Complete Report

Project "Taxonomy, Phylogeny and Biochemistry of Thai Basidiomycetes (Mushrooms)"

By Prof. Dr. Kevin D Hyde and Researchers

30 July 2015

Contract No.BRG5580009

Complete Report

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สนับสนุนโดยสำนักงานกองทุนสนับสนุนการวิจัย

(ความเห็นในรายงานนี้เป็นของผู้วิจัย สกว. ไม่จำเป็นต้องเห็นด้วยเสมอไป)

Contract No. BRG5580009
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Final report

Abstract

จากการศึกษาความหลากหลายทางชีวภาพของเห็ดในกลุ่มเบสิดิโอไมซิทีสในประเทศไทย ในระยะเวลาสามปีได้เก็บเห็ดในช่วงฤดูฝนของทุกๆปีได้เห็ดมากกว่า 1000 ตัวอย่างและเป็นเห็ดที่มีความแตกต่างกันใน 87 สกุล ตัวอย่างได้ถูกเก็บรักษาไว้ที่หน่วยเก็บรักษาตัวอย่างแห้ง และเชื้อบริสุทธิ์ที่แยกได้จากเนื้อเยื่อของเห็ดจำนวน 106 ไอโซเลท จาก 26 สกุล ได้ถูกจัดเก็บไว้ที่หน่วยจัดเก็บรักษาเชื้อรา ที่มหาวิทยาลัยแม่ฟ้าหลวง มีเห็ดมากกว่า 200 ชนิดที่ถูกนำมาศึกษา และจำนวน 25 ชนิดได้ถูกนำมาศึกษาในด้านอนุกรมวิธานอย่างละเอียด ส่วนการศึกษาทางด้านวงศ์วานวิวัฒนาการเป็นการจำแนกโดยการวิเคราะห์ในระดับโมเลกุลจากการใช้ยีน ITS, LSU และ SSU และมีการรายงานเห็ดชนิดใหม่มากกว่า 10 ชนิด ที่พบในประเทศ ประกอบด้วย 3 สกุล คือ *Agaricus, Auricularia, Clitopilus* และ *Lactarius* นอกจากนี้ได้ศึกษาทางด้านวิเคราะห์ชีวเคมีของบลาซิลสไปรอลของเห็ด *Agaricus subrufescens* สายพันธุ์ผสม อีกทั้งยังพบสารเคมีใหม่ทางยาจากเห็ด *Gymnopus* sp. และพยายามเพาะปลูกเห็ด 8 ชนิด ในโครงการนี้มีนักศึกษาร่วมวิจัยจำนวน 10 คน เป็นนักศึกษาระดับปริญญาโท 4 คน และระดับปริญญาเอก 6 คน จนถึงปัจุบันนี ผลงานที่ที่ได้รับการตีพิมพ์ 24 ฉบับ (22 SCI) และ 5 ฉบับอยุ่ในระหว่างขั้นตอนการตรวจสอบและระหว่างการตีมพิมพ์กับทางวารสาร และอีกจำนวน 12 ฉบับบอยุ่ในขั้นตอนการเตรียมสำหรับการตีพิมพ์.

Abstract

We have studied the biodiversity of Thai Basidiomycetes throughout the wet seasons of 2012 to 2015 and have collected more than 1000 specimens of taxa in 87 genera. All collections have been dried and prepared as herbarium specimens and placed in the MFLU herbarium. This study has isolated 106 strains belonging to 26 genera. More than 200 taxa have been studied in detail and 25 examples are given in this report. ITS, LSU and SSU sequence data has been obtained for 124 strains. This project has introduced more than ten new species from Thailand in the genera *Agaricus*, *Auricularia, Clitopilus* and *Lactarius*. Moreover, this report have analyzed the production of Blazeispirols from new hybrids of *Agaricus subrufescens*. We also found new medicinal chemicals from a *Gymnopus* sp. and also attempted to grow eight mushrooms. Four Master and six PhD students are carrying out research with help from this project. To date, we have published 24 papers (22 SCI) that acknowledge the grant, submitted five papers and a further twele publications are in preparation. We have also published two conference proceedings.

Keyword: Basidiomycete, taxonomy, Phylogeny, cultivation

1. Execlusive summary

1.1 Objectives

1.1.1 Carry out taxonomic and molecular phylogenetic studies of the genus *Agaricus* and other selected potential, edible macrofungal groups in northern Thailand and new species with the potential of cultivating will be identified through this.

1.1.2 Develop ways to cultivate some of these fungi including the new strain of *Agaricus bisporus* which will sporulate at 25 ˚C, new species of *Agaricus* and the members of other genera.

1.1.3 Maintaining a culture collection of macrofungi and sending the duplicates of those cultures in order to deposit in BCC, BOITEC & MFLUCC.

1.1.4 Carry out a molecular study of selected taxa in order to establish their phylogeny, which will result in relatively high impact publications. This will apply in particular to new taxa.

1.1.5 Investigate the potential nutritious and medicinal properties (nutriceuticals) of selected indigenous species and their characterization. Any novel chemical structures will be characterized and the results will be published in international journals with impact ratings.

1.2 Conclusion/Outcomes

1.2.1 Carry out taxonomic and molecular phylogenetic studies

Mushrooms were collected during the wet season in Northern Thailand and more than 1000 specimens were identified and isolated. Some identified specimens are deposited as herbarium specimens in MFLU and cultures are also deposited in MFLU culture collection (MFLUCC) (please see appendix A part 1). We have identified many new species and some have the potential for cultivation. We will continue research on this project.

1.2.2 Develop ways to cultivate some new fungi

Three selected mushrooms can be successfully cultivated (please see appendix A part 4). This has resulted in three publications on growing these mushrooms.

1.2.3 Maintaining a culture collection of macrofungi

We have isolated more than 100 strains and placed then in the culture collection of MFLUCC with some duplicates in BCC

1.2.4 Phylogenetic and molecular study

Molecular analysis of new species and other ill-defined taxa of mushroom have been carried out (please see appendix A part 2). This has resulting in us revealing several new species which have been published and has resulted in eleven publications.

1.2.5 Characterization of bioactive compounds from mushrooms

Some selected mushrooms have been characterized for compounds (please see appendix A part 3). This has resulted in three publications.

1.2.6 Mushroom growing

New mushrooms were attempted to grow with the condition in Northern Thailand. Three selected mushrooms can be successfully cultivated (please see appendix A part 4).

2. Any activities

2.1 Published (Please see appendix B)

We have twenty-six papers were published, five papers in press (accepted/submitted) and twele papers in preparation papers as the result of this grant.

2.2 Poster (Please see appendix C)

2.2.1 The poster was presented on the "Fungal Biodiversity and Biotechnology" at Mae Fah Luang University, Chiang Rai 10th – 12th January 2014. Title "Cultivation of *Agaricus subrufescens* hybrid strains on rice straw based compost media".

2.2.2 The poster was presented at the "The 26th Annual Meeting of the Thai Society for Biotechnology and International Conference" at 26th – 29th November 2014, Mae Fah Luang University, Chiang Rai, Thailand. Title "Optimization condition for cultivation of Agaricus subrufescens hybrid strains".

2.3 An oral presentation / invited speaker

2.3.1 Prof. Dr. Kevin D Hyde gave a talk entitled "Domesticating Wild Mushrooms" RGJ-Ph.D. Congress XIV at Jomtein Palm Beach Resort, Pattaya, Chonburi on 6 April 2013.

2.3.2 Prof. Dr. Kevin D Hyde was invited speaker in the 4th Medical Science Academic Annual Meeting on the topic "Key to becoming a successful researcher" on 26 December 2013.

