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Auricularia thailandica sp. nov. (*Auriculariaceae*, *Auriculariales*) a widely distributed species from Southeastern Asia

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Abstract

Auricularia is an important genus among the jelly fungi due to its popular consumption and medicinal properties. A new species of *Auricularia*, *A. thailandica* is described from fresh collections made from the Philippines, Thailand and Southern China based on morphological and molecular characters. *Auricularia thailandica* differs from other species by having short and loosely arranged abhymenial hairs on the basidiomata and in the different size of the zones in a cross section of the basidiomata. The species is found to be widely distributed in Southeastern Asia. Phylogenetic relationships were inferred based on the nuclear ribosomal internal transcribed spacer (ITS) region. The new species is introduced with full description and illustrations.

Key words: Jelly fungi, morphology, phylogeny, taxonomy

Introduction

Auricularia Bull. is a genus of jelly fungi in the family *Auriculariaceae* Fr., typified by *Auricularia mesenterica* (Dicks.: Fr.) Pers. Species of *Auricularia* are distributed in tropical, subtropical and temperate regions (Lowy, 1952). Most *Auricularia* species are edible and *Auricularia auricula-judae* (Bull.: Fr.) Queìl. and *A. polytricha* (Mont.) Sacc. are widely produced commercially (Wu *et al.*, 2014a; Yan *et al.*, 2004).

As the macroscopic features of *Auricularia* vary with the age of the specimen, exposure to light, availability of moisture and other environmental factors; the current morphological classification of *Auricularia* is based on internal stratification of different layers and abhymenial hairs on the basidiomata (Kobayashi, 1981; Lowy, 1951). Ten species were described worldwide by Lowy (1952). Later on, mating studies (Duncan & MacDonald, 1967) and differences of spore sizes (Parmasto & Parmasto, 1987) were used to classify species. Fifteen species and five variants of *Auricularia* were monographed by Kobayashi (1981). A recent study estimated that this genus comprises 10–15 species throughout the world (Looney *et al.*, 2013), while Kirk *et al.* (2008) estimated there are eight species worldwide.

Phylogenetic analysis of ITS shows that *Auricularia* is a monophyletic genus (Weiß & Oberwinkler, 2001). ITS analysis has separated *A. auricula-judae, A. polytricha* and *A. fuscosuccinea* into three well-supported clades (Montoya-Alvarez *et al.*, 2011). Further analyses of ITS with a large sample size revealed nine species of *Auricularia* with relevant morphological and ecological characters (Looney *et al.*, 2013). In addition, the analysis of *rpb2* showed similar groupings as the ITS sequence results, but with a higher bootstrap support (Looney *et al.*, 2013).

According to the literature, 15 species of *Auricularia* have been recorded in China based on morphology. However, due to the invalid nomenclature of *A. reticulata* L.J. Li and misidentification of *A. rugosissima,* both species cannot be considered as members of the genus (Wu *et al.*, 2014a). Molecular analyses have been used for species delineation. RFLP and RAPD techniques classified eight *Auricularia* species in China (Yan *et al.*, 2002; Yan *et al.*, 1999). Wen *et al.* (2005) identified three species of *Auricularia* using ERIC analysis. *Auricularia auricula*, *A. delicata*, *A. fuscosuccinea* and *A. polytricha* were confirmed to occur in China based on ITS sequence analysis (Wang *et al.*, 2013). Overall, phylogenetic studies of this genus in China are however, still at the initial stage (Wu *et al.*, 2014a).

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Of the ten *Auricularia* species re-described by Lowy (1952), eight were recorded by Lalap (1981) from the Philippines (Musngi *et al.*, 2005). One species of *Auriculariaceae* was reported in a study on the mushroom diversity at Mt. Malinao, Albay (Daep & Cajuday, 2003). Four species of *Auricularia* (*A. auricula, A. fuscossucinea, A. polytricha* and *A. tenuis*), were collected in the University grounds of the Central Luzon State University (Musngi *et al.*, 2005) and *A. fuscossucinea* was found at Puncan, Carranglan, Nueva Ecija (Sibounnavong *et al.*, 2008). *Auricularia mesenterica* and an unknown *Auricularia* species were found with three previously recorded species from central Luzon in Philippines (De Leon *et al.*, 2013). All the previous studies of *Auricularia* in Philippines were based on morphology, while this is the first study using morphology and a molecular phylogeny.

