A new species, new combination, and a nomen novum in the genus Trechispora from India

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Research Article

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Abstract

The genus *Trechispora* accommodate species with corticioid, clavarioid, and polyporoid basidiomata, smooth to verrucose, angular basidiospores, monomitic or dimitic hyphal systems with clamp-connections, and ampullaceous septa. During a study of clavarioid fungi of Kerala, seven *Trechispora* species with clavarioid basidiomata were collected and studied. Morphological and molecular analyses revealed one species, *T. cystidiata*, characterized by cystidia, to be new to science. In addition, a new combination (*T. angulispora*) and a *nomen novum* (*T. corneri*) are also proposed. Descriptions of all the species collected and studied from Kerala, along with their phylogenetic placement in the order Trechisporales is presented. A taxonomic key to the clavarioid species of Trechisporales from India is also provided.

Introduction

The genus *Trechispora* was first described by Karsten (1890) to accommodate a species (*T. onusta* P. Karst.) with resupinate basidiomata and a poroid hymenophore. Hibbett *et al.* (2007) described the order Trechisporales with *Trechispora* as the type genus, based on molecular evidences (Larsson et al. 2004; Binder et al. 2005; Matheny et al. 2007; Hibbett et al. 2007, 2014; Liu et al. 2022). *Trechispora* is the largest genus in the order Trechisporales, with 87 accepted species (Liu et al. 2022). At present, the genus mostly consists of corticioid fungi, with few exceptions having clavarioid and polyporoid basidiomata, smooth, odontioid, hydnoid, or poroid hymenophores, monomitic or dimitic hyphal systems with clamp-connections, ampullaceous septa, and smooth to verrucose, angular basidiospores (Larsson 1992; Larsson et al. 2004).

The clavarioid genus *Scytinopogon*, shows morphological similarities with *Trechispora* (Julich 1981; Larsson 1992; Meiras-Ottoni et al. 2021). Certain clavarioid species of the genus *Scytinopogon* nested in the *Trechispora* clade in various molecular phylogenetic studies (Larsson 2007; Birkebaket al. 2013; Desjardin & Perry 2015; Chikowskiet al. 2020; Meiras-Ottoniet al. 2021). Based on these observations, many species earlier considered in *Scytinopogon* had to be formally transferred to *Trechispora* (like *T. chartacea, T. havencampii, T. minispora, T. pallescens*, and *T. papillosa*) by Meiras-Ottoni et al. (2021). Recently, Liu et al. (2022) conducted a phylogenetic study of the order Trechisporales, and supported the synonymization of the genus *Scytinopogon* with *Trechispora.*

An account of the genus *Trechispora* based on specimens collected from Kerala, India is presented here. Based on our morphological and molecular data, a new clavarioid species is described, a new combination and a *nomen novum*., are proposed in the genus *Trechispora*.

Materials and methods

Morphological characterization

Basidiomata were collected from Kerala State, India, during south-west (June to September) and north-east (October to December) monsoon seasons. Fresh materials were examined macroscopically and tested for reactions with $FeCl_3$ and KOH. For microscopic examination, fresh and dried materials were stained using aqueous solutions of 3% Phloxine and 1% Congo red, and mounted in 5% aqueous KOH. Twenty basidiospores were measured to calculate dimensions, mean, and standard deviation for length and width, range of spore quotient (Q, length/width ratio) and its mean value (Qm). Basidiospore reactivity to Melzer's reagent and cotton blue were noted. The holotype and other voucher specimens have been deposited at the Zamorin's Guruvayurappan College Herbarium, Kozhikode, Kerala, India (ZGC).

Molecular characterization & phylogenetic analysis

Genomic DNA was extracted from fresh basidiomata, using REDExtract-N-Amp kit by Sigma-Aldrich. The ITS region was amplified by ITS1F and ITS4 primers. After PCR amplification, quality check for the samples were carried out by gel electrophoresis (2% agarose gel). PCR product was purified using QIAGEN QIAquick PCR Purification Kit. Sequencing PCR reaction was set-up in Applied Biosystems™MiniAmp™ Plus Thermal cycler using Big Dye ™ Terminator V3.1 kit. The newly generated sequences were deposited in GenBank (www.ncbi.nlm.nih.gov); accession numbers indicated in Table 1.

BLAST searches in the GenBank nucleotide database using the newly generated sequences were conducted for finding taxa with close sequence similarity. A data matrix was constructed by combining the newly generated sequences and the related ITS sequences retrieved from GenBank. The final assembled dataset had 92 representative sequences belonging to the order Trechisporales, and two outgroup taxa (Table 1). *Neofavolus alveolaris* (DC.) Sotome& T. Hatt. and *Cerioporus squamosus* (Huds.) Quèl. (Polyporaceae, Polyporales) were chosen as the outgroup taxon following Liu et al. (2022). The combined dataset was aligned automatically with MUSCLE in MEGA X64 (Kumar et al. 2018), and then manually edited using the same programme. The final dataset was submitted to TreeBase with submission ID 30419.