2.3.3 Prof. Dr. Kevin D Hyde Invited speaker in the forthcoming second International Conference on Integration of Science and Technology for Sustainable Development (ICIST) on November 28-29, 2013 at the Faculty of Agriculture, KMITL, Bangkok, Thailand on the topic "Amazing time to study fungi"

2.3.4 Prof. Dr. Kevin D Hyde Invited gave a talk at KIB

3. Co-operation with other international institutes and in Thailand

Thailand

3.1 Mr. Masahiko Isaka (PhD), Organic Chemistry, National Center for Genetic Engineering and Biotechnology (BIOTEC), 113 Thailand Science Park, Phaholyothin Road, Klong Luang, Pathumthani 12120, Thailand

France

3.2 Phillippe Callac, INRA, Bordeaux, France M. Stadler, Helmholtz Institute, Branchweig, Germany

China

3.3 Professor Jianchu XU, Kunming Institute of Botany, Address: 132# Lanhei Road, Heilongtan, Kunming 650201, Yunnan, China

3.4 Dr. Peter Mortimer, Kunming Institute of Botany, Address: 132# Lanhei Road, Heilongtan, Kunming 650201, Yunnan, China

4. Co-operated with the same university (MFU)

4.1 Mr. Ekachai Chukeatirote, Assistant Professor, School of Science, Mae Fah Luang University 333 M.1 T. Tasud, Muang District, Chiang Rai 57100

4.2 Miss. Sunita Chamyuang (Ph.D.), Lecturer, School of Science, Mae Fah Luang University 333 M.1 T. Tasud, Muang District, Chiang Rai 57100

4.3 Miss. Pattana Kakumyan (Ph.D.), Lecturer, School of Science, Mae Fah Luang University 333 M.1 T. Tasud, Muang District, Chiang Rai 57100

Table 1 Table of project output

Epected output	Output indicator	1st year		2nd year		3rd year		Comments
		1	2	1	2	1	2	
Taxonomy	Collections and isolation of fungi	√	√	√	√	√		Appendix A
	- Culture collection	√	√	√	√	√		
	- Identification	√	√	√	√	√		
Molecular phylogenetic	Molecular analysis	√	√	√	√	√		Appendix A
Chemistry	Characteization of initial compound		√	√	√	√		Appendix A
Cultivation	Initial attatempts to grow new mushrooms		√	√	√	√		Appendix A
Knowledge	Publications		√	√	√	√	√	Appendix B

Research contents

Taxonomy, Phylogeny and biochemistry of Thai Basidiomycete (Mushrooms)

↓

Part 1: Taxonomy

(Collectios and iolation of fungi / Culture collection and Idendipication)

↓

Part 2: Molecular analysis

↓

Part 3: Characterization of initial compounds

↓

Part 4: Cultivation

Appendix A

Final report

Part 1

Collection and isolation of fungi

1. Collecting sites

Collecting sites and forest types in Chiang Rai Province, Thailand

We presently have seven different collecting sites ranging from forests through to grassland to survey the diversity of fungi in Chiang Rai Province in Thailand

Doi Mae Sa Long

A) Disturbed secondary forest (close to pagoda at the highest point of Doi Mae Sa Long, many tree species).
B) Grassland (steep land with poor tree species, 80% of grass).
C) Disturbed forest (forest of *Lithocarpus* spp.; *Castanosis* spp. and coffee plantation under shade, burnt forest).
D) Secondary forest (with many tree species, good forest).
E) Plantation of rubber tree and tea.
F) Disturbed forest with some tree species and bamboo.
G) Pine forest (*Pinus kesiya*)

Doi Pui

A) Dipterocarp forest means the top of Doi Pui? Deciduous forest dominated by Fagaceae, Doi Pui, television repeater, Chiang Rai, N19°49'00" - E99°52'03", 740 m
B) Bamboo forest means the spot with bamboo trees at the entrance? Depend on the spot you collected. Deciduous forest dominated by Fagaceae, 1 km down from top of Doi Pui, GPS N19°49'26" - E99°52'19", 655 m.

Doi Tung

A) Evergreen forest –mixed forest between *Pinus kesiya* and deciduous forest Doi Tung, Chiang Rai --- THAILAND, Chiang Rai Prov., Highway No.110 to Mae Sai, Doi Tung, elevation of 950 metres above sea-level.

Mae Fah Luang University (MFU)

A) Glass land

Khun Kone Waterfall

A) Natural forest

Mae Lao training Centre

A) Natural forest

Collecting sites and type of forest Chiangmai and Lampang, Thailand

We presently have 7 different collecting sites ranging from forests through to grassland to survey the diversity of fungi in Chiangmai and Lampang provinces in Thailand

Site 1: Mae Kam Pong Waterfall, deciduous forest

Site 2: Than Tong Lodge (Grass land), Chiangmai, Thailand
Site 3: 3 Km from Than Tong Lodge, Dry dipterocarp forest dominated by Dipterocarpus obtusifolius, N18°51'55" - E99°17'23", 710 m
Site 4: Grass forest sideway at Doi Sa Ket, Chiangmai to Chaeson, Lampang
Site 5: Coffee plantation, Lampang
Site 6: Sideways at Chiangmai to Lampang
Site 7: Sideways at Chiangmai to Lampang (2)

Collecting sites and type of forest Chiangmai, Thailand
Site 1: Mushroom Research Centre (MRC), deciduous forest dominated by Fagaceae, N19° 07.200′ E98° 44.044′, 900m.
Site 2: MRC temple, Chiang Mai, Mae Taeng Dist., Ban Pha Deng village, Pathummikaram Temple, forest trail, 1050 m alt., N19 06.28,8 E98 44.47,3, deciduous forest dominated by Fagaceae, and *Dipterocarpus* sp.,
Site 3: Mae Tang Waterfall, deciduous forest
Site 4: Doi Inthanon**.** There are 2 spots in there
A) Chiang Mai, Doi Inthanon, Hwy 1009, solitary in the soil among pine leaves, rain forest dominated by *Castanopsis armata* and *Pinus* sp.
B) Chiang Mai, Doi Inthanon, Hwy 1009 and road to Mae Chem, 1700 m alt., humid montane rain forest with *Quercus*, *Castanopsis armata*, *Lithocarpus echinops*

Mae Taeng River Research Center Sop Poeng Chiang Mai
THAILAND, Chiang Mai Prov, Mae Taeng, N19˚07’29.99” E98˚45’46.42, elev 727m.

Table 2 Details of mushroom collection

No	Scientific Name	MFLU code	MFUCC code	Original code	Substrate	Location	Collector	Date collecting	Able to culture
1	***Agaricus* sp.**				Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013	
2	***Agaricus* sp.**				Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013	
3	***Agaricus* sp.**	13-0665		AKK 044	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
4	***Agaricus* sp.**	13-0663		AKK 051	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
5	***Agaricus* sp.**			AKK 065	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	
6	***Agaricus* sp.**	13-0715		AKK 090	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
7	***Agaricus* sp.**	13-0707		AKK 093	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
8	***Agaricus* sp.**	13-0683		AKK 100	On soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
9	***Agaricus* sp.**	13-0680		AKK 103	On soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
10	***Agaricus* sp.**	13-0679		AKK 104	Soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
11	***Agaricus* sp.**	13-0677		AKK 106	Soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
12	***Agaricus* sp.**			AKK 107	Soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
13	***Agaricus* sp**			K2013001	Soil	MFU	Anan	06-05-2013	
14	***Agaricus* sp.**			K2013002	Soil	MFU	Anan	06-05-2013	
15	***Agaricus* sp.**			K2013003	Soil	MFU	Anan	06-05-2013	yes
16	***Agaricus* sp.**			K2013004	Soil	MFU	Anan	06-05-2013	
17	***Agaricus* sp.**			K2013005	Soil	MFU	Anan	06-05-2013	
18	***Agaricus* sp.**			K2013009	Soil	MFU	Anan	20-05-2013	yes
19	***Agaricus* sp.**			K2013010	Soil	MFU	Anan	22-05-2015	
20	***Agaricus* sp.**			K2013011	Soil	MFU	Anan	22-05-2013	
21	***Agaricus floccipes***			K2013015	Soil	MFU	Anan	17-06-2013	
22	***Agaricus* sp.**			K2013017	Soil	MFU	Anan	17-06-2013	
23	***Agaricus* sp.**			K2013022	Soil	MFU	Anan	02-07-2013	yes
24	***Agaricus* sp.**			K2013023	Soil	MFU	Anan	02-07-2013	yes
25	***Agaricus* sp.**			K2013024	Dead leaf	MFU	Anan	05-07-2013	
26	***Agaricus* sp.**			K2013025	Dead leaf	MFU	Anan	05-07-2013	
27	***Agaricus* sp.**			K2013026	Soil	MFU	Anan	06-07-2013	
28	***Agaricus* sp.**			K2013027	Dead leaf	MFU	Anan	06-07-2013	
29	***Agaricus* sp.**			K2013028	Dead leaf	MFU	Anan	06-07-2013	
30	***Agaricus* sp.**			K2013029	Soil	MFU	Anan	06-07-2013	
31	***Agaricus* sp.**			K2013030	Soil	MFU	Anan	06-07-2013	
32	***Agaricus* sp.**			K2013031	Soil	MFU	Anan	06-07-2013	
33	***Agaricus* sp.**			K2013032	Soil	MFU	Anan	10-07-2013	Yes
34	***Agaricus* sp.**			K2013034	Dead leaf	MFU	Anan	10-07-2013	
35	***Agaricus* sp**			K2013035	Dead leaf	MFU	Anan	10-07-2013	Yes
36	***Agaricus* sp.**			K2013036	Dead leaf	MFU	Anan	10-07-2013	Yes
37	***Agaricus* sp.**			K2013037	Soil	MFU	Anan	12-07-2013	
38	***Agaricus* sp.**			K2013038	Soil	MFU	Anan	12-07-2013	
39	***Agaricus* sp.**			K2013039	Soil	MFU	Anan	12-07-2013	
40	***Agaricus* sp.**			K2013040	Soil	MFU	Anan	12-07-2013	
41	***Agaricus* sp.**			K2013041	Dead leaf	MFU	Anan	12-07-2013	
42	***Agaricus* sp.**			K2013042	Dead leaf	MFU	Anan	12-07-2013	
43	***Agaricus* sp.**			K2013043	Dead leaf	MFU	Anan	12-07-2013	
44	***Agaricus* sp.**			K2013044	Dead leaf	MFU	Anan	12-07-2013	
45	***Agaricus* sp.**			K2013045	Dead leaf	MFU	Anan	10-07-2013	
46	***Agaricus* sp.**			K2013048	Soil	MFU	Anan	10-07-2013	
47	***Agaricus* sp.**			K2013049	Dead leaf	MFU	Anan	16-07-2013	
48	***Agaricus* sp.**			K2013050	Soil	MFU	Anan	16-07-2013	