Auricularia species (locally called Hed Hoo Noo) are popular edible mushrooms in Thailand (Jones *et al.*, 1994; Klomklung *et al.*, 2012). However, there is no scientific literature on *Auricularia* in Thailand, except the field guides that report *A. delicata, A. fuscosuccinea, A. mesenterica* and *A. polytricha* (Chandrasrikul *et al.*, 2008; Ruksawong & Flegel, 2001). There have been very few studies on the genus *Auricularia* in Thailand and this study is the first report based using both morphology and molecular phylogeny to define species.

In this study, we introduce a novel species of *Auricularia* from three Southeast Asian countries: China, Philippines and Thailand. The morphology-based classification of Lowy (1951) and ITS sequence data were used to define species boundaries in the genus.

Materials and Methods

Sample collection

Fruiting bodies were collected on decaying wood from Mengsong in China, Unisan, Quezon in Philippines and Chiang Mai and Chiang Rai provinces in Thailand during the rainy seasons of 2012–2013. The specimens were hot air dried (50^0C) and sealed in Ziplock plastic bags containing dehydrated silica gel as a desiccant to control humidity. All herbarium specimens are deposited in the Herbarium of Mae Fah Luang University (MFLU), Chiang Rai, Thailand. Duplicate specimens are deposited in Kunming Institute of Botany, Chinese Academy of Sciences (KUN), Kunming, Yunnan, China.

Morphological character examination

Macro-morphological characters were described based on the fresh material, and photographed. Colour notations in the descriptions were from Kornerup & Wanscher (1978). Microscopic characters were studied from free-hand sections of the dried material mounted in distilled water at a magnification up to 1000× with a Nikon Eclipse 80i (Nikon, Tokyo, Japan) microscope. Microphotography of the internal details was done under the same microscope with a Canon EOS 550D (Tokyo, Japan) camera mounted on top. Measurements were taken using Image framework (Tarosoft, v0.9.7). The spore shape quotient (Q = L/W) was calculated considering the mean value of the lengths and widths of 30 basidiospores.

DNA extraction, PCR and sequencing

Dried basidiomata were ground using a porcelain mortar and pestle. DNA was extracted from the ground product using an E.Z.N.A.® Forensic DNA kit, D3591–01, (Omega Bio-Tek, Norcross, GA). The nuclear ribosomal ITS1-5.8S-ITS2 barcode region was amplified using standard primer pairs ITS4/ITS5 following the polymerase chain reaction protocol of White *et al.* (1990). Sequencing was performed on ABI 3730 XL DNA analyser (Applied Biosystems) at Shanghai Majorbio Bio-Pharm Technology Co., Ltd, China and BiK-F laboratory, Frankfurt am Main, Germany.

Phylogenetic analyses

The ITS sequences derived from this study (Table 1, in bold) plus those retrieved from GenBank were aligned using MAFFT online server (Katoh & Standley, 2013) and manually adjusted using Bioedit v7.2.5 (Hall, 1999). Maximum Likelihood (ML) analysis was performed by raxmlGUI v1.31 (Silvestro & Michalak, 2012) using rapid bootstrap analysis with 1000 replicates in GTR model. *Exidia recisa* (Ditmar) Fr., and *Exidiopsis sp.* were used as outgroup taxa

(Weiß & Oberwinkler, 2001). Maximum Parsimony (MP) analysis was performed with PAUP v. 4.0b10 (Swofford, 2003). Trees were inferred by using the heuristic search option with TBR branch swapping and 1,000 random sequence additions. The maximum number of retained trees was limited to 10,000, branches of zero length were collapsed and all multiple equally most parsimonious trees were saved. A most suitable model for the Bayesian analysis was selected using MrModeltest v. 2.2 (Nylander, 2004). The Bayesian analyses (MrBayes v. 3.2; Ronquist *et al.*, 2012) of four simultaneous Markov Chain Monte Carlo (MCMC) chains were run from random trees for 100,000,000 generations and sampled every 1,000 generations. The temperature value was lowered to 0.15, burn-in was set to 0.25, and the run was automatically stopped as soon as the average standard deviation of split frequencies reached below 0.01. We consider bootstrap support >70 as strong support, between 50 and 70 as moderate support and below 50 as poor support.