Phylogenetic analysis was conducted using Maximum Likelihood (ML) method. ML analysis was done with Tamura-Nei model (Tamura & Nei 1993) in MEGA. Initial tree(s) for the heuristic search were obtained by applying Neighbour-Joining and BioNJ algorithms to a matrix of pair wise distances estimated using the Maximum Composite Likelihood (MCL) approach, and then selecting the topology with superior log likelihood value. The tree with the highest log likelihood value (-33395.11) was selected. The tree was drawn to scale, with branch lengths measured in the number of substitutions per site. In the phylogenetic tree, bootstrap (BS) values above 50% alone are shown.

Results and Discussion

TAXONOMY

Trechispora cystidiata Krishnapriya & T.K.A. Kumar, **sp. nov**. Figure 1

MycoBank: MB846921

Etymology: referring to the presence of cystidia in the hymenium.

Holotype: INDIA. Kerala State, Kozhikode district, Pokkunu, 18 June 2020 (ZGCKP151, **holotype**; ZGCKP212, isotype). GenBank: ITS = OP627562, OP627563.

Description: **Basidiomata** 70–80 × 5–6 mm, fragile, branched, main branches polychotomous, terminal and lateral branches dichotomous, with a distinct stalk, up to 5 mm high, arising from a white mycelial patch, glabrous, ellipsoid in cross section, solid, apex pyxidate, pale brown, becomes purplish towards the apex, apex white, tomentose at the base, context fleshy, with a pleasant odour, no positive reaction in Fe_3Cl, and KOH. This species is characterized by the presence of fusiform to utriform cystidia.

Basidiospores 6–7 × 4–5 µm (Q = 1.2–1.5 µm Q_m=1.3 µm), ellipsoid, angular, agguttulate to uniguttulate, verruccose, thin-walled, hyaline, apiculus not prominent, inamyloid, cyanophilic in cotton blue. **Basidia** 22–38 × 5–8 µm, guttulate, clavate to cylindrical, with basal clamp-connection, tetra-sterigmate (up to 6 µm long), cyanophilic in cotton blue. **Cystidia** 40–60 × 5–6 µm, fusiform to utriform, thin-walled, hyaline, inamyloid. **Hymenium** 60 to 80 µm wide, **Subhymenium** not distinguishable. **Context** composed of generative hyphae, 4–6 µm wide, septate, hyaline, thin- to slightly thick-walled (0.5 µm), inflated up to 18 µm wide, inamyloid, cyanophilic in cotton blue. Hyphal clamp-connections present, not frequent.

Remarks: *T. echinospora*, *T. foetida* and *T. havencampii* are the clavarioid species with pigmented basidiomata in the genus *Trechispora. T. echinospora* differs from the present specimen by its smaller, thin branched, purple basidiomata, echinulate basidiospores, bi-sterigmate basidia and, absence of cystidia. *T. foetida* differs by its dark brownish basidiomata, with whitish stalk, uninflated hyphae and absence of cystidia in it. *T. havencampii* is distinct by its purple basidiomata, bi-sterigmate basidia, ampullaceous septa and absence of cystidia.

Habit: solitary in humus layers on soil, under *Terminalia* species.

Material examined: India; Kerala State, Kozhikode district, Pokkunu, 18 June 2020, Krishnapriya KP151; 15 July 2021, Krishnapriya KP212.

Trechispora angulispora ((Berkeley) Corner) Krishnapriya & T. K. A. Kumar, **comb. nov. Figure 2**

MycoBank: MB846922

Etymology: *angulispora*, refers to the angular basidiospores.

Description: **Basidiomata** 40–60 × 2–3 mm, branching irregular, polychotomous below, dichotomous upwards, terminal branches are fused in some, apex dichotomous to pyxidate, branches elongate, with distinct stalk (up to 20 mm long), slightly rigid, arising from prominent white mycelial strands that are usually found attached to the substratum, ellipsoid in cross section, solid, sterile towards the apex, white,

becoming ochraceous on drying, distinct fungoid odour, context fleshy, no positive reaction in Fe_3Cl and KOH.

Basidiospore 5–7 × 4–5 µm (Q = 1.2–1.5 µm Q_m=1.3 µm), ellipsoid, angular, verrucose, aguttulate to guttulate, slightly thick-walled (0.5 µm), wall greyish, apiculus not prominent, hyaline, inamyloid, cyanophilic in cotton blue. **Basidia** 25–35 × 6–7 µm, guttulate, cylindrical to clavate, with basal clamp-connection, tetra-strigmate (up to 5 µm long). **Hymenium** up to 200 µm wide. **Subhymenium** up to 50 µm wide. **Context** composed of generative hyphae, 3 to 8 µm wide, inflated up to 15 µm wide, interwoven, septate, hyaline, slightly thick-walled (0.5 µm). Hyphal clamp-connections present.

Remarks: The characters of the present specimen fit with the species description of *S. angulisporus* (now *C. connata*) by Corner (1950). The present specimen may get confused with *Ramariopsis kunzei* by the whitish basidiomata, but can be differentiated by the angular ellipsoid basidiospores in the former (Corner 1950).

Habitat: In gregarious clusters, on the humus layer of soil,

Material examined: India, Kerala State, Kozhikode District, Pokkunnu, 10 July 2017, Krishnapriya ZGCKP36; 18 July 2017; Krishnapriya ZGCKP40, ZGCKP44; 02 September 2013, Binusha VB9; Kozhikode District, Thamarassery, 24 June 2022, Krishnapriya K., ZGCKP255.