49	**_Agaricus_ sp.**			K2013051	Dead leaf	MFU	Anan	18-07-2013	
50	**_Agaricus_ sp.**			K2013053	Dead leaf	MFU	Anan	18-07-2013	
51	**_Agaricus trisulfuratus_**			K2013060	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
52	**_Agaricus_ sp.**			K2013062	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
53	**_Agaricus trisulfuratus_.**			K2013072	Soil	MRC	Anan	29-07-2013	
54	**_Agaricus_ sp.**			K2013073	Soil	MRC	Benjarong	29-07-2013	yes
55	**_Agaricus_ sp.**			K2013074	Soil	MRC	Bejarong	29-07-2013	
56	**_Agaricus flucculocipes_**			K2013079	Soil	MRC Temple, Chiangmai	Anan	30-07-2013	
57	**_Agaricus_ sp.**			K2013080	Soil	MRC Temple, Chiangmai	Anan	30-07-2013	
58	**_Agaricus trisulfuratus_**			K2013084	Soil	MRC Temple, Chiangmai	Anan	31-07-2013	yes
59	**_Agaricus_ sp.**			K2013086	Soil	Mea Tang watered research center	Olivea	30-07-2013	
60	**_Agaricus subrufescens_**			MFU-01	Leaf litter	MFU	Samantha	10-06-2013	Yes
61	**_Agaricus flocculocipes_**			MFU-02	Leaf litter	MFU	Samantha	10-06-2013	Yes
62	**_Agaricus_ sp.**			MFU-03	Leaf litter	MFU	Samantha	10-06-2013	Yes
63	**_Agaricus_ sp.**			MFU-04	Leaf litter	MFU	Samantha	10-06-2013	Yes
64	**_Agaricus_ sp.**			MFU-06	Leaf litter	MFU	Samantha	10-06-2013	Yes
65	**_Agaricus_ sp.**			KKW-07	Dead leaf litter	Khun Kone Waterfall	Samantha	13-06-2-13	Yes
66	**_Agaricus_ sp.**			KKW-08	Dead leaf litter	Khun Kone Waterfall	Samantha	13-06-2-13	Yes
67	**_Agaricus_ sp.**			TS-03	Soil	Mae Lao training centre	Samantha	13-06-2-13	Yes
68	**_Agaricus_ sp.**			TS-04	Soil	Mae Lao training centre	Samantha	13-06-2-13	Yes
69	**_Agaricus_ sp.**			MFU-12	Leaf litter	MFU	Samantha	14-06-2-13	Yes
70	**_Agaricus_ sp.**		13-0812	AK-009	On soil	MFU	Kritsana	31-07-2013	Yes
71	**_Agaricus_ sp.**			DMS-309	On soil	DMS, Chiangrai	Samantha	03-08-2013	
72	**_Agaricus_ sp.**			DMS-389	On soil	DMS, Chiangrai	Samantha	24-08-2013	
73	**_Agaricus trisulfuratus_**			DMS-413	On soil	DMS, Chiangrai	Samantha	02-09-2013	
74	**_Agaricus chiangmaiensis_**			DMS-468	On soil	DMS, Chiangrai	Samantha	10-09-2013	
75	**_Agaricus subrufescens_**			DMS-500	On soil	DMS, Chiangrai	Samantha	18-09-2013	
76	**_Agaricus subrufescens_**			DMS-524	On soil	DMS, Chiangrai	Samantha	27-09-2013	
77	**_Agaricus_ sp.**	15-1560		DMS14-38	On soil	DMS, Chiangrai	Anan	07-06-2014	Yes
78	**_Agaricus_ sp.**	15-1564		DMS14-42	On soil	DMS, Chiangrai	Anan	11-06-2014	
79	**_Agaricus_ sp.**	15-1568		DMS14-46	On soil	DMS, Chiangrai	Anan	11-06-2014	Yes
80	**_Agaricus_ sp.**	15-1575		DMS14-53	On soil	DMS, Chiangrai	Anan	16-06-2014	
81	**_Agaricus_ sp.**	15-1576		DMS14-54	On soil	DMS, Chiangrai	Anan	16-06-2014	
82	**_Agaricus_ sp.**	15-1577		DMS14-55	On soil	DMS, Chiangrai	Anan	16-06-2014	
83	**_Agaricus_ sp.**	15-1590		DMS14-68	On soil	DMS, Chiangrai	Anan	20-06-2014	
84	**_Agaricus_ sp.**	15-1617		DMS14-95	On soil	DMS, Chiangrai	Asanka	2706-2014	Yes
85	**_Agaricus_ sp.**			K14-08	On soil	DMS, Chiangrai	Benjarong	17-06-2014	
86	**_Agaricus_ sp.**			K14-09	On soil	DMS, Chiangrai	Anan	17-06-2014	Yes
87	**_Agaricus_ sp.**			K14-10	On soil	DMS, Chiangrai	Olvier	17-06-2014	Yes
88	**_Agaricus_ sp.**			K14-11	On soil	DMS, Chiangrai	Olvier	17-06-2014	Yes
89	**_Agaricus_ sp.**			K14-14	On soil	DMS, Chiangrai	Benjarong	17-06-2014	Yes
90	**_Agaricus_ sp.**			K14-22	On soil	DMS, Chiangrai	Anan	17-06-2014	
91	**_Agaricus_ sp.**			K14-24	On soil	DMS, Chiangrai	Asanka	18-06-2014	Yes
92	**_Agaricus_ sp.**			K14-25	On soil	Dr. Hyde’s Farm	Worker in K.D. Hyde farm	19-06-2014	Yes
93	**_Agaricus_ sp.**			K14-26	On soil	DMS, Chiangrai	Leela	19-06-2014	Yes
94	**_Agaricus_ sp.**			K14-27	On soil	DMS, Chiangrai	Anan	19-06-2014	Yes
95	**_Agaricus_ sp.**			K14-28	On soil	DMS, Chiangrai	Anan	19-06-2014	Yes
96	**_Agaricus_ sp.**			K14-32	On soil	DMS, Chiangrai	Samantha	20-06-2014	Yes
97	**_Agaricus_ sp.**			K14-34	On soil	DMS, Chiangrai	Anan	21-06-2014	
98	**_Agaricus_ sp.**			K14-35	On soil	DMS, Chiangrai	Anan	21-06-2014	
99	**_Agaricus_ sp.**			K14-36	On soil	DMS, Chiangrai	Anan	21-06-2014	
100	**_Agaricus_ sp.**			K14-37	On soil	DMS, Chiangrai	Anan	21-06-2014	
101	**_Agaricus_ sp.**			K14-38	On soil	DMS, Chiangrai	Anan	21-06-2014	Yes

