several species exhibit vivid blue pigmentation, but few are as iconic as *Entoloma hochstetteri* Reichardt, a distinctive sky-blue mushroom endemic to New Zealand. The species is characterized by its bright blue basidiomata and pinkish spores, features that have made it one of the most recognizable fungi in the world with early records scattered across tropical and subtropical regions (Horak 2008). Notable discoveries included *Entoloma hochstetteri* in New Zealand, *E. virescens* in India, *E. mengsongense* and *E. wuyishanense* in China, and newly described taxa from Southeast Asia and South America (Largent 1994; Noordeloos; Manimohan et al., 2006; Coelho et al., 2019; Horak 2008; Karunaratna et al., 2016; Ediriweera et al., 2017; Ratnaweera and Hyde 2018; Reschke, K., et al., 2022; Chen et al., 2025; Liu et al., 2025).

According to the mushroom observation at the Phupeng-Phuromthip mountains, Nong bua daeng District, Chaiyaphum province, Northeast Thailand on November 2025. The mushroom growth at the mountain peak with Pygmy bamboo plants (*Vietnamosasa pusilla*). The ecology of plant on this Phuromthip mountain were Dry Dipterocarp Forest, most tree were Burmese sal and Pygmy bamboo plants. The most edible mushroom presented not many species and separated to the large two genera, *Amanita* and *Boletus* species. The look like sky-blue pinkgill mushroom not so many areas for growing, so very rare for finding.

A mushroom single and clumping growing with a sky-blue cap and stem, and gills that are dark blue to blue, a cap diameter of 1-3 cm and the stem have height about 1-7cm, presented pale blue to blue mycelium. The spore of mutual mushroom was pink-brown colors cover on the cap and the surface of the cap presented looks like scales pale blue to white, this profile presented to look like sky-blue *Entoloma* species. However, previously reported of *Entoloma sequestratum*, a new species from northern Thailand in 2020, but not sky-blue color mushroom (Elliott et al., 2020).

This paper aims to report and document the first recorded occurrence of the rare sky-blue pinkgill mushroom, collected from Chaiyaphum province, Northeast Thailand by using the morphology taxonomy.

II. BODY OF ARTICLE

Material and Methode

The *Entoloma* spp., specimen sample was collected from Dry Dipterocarp Forest, most trees were Burmese sal (*Shorea siamensis*) and Pygmy bamboo plants (*Vietnamosasa pusilla*), at the mountain peak of Phupeng-Phuromthip mountains, Nong bua daeng District, Chaiyaphum province, Northeast Thailand in the rainy season-winter season, November 2025. The Basidiomata and environment ecology habitat were photographed using a digital camera. This area was presented, 16°10'15.47"N, 101°31'32"E 300-316 m.

The information of the mushroom for macromorphology characterization was recorded with Ediriweera et al., 2017, previously described. The specimens were collected and drying at 40°C for 24-48 hr., temporary deposited at the herbarium of Forest Biodiversity Division, Forest Research Development office, Royal Forest Department, Bangkok 10900, Thailand.

III. CONCLUSION

Results and Discussion

Pileus 2.5-3.0 cm diam., 3.0-6.5 cm high, conic-convex with a sky-blue papillate umbonate, fibrillose cap and sky-blue color when it is young, but turns yellow to brown as it matures. Lamellae adnexed, moderately spaced, with lamellulae of three lengths, ventricose, deep blue. Stipe 3.0-7.0 cm×2.5-3 mm, central, confluent with the pileus, glabrous, fragile, flattened cylindrical, hollow, slightly striated, and concolorous with the pileus, with light blue basal mycelium. Context was thin, deep blue consisting of hyaline, thin walled, inflated hyphae. Odor distinct but unidentifiable. Taste unknown (Fig 1.)

Spore print photography and microscopic examination observed on dry specimen were using a dissection microscope (Fig 2.). The slide preparation with Lactophenol Cotton Blue (LCB). Basidiospore measuring 10.0-15.0×10-14.0 μm., looking a slightly thickened, cuboid, with the four regular to irregular angles in side views, these spores profile similar to *E. virescens*.