Trechispora corneri ((Berkeley) Corner) Krishnapriya & T. K. A. Kumar, **nomen. novum. Figure 2**

MycoBank: MB846923

Etymology: refers to the author E. J. H. Corner.

Description: **Basidiomata** 50 × 2 mm, branched, repeatedly dichotomous, apex bifid to pyxidate, with a distinct stalk, up to 10 mm long, arising from a white mycelial mat, glabrous, solid, ellipsoid in cross section, purple, stalk brownish, whitish at the extreme apex, context fleshy, with a distinct odour, no positive reaction in Fe_3Cl and KOH.

Basidiospores 4–7 × 4–5 µm (Q = 1.2–1.5 µm Q_m=1.29 µm), ellipsoid, angular, uniguttulate, echinulate (spines up to 0.5 µm), thin-walled, hyaline, apiculus not prominent, inamyloid, cyanophilic in cotton blue. **Basidia** 20–30 × 5–6 µm, clavate to broadly clavate, with basal clamp-connection, bi-sterigmate, (up to 5 µm long). **Hymenium** up to 40 µm wide. **Subhymenium** not distinct. **Context** composed of parallely arranged generative hyphae, 4–12 µm wide, septate, hyaline, thin-walled, inamyloid, cyanophilic in cotton blue. Hyphal clamp-connections present.

Remarks: The present specimen fits with the species description of *S. echinosporus* by Corner (1950) and Furtado et al. (2021). Although the species should have been considered as belonging to *Trechispora* according to the synonimization of *Scytinopogon* with *Trechispora* based on Liu et al. (2022) and Furtado et al. (2021), due to the lack of molecular evidence, a formal genus transfer had not yet been done.

Habitat: **S**olitary, on humus layer of soil.

Material examined: India, Kerala State, Thiruvananthapuram District, Palode, 01 October 2021, Krishnapriya K., ZGCKP237.

Trechispora dealbata (Berk.) L.W. Zhou & S.L. Liu, inLiu, He, Wang, May, He, Chen & Zhou, Mycosphere 13 (1): 911 (2022)

Description: **Basidiomata** 80 × 4 mm, branched, branches polychotomous below, dichotomous above, branches up to 3 mm wide, erect, apex bifurcate, with a distinct stalk, 15 mm long, glabrous, solid, cylindrical, terete in cross section, white, with a pale pink tinge, brownish on drying, context fleshy, brittle, without any distinct odour, no positive reaction in Fe_3Cl and KOH.

Basidiospores 4–5 × 3–4 µm (Q = 1–1.5 µm Q_m=1.3 µm), ellipsoid, angular, uniguttulate, echinulate (spines up to 0.5 µm long), slightly thick-walled (0.5 µm), apiculus not prominent, inamyloid, cyanophilic in cotton blue. **Basidia** 15–25 × 6–7 µm, agguttulate, broadly clavate to cylindrical, with basal clamp-connection, sterigmata 2 to 4 (up to 5 µm long), cyanophilic in cotton blue. **Hymenium** up to 100 µm wide. **Subhymenium** up to 20 µm wide. **Context** composed of generative hyphae, 3 to 15 µm wide, agglutinated, septate, thin-walled, hyaline, inamyloid, cyanophilic in cotton blue. Hyphal clamp-connections present.

Remarks: Species description of the present collection matches with that of *Scytinopogon dealbatus* (now *T. dealbata*) described by Corner (1970) and Furtado et al. (2021). *S. scaber* resembles the present specimen by its whitish basidiomata, but differs by its papillate branches.

Habitat: on soil, solitary among leaf litter.

Material examined: India, Kerala State, Malappuram District, Nilambur Teak Museum, 03 July 2018, Krishnapriya K., ZGCKP135

Trechispora foetida (A.N.M. Furtado & M.A. Neves), L.W. Zhou & S.L. Liu, in Liu, He, Wang, May, He, Chen & Zhou, Mycosphere 13 (1): 912 (2022)

Description

Basidiomata 30–60 × 3–5mm, branched, branches erect, polychotomous below, dichotomous upwards, branches cylindrical, with a distinct stalk, up to 20 mm long, glabrous, solid, terete in cross section, apex bifurcate, purple to dark brown, stalk whitish with a purple tinge, context fleshy, with an unpleasant odour, no positive reaction in Fe_3Cl and KOH.

Basidiospores 5–6 × 4–5 µm (Q = 0.8–1.2 µm Q_m=1 µm), ellipsoid, angular, guttulate, verrucose to warty, thin-walled, hyaline, apiculus not prominent, inamyloid, cyanophilic in cotton blue. **Basidia** 20–25 × 8–9 µm, aguttulate, broadly clavate, with basal clamp-connection, tetra-sterigmate (up to 5 µm long).

Hymenium 30 µm wide. **Subhymenium** up to 50 µm wide. **Context** composed of generative hyphae, 3–8 µm wide, septate, hyaline, thin- to slightly thick-walled (up to 0.5 µm), inamyloid, cyanophilic in cotton blue. Hyphal clamp-connections present.