102	***Agaricus* sp.**			K14-42	On soil	DMS, Chiangrai	Anan	21-06-2014	
103	***Agaricus* sp.**			K14-40	On soil	DMS, Chiangrai	Olvier	210-6-2014	
104	***Agaricus trisulphuratus***		13-0897	BZ2013-036	Grass land	MFU	Benjarong	13-06-2013	Yes
105	***Agaricus* sp.**		14-1019	Ak-1	Soil	DMS, Chiangrai	Kritsana	-	Yes
106	***Agaricus* sp.**	14-0840		DSK-2B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
107	***Agaricus* sp.**	14-0841		DSK-3B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
108	***Agaricus* sp.**	14-0843	14-1020	DSK-6B	Soil	Doi Sa Ket	Boontiya	30-06-2014	Yes
109	***Agaricus* sp.**		14-1021	DSK-32B	Soil	Doi Sa Ket	Boontiya	02-07-2014	Yes
110	***Agaricus* sp.**	14-0866		DSK-37B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-07-2014	
111	***Agaricus* sp.**	14-0867		DSK-38B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-07-2014	
112	***Agaricus* sp.**	14-0890	14-1023	MFU-4B	Soil	MFU	Boontiya	20-06-2014	Yes
113	***Agaricus* sp.**	14-0891	14-1024	MFU-5B	Soil	MFU	Boontiya	20-06-2014	Yes
114	***Agaricus* sp.**	14-0892	14-1025	MFU-6B	Soil	MFU	Boontiya	20-06-2014	Yes
115	***Agaricus* sp.**	14-0874		MFU-7B	Soil	MFU	Boontiya	18-07-2014	
116	***Agaricus* sp.**		14-1026	MFU-7A	Soil	MFU	Asanka	-	Yes
117	***Agaricus* sp.**		14-1028	MFU-9S	Soil	MFU	Samantha	18-07-2014	Yes
118	***Agaricus* sp.**	14-0876	14-1029	MFU-10S	Soil	MFU	Samantha	18-07-2014	Yes
119	***Agaricus* sp.**	14-0877		MFU-11B	Soil	MFU	Boontiya	22-07-2014	
120	***Agaricus* sp.**	14-0880	14-1030	MFU-14B	Soil	MFU	Boontiya	22-07-2014	Yes
121	***Agaricus* sp.**	14-0881		MFU-15B	Soil	MFU	Boontiya	22-07-2014	
122	***Agaricus* sp.**		14-1031	MFU-19B	Soil	MFU	Boontiya	-	Yes
123	***Agaricus* sp.**	14-0883	14-1032	DH-1B	Soil	Baan Pong Prabaht	Boontiya	10-07-2014	Yes
124	***Agaricus* sp.**	14-0884	14-1033	DH-2L	Soil	Baan Pong Prabaht	Leela Rizal	14-07-2014	Yes
125	***Agaricus* sp.**	14-0885	14-1034	DH-3K	Soil	Baan Pong Prabaht	Anan	18-07-2014	Yes
126	***Agaricus* sp.**	14-0886	14-1035	DH-4K	Soil	Baan Pong Prabaht	Anan	18-07-2014	Yes
127	***Agaricus* sp.**	14-0894		MRC-8B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
128	***Agaricus sp.***	14-0903		MRC-17B	Soil	Pangsadet water management	Boontiya	30-07-2014	
129	***Agaricus* sp.**	14-0908	14-1036	MRC-23B	Soil	Mae Tang water research station	Boontiya	31-06-2014	Yes
130	***Agaricus* sp.**	14-0909	14-1037	MRC-24B	Soil	Mae Tang water research station	Boontiya	31-06-2014	Yes
131	***Agaricus* sp.**	14-0910	14-1038	MRC-25B	Soil	Mae Tang water research station	Boontiya	31-06-2014	Yes
132	***Agaricus* sp.**	14-0911		MRC-26B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
133	***Agaricus* sp.**	14-0912	14-1039	MRC-27B	Soil	Mae Tang water research station	Boontiya	31-06-2014	Yes
134	***Agaricus* sp.**	14-0913		MRC-28B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
135	***Agaricus* sp.**	14-0914	14-1040	MRC-29B	Soil	Mae Tang water research station	Boontiya	31-06-2014	Yes
136	***Agaricus* sp.**	14-0915		MRC-30B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
137	***Agaricus* sp.**	14-0916		MRC-31B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
138	***Agaricus* sp.**	14-0922		MRC-37B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
139	***Agaricus* sp.**	14-0922	14-1041	MRC-38B	Soil	Mae Tang water research station	Boontiya	31-06-2014	Yes
140	***Agaricus* sp.**	14-0923	14-1042	MRC-39B	Soil	Pang Sa Det water management	Boontiya	31-06-2014	Yes
141	***Agaricus* sp.**	14-0924	14-1043	MRC-40B	Soil	Pang Sa Det water management	Boontiya	01-06-2014	Yes
142	***Agaricus* sp.**	14-0925		MRC-41B	Soil	Pang Sa Det water management	Boontiya	01-08-2014	
143	***Agaricus* sp.**	14-0926	14-1044	MRC-42B	Soil	Pang Sa Det water management	Boontiya	01-06-2014	Yes
144	***Agaricus* sp.**	14-0927	14-1045	MRC-43B	Soil	Pang Sa Det water management	Boontiya	01-06-2014	Yes
145	***Agaricus* sp.**			DMS14-38	Soil	DMS, Chiang rai	Anan	07-06-2014	Yes
146	***Agaricus* sp.**	15-1632		DMS14-110	Soil	DMS, Chiang rai	Anan	02-07-2014	
147	***Agaricus* sp.**	15-1652		DMS14-130	Soil	DMS, Chiang rai	Anan	05-07-2014	
148	***Agaricus* sp.**	15-1755		DMS14-233	Soil	DMS, Chiang rai	Anan	04-09-2014	
149	***Agrocybe* sp.**		14-1022	DSK-33B	Soil	Doi Sa Ket	Boontiya	02-07-2014	Yes
150	***Agrocybe* sp.**	14-1920		MRC-35B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
151	***Agrocybe* sp.**		14-1027	MFU-8Ak	Soil	MFU	Kritsana	17-07-2014	Yes
152	***Amanita* sp.**				Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013	
153	***Amanita* sp.**				Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013	
154	***Amanita* sp.**	13-0669		AKK 031	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	

