A new record of *Tremellodendropsis tuberosa* (Grev.) D.A. Crawford, from India

KshamaTripathi[1], Preeti Prakash[2], Harshita Pathak[3], Nootan Singh[4], Shashank K. Singh[5] and Savariraj Dominic Rajkumar[6*]

Department of Botany, St. Andrew's College, Gorakhpur - 273001, Uttar Pradesh, India
E-mail: dominicrajkumar1@gmail.com

Abstract

Tremellodendropsis tuberosa (Basidiomycota) is described and illustrated from the state of Uttar Pradesh, India. The study area which is at the foot hills of Himalayas is rich in diversity. This is the first report of Agaricobiota (Fungi: Basidiomycota) from India. This is a rare and interesting fungi found in the forest-steppe zone, on dead stems of the trees.

Keywords: *Tremellodendropsis tuberosa, Tremellodendropsidales, Basidiomycota fungi, forest-steppe, new data, micro-habitats, Gorakhpur, Uttar Pradesh.*

1. Introduction

The kingdom fungi are the most varied eukaryotic lineages on earth with estimates of several million existent species (O'Brien *et al.* 2005, Blackwell2011, Taylor *et al.* 2014). About 80,000 to 1,20,000 species of fungi have been reported to date, although the total number of species is said to be around 1.5 million (Hawksworth 2001, Kirk *et al.* 2001), the ubiquitous fungi are an awesomely successful kingdom. Fungi represent very diverse and flourishing group of microorganisms whose numbers are estimated at more than 1.6 million species (Gardes & Bruns 1996). There are around 1600 wood decay species (Bennet *et al.* 2002). Basidiomycetes are characterized in part because their basidiospores are produced on a basidium and many but not all have clamp connections. No other group of fungi has these special structures. Millions of these basidiospores are quite variable in form. These are discharged in a short distance into the space between the gills, tubes, or teeth, of the sporocarp. Later they fall out of the cap to be taken away by air currents (Alexopolous *et al.* 1996). While most are saprobes that decay organic matter, symbionts of plants or harmless commensals, the pathogenic species are of particular interest: an estimated 32% of fungi are plant pathogens, while only 0.5% (roughly 400 species) are clinically relevant human pathogens (Shivas & Hyde 1997, De Hoog2000, Hawksworth 2001, Kirk *et al.* 2001).

Fungi plays an important role in carbon and nutrient cycling of terrestrial and aquatic ecosystems, and they are important pathogens and mutualists (Read & Perez-Moreno 2003, Taylor *et al.* 2012, Grossart *et al.*2016). Despite their impacts on primary ecosystem functions, assessments of fungal biodiversity estimate that only 10% of fungal species have been described (Bass & Richards 2011, Hibbett *et al.* 2011). Traditional methods for identifying decay fungi are difficult and time consuming.Traditionally specimen based taxonomic studies have been the only way to discover new species. Because most fungi have microscopic life-stages and convergent morphological features (Rivas-Plata & Lumbsch 2011, Wynns 2015), many fungal groups remain severely under sampled. In particular, many environmental sequences cannot be associated with a known fungal species or lineage. This remains a major challenge to decipher fungal community composition and understand ecological roles of fungi in leaf litter, soil, or inside plants (Yahr *et al.* 2016). Today's threats to biodiversity from habitat loss and climate change are occurring at anstrange scale, and it is possible that many species may become extinct before they have been even

discovered (Costello *et al.* 2013, Monastersky 2014).Phylum Basidiomycota, numbers estimated 30000 species. A notable number of basidiomycetes are pathogenic: the rusts and smuts number about 7000 and 1400 species, respectively, and in addition 40 yeast species have been reported to infect humans and animals (Kirk *et al.*2001, Mitchell 2005).

The basidiomycetes are easily the largest, most important, and common group of fungi that cause wood decay. Most arborists know them as the mushrooms and conks that grow on living or dead trees and people have written volumes on wood decay caused by members of this group of fungi. It would be easy to leave the discussion of urban wood decay fungi to the basidiomycetes alone. Volumes I and II of North American Polypores by Gilbertson and Ryvarden (1986, 1987) identify nearly 500 different basidiomycetes responsible for decaying wood of living and dead trees. This list does not include the extensive group of gilled mushrooms and other types of basidiomycetes that also decay wood.