When comparing the basidiomes morphology of sky-blue colored pinkgill mushroom species, *E. hochstetteri*, *E. virescens*, *E. mengsongense*, and *Entoloma* spp, in this study. The *Entoloma* spp. look more like *E. hochstetteri* than *E. virescens* and *E. mengsongense* (Fig 3.). In addition, *E. hochstetteri* was not only found in New Zealand, but the species was also presented in India. Habit and habitat of *Entoloma* spp., growth at Dry Dipterocarp Forest, most trees were Burmese sal (*Shorea*

siamensis) and Pygmy bamboo plants (*Vietnamosasa pusilla*), Phupeng-Phuromthip mountains, Nong bua daeng District, Chaiyaphum province, Northeast Thailand. This area was 16°10'15.47"N, 101°31'32"E 300-316 m., with high humidity of 80-90% and low temperatures of 19-25 °C.

However, this study is the first report of the presence of the blue sky pinkgill mushroom in Thailand. It resembles *Entoloma hochstetteri* from New Zealand, but differs in color from *E.virescens* from India, *E.mengsongense* and *E. wuyishanense* from China, Southeast Asia, and South America. Although, nearby countries such as Vietnam have reported *Entoloma cycneum*, a white/whitish mushroom with yellow tinges and a smooth cap, and *Entoloma peristerinum*, which features a beige conical pileus that fades to white with age, this report presents the blue sky pinkgill mushroom collected from Thailand, which may be distinct from those in New Zealand, Southeast Asia, and South America.

The morphological taxonomy of the *Entoloma* spp. in this study may suggest the old species previously reported as *Entoloma hochstetteri* and may be separated into new species in the future, unidentified at this time. So, next, our experimental study requested genetic taxonomy identified for species-level features.

Acknowledgements

The present authors express their sincere thanks for citing the experimental data of the authors.

Funding information

The present authors received grant from Department of Industrial Microbiology, Faculty of Science and Technology, Suan Sunandha Rajabhat University, Bangkok 10300, Thailand.

Conflict of interest

The authors declare that there are no conflicts of interest.

Author contributions

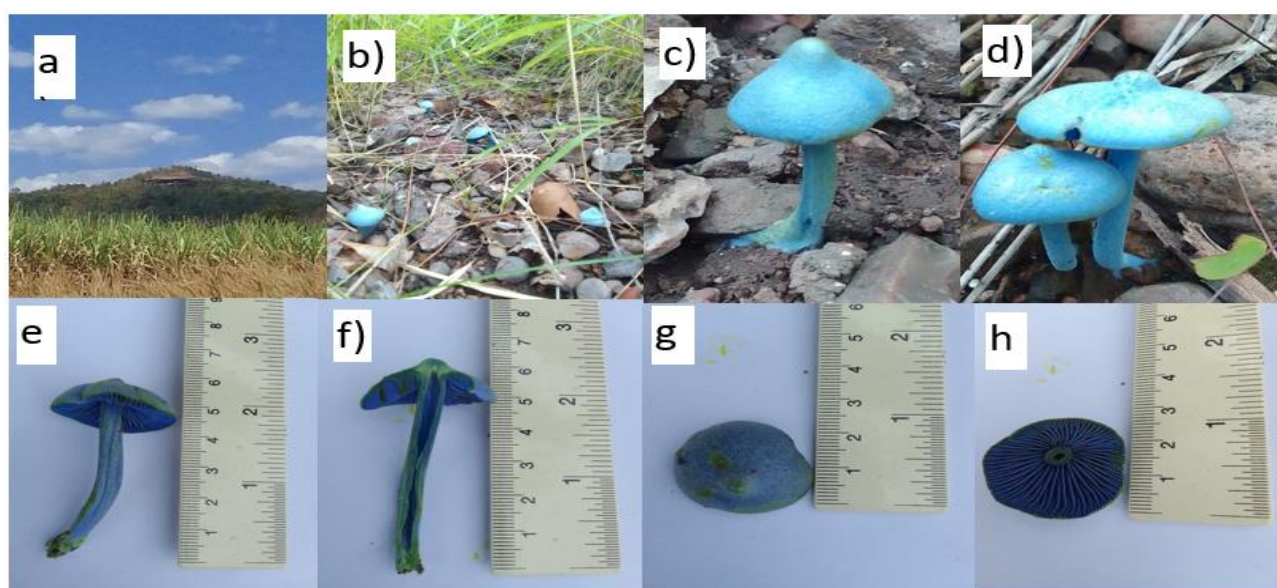
T. B., T. M., J. P., A. P., M. D., and S. T. designed the study. T. B. performed the main experiments. T. M. and J. P. instructed the experiments. T. B., T. M and S.T. prepared the manuscript. The detailed discussions were made among the six.