155	***Amanita* sp.**	13-0667	AKK 048	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
156	***Amanita* sp.**		AKK 072	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013
157	***Amanita* sp.**	13-0708	AKK 075	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013
158	***Amanita* sp.**		AKK 138	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
159	***Amanita* sp.**	13-0654	AKK 142	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
160	***Amanita* sp.**	13-0705	AKK 145	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	15-06-2013
161	***Amanita mirecor.***		K2013076	Soil	MRC	Anan	29-07-2013
162	***Amanita* sp.**		DMS-305	On soil	DMS, Chiangrai	Samantha	03-08-2013
163	***Amanita* sp.**		DMS-306	On soil	DMS, Chiangrai	Samantha	03-08-2013
164	***Amanita* sp.**		DMS-311	On soil	DMS, Chiangrai	Samantha	03-08-2013
165	***Amanita* sp.**		DMS-312	On soil	DMS, Chiangrai	Samantha	03-08-2013
166	***Amanita* sp.**		DMS-318	On soil	DMS, Chiangrai	Samantha	15-08-2013
167	***Amanita rubrovolvata***		DMS-325	On soil	DMS, Chiangrai	Samantha	15-08-2013
168	***Amanita hemibapha***		DMS-333	On soil	DMS, Chiangrai	Samantha	20-08-2013
169	***Amanita* sp.**		DMS-338	On soil	DMS, Chiangrai	Samantha	20-08-2013
170	***Amanita vaginata***		DMS-356	On soil	DMS, Chiangrai	Samantha	20-08-2013
171	***Amanita* sp.**		DMS-358	On soil	DMS, Chiangrai	Samantha	24-08-2013
172	***Amanita* sp.**		DMS-360	On soil	DMS, Chiangrai	Samantha	24-08-2013
173	***Amanita* sp.**		DMS-363	On soil	DMS, Chiangrai	Samantha	24-08-2013
174	***Amanita rubrovolvatas***		DMS-391	On soil	DMS, Chiangrai	Samantha	28-08-2013
175	***Amanita* sp.**		DMS-397	On soil	DMS, Chiangrai	Samantha	28-08-2013
176	***Amanita* sp.**		DMS-415	On soil	DMS, Chiangrai	Samantha	02-09-2013
177	***Amanita* sp.**		DMS-417	On soil	DMS, Chiangrai	Samantha	02-09-2013
178	***Amanita* sp.**		DMS-418	On soil	DMS, Chiangrai	Samantha	02-09-2013
179	***Amanita* sp.**		DMS-421	On soil	DMS, Chiangrai	Samantha	02-09-2013
180	***Amanita* sp.**		DMS-424	On soil	DMS, Chiangrai	Samantha	02-09-2013
181	***Amanita* sp.**		DMS-444	On soil	DMS, Chiangrai	Samantha	06-09-2013
182	***Amanita* sp.**		DMS-448	On soil	DMS, Chiangrai	Samantha	06-09-2013
183	***Amanita rubrovolvata***		DMS-457	On soil	DMS, Chiangrai	Samantha	06-09-2013
184	***Amanita* sp.**		DMS-458	On soil	DMS, Chiangrai	Samantha	06-09-2013
185	***Amanita rubrovolvata***		DMS-469	On soil	DMS, Chiangrai	Samantha	10-09-2013
186	***Amanita hemibapha***		DMS-484	On soil	DMS, Chiangrai	Samantha	14-09-2013
187	***Amanita rubrovolvata***		DMS-485	On soil	DMS, Chiangrai	Samantha	14-09-2013
188	***Amanita* sp.**		DMS-495	On soil	DMS, Chiangrai	Samantha	14-09-2013
189	***Amanita* sp.**		DMS-511	On soil	DMS, Chiangrai	Samantha	23-09-2013
190	***Amanita rubrovolvata***		DMS-512	On soil	DMS, Chiangrai	Samantha	23-09-2013
191	***Amanita* sp.**		DMS-515	On soil	DMS, Chiangrai	Samantha	23-09-2013
192	***Amanita rubrovolvata***		DMS-523	On soil	DMS, Chiangrai	Samantha	27-09-2013
193	***Amanita* sp.**		DMS-501	On soil	DMS, Chiangrai	Samantha	18-09-2013
194	***Amanita* sp.**		DMS-526	On soil	DMS, Chiangrai	Samantha	27-09-2013
195	***Amanita* sp.**		DMS-529	On soil	DMS, Chiangrai	Samantha	27-09-2013
196	***Amanita* sp.**		DMS-544	On soil	DMS, Chiangrai	Samantha	01-10-2013
197	***Amanita* sp.**		DMS-547	On soil	DMS, Chiangrai	Samantha	01-10-2013
198	***Amanita rubrovolvata***		DMS-551	On soil	DMS, Chiangrai	Samantha	01-10-2013
199	***Amanita* sp.**	15-1531	DMS14-09	On soil	DMS, Chiangrai	Anan	19-05-2014
200	***Amanita* sp.**	15-1569	DMS14-47	On soil	DMS, Chiangrai	Anan	11-06-2014
201	***Amanita* sp.**	15-1570	DMS14-48	On soil	DMS, Chiangrai	Anan	11-06-2014
202	***Amanita* sp.**	15-1589	DMS14-67	On soil	DMS, Chiangrai	Anan	16-06-2014
203	***Amanita* sp.**	15-1590	DMS14-68	On soil	DMS, Chiangrai	Anan	16-06-2014
204	***Amanita* sp.**	15-1592	DMS14-70	On soil	DMS, Chiangrai	Anan	20-06-2014
205	***Amanita* sp.**	15-1593	DMS14-71	On soil	DMS, Chiangrai	Anan	20-06-2014
206	***Amanita* sp.**	15-1631	DMS14-109	On soil	DMS, Chiangrai	Asanka	27-06-2014

207	***Amanita* sp.**	14-0895		MRC-9B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
208	***Amanita* sp.**	14-0898		MRC-12B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
209	***Amanita* sp.**	14-0900		MRC-14B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
210	***Amanita* sp.**	14-0918		MRC-33B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
211	***Amanita* sp.**	15-1637		DMS14-115	Soil	DMS, Chiang rai	Anan	02-07-2014	
212	***Amanita* sp.**	15-1642		DMS14-120	Soil	DMS, Chiang rai	Anan	02-07-2014	
213	***Amanita* sp.**	15-1648		DMS14-126	Soil	DMS, Chiang rai	Anan	05-07-2014	
214	***Amanita* sp.**	15-1649		DMS14-127	Soil	DMS, Chiang rai	Anan	05-07-2014	
215	***Amanita* sp.**	15-1660		DMS14-138	Soil	DMS, Chiang rai	Anan	14-07-2014	
216	***Amanita* sp.**	15-1667		DMS14-145	Soil	DMS, Chiang rai	Anan	14-07-2014	
217	***Amanita* sp.**	15-1677		DMS14-155	Soil	DMS, Chiang rai	Anan	17-07-2014	
218	***Amanita* sp.**	15-1679		DMS14-157	Soil	DMS, Chiang rai	Anan	17/07-2014	
219	***Amanita* sp.**	15-1689		DMS14-167	Soil	DMS, Chiang rai	Anan	23/07-2014	
220	***Amanita* sp.**	15-1690		DMS14-168	Soil	DMS, Chiang rai	Anan	23/07-2014	
221	***Amanita* sp.**	15-1712		DMS14-190	Soil	DMS, Chiang rai	Lou	15/08-2014	
222	***Amanita* sp.**	15-1734		DMS14-212	Soil	DMS, Chiang rai	Asanka	15/08-2014	
223	***Amanita* sp.**	15-1744		DMS14-222	Soil	DMS, Chiang rai	Linda	15/08-2014	
224	***Amanita* sp.**	15-1767		DMS14-245	Soil	DMS, Chiang rai	Anan	08-09-2014	
225	***Amanita* sp.**	15-1777		DMS14-255	Soil	DMS, Chiang rai	Anan	08-09-2014	
226	***Amanita* sp.**	15-1778		DMS14-256	Soil	DMS, Chiang rai	Anan	08-09-2014	
227	***Amanita* sp.**	15-1779		DMS14-257	Soil	DMS, Chiang rai	Anan	08-09-2014	
228	***Amanita* sp.**	15-1786		DMS14-264	Soil	DMS, Chiang rai	Anan	12-09-2014	
229	***Amanita* sp.**	15-1797		DMS14-275	Soil	DMS, Chiang rai	Anan	12-09-2014	
230	***Amanita rubrovolvata***			DMS-523	On soil	DMS, Chiangrai	Samantha	27-09-2013	
231	***Amanita rubrovolvata***			DMS-551	On soil	DMS, Chiangrai	Samantha	01-10-2013	
232	***Amanita rubrovolvatas***			DMS-391	On soil	DMS, Chiangrai	Samantha	28-08-2013	
233	***Amaruderma* sp.**			DMS-536	On soil	DMS, Chiangrai	Samantha	27-09-2013	
234	***Amaruderma* sp.**			DMS-345	On soil	DMS, Chiangrai	Samantha	20-08-2013	
235	***Amaruderma* sp.**			DMS-548	On soil	DMS, Chiangrai	Samantha	01-10-2013	
236	***Amaruderma* sp.**			DMS-488	On soil	DMS, Chiangrai	Samantha	14-09-2013	
237	***Armillaria tabescens***			KK-06	Dead wood	Khun Kone Waterfall	Samantha	28-06-2013	Yes
238	***Armillaria* sp.**		13-0896	BZ2013-035	On soil	DMS, Chiangrai	Benjarong	13-06-2013	Yes
239	***Astraeus* sp.**			DMS-465	On soil	DMS, Chiangrai	Samantha	06-09-2013	
240	***Astraeus hygrometricus***		14-0589	AA2	Soil	Fah Thai Market	Kritsana	22-06-2014	Yes
241	***Astraeus* sp.**		14-1066	AK14-30	Soil	3 kg from Thranthing lodge	Kritsana	01-07-2014	Yes
242	***Auricularia* sp**	15-1573		DMS14-51	wood	DMS, Chiang rai	Anan	11-06-2014	
243	***Auricularia* sp.**	15-1580		DMS14-58	Wood	DMS, Chiang rai	Anan	16-06-2014	
244	***Auricularia* sp.**	15-1581		DMS14-59	Wood	DMS, Chiang rai	Anan	16-06-2014	
245	***Auricularia* sp**	15-1614		DMS14-92	Soil	DMS, Chiang rai	Anan	24-06-2014	Yes
246	***Auricularia* sp**	151615		DMS14-93	Wood	DMS, Chiang rai	Asanka	27-06-2014	Yes
247	***Auricularia* sp**	15-1616		DMS14-94	Wood	DMS, Chiang rai	Asanka	27-06-2014	Yes
248	***Auricularia* sp**			K14-30	On dead wood	DMS, Chiangrai	Anan	20-06-2014	
249	***Auricularia* sp.**			K14-31	On dead wood	DMS, Chiangrai	Anan	20-06-2014	
250	***Auricularia* sp**	15-1573		DMS14-51	On dead wood	DMS, Chiangrai	Anan	11-06-2014	