TABLE 1. Sequences used in the phylogenetic analyses. Newly produced sequences are in bold.

Species	Herberium	Collection	GenBank accession ITS	Locality
Auricularia americana	TENN049666	TFB2897	JX065152	North Carolina, USA
A. americana	TENN051203	TFB4651	JX065151	Tennessee, USA
A. americana	TENN061466	TFB13202	JX065146	Tennessee, USA
A. americana	TENN067030	BPL116	JX065163	Tennessee, USA
A. americana	TENN067029	BPL112	JX065166	Tennessee, USA
A. americana	TENN052403	TFB5612	JX065154	Idaho, USA
A. americana		PBM2295	DQ200918	Oregon, USA
A. auricula-judae	MFLU130394		**KR336695**	Kassel, Germany
A. auricula-judae		MW446	DQ520099	Germany
A. auricula-judae		MFUAB38	**KR336696**	Rome, Italy
A. auricula-judae	TENN050632	TFB4296	JX065174	Switzerland
A. auricula-judae			HQ388355	China
A. auricula-judae			FJ478123	China
A. auricula-judae		AFM21	AB615232	Kochi, Japan
A. auricula-judae			HQ388358	China
A. cornea	TENN066990	PBM3754	JX065164	Queensland, Australia
A. cornea			HM448454	China
A. cornea			HM448462	China
A. cornea		MFUAB36	**KR336702**	Zhaoquing, China
A. cornea	PDD92640		**KR336699**	Wairarapa, NewZealand
A. cornea	PDD97684		**KR336700**	Wellington, New Zealand
A. cornea	PDD103780		**KR336701**	Bay of Plenty, New Zealand
A. cornea	TENN049019	TFB3470	JX065149	Puerto Rico
A. delicata	TENN067025	CNSBlitz0012	JX065169	Queensland, Australia
A. delicata	TENN067026	CNSBlitz0050	JX065168	Queensland, Australia
A. delicata	TENN067027	CNSBlitz0093	JX065165	Queensland, Australia
A. delicata	TENN067028	CNSBlitz0098	JX065171	Queensland, Australia
A. delicata		USJ54470	AF291269	Costa Rica
A. delicata	TENN028734	TENN28734	JX065159	Loreto, Peru
A. delicata	TENN017797	AJS5896	JX065162	San Luis Potosiì, Mexico
A. delicata	TENN016963	AJS1304	JX065158	Veracruz, Mexico
A. fuscosuccinea	TENN058951	TFB10743	JX065141	Buenos Aires, Argentina
A. fuscosuccinea	TENN056263	TFB9503	JX065157	Louisiana, USA
A. fuscosuccinea	TENN059094	TFB11289	JX065153	Misiones, Argentina
A. fuscosuccinea	TENN019800	LRH19800	JX065138	Tamaulipas, Mexico
A. fuscosuccinea	TENN063200	KF09	JX065173	Tennessee, USA
A. heimuer		Cui7100	KM396796	Jilin, China
A. heimuer		Dai13647	KM396790	Jilin, China
A. heimuer		Dai13765	KM396793	Heilongjiang, China
A. heimuer	LE296423		KJ698422	Russia
A. mesenterica	MFLU130393		**KR336697**	Edersee, Germany
A. mesenterica		FO25132	AF291271	Germany
A. mesenterica		MFUAB39	**KR336698**	Rome, Italy
A. minor	LE 296424		KJ698434	Russia

...Continue on the next page

TABLE 1. (Continued)