The species *Tremellodendropsis tuberose* was first described as *Merisma tuberosum* by Scottish mycologist Robert Kaye Greville in 1825. D.A. Crawford transferred it to its current genus *Tremellodendropsis* in 1954 and made it the type species. It is classified in the subgenus *Tremellodendropsis*, which contains species with basidia that are partially partitioned (septate) at their apices, other species in this subgenus include *T. pusio* and *T. flagelliformis*. Corner (1953), recognised a subgenus *Tremellodendropsis*, in which species are with clamped hyphae, and sub-tremellaceous basidia. *Tremellodendropsis tuberosa* is commonly known as the 'ashen coral', is a species of coral fungus in the family Tremellodendropsidaceae. Described in 1825, it is found in Europe, North America, South America and Asia.

Tremellodendropsis tuberosa is a coralloid relative of jelly fungi. It is small, whitish to pale brownish fruit bodies usually arise from a single, long, whitish, stipe-like base and have a distinctive upright stature. *Tremellodendropsis tuberosa* usually is found on bare soil in forests; it is fairly common but is not well known. The spores are generally ellipsoid to somewhat spindle-or almond-shaped, 12—20 x5—9 µm, and are borne on basidia that are divided lengthwise, at least near their tips. Small, sparingly branched versions of *Tremellodendron schwenitzii* (AKA *Tremellodendron pallidum*) and other, less well-known species of *Tremellodendron* are very similar in appearance and are also tough-flesh, these are best separated with microscopic examination. Additionally, many small and whitish coral fungi are superficially similar but have fragile, brittle flesh and are thus more easily separated. *Tremellodendropsis tuberosa* has been causing taxonomic problems since the day it was discovered. At issue is its placement relative to other groups of fungi. It has funky, interesting basidia (the prong-like structures on which spores are borne) that seem to be a combination of two well-established types. Jelly fungi develop divided basidia, while other mushrooms that bear spores on basidia do not. But the basidia of *Tremellodendropsis tuberosa* are partially divided, a crease develops at the base of the spore-holding prongs, creating a basidium type that has been called "partially septate," or "sub-tremellaceous" (Kuo 2017). Thus, the very tiny genus *Tremellodendropsis*, and even a separate family to hold the genus, the Tremellodendropsidaceae, were created to hold this mushroom long before. The most recent work Berbee and collaborators supports giving *Tremellodendropsis* its own order (the rank above family), the Tremellodendropsidales. Berbee *et al.* (2016) recently showed that *T. tuberosa* belongs to a unique Agaricomycete lineage in the Order Tremellodendropsidales, Family Tramellodendropsidaceace. It has partially septate basidia, apices flattened, spathula like, basidia with longitudinal internal walls.

The present collection of *Tremellodendropsis tuberosa* is the first report of this species from India. *T. tuberosa* has been collected from different locations of Kushmi Forest, Gorakhpur (Fig. 1), Uttar Pradesh, India.

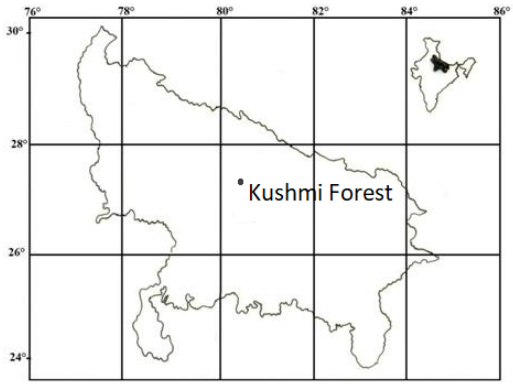

Figure 1. Showing Map of Study Area

2. Materials and Methods

A field survey on the Kushmi forest, Gorakhpur, Uttar Pradesh, India was conducted during August and September months (2021). The fruiting body of the fungus was found in the forest area of Gorakhpur (Uttar Pradesh). Fungus was carefully dugout with the help of a knife and photographed in the field. Identification of fungi collected were characterized morphologically. The collected specimens were identified by Conventional morphology based taxonomic methods. The specimens collected from different locations were preserved in formaldehyde for further studies. All the specimens have been deposited at St. Andrew's college herbarium (SACH), Department of Botany, St. Andrew's College, Gorakhpur, Uttar Pradesh, India

Species Examined:

Tremellodendropsis tuberosa- Kushmi Forest, Gorakhpur District, Uttar Pradesh 90 m, SACH: 1252, 8 August 2021; SACH 1268, 1271, 28 September 2021. Found in shade, under & on decaying trees and stems.

3. Results and Discussion

The collected species was identified based on their morphology. These fungi are very significant for recycling of nutrient through decaying (rotting) mechanisms of fallen wood tree and solid waste of agricultural products. These are a very important component of the basidiomycete fungi in forest ecosystems for wood decaying process and also as tree pathogens.