251	***Bolete* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
252	***Bolete* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
253	***Bolete* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
254	***Bolete* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
255	***Bolete* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
256	***Bolete* sp.**	13-0651	AKK 146	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
257	***Bolete* sp.**	13-0698	AKK 147	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
258	***Bolete* sp.**	13-0649	AKK 148	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
259	***Bolete* sp.**	13-0648	AKK 150	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
260	***Boletus* sp.**	13-0695	AKK 038	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
261	***Boletus* sp.**	13-0672	AKK 042	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
262	***Boletus* sp.**		DMS-307	On soil	DMS, Chiangrai	Samantha	03-08-2013
263	***Boletus* sp.**		DMS-326	On soil	DMS, Chiangrai	Samantha	15-08-2013
264	***Boletus* sp.**	13-0656	AKK 117	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013
265	***Boletus* sp.**		DMS-367	On soil	DMS, Chiangrai	Samantha	24-08-2013
266	***Boletus* sp.**		DMS-372	On soil	DMS, Chiangrai	Samantha	24-08-2013
267	***Boletus* sp.**		DMS-378	On soil	DMS, Chiangrai	Samantha	24-08-2013
268	***Boletus* sp.**		DMS-375	On soil	DMS, Chiangrai	Samantha	24-08-2013
269	***Boletus* sp.**		DMS-459	On soil	DMS, Chiangrai	Samantha	06-09-2013
270	***Boletus* sp.**		DMS-482	On soil	DMS, Chiangrai	Samantha	10-09-2013
271	***Boletus* sp.**		DMS-502	On soil	DMS, Chiangrai	Samantha	18-09-2013
272	***Boletus* sp.**		DMS-506	On soil	DMS, Chiangrai	Samantha	18-09-2013
273	***Boletus* sp.**		DMS-528	On soil	DMS, Chiangrai	Samantha	27-09-2013
274	***Boletus* sp.**	15-1537	DMS14-07	On soil	DMS, Chiangrai	Anan	19-05-2014
275	***Boletus* sp.**	15-1538	DMS14-08	On soil	DMS, Chiangrai	Anan	19-05-2014
276	***Boletus* sp.**	15-1533	DMS14-11	On soil	DMS, Chiangrai	Anan	19-05-2014
277	***Boletus* sp.**	15-1536	DMS14-14	On soil	DMS, Chiangrai	Anan	27-05-2014
278	***Boletus* sp.**	15-1537	DMS14-15	On soil	DMS, Chiangrai	Anan	27-05-2014
279	***Boletus* sp.**	15-1539	DMS14-17	On soil	DMS, Chiangrai	Anan	27-05-2014
280	***Boletus* sp.**	15-1555	DMS14-33	On soil	DMS, Chiangrai	Anan	07-06-2014
281	***Boletus* sp.**	15-1556	DMS14-34	On soil	DMS, Chiangrai	Anan	07-06-2014
282	***Boletus* sp.**	15-1563	DMS14-41	On soil	DMS, Chiangrai	Anan	07-06-2014
283	***Boletus* sp.**	15-1566	DMS14-44	On soil	DMS, Chiangrai	Anan	11-06-2014
284	***Boletus* sp.**	15-1567	DMS14-45	On soil	DMS, Chiangrai	Anan	11-06-2014
285	***Boletus* sp.**	15-1571	DMS14-49	On soil	DMS, Chiangrai	Anan	11-06-2014
286	***Boletus* sp.**	15-1585	DMS14-63	On soil	DMS, Chiangrai	Anan	16-06-2014
287	***Boletus* sp.**	15-1586	DMS14-64	On soil	DMS, Chiangrai	Anan	16-06-2014
288	***Boletus* sp.**	15-1595	DMS14-73	On soil	DMS, Chiangrai	Anan	20-06-2014
289	***Boletus* sp.**	15-1596	DMS14-74	On soil	DMS, Chiangrai	Anan	20-06-2014
290	***Boletus* sp.**	15-1598	DMS14-76	On soil	DMS, Chiangrai	Anan	20-06-2014
291	***Boletus* sp.**	15-1600	DMS14-78	On soil	DMS, Chiangrai	Anan	20-6-2014
292	***Boletus* sp.**	15-1603	DMS14-81	On soil	DMS, Chiangrai	Anan	20-06-2014
293	***Boletus* sp.**	15-1604	DMS14-82	On soil	DMS, Chiangrai	Anan	24-06-2014
294	***Boletus* sp.**	15-1605	DMS14-83	On soil	DMS, Chiangrai	Anan	24-06-2014

295	*Boletus* sp.	15-1613		DMS14-91	On soil	DMS, Chiangrai	Anan	24-06-2014	
296	*Boletus* sp.	15-1638		DMS14-116	Soil	DMS, Chiang rai	Anan	02-07-2014	
297	*Boletus* sp.	15-1639		DMS14-117	Soil	DMS, Chiang rai	Anan	02-07-2014	
298	*Boletus* sp.	15-1664		DMS14-142	Soil	DMS, Chiang rai	Anan	14-07-2014	
299	*Boletus* sp.	15-1665		DMS14-143	Soil	DMS, Chiang rai	Anan	14-07-2014	
300	*Boletus* sp.	15-1678		DMS14-156	Soil	DMS, Chiang rai	Anan	17-07-2014	
301	*Boletus* sp.	15-1680		DMS14-158	Soil	DMS, Chiang rai	Anan	23-07-2014	
302	*Boletus* sp.			DMS14-172(1)	Soil	DMS, Chiang rai	Anan	26-07-2014	
303	*Boletus* sp.			DMS14-172(2)	Soil	DMS, Chiang rai	Anan	26-07-2014	
304	*Boletus* sp.	15-1701		DMS14-179	Soil	DMS, Chiang rai	Anan	26-07-2014	
305	*Boletus* sp.	15-1719		DMS14-197	Soil	DMS, Chiang rai	Lou	15-08-2014	
306	*Boletus* sp.	15-1720		DMS14-198	Soil	DMS, Chiang rai	Lou	15-08-2014	
307	*Boletus* sp.	15-1722		DMS14-199	Soil	DMS, Chiang rai	Lou	15-08-2014	
308	*Boletus* sp.	15-1782		DMS14-260	Soil	DMS, Chiang rai	Anan	08-09-2014	
309	Boletus sp.	15-1650		DMS14-128	Soil	DMS, Chiang rai	Anan	05-07-2014	
310	*Boletus sp.*	14-0847		DSK-10B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
311	*Boletus sp.*	14-0845		DSK-8B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
312	*Boletus* sp.	14-0890		MRC-4B	Soil	MRC, Chingmai	Boontiya	28-07-2014	
313	*Boletus* sp.	14-0892		MRC-6B	Soil	MRC, Chingmai	Boontiya	28-07-2014	
314	*Boletus* sp.			DMS-482	On soil	DMS, Chiangrai	Samantha	10-09-2013	
315	*Boletus* sp.			DMS-459	On soil	DMS, Chiangrai	Samantha	06-09-2013	
316	*Boletellus* sp.			DMS-327	On soil	DMS, Chiangrai	Samantha	15-08-2013	
317	*Boletellus emodensis*			DMS-361	On soil	DMS, Chiangrai	Samantha	24-08-2013	
318	*Boletellus* sp.			DMS-365	On soil	DMS, Chiangrai	Samantha	24-08-2013	
319	*Canthaellus* sp.	13-0645		AKK 101	On soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
320	*Cantharellus* sp.			DMS-449	On soil	DMS, Chiangrai	Samantha	06-09-2013	
321	*Canthaallus* sp.	15-1762		DMS14-240	Wood	DMS, Chiang rai	Anan	04-09-2014	
322	*Clavaria* sp.			DMS-426	On soil	DMS, Chiangrai	Samantha	02-09-2013	
323	*Clavaria* sp.			DMS-494	On soil	DMS, Chiangrai	Samantha	14-09-2013	
324	*Clavaria* sp.			DMS-538	On soil	DMS, Chiangrai	Samantha	27-09-2013	
325	*Clavaria* sp.	15-1781		DMS14-259	Dead leaf	DMS, Chiang rai	Anan	08-09-2014	
326	*Clavatia* sp.			MFU-08	On soil with leaf litter	MFU	Samantha	11-06-2013	
327	*Clarkeinda trachodes*			KK-05	Soil	Khun Kone Waterfall	Samantha	28-06-2013	Yes
328	*Clavulina* sp.			DMS-474	On soil	DMS, Chiangrai	Samantha	10-09-2013	
329	*Clavulina* sp.	15-1656		DMS14-134	Soil	DMS, Chiang rai	Anan	14-07-2014	
330	*Claudopus/Rhodotus*		14-1080	AK-MRC-37	Dead wood	Ban Tapha, Chiangmai	Kritsana	31-07-2014	Yes
331	*Clitocybe* sp.			MFU-05	Leaf litter	MFU	Samantha	10-06-2013	
332	*Clitocybe*			MFU-10	Leaf litter	MFU	Samantha	14-06-2-13	
333	*Clitopilus* sp.			DT-08	Soil	Doi Tung	Samantha	25-06-2-13	
334	*Clitopilus* sp.		13-0809	AKK 109	Soil	CP, Lampang	Kritsana and Thatsanee	13-06-2013	Yes
335	*Clitopilus* sp.			AKK 110	Soil	CP, Lampang	Kritsana and Thatsanee	13-06-2013	Yes
336	*Clitopilus* sp.		13-0806	AK-003	On soil	DMS, Chiangrai	Samantha	26-06-2013	Yes
337	*Clitopilus* sp.		13-0808	AK-005	On soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	Yes
338	*Clitopilus* sp.		13-0809	AK-006	On soil	CP, Lampang	Kritsana and Thatsanee	13-06-2013	Yes
339	*Clitopilus* sp.		14-0590	AK001-14	Soil	Maesuai, Chiang rai	Kritsana	21-06-2014	Yes
340	Mightbe *Clitopilus*		14-1082	Z61	Soil	Maesuai, chiangrai	Benjarong	21-06-2014	Yes
341	*Coltricia* sp.			DMS-554	On soil	DMS, Chiangrai	Samantha	01-10-2013	
342	*Coltricia* sp.			DMS-393	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
343	*Coltricia* sp.			DMS-432	On soil	DMS, Chiangrai	Samantha	02-09-2013	
344	*Coltricia* sp.			DMS-452	On soil	DMS, Chiangrai	Samantha	06-09-2013	
345	*Coltricia* sp.			DMS-554	On soil	DMS, Chiangrai	Samantha	01-10-2013	
346	*Coprinus* sp.				Soil	DMS, Chiangrai	Benjarong	30-05-2013	
347	*Coprinus* sp.				Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013	