Remarks: The present specimen fits with the species description of *Scytinopogon foetidus* (now *T. foetida*) by Corner (1970) and Furtado et al. (2021). Morphologically, it resembles *T. havencampii* Desjardin & B.A. Perry, but differs by the bi-sterigmate basidia of the latter (Furtado et al. 2021). Currently, the species has been recombined as *T. foetida* by Liu et al. (2022).

Habitat: On soil, in gregarious groups.

Material examined: India, Kerala State, Kannur District, Aralam, 28 June 2019, Krishnapriya K., ZGCKP161.

Trechispora havencampii (Desjardin & B.A. Perry) Meiras-Ottoni & Gibertoni, in Meiras-Ottoni, Larsson & Gibertoni, Mycol. Progr. 20(2): 215 (2021)

Description: **Basidiomata** 40–90 × 5–6 mm, densely branched, bushy, polychotomous below, dichotomous upwards, 3 mm wide, apex dichotomous, with a distinct stalk, stalk up to 30 mm long, solid, ellipsoid in cross section, pruinose, branches purple, whitish at the extreme apex, yellowish brown towards and at the stalk, context fleshy, without any distinct odour, no reaction with KOH and Fe_3Cl.

Basidiospores 6–7 × 4–6 µm (Q = 1–1.5 µm Q_m=1.3 µm), ellipsoid, angular, uniguttulate, verruccose, slightly thick-walled, apiculus not prominent, inamyloid, cyanophilic in cotton blue. **Basidia** 18–27 × 9–10 µm, agguttulate, broadly clavate, with basal clamp-connection, bi-sterigmate (4 to 5 µm long), cyanophilic in cotton blue. **Hymenium** up to 80 µm wide, **Subhymenium** up to 100 µm wide. **Context** composed of generative hyphae, 3 to 10 µm wide, septate, hyaline, thin-walled, ampulliform swelling at septa (up to 15 µm wide), inamyloid, cyanophilic in cotton blue. Hyphal clamp-connections present.

Remarks: The present specimen fits with the species description of *S. havencampii* (now T. *havencampii*) by Desjardin & Perry (2015). *T. robusta* shows phenotypic similarity with the present specimen, but differs by the tetra-sterigmate basidia in the former (Corner 1970).

Habitat: On soil in gregarious clusters among dead and decayed leaf litter.

Material examined: India, Kerala State, Kannur District, Aralam Wild Life Sanctury, 28 June 2019, Krishnapriya K., ZGCKP160.

Trechispora robusta (Rick) L.W. Zhou & S.L. Liu, inLiu, He, Wang, May, He, Chen & Zhou, Mycosphere 13 (1): 911 (2022)

Description: **Basidiomata** 70–80 × 5–6 mm, branched, polychotomous below, dichotomous upwards, apex bifurcate, pruinose, with a distinct stalk in some (up to 30 mm long), base tomentose, cylindrical,

solid, ellipsoid in cross section, greyish white, tip concolourous, becoming brownish black on drying, context fleshy, without any odour, no positive reaction in Fe_3Cl and KOH.

Basidiospores 6–7 × 4–5 µm (Q = 1.2–1.7 µm Q_m=1.4 µm), ellipsoid, angular, guttulate, echinulate to verruccose (spines up to 0.5 µm long), slightly thick-walled (0.5 µm), hyaline, apiculus not prominent, inamyloid, cyanophilic in cotton blue. **Basidia** 20–30 × 5–10 µm, agguttulate, broadly clavate, with basal clamp-connection, bi-sterigmate to 4 (3 to 5 µm long), cyanophilic in cotton blue. **Hymenium** up to 50 µm wide, **Subhymenium** up to 30 µm wide. **Context** composed of generative hyphae, 3 to 10 µm wide, septate, thin-walled, hyaline, inamyloid, cyanophilic in cotton blue. Hyphal clamp-connections present.

Remarks: The present specimen is identified as *Scytinopogon robustus* (now *T. robusta* (Liu et al. 2022)) from the species description by Corner (1950). *S. pallescens* (Bres.) Singer is similar to the present specimen, but differs by its white basidiomata, pyxidate branch apex, and by the presence of calcium oxalate crystals inside the hyphae (Corner 1970).

Habitat: On soil, in gregarious clusters among leaf litter.

Material examined: India, Kerala State, Kozhikode District, The Zamorin's Guruvayurappan College campus, 02 July 2018, Krishnapriya K., ZGCKP131; Malappuram District, Nilambur Teak Museum, 03 July 2018, Krishnapriya K., ZGCKP134.

Phylogenetic analysis

The data set included a total of 94 taxa (Table 1). Eight newly generated ITS sequences and those sequences retrieved from GenBank of 70 representative sequences in the order Trechisporales (following Liu et al. 2022), 11 representative sequences in the genus *Clavulina* (Hydnaceae, Cantherellales) and three representative sequences of the newly segregrated order Sistotrematales, were aligned using MEGA X64 (Kumar et al. 2018). *Neofavolus alveolaris* (DC.) Sotome & T. Hatt. and *Cerioporus squamosus* (Huds.) Quèl. (Polyporaceae, Polyporales) were chosen as the outgroup taxa, following Liu et al. (2022).