REFERENCES

- [1] Alves M.H., and Nascimento C.C. (2012). *Entoloma virescens* (Sacc.) E. Horak ex Coutec., 1986 (Agaricales: Entolomataceae): The first record for the Caatinga biome, Ceará, Brazil. *Chech List* 8(3): 577-580. ISSN 1809-127X (available at www.checklist.org.br)
- [2] Anil Raj, K.N., Manimohan, (2016). Three new species of *Entoloma* subgenus *Nolanea* from India based on morphology and molecular phylogeny. *Phytotaxa*. Vol. 286 No. 4: 5 December 2016 <https://doi.org/10.11646/phytotaxa.286.4.2>
- [3] Anil Raj, K.N., Manimohan, (2017). Four new species of *Entoloma* subgenus *Pouzarella* from India. *Phytotaxa*. Vol. 307 No. 2, <https://doi.org/10.11646/phytotaxa.307.2.1>
- [4] Ediriweera, A.N., Karunarathna, S.C., Xu, J., Hyde, K. D., Mortimer, P.E. (20 17). *Entoloma mengsongense* sp.nov. (Entolomataceae, Agaricales), a remarkable blue mushroom from Yunnan province, China. *Turk Bot* 41:505-515. <http://doi:10.3906/bot-1611-13>
- [5] Elliott TF, Nelsen DJ, Karunarathna SC, Stephenson SL (2020). *Entoloma sequestratum*, a new species from northern Thailand, and a worldwide key to sequestrate taxa of *Entoloma* (Entolomataceae) *Fungal Systematics and Evolution* 6: 253–263. doi: 10.3114/fuse.2020.06.12.
- [6] Liu X., Chen Q., Xiang Q., Gu Y., Han X., Xing R., Zhao R., He M. (2025). Addition to the *Entoloma* (Agaricales, Entolomataceae) from China: Description of five species with one new to science. *MycKeys* 123: 89-103. <http://doi.org/10.3897/mycokeys.123.162577>.
- [7] Nautiyal CS (1999) An efficient microbiological growth medium for screening phosphate solubilizing microorganisms. *FEMS Microbiol Lett* 170, 265–270.
- [8] Peter Buchanan, Fungi – New Zealand fungi, Te Ara – the Encyclopedia of New Zealand, <https://teara.govt.nz/en/photograph/11560/blue-mushroom> (accessed 10 June 2026)

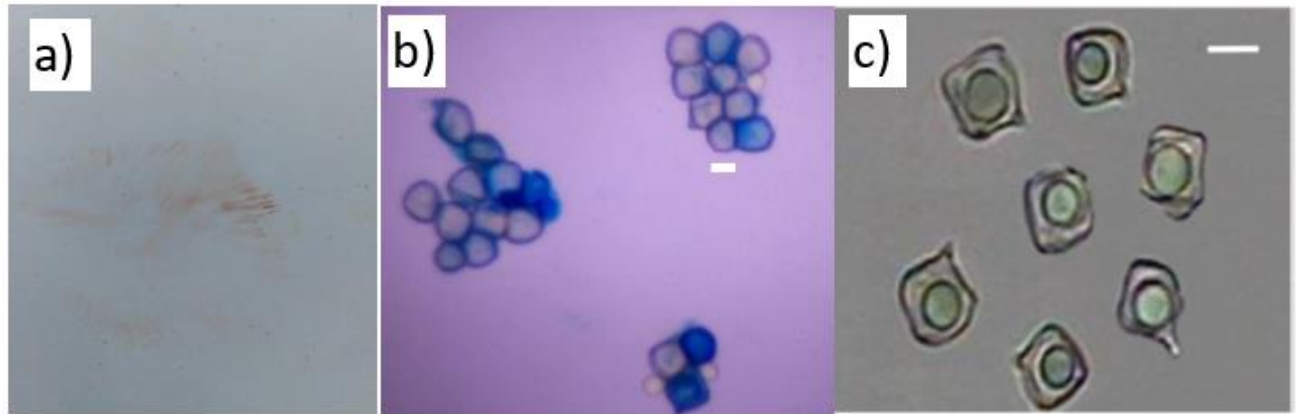
- [9] Seemann T (2014) Prokka: rapid prokaryotic genome annotation. *Bioinformatics* **30**, 2068–2069.
- [10] Svehla, G., *Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis*, London: Longman, 1979.
- [11] Horak, E. 2008. Agaricales of New Zealand 1: Pluteaceae - Entolomataceae. :1-305
- [12] He XL, Peng WH., Gan BC. (2015). Morphological and molecular evidence for a new species in *Entoloma* subgenus *Claudopus* from Sichuan Province, southwest China. *Mycoscience* **56**(3):326-331. <https://doi.org/10.1016/j.myc.2014.10.001>
- [13] He XL, Horak E., Wang D., Li TH., Peng WH., Gan BC., (2019). Description of five new species in *Entoloma* subgenus *Claudopus* from China, with molecular phylogeny of *Entoloma* sl. *Mycoskeys* **61**:1. <http://doi.org/10.3897/mycokeys.61.46446>
- [14] Kaygusuz O., Reschke K., Kaya A., Dima B., Morozova O., Noordeloos ME., Piepenbring M. (2024). Morphology and molecular phylogeny of four new species of *Entoloma* (Entolomataceae, Agaricales) from Europe and Western Eurasia. *Mycological progress* **23**(1): 34. <http://doi.org/10.1007/s11557-024-01972-2>
- [15] Morozova, O.; Pham, T.H.G. (2023) New Species of *Entoloma* Subgenera *Cubospora* and *Leptonia* (Agaricales, Basidiomycota) from Central Vietnam. *J. Fungi*, **9**, 621. <https://doi.org/10.3390/jof9060621>
- [16] Noordeloos M.E. (1981). Introduction to taxonomy of the genus *Entoloma* sensu lato (Agaricales). *Persoonia-Molecular Phylogeny and Evolution of Fungi* **11**(2):121-151
- [17] Noordeloos ME. (1985). Notulae ad Floram Agaricinae neerlandicam-X-XI. *Entoloma*. *Persoonia-Molecular Phylogeny and Evolution of Fungi* **12**(4):457-462
- [18] Noordeloos M.E., Machiel E., Genevieve M.G., Walsmit-Sachs A. (2012). The Entolomataceae of Tasmania. Vol 22. Springer, New York. <http://doi.org/10.1007/978-94-007-4679-4>
- [19] Reschke, K., Noordeloos, M.E., Manz, C., Hofmann, T.A., Cedeño, J.R., Dima, B., Piepenbring, M. (2022). Fungal diversity in the tropics: *Entoloma* spp. in Panama. *Mycological Progress*. <https://doi.org/10.1007/s11557-021-01752-2>