348	***Coprinus* sp.**	13-0741		AKK 088	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
349	***Coprinus* sp.**			DT-11	Soil	Doi Tung	Samantha	25-06-2-13	
350	***Coprinus* sp.**	15-1574		DMS14-52	On soil	DMS, Chiangrai	Anan	11-06-2014	
351	***Coprinus* sp.**			K14-29	On soil	DMS, Chiangrai	Anan	19-06-2014	
352	***Coprinus* sp.**	15-1622		DMS14-100	On soil	DMS, Chiangrai	Asanka	27-06-2014	Yes
353	***Coprinus* sp.**			DMS14-261	Wood	DMS, Chiang rai	Anan	08-09-2014	
354	***Coprinus* sp.**	15-1614		DMS14-92	Soil	DMS, Chiang rai	Anan	24-06-2014	
355	***Coprinus* sp.**		14-1070	AK-MRC-01	Wood	Mushroom Reach Center, CM	Kritsana	27-07-2014	Yes
356	***Coprinus* sp.**		14-1075	AK-MRC-20	Dead wood	Maesae, Chiangmai	Kritsana	30-07-2014	Yes
357	***Cortinarius* sp.**			DMS-304	On soil	DMS, Chiangrai	Samantha	03-08-2013	
358	***Cortinarius* sp.**			DMS-337	On soil	DMS, Chiangrai	Samantha	20-08-2013	
359	***Cortinarius* sp.**			DMS-396	On soil	DMS, Chiangrai	Samantha	28-08-2013	
360	***Cortinarius* sp.**			DMS-401	On soil	DMS, Chiangrai	Samantha	28-08-2013	
361	***Cortinarius* sp.**			DMS-420	On soil	DMS, Chiangrai	Samantha	02-09-2013	
362	***Cortinarius* sp.**			DMS-430	On soil	DMS, Chiangrai	Samantha	02-09-2013	
363	***Cortinarius* sp.**			DMS-507	On soil	DMS, Chiangrai	Samantha	18-09-2013	
364	***Cortinarius* sp.**	15-1658		DMS14-136	Soil	DMS, Chiang rai	Anan	14-07-2014	
365	***Cortinarius* sp.**	15-1682		DMS14-160	Soil	DMS, Chiang rai	Anan	23-0-/2014	
366	***Cortinarius* sp.**	15-1687		DMS14-165	Soil	DMS, Chiang rai	Anan	23-07-2014	
367	***Cortinarius* sp.**	15-1720		DMS14-189	Soil	DMS, Chiang rai	Lou	15-08-2014	
368	***Cortinarius* sp.**	15-1771		DMS14-249	Soil	DMS, Chiang rai	Anan	08-09-2014	
369	***Craterellus* sp.**	15-1768		DMS14-246	Soil	DMS, Chiang rai	Anan	08-09-2014	
370	***Craterellus* sp.**	15-1780		DMS14-258	Soil	DMS, Chiang rai	Anan	08-09-2014	
371	***Crepidotus* sp.**	13-0709		AKK 064	Decay wood	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	
372	***Crepidotus* sp.**	13-0725		AKK 070	Decay wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
373	***Crepidotus* sp.**	13-0736		AKK 077	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
374	***Crepidotus* sp.**	13-0713		AKK 080	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
375	***Crepidotus* sp.**	13-0726		AKK 086	Dead wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
376	***Crepidotus* sp.**			K2013063	Wood	MRC Temple, Chiangmai	Anan	28-07-2013	
377	***Crepidotus* sp.**			DMS-472	On soil	DMS, Chiangrai	Samantha	10-09-2013	
378	***Crepidotus* sp.**			DMS-489	On soil	DMS, Chiangrai	Samantha	14-09-2013	
379	***Crepidotus* sp.**	15-1552		DMS14-30	On dead wood	DMS, Chiangrai	Anan	03-06-2014	Yes
380	***Crepidotus* sp.**	15-1557		DMS14-35	On dead wood	DMS, Chiangrai	Anan	07-06-2014	
381	***Crepidotus* sp.**		14-0599	AK14-24	Dead wood	Tebsadet waterfall, ChiangMai	Kritsana	30-06-2014	Yes
382	***Crepidotus* sp.**		14-1077	AK-MRC-22	Dead wood	Maesae, Chiangmai	Kritsana	30-07-2014	Yes
383	***Crepidotus* sp.**	15-1653		DMS14-131	Wood	DMS, Chiang rai	Anan	14-07-2014	
384	***Creterellus cornucopides***			DMS-316	On soil	DMS, Chiangrai	Samantha	15-08-2013	
385	***Creterellus cornucopides***			DMS-346	On soil	DMS, Chiangrai	Samantha	20-08-2013	
386	***Creterellus cornucopides***			DMS-409	On soil	DMS, Chiangrai	Samantha	28-08-2013	
387	***Creterellus cornucopides***			DMS-462	On soil	DMS, Chiangrai	Samantha	06-09-2013	
388	***Creterellus cornucopides***			DMS-476	On soil	DMS, Chiangrai	Samantha	10-09-2013	
389	***Creterellus cornucopides***			DMS-486	On soil	DMS, Chiangrai	Samantha	14-09-2013	
390	***Creterellus cornucopides***			DMS-508	On soil	DMS, Chiangrai	Samantha	18-09-2013	
391	***Creterellus cornucopides***			DMS-516	On soil	DMS, Chiangrai	Samantha	23-09-2013	
392	***Creterellus cornucopides***			DMS-534	On soil	DMS, Chiangrai	Samantha	27-09-2013	
393	***Creterellus cornucopides***			DMS-553	On soil	DMS, Chiangrai	Samantha	01-10-2013	
394	***Cup fungi***			DMS-320	On dead wood	DMS, Chiangrai	Samantha	15-08-2013	
395	***Cyattus* sp.**		13-0890	BZ2013-014	On wood	Doi Pui, Chaingrai	Benjarong	12-06-2013	Yes
396	***Daldinia* sp.**			DMS-557	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
397	***Dictyophora* sp.**	15-1760		DMS14-238	Soil	DMS, Chiang rai	Anan	04-09-2014	
398	***Dictyophora* sp.**			KKW-03	Leaf litter	Dominated by Bamboo	Samantha	13-06-2013	
399	***Entoloma* sp.**			K2013082	Soil	MRC Temple, Chiangmai	Samantha	30-07-2013	
400	***Entoloma* sp.**		13-0805	AK-002	On soil	Mae sa waterfall, Chiangmai	Kritsana	16-09-2012	