Distribution and Habitat:

Growing, scattered to gregariously on the ground, sometimes from well-decayed woody debris, in woods. Fruiting body is clavarioid, a small, sparingly branched, rarely sub-simple and tufted pale colored fruit structure arising from a shared stem; about 4 - 6 cm high and 2 - 3 cm across in diameter (Fig. 2). Branches are forked and feature elongated, tapering tips, terete to flattened, round or somewhat flattened in cross-section; dry; smooth and bald; dull yellowish white, with starker white tips when fresh; discoloring a little brownish with age, beginning with the tips, polychotomous to dichotomous, rugose to smooth, sub-coriaceous to tough and fleshy, possessing a high percentage of water yet not really gelatinous. Stem is smooth and bald, whitish to brownish.The tough stem is white, as is the flesh and is covered with whitish mycelia at the base. The edibility of the fruit body is unknown. Fruiting body is slender, upright, 3- 6 cm tall, the base usually distinct from a sparsely branched upper portion; adjacent fruiting bodies sometimes

partially fused below to form a "pseudo-base," individual branches round in cross-section becoming flattened above, color of lower portion dull cream-buff to greyish-tan, the tips paler, surface of upper branches more or glabrous or with scattered whitish hairs, the base often covered with a white tomentum, context tough, pliant, colored like the surface, unchanging, odor sharp, somewhat aromatic, taste not distinctive to slightly astringent. Spore is white, 15-20 x 4-7 µm, white, fusiform, sub-fusiform, or ovoid or elongated, smooth walled, sub-globose, oblong, hyaline in KOH.

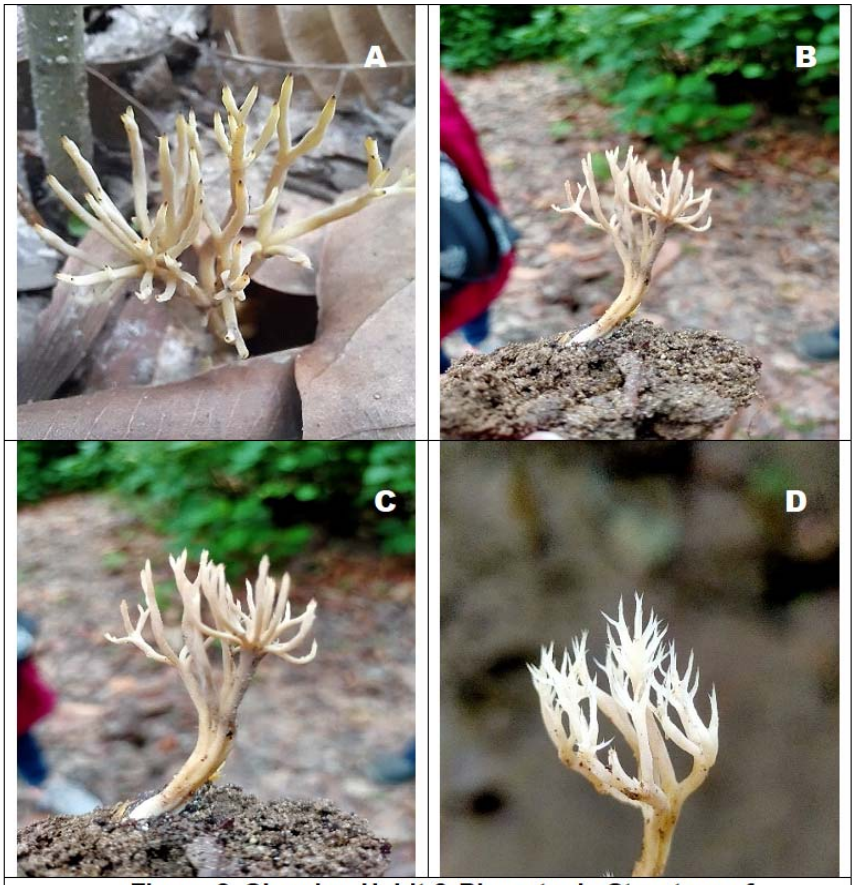

Figure 2. Showing Habit & Phenotypic Structure of *Tremellodendropsis tuberosa*

Tremellodendropsis tuberosa apices rounded to subcristate, basidia without internal walls, very similar to *Aphelaria*. Basidia mostly longitudinally septate, Basidia two-sterigmate, to about 55 x 12.5 µm, clavate, sterigmata quite long, elongated, with thick bases, developing a cleft or crease at the bases of the sterigmata, in the apex of the basidium, large apex cruciately sub-septate or septate. Clamp connections present. Hymenium generally thickening, absent from stem and parts of upper sides of some branches or rudimentary, cystidia absent. Hyphae monomitic, clamped, occasionally secondarily septate, not inflated, cells elongated, walls thickening (Fig. 3, 4 & 5).