Species	Herberium	Collection	GenBank accession ITS	Locality
A. nigricans	TENN056825	TFB4405	JX065172	Louisiana, USA
A. nigricans	TENN059115	TFB11410	JX065176	Misiones, Argentina
A. nigricans	WTU	JMB04010803	JX065167	San Joseì, Costa Rica
A. scissa	FH00301771	F64	JX065175	Florida, USA
A. scissa	TENN059729	TFB11193	JX065160	La Vega, Dominican Republic
A. subglabra	TENN057615	TFB10046	JX524199	Alajuela, Costa Rica
A. subglabra	TENN053855	TFB7868	JX065142	Puntarenas, Costa Rica
A. subglabra	TENN058607	TFB10499	JX065155	Puntarenas, Costa Rica
A. subglabra	TENN058100	TFB10405	JX065161	San Joseì, Costa Rica
A. thailandica	MFLU130396		**KR336690**	Chiang Mai, Thailand
A. thailandica	MFLU130399		**KR336691**	Chiang Rai, Thailand
A. thailandica	MFLU130410		**KR336693**	Chiang Rai, Thailand
A. thailandica	MFLU130411		**KR336694**	Mengsong, China
A. thailandica	MFLU130417		**KR336692**	Quezon, Philippine
A. villosula		Dai 13453	KM396813	Jiangxi, China
A. villosula		Dai 13652	KM396814	Chongqing, China
A. villosula		HMAS 130446	KM396817	Tibet, China
A. villosula	LE 296422		KJ698418	Russia
Exidia recisa		MW315	AF291276	Sweden
Exidiopsis sp.		FO46291	AF291282	Germany

Results

Phylogeny

The final ITS dataset comprised 63 sequences of *Auricularia*, with *Exidia recisa* and *Exidiopsis sp.* as outgroup taxa. The final alignment comprised 529 characters, of which 382 were constant, 25 were parsimony-uninformative and 122 were parsimony-informative characters. The ML tree is shown in Fig. 1. In total 13 species defined by morphological characters were included in the phylogenetic analysis.

Ten distinct clades in the ITS tree were strongly supported and defined the following species: *A. auricula-judae* (100/100/99), *A. cornea* (82/100/90), *A. fuscosuccinea* (93/94/88), *A. heimuer* (90/100/86), *A. mesenterica* (100/100/100), *A. nigricans* (89/90/77), *A. scissa* (98/99/79), *A. subglabra* (100/100/99) and *A. villosula* (99/100/100), with a new species labeled as *A. thailandica* (100/100/100) introduced in this study. The collections labeled as *A. delicata* and *A. americana* are polyphyletic or paraphyletic.

Taxonomy

Auricularia thailandica Bandara & K.D. Hyde, *sp. nov*. (Fig. 2) Index Fungorum Number: IF550992, *Facesoffungi number*: FoF 00467.

Type:—THAILAND. Chiang Mai: Bahn Pa Dheng, Mushroom Research Center, dead wood, 14 August 2013, *S.C. Karunarathne K2013117* (MFLU 130410, holotype).

Etymology:—The species epithet "thailandica" refers to the country from where the holotype was collected.

Basidiome:—2–5 cm diam., short stalks, orbicular to cupulate to auriculiform, semi-transparent, brownish orange, 5C5, ridges and veins seen on abhymenial surface, individual hairs clearly distinguishable, hairs not dense, margins darker brown, 6E8.

Internal features: thickness 340–700 µm; medulla present; abhymenial hairs scattered, non-gregarious, hyaline, acute tip, thin or thick walled, 0.9–3.7 µm, clear lumen, septa observed, hair bases 5–11.4 µm wide, hair bases pigmented, light brown, plasmatic; clamp connections present; zona pilosa ≤80 µm; zona compacta 23–46 µm; zona subcompacta superioris 10–29 µm; zona laxa superioris 35–181 µm; medulla 31–98 µm; zona laxa inferioris 98–307 µm; zona subcompacta inferioris 21–78 µm; hymenium 44–78 µm; basidia 34.67–48.41 × 2.73–6.31 µm, cylindrical, tapered or blunt ends, transversely 3-septate, sterigmata observed; spores smooth walled, allantoid, 9.47–13.10 × 4.45–5.66 μm, Q = 1.80–2.80, with one or two large guttules.