LIST OF FIGURES



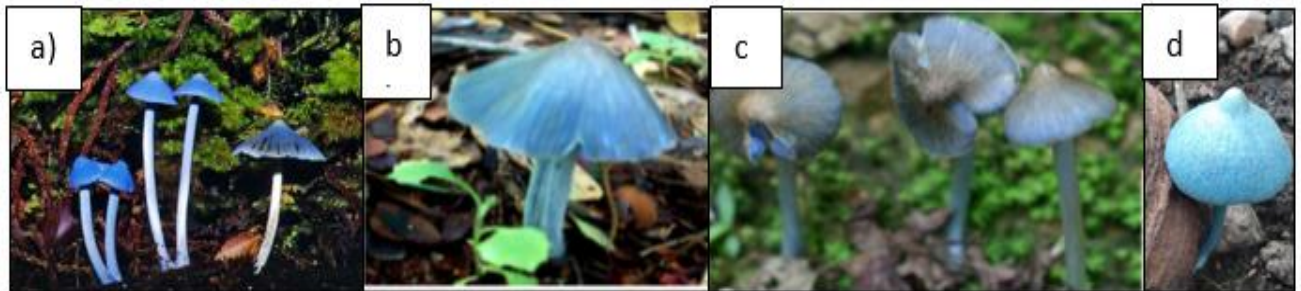
a) Phupeng-Phuromthip mountains; b) Habitat of of *Entoloma* spp., growing; c)-h) Morphology and basidiomes of *Entoloma* spp.

Fig 1. Phupeng-Phuromthip mountains and Morphology of *Entoloma* spp.



a) Spore print photography of *Entoloma* spp.; b) Basidiospores of *Entoloma* spp.; c) Basidiospores of *E. virescens* (Alves and Nascimento., 2012), scale bars: b=10 μ m; c=10 μ m

Fig 2. Spore print photography and Basidiospores of *Entoloma* spp.



a) *E. hochstetteri*; b) *E. virescens*; c) *E. mengsongense*; d) *Entoloma* spp (this study)

Fig 3. Basidiomes compression of blue-sky colored *Entoloma* species

Image source: pictures a) Peter Buchanan, Fungi – New Zealand fungi, Te Ara – the Encyclopedia of New Zealand, <https://teara.govt.nz/en/photograph/11560/blue-mushroom> (accessed 10 June 2026); b) Alves and Nascimento., 201; c) Ediriweera et al., 2017.