Habitat is Terrestrial, on hard clay to rich humus, scattered to gregarious, often growing under decaying woods of different varieties of trees. *Ramaria stricta* and related species are similar but can be distinguished by a lignicolous habit. Another small terrestrial coral that bears a

resemblance is *Clavulina cristata*. It is small, pallid, with pointed tips, but it lacks a parallel branching pattern and is found mainly with pine. The basidia of *Tremellodendropsis tuberosa* are

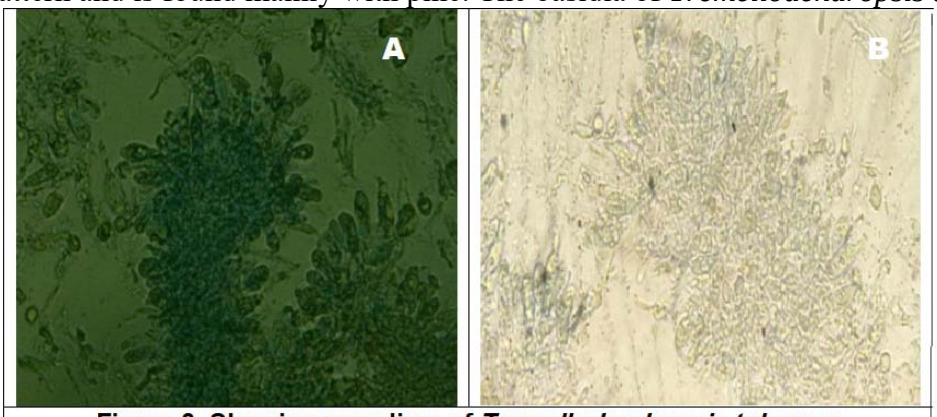

Figure 3. Showing mycelium of *Tremellodendropsis tuberosa*

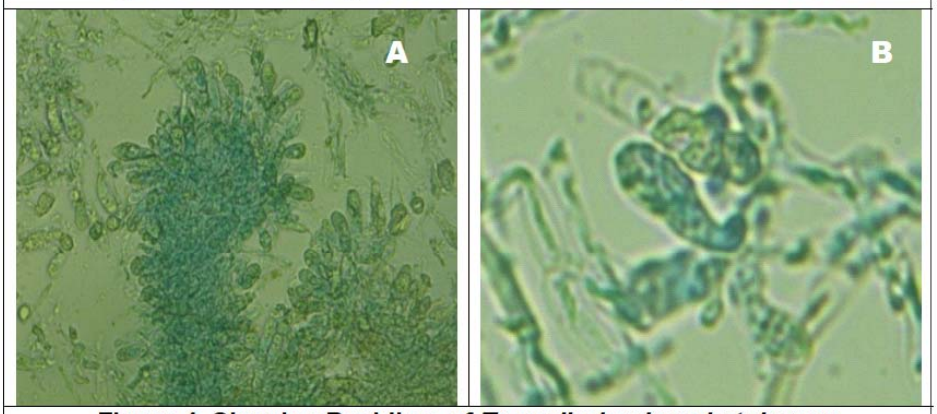

Figure 4. Showing Basidium of *Tremellodendropsis tuberosa*

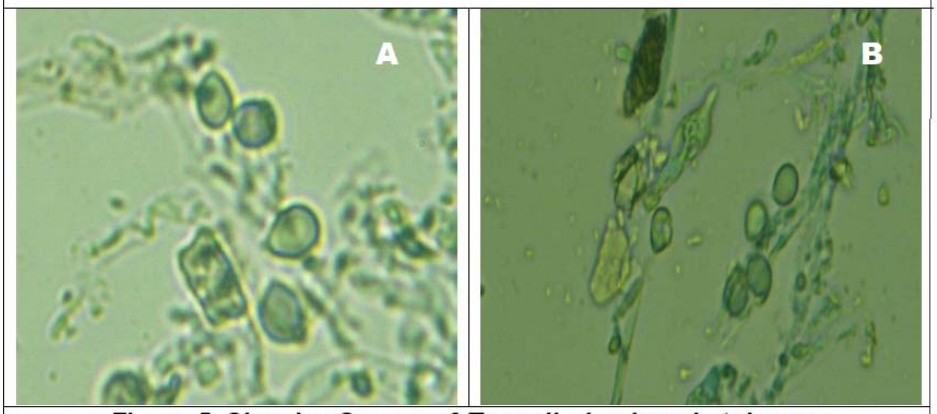

Figure 5. Showing Spores of *Tremellodendropsis tuberosa*

unusual, mostly longitudinally septate, similar to those of the jelly fungus genus *Tremella*, with which it was thought to be distantly related.

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