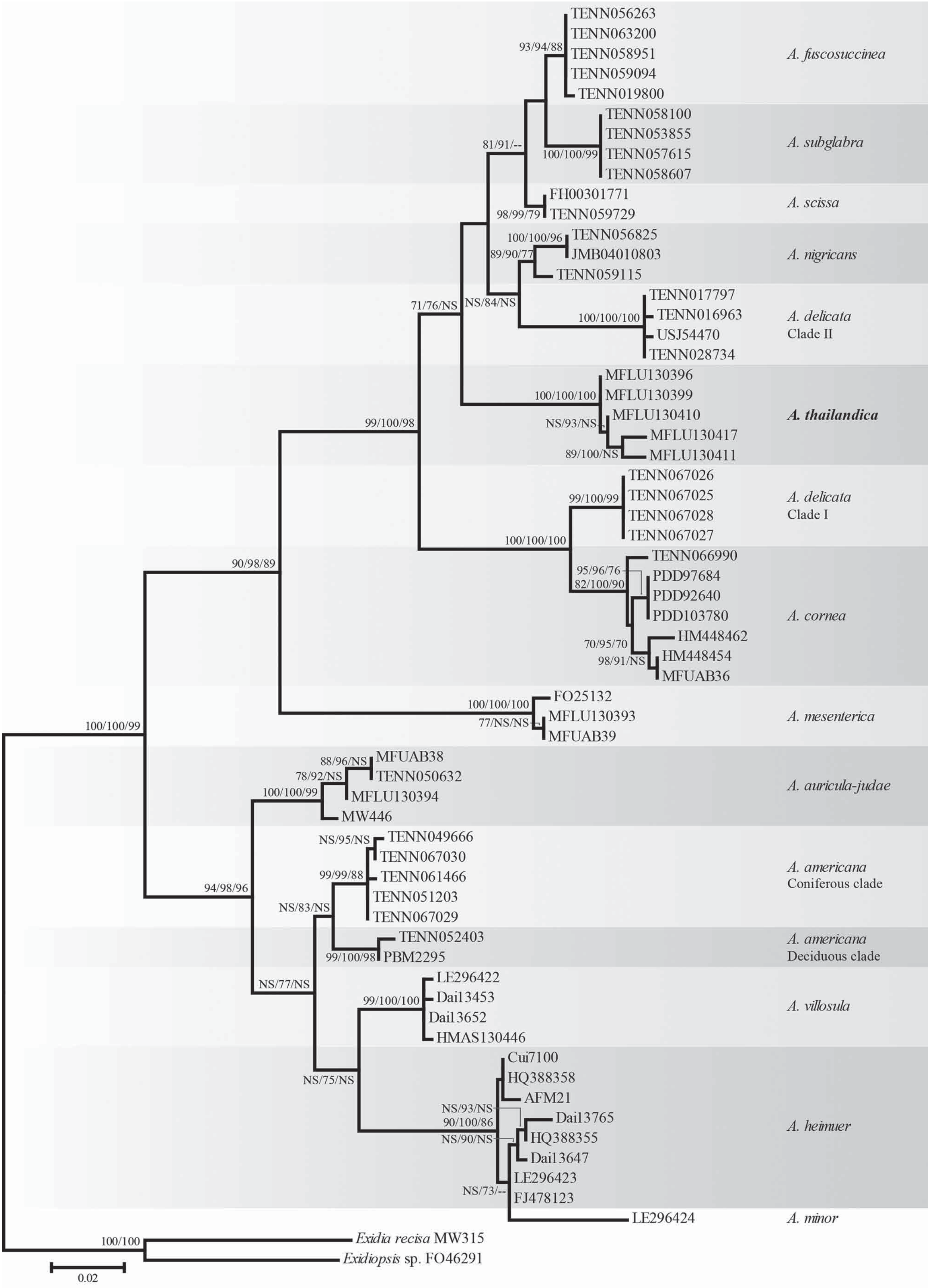

FIGURE 1. The phylogram inferred from a Maximum Likelihood analysis of ITS sequences of *Auricularia*. Species names are followed by the herbarium code or collection code or GenBank accession number. RAxML/ Bayesian posterior probabilities / MP bootstrap values ≥70 % are displayed above or below each node. The tree is rooted with *Exidia recisa* (MW315) and *Exidiopsis sp.* (FO46291).