Table 1
List of the Trechisporales taxa, GenBank accession numbers of sequences (ITS), voucher numbers and locality used in this study. Sequence accessions generated during this study are highlighted in bold.

Taxon	GenBank numbers	Voucher numbers	Locality
Allotrechispora daweishanensis	MW302337	CLZhao17860	China
Allotrechispora xantha	MW302339	CLZhao2632	China
Brevicellicium atlanticum	HE963773	LISU178566	Portugal
Brevicellicium xanthum	MW302340	CLZhao17781	China
Clavulina cerebriformis	J168690	MCA4022	Guyana
Clavulina cerebriformis	NR121504	BRGMCA4022	Guyana
Clavulina cinereoglebosa	NR119975	BRGTH8561	Guyana
Clavulina rosiramea	NR120086	BRGTH8954	Guyana
Clavulina craterelloides	NR12114	BRGTH8324	Guyana
Clavulina caespitose	NR119560	BRGTH8709	Guyana
Clavulina guyanensis	NR120085	BRGTH9245	Mexico
Clavulina parvispora	NR166245	FCME27650	Guyana
Clavulina monodiminutiva	NR119559	BRGTH8738	Guyana
Clavulina pakaraimensis	NR121533	BRGTH9194	Mexico
Clavulina tepurumenga	NR119925	NY1194099	China
Dextrinocystis calamicola	MK204533	He5693	China
Dextrinocystis calamicola	MK204534	He5701	China
Fibrodontia alba	NR153983	TNMF24944	China
Fibrodontia alba	MK204599	He4761	China
Fibrodontia austrosinensis	MT802109	He3453	China
Fibrodontia brevidens	MK204528	He3559	China
Fibrodontia subalba	MT802106	Dai15931	Portugal
Luellia cystidiata	MW371211	JHP-09455	Norway
Luellia recondita	UDB038222	O-F-253622	Czech Republic
Porpomyces mucidus	KT157833	Dai12692	China
Porpomyces submucidus	KT152143	CUI5183	China

Taxon	GenBank numbers	Voucher numbers	Locality
Subulicystidium acerosum	MK204539	He3804	USA
Subulicystidium brachysporum	MK204533	He2207	Costa Rica
Subulicystidium boidinii	MH041537	KHA12830	Puerto Rico
Subulicystidium fusisporum	MH041535	KHA10360	Costa Rica
Subulicystidium grandisporum	MH041547	506781	Reunion
Subulicystidium harpagum	MH041532	L1726a	Brazil
Subulicystidium meridense	MH041538	Hjm16400	Reunion
Subulicystidium nikau	MH041513	L1296	Reunion
Subulicystidium parvisporum	MH041529	L0140	Jamaica
Subulicystidium robustius	MH041514	KHL10813	Slovenia
Sertulicium lateclavigerum	MW049161	Spirin13457	China
Sertulicium guttuliferum	MK204540	He3338	China
Sistotremastrum aculeatum	MN991176	Miettinen 10380	Brazil
Scytinopogo nscaber	MK458773	FLOR56189	Brazil
Scytinopogon sp.	MK458769	FLOR56315	India
Scytinopogon sp.	KT04576	BAB5120	India
Scytinopogon sp.	MZ518207	MYB-2021a	Australia
Scytinopogon sp.	KP012947	MEL2382992	Brazil
Scytinopogon robustus	MK458770	FIOR56179	Sweden
Trechispora araneosa	AF347084	KHL8570	-
Trechispora alnicola	DQ411529	AFTOL-ID665	-
Trechispora angulispora	**OP6275666**	**ZGCKP255**	**India**
Trechispora caulocystidiata	MK458772	FLOR56314	Brazil
Trechispora cf. cohaerens	KP814538	UC2022832	USA
Trechispora confinis	AF347081	KHL11064	Sweden
Trechispora copiosa	MN701014	AMO423	Brazil
Trechispora corneri	**OP881892**	**ZGCKP237**	**India**
Trechispora chartacea	MK458775	FLOR56185	Brazil

Taxon	GenBank numbers	Voucher numbers	Locality
Trechispora cystidiata	**OP627562**	**ZGCKP152**	**India**
Trechispora cystidiata	**OP627563**	**ZGCKP212**	**India**
Trechispora dealbata	MK458776	FLOR56182	Brazil
Trechispora dealbata	**OP948880**	**ZGCKP137**	**India**
Trechispora dentata	OK298491	Dai22565	China
Trechispora dimitiella	OK298493	Dai21181	China
Trechispora echinospora	JX392845	E11/37 – 03	Equatorial Guinea
Trechispora echinospora	JX392853	E11/37 – 12	Equatorial Guinea
Trechispora fissurata	MW544027	CLZhao4571	China
Trechispora foetida	MK458769	FLOR 56315	Brazil
Trechispora foetida	**OP881893**	**ZGCKP161**	**India**
Trechispora fragilis	OK298494	Dai 20535	China
Trechispora fimbriata	EU909231	CLZhao4154	Germany
Trechispora gelatinosa	MN701021	AMO1139	Brazil
Trechispora gelatinosa	MN701020	AMO824	Brazil
Trechispora hymenocystis	MT816397	KHA16444	Norway
Trechispora hondurensis	MT571523	HONDURAS19-	Honduras
Trechispora havencampii	NR154418	F016a	Africa
Trechispora havencampii	**OP881891**	**ZGCKP160**	**India**
Trechispora invisitata	KP814182	UC2022935	USA
Trechispora invisitata	KP814425	UOC2023088	USA
Trechispora incisa	AF347085	EH24/98	-
Trechispora incisa	KU747095	GB-0090648	Sweden
Trechispora laevispora	OK298495	Dai21655	China
Trechispora nivea	JX392837	MA-FUNGI76253	-
Trechispora papillosa	MN701022	AMO713	Brazil
Trechispora papillosa	MN701023	AMO795	Brazil
Trechispora pallescens	MK458774	FLOR56188	Brazil