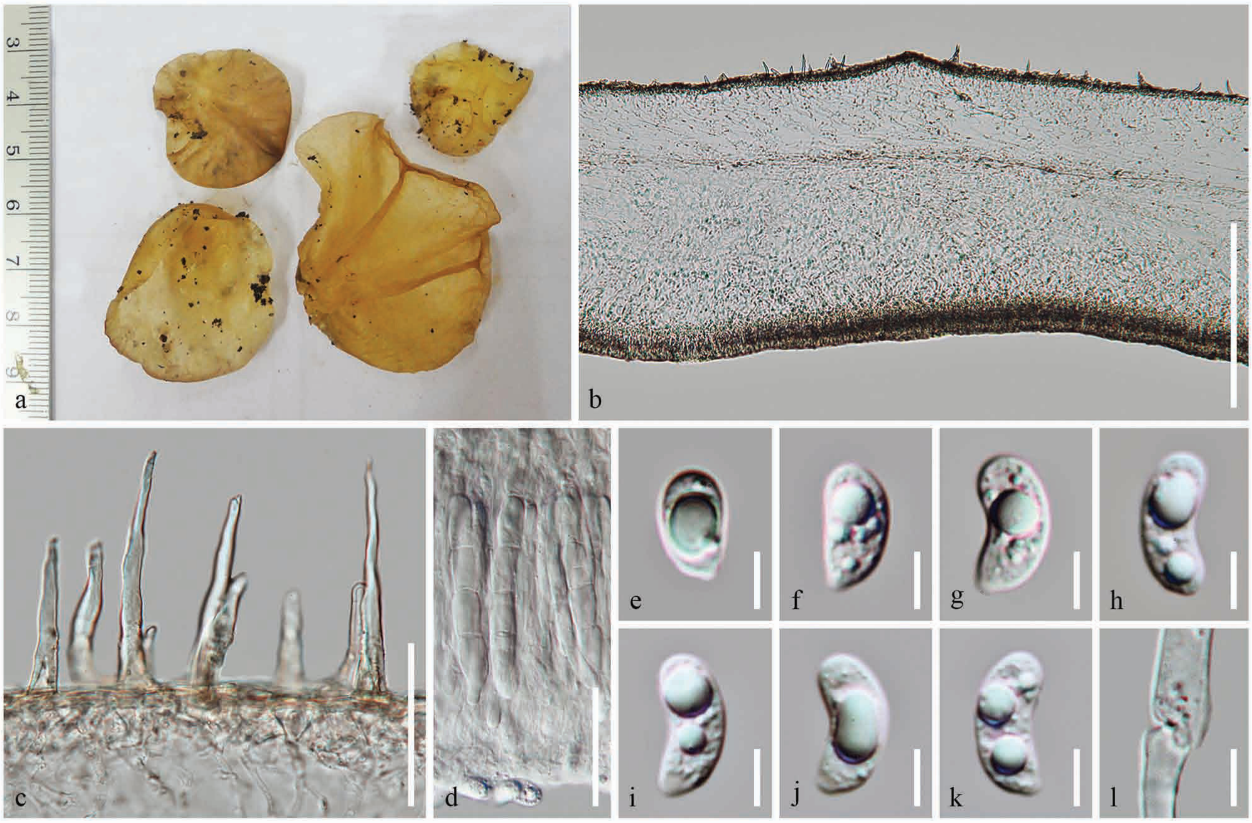

FIGURE 2. *Auricularia thailandica* (MFLU 130410, holotype). a. Basidiocarps. b. Cross-section of the fruitbody. c. Abhymenial hairs. d. Close-up of hymenial layer. e–k. Basidiospores. l. Clamp-connection of a hypha. Scale bars: b=500 µm, c=50 µm, d=25 µm, e–l =5 µm. (Photos by Asanka R. Bandara).

Collections examined:—CHINA. Yunnan: Mengsong, Plot-145, on dead wood, 23 May 2012, *S.C. Karunarathne MS09* (MFLU 130411); THAILAND. Chiang Mai: Bahn Pa Dheng, Mushroom Research Center, dead wood, 12 June 2013, *A.B. Bandara AB201323* (MFLU 130396); THAILAND. Chiang Rai: Doi Mae Salong, decaying tree trunk, June 2013, *A.B. Bandara AB201326* (MFLU 130399); PHILIPPINES. Quezon: Unisan, on deadwood, March 2012, *P. Alva PA30* (MFLU 130417).