Taxon	GenBank numbers	Voucher numbers	Locality
Trechispora robusta	MK458770	FLOR56179	Brazil
Trechispora robusta	**OP881894**	**ZGCKP160**	**India**
Trechispora subsphaerospora	AF347080	UC2022935	Sweden
Trechispora stevensonii	JX392843	UC2023088	-
Trechispora stevensonii	JX392841	EH24/98	-
Trechispora torrendii	MK515148	GB0090648	Brazil
Trechispora termitophila	MN701024	Dai21655	Brazil
Neofavolus alveolaris	Dai11290	MA-Fungi76253	China
Polyporus squamosus	KU189778	AMO713	China

As part of the study, seven *Trechispora* species were collected and are reported for the first time from Kerala. They are *T. angulisporus, T. cystidiata*., *T. dealbata, T. corneri, T. foetida, T. havencampii*, and *T. robusta*. So far, only a single species (*S. angulisporus*) have been reported from India (De 1991; Banerjee 1947).

Previous phylogenetic studies by Chikowskiet al. (2020), Meiras-Ottoniet al. (2021), and Liu et al. (2022) confirmed the synonymization of *Sytinopogon* in *Trechispora*. Our phylogenetic tree confirmed the tree topology of the earlier phylogenetic studies in Trechisporales, with good bootstrap values for all clades. The tree confirmed the placement of these species in clavarioid clade (clade that had clavarioid taxa) that included *T. havencampii, T. termitophila, T. robusta*, and *Scytinopogon* species. However, this monophyletic clade received only a low support value (< 50%). *T. cystidiata* settled within the clavarioid clade.

S. cryptomeroides, *S. echinosporus* and *S. parvus* are the clavarioid taxa, which have not been formally transferred to *Trechispora*. Out of this, *S. cryptomeroides* and *S. echinosporus* lacked molecular sequences. Our study generated sequence for *S. echinosporus* and was included in the molecular phylogenetic analysis. *S. echinosporus* settled within the clavarioid *Trechispora* clade, and the placement supports the formal transfer of that species to *Trechispora*. However, a species with that specific epithet (*echinospora*) already exists in the genus *Trechispora* (a resupinate species, *T. echinospora*, described earlier (Phookamsak 2019)). Hence, in order to avoid the duplication of the species name during new combination, a *nomen novum* has to be proposed. We propose the *nomen novum* as *T. corneri* in the study.

Phylogenetic analyses confirmed our morphology-based identification of *Trechispora* species collected from Kerala. None of the molecular phylogenetic studies so far conducted included *S. angulisporus*. The taxon was considered under both *Scytinopogon* and *Clavulina*, according to Index Fungorum, accessed

on 01 April 2023. The morphology of the species is more related to *Trechispora* by its verrucose, angularly ellipsoid basidiospores, and small, broadly clavate, tetra-sterigmate basidia. Whereas, *Clavulina* is characterized by smooth, subglobose to globose basidiospores and cylindrical, bi-sterigmate basidia. Our study included the molecular sequence of *S. angulisporus* and compared it with those of the *Trechispora* and *Clavulina* group. The species from Kerala settled with the monophyletic clade containing clavarioid *Trechispora* species. Sequences of two unidentified *Scytinopogon* species from India also settled along with the Kerala collection. Based on our phylogenetic analysis, we confirmed the placement of this species as belonging to *Trechispora* rather than in *Clavulina*. Also, *S. angulisporus* has not yet been formally transferred to *Trechispora*. Hence a new combination for the species is hereby proposed.

It was reported that many clavarioid basidiomata in *Trechispora* are white (Furtado et al. 2021). Here three species were reported as so. They are *T. dealbata, T. robusta* and *T. angulispora*. Newly generated sequence of *T. dealbata* nested with *T. dealbata* species from Brazil in a well-supported clade with 100% BS. *T. robusta* also forms a well-supported sister clade to *T. robusta* species from Brazil. Pigmented species of *Trechispora* collected during this study are *T. foetida, T. corneri, T. havencampii*, and the novel species *T. cystidiata.* All the above species appeared as a strongly supported clade within the order Trechisporales.

A key to clavarioid species of Trechispora from India

1a. Basidiomata purple to dark brown 2

1b. Basidiomata white to greyish3

2a. Basidiomata brownish to purple; branches pruinose 4

2b. Basidiomata white with purple tinge and dark brown branches; basidiospores 5–6 × 4–5 µm; branches glabrous *T. foetida*

3a. Basidiospores 6–7 × 4–5 µm5

3b. Basidiospores 4–5 × 3–4 µm *T. dealbata*

4a. Basidia tetra- sterigmate6

4b. Basidia bi-sterigmate, basidiospores 6–7 × 4–6 µm *T. havencampii*

5a. Basidiomata greyish white; basidiospores 6–7 × 4–5 µm; hyphae not inflated *T. robusta*

5b. Basidiomata white; basidiospores 5–7 × 4–5 µm; hyphae inflated *T. angulispora*

6a. Basidiomata tomentose at base; basidiospores 6–7 × 4–5 µm; hyphae inflated; cystidia present *T. cystidiata*

6b. Basidiomata glabrous; basidiospores 4–7 × 4–5 µm; hyphae not inflated; cystidia absent *T. corneri*

Declarations

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Author contribution The study was conceived and designed by both authors. First author was involved with specimen collections, photography and data generation. Both authors contributed to data analysis and interpretations. Manuscript was written by both authors.

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Data availability All materials used in this study are deposited at the Zamorin's Guruvayurappan College Herbarium (ZGC). The DNA sequences newly generated during the study are deposited in GenBank. Final aligned data sets have been deposited in TreeBase.

Data will be available online after the acceptance of the manuscript.

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

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Figures

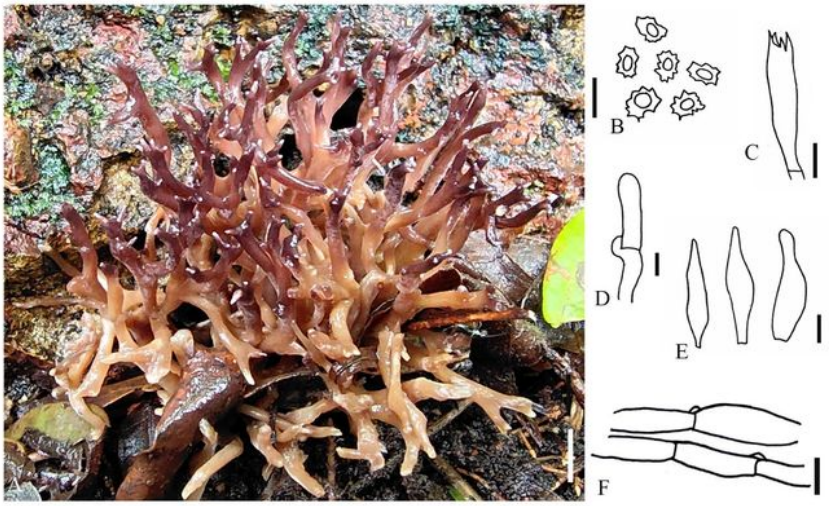

Fig. 1 *Trechispora cystidiata* A. Basidiomata B. Basidiospores C. Basidium D. Basidiole with basal clamp-connection E. Cystidia F. Hyphal clamp-connection. Scale bars: A=10 mm, B=6 µm, C–D=5 µm, E=10 µm, F=10 µm.

Figure 1

See image above for figure legend

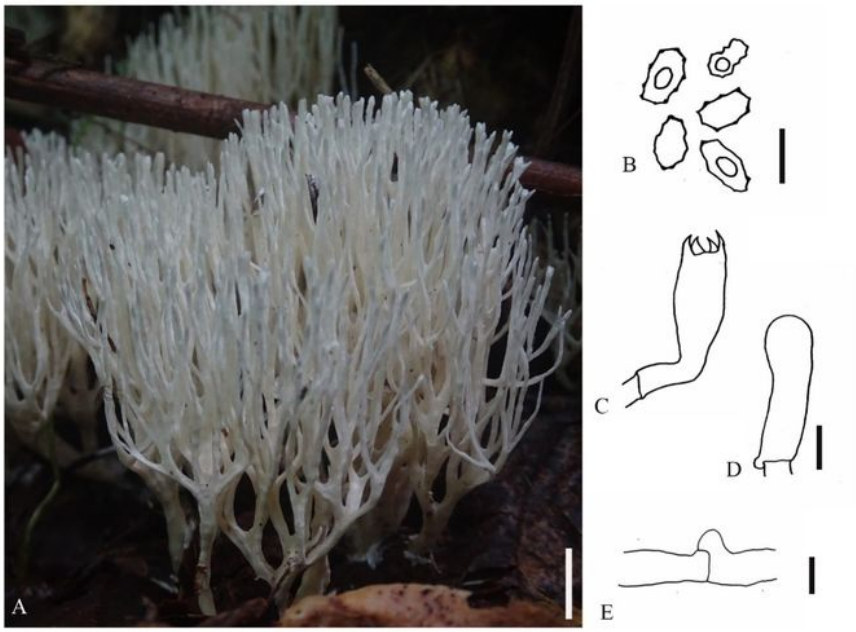

Fig. 2 *Trechispora angulispora* A. Basidiomata B. Basidiospores C. Basidium D. Basidiole with basal clamp-connection E. Hyphal clamp-connection. Scale bars: A= 10 mm, B=6 µm, C–D= 5µm, E=7 µm.