Note:—*A. thailandica* can be distinguished from other species of *Auricularia* that have short and loosely arranged abhymenial hairs of the basidiomata. Among the species which have a medulla, the size of the zona pilosa of *A. thailandica* is similar to *A. fibrillifera*, *A. fuscosuccinea*, *A. minor*, *A. scissa* and *A. subglabra* (Table 2). The abhymenial hairs of *A. fuscosuccinea* and *A. scissa* are gregarious and tufted (Looney *et al.*, 2013). Although *A. minor* is characterized by short abhymenial hairs the basidiomata are smaller (less than 2 cm) (Malysheva & Bulakh, 2014) than *A. thailandica*. *A. fibrillifera* is distinct from *A. thailandica* in having thick-walled, acute, free or partly fasciculate hairs and thinner zones (Kobayashi, 1981). *A. subglabra* has solitary, infrequent hairs (Looney *et al.*, 2013). *A. subglabra* is distinguished from *A. thailandica* by the lack of abhymenial hairs, with only a few short hairs present at irregular intervals throughout the zona pilosa.

Discussion

The use of the internal zone of the basidiomata has been used as a taxonomic criterion for defining *Auricularia* species. The widths of zones are however, not always stable among specimens of the same species (Table 2; e.g. *A. cornea*, *A. fuscosuccinea* and *A. polytricha*). The thickness of basidioma zones of *A. thailandica* in cross section randomly overlap with those of certain other species (Table 2). The sizes of zones of *A. thailandica* in cross section are similar to certain corresponding zones of *A. tenuis* but not similar with all zones (Lowy, 1952; Wong & Wells, 1987). However, Wong & Wells (1987) synonymized *A. tenuis* to *A. cornea* based on interfertility and the presence of a double medulla in both taxa.

TABLE 2. Synopsis of dimensions of basidiocarps, internal zones, basidia and spores of *A. thailandica* and similar species of *Auricularia*. TH=thickness of basidiocarp, ZP=zona pilosa, ZC=zona compacta, ZSS=zona subcompacta superioris, ZLS=zona laxa superioris, M=medulla, ZLI=zona laxa inferioris, ZSI=zona subcompacta inferioris, H=hymenium, a=allantoid, cl=clavate, cu= curved, cy=cylindrical, e=ellipsoid, f=fusiform, o=ovoid *(Lowy, 1952), †(Kobayashi, 1981), •(Looney *et al.*, 2013)

Species	TH mm	ZP µm	ZC µm	ZSS µm	ZLS µm	M µm	ZLI µm	ZSI µm	H µm	Basidia µm	Spores µm
**Auricularia cornea*	0.8–1	180–200	70–80	20–30	40–50	570–600	30–40	70–80	80–90	45–55 × 4–5 cl	14–16 × 5–6 a
†*A. cornea*	0.55–0.6	70–310	25	65	180–185	130	150	35–40	115–120	100–110 × 4–5 cl	8–10 × 4 f/e
•*A. cornea*	0.8–1	211–336	26–29	45–79	320–410	131–135	119–223	87–143	93–99	52–69 × 3.2–6	13.5–17.5 × 6–7.5 a
*†*A. emini*	0.6–0.9	3–5 cm	60–70	40–50	150–160	90–100	140–150	40–50	60–70	45–55 × 4–5 cl–cy	12–14 × 4–5 a
†*A. fibrillifera*	0.35–0.5	65–100	5–6.5	10–13	100	30–50	150	25	50–60	–	11–12 × 4–5 a
**A. fuscosuccinea*	0.5–0.8	60–80	25–35	10–15	140–150	30–50	150–160	60–70	70–80	50–60 × 4–5 cy	12–14 × 4–5 a
†*A. fuscosuccinea*	0.3–0.4	35–90	30–35	50–55	90		100	40	40	55–60 × 3–3.5	7.5–8.5 × 4 cu/e
•*A. fuscosuccinea*	1–4	38–136	13–45	30–111	82–607	32–361	26–506	55–224	41–86	45–59 × 3–6.5	11–13.6 × 6.5–8.5 a
†*A. minor*	0.65–0.8	30–80	8–9	40–45	300	75–80	220–230	30–35	70	70 × 5	7–8 × 3–4
•*A. nigricans*	1–4	865–897	13–45	30–111	82–607	32–361	26–506	55–224	41–86	52–73 × 3.2–6.5	14.5–17 × 5–7 a
**A. polytricha*	1–1.5	450	20–25	75–85	250–260	250	250–260	90–100	80–90	50–60 × 4–5 cy	12–15 × 5–6
†*A. polytricha*	1–1.5	>600	40–45	60	370–380	65–70	440–445	65–70	80–85	65–90 × 4.5–6 cy	12.5–15.5 × 6.5–7 f/e
•*A. scissa*	1–3	38–132	15–50	9–45	64–135	38–57	52–124	39–98	29–71	30–44 × 3.7–4.9 cl	8.7–13 × 3.7–5.7 a
•*A. subglabra*	1–2	40	58–114	27–81	130	70–85	99–264	24–45	56–135	33–41 × 3.6–5.1 cl	10–11.5 × 4.5–5.5 a
*†*A. tenius*	0.8–1	85–100	40–50	20–30	195–210	190–210	170–185	20–30	80–90	50–60 × 4–6	12–15 × 5–6 e/o
A. thailandica	0.34–0.7	≤80	23–46	10–29	35–181	31–98	98–307	21–78	44–78	34.67–48.41 × 2.73–6.31 cy	9.47–13.10 × 4.45–5.66 a