Figure 2

See image above for figure legend

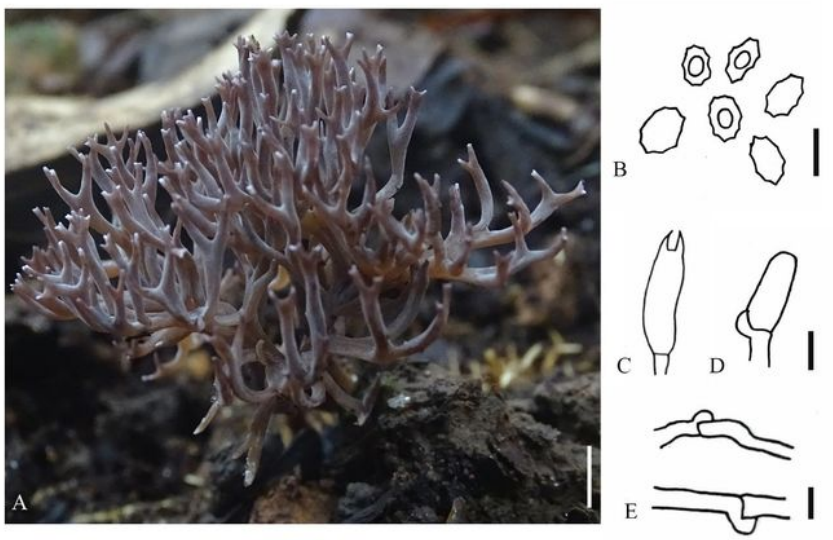

Fig. 3 *Trechispora corneri* A. Basidiomata B. Basidiospores C. Basidium D. Basidiole with basal clamp-connection E. Hyphal clamp-connection. Scale bars: A=10 mm, B=7 µm, C–D= 5 µm, E= 7 µm.

Figure 3

See image above for figure legend

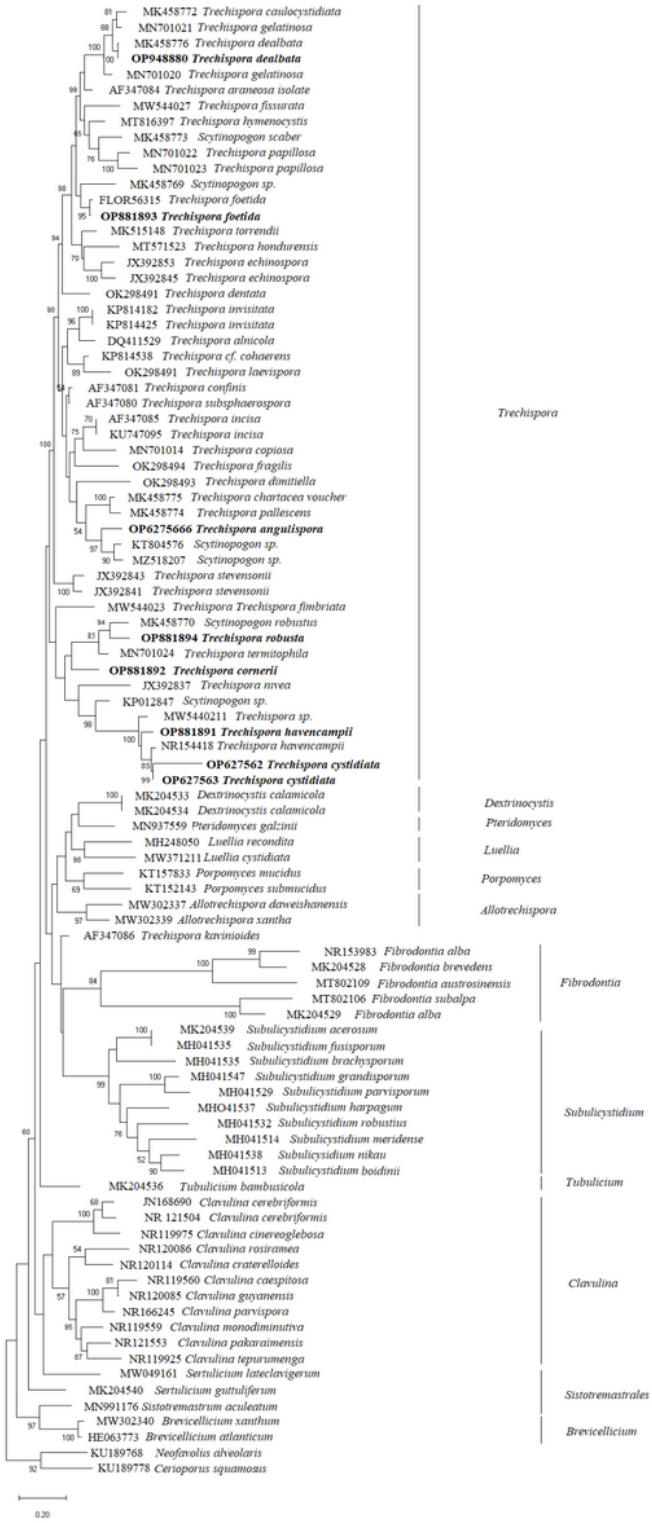

Figure 4

Maximum Likelihood tree generated using the ITS sequence data. Values at the nodes indicate the ML bootstrap values. BS value above 50% are shown. Newly generated sequences are indicated in bold.