Though the characters of the hairs are certainly not a sufficient criterion to allow a diagnosis of a species (Lowy, 1951), hairs of *A. thailandica* show considerable differences from other species with a medulla. Though the size of the zona pilosa of *A. thailandica* is similar to *A. fibrillifera*, *A. fuscosuccinea*, *A. minor*, *A. scissa* and *A. subglabra* (Table 2), the loosely (scattered) arranged abhymenial hairs of *A. thailandica* are a useful character to distinguished this latter species. The nature of hair tips, size of hair walls and size of basidiocarp are also supportive characters which can distinguish *A. thailandica* from similar species. In the ITS phylogeny all the specimens from different geographic locations group in a monophyletic clade and *A. thailandica* is a distinct species with high bootstrap support. In the present study we used both morphological and molecular data to define *A. thailandica* as a distinct species (Looney *et al.*, 2013; Malysheva & Bulakh, 2014; Wu *et al.*, 2014b).

The ITS region can be used to define species of *Auricularia* corresponding to their morphology (Looney *et al.*, 2013; Weiß & Oberwinkler, 2001) and can also resolve interspecies relationships. Combining the gene analyses of ITS and rpb2 (Looney *et al.*, 2013) and ITS and LSU has been used in phylogenetic analyses in different studies (Weiß & Oberwinkler, 2001). However, considering both morphological and phylogenetic analysis, ITS appears to be an adequate molecular marker for phylogenetic species delimitation in *Auricularia.*

Auricularia is the fourth most cultivated mushroom genus after *Agaricus, Lentinula* and *Pleurotus* (Chang, 1996). Due to its nutritional value, medicinal value, and general appreciation as a table delicacy, the importance of this mushroom has increased rapidly (Miles & Chang, 2004). The fruiting bodies of *Auricularia* are a rich source of polysaccharides (De Silva *et al.*, 2012a; Miles & Chang, 2004) and possess antioxidant activities, anticoagulant activities and decrease blood sugar levels (De Silva *et al.*, 2012b; De Silva *et al.*, 2013; Mortimer *et al.*, 2014). The new species, *A. thailandica* may have the potential for domestication as a new edible mushroom that grows in tropical climates (Thawthong *et al.*, 2014).

Currently, 163 names of *Auricularia* have been recorded in Index Fungorum (2015), but many are synonyms, invalid names or species variants. Out of 163 records 75 are possibly valid names (Wu *et al.*, 2014a). Due to a lack of taxonomic and phylogenetic investigations, the number of species of *Auricularia* is still poorly known, particularly from the tropics; therefore future research should focus on investigating the genus *Auricularia* in tropical and subtropical areas.

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