401	***Entoloma* sp.**			DMS-324	On soil	DMS, Chiangrai	Samantha	15-08-2013	
402	***Entoloma* sp.**			DMS-342	On soil	DMS, Chiangrai	Samantha	20-08-2013	
403	***Entoloma* sp.**			DMS-381	On soil	DMS, Chiangrai	Samantha	24-08-2013	
404	***Entoloma* sp.**			DMS-394	On soil	DMS, Chiangrai	Samantha	28-08-2013	
405	***Entoloma* sp.**			DMS-475	On soil	DMS, Chiangrai	Samantha	10-09-2013	
406	***Entoloma* sp.**			DMS-481	On soil	DMS, Chiangrai	Samantha	10-09-2013	
407	***Entoloma* sp.**			DMS-499	On soil	DMS, Chiangrai	Samantha	18-09-2013	
408	***Entoloma* sp.**			DMS-510	On soil	DMS, Chiangrai	Samantha	18-09-2013	
409	***Entoloma* sp.**			DMS-521	On soil	DMS, Chiangrai	Samantha	23-09-2013	
410	***Entoloma* sp.**			DMS-530	On soil	DMS, Chiangrai	Samantha	27-09-2013	
411	***Entoloma* sp.**			DMS-533	On soil	DMS, Chiangrai	Samantha	27-09-2013	
412	***Entoloma* sp.**		14-0588	A1	Soil	DMS, Chiang rai	Anan	02-07-2014	Yes
413	***Entoloma* sp.**		14-0593	AK14-02	Soil	Maesuai, Chiang rai	Kritsana	21-06-2014	Yes
414	***Entoloma* sp.**		14-0596	AK14-11	Soil	DMS, Chiang rai	Kritsana	24-06-2014	Yes
415	***Entoloma* sp.**		14-0597	AK14-12	Soil	DMS, Chiang rai	Kritsana	24-06-2014	Yes
416	***Entoloma* sp.**		14-1065	AK14-20	Soil	Tebsadet waterfall, Chiangmai	Kritsana	30-06-2014	Yes
417	***Entoloma* sp.**	15-1623		DMS14-101	Soil	DMS, Chiang rai	Asanka	27-6-2014	Yes
418	***Entoloma* sp.**	15-1635		DMS14-113	Soil	DMS, Chiang rai	Anan	02-7-2014	
419	***Entoloma* sp.**	15-1657		DMS14-135	Soil	DMS, Chiang rai	Anan	14-07-2014	
420	***Entoloma* sp.**	15-1661		DMS14-139	Soil	DMS, Chiang rai	Anan	14-07-2014	
421	***Entoloma* sp.**	15-1685		DMS14-163	Soil	DMS, Chiang rai	Anan	23-07-2014	
422	***Entoloma* sp.**	15-1688		DMS14-166	Soil	DMS, Chiang rai	Anan	23-07-2014	
423	***Entoloma* sp.**	15-1693		DMS14-171	Soil	DMS, Chiang rai	Anan	23-07-2014	
424	***Entoloma* sp.**	15-1697		DMS14-175	Soil	DMS, Chiang rai	Anan	26-07-2014	
425	***Entoloma* sp.**	15-1713		DMS14-191	Soil	DMS, Chiang rai	Lou	15-08-2014	
426	***Entoloma* sp.**	15-1736		DMS14-214	Soil	DMS, Chiang rai	Asanka	15-08-2014	
427	***Entoloma* sp.**	15-1747		DMS14-225	Soil	DMS, Chiang rai	Linda	15-08-2014	
428	***Entoloma* sp.**	15-1789		DMS14-267	Soil	DMS, Chiang rai	Anan	12-09-2014	
429	***Entoloma* sp.**	15-1790		DMS14-268	Soil	DMS, Chiang rai	Anan	12-09-2014	
430	***Entoloma* sp.**	15-1795		DMS14-273	Dead leaf	DMS, Chiang rai	Anan	12-09-2014	
431	***Favolus* sp.**			DMS-545	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
432	***Filoboletus* sp.**		14-0594	AK14-08	Dead wood	Maesuai, Chiang rai	Kritsana	21-06-2014	Yes
433	***Filoboletus* sp.**		14-1076	AK-MRC-21	Dead wood	Maesae, Chiangmai	Kritsana	30-07-2014	Yes
434	***Fomes***			DMS-549	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
435	***Ganoderma* sp.**		14-1071	AK-MRC-09	Wood	Wat Pa Doi Pha Deng	Kritsana	27-07-2014	Yes
436	***Ganoderma* sp.**		14-1072	AK-MRC-13	Wood	Wat Pa Doi Pha Deng	Kritsana	27-07-2014	Yes
437	***Ganoderma* sp.**		14-1073	AK-MRC-14	Wood	Wat Pa Doi Pha Deng	Kritsana	27-07-2014	Yes
438	***Ganoderma* sp.**		14-1074	AK-MRC-15	Wood	Wat Pa Doi Pha Deng	Kritsana	27-07-2014	Yes
439	***Ganoderma* sp.**	15-1561		DMS14-39	Soil	DMS, Chiang rai	Anan	07-06-2014	
440	***Ganoderma* sp.**	15-1717		DMS14-195	Soil	DMS, Chiang rai	Lou	15-09-2014	
441	***Ganoderma* sp.**	15-1754		DMS14-232	Soil	DMS, Chiang rai	Anan	04-09-2014	
442	***Ganoderma* sp.**	15-1765		DMS14-243	Wood	DMS, Chiang rai	Anan	04-09-2014	
443	***Ganoderma* sp.**	15-1785		DMS14-263	Wood	DMS, Chiang rai	Anan	08-09-2014	
444	***Ganoderma* sp.**			AKK 060	Dead wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
445	***Ganoderma* sp.**			K2013070	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	yes
446	***Ganoderma* sp.**		12-0527	LT-12-072	Decay hardwood	CMU	Thatsanee	17-10-2012	Yes
447	***Ganoderma* sp.**			DMS-314	On dead wood	DMS, Chiangrai	Samantha	03-08-2013	
448	***Ganoderma* sp.**			DMS-314	On dead wood	DMS, Chiangrai	Samantha	03-08-2013	
449	***Ganoderma* sp.**			K14-16	On dead wood	DMS, Chiangrai	Anan	17-06-2014	
450	***Ganoderma* sp.**			K14-20	On dead wood	DMS, Chiangrai	Anan	17-06-2014	Yes
451	***Ganoderma sp.***	14-0844		DSK-7B	Dead wood	Doi Sa Ket	Boontiya	30-06-2014	
452	***Ganoderma* sp.**	14-0901		MRC-15B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
453	***Ganoderma* sp.**	14-0902		MRC-16B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	

454	***Ganoderma* sp.**	14-0906		MRC-21B	Soil	Pangsadet water management	Boontiya	30-07-2014	
455	***Ganoderma* sp.**	14-0907		MRC-22B	Soil	Pangsadet water management	Boontiya	30-07-2014	
456	***Geastrum* sp.**			DMS-410	On soil	DMS, Chiangrai	Samantha	28-08-2013	
457	***Geastrum* sp.**			DMS-498	On soil	DMS, Chiangrai	Samantha	14-09-2013	
458	***Geastrum* sp.**	15-1716		DMS14-194	Soil	DMS, Chiang rai	Lou	15-08-2014	
459	***Gomphus* sp.**			K2013088	Soil	Mea Tang watered research center	Anan	30-07-2013	
460	***Gymnopilus* sp.**		13-0517	LT 2013-001	Wood	DMS, Chiangrai	Thatsanee	26-05-2013	Yes
461	***Gymnopilus* sp.**			DMS-433	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
462	***Gymnopilus* sp.**			DMS-504	On dead wood	DMS, Chiangrai	Samantha	18-09-2013	
463	***Gymnopilus* sp.**			DMS-517	On dead wood	DMS, Chiangrai	Samantha	23-09-2013	
464	***Gymnopilus* sp.**			DMS-527	On dead wood	DMS, Chiangrai	Samantha	27-09-2013	
465	***Gymnopilus* sp.**			DMS-556	On soil	DMS, Chiangrai	Samantha	01-10-2013	
466	***Gymnopilus* sp.**	15-1634		DMS14-112	Soil	DMS, Chiang rai	Anan	02-07-2014	
467	***Gymnopilus* sp.**	15-1750		DMS14-228	Wood	DMS, Chiang rai	Anan	04-09-2014	
468	***Gymnopus* sp.**			KK-07	Dead wood	Khun Kone Waterfall	Samantha	28-06-2-13	
469	***Gymnopus* sp.**		13-0889	BZ2013-013	On wood	Lordges resort, Chiangmai	Kritsana, Thatsanee, Anan	12-06-2013	Yes
470	***Gymnopus* sp.**		13-0904	BZ2013-061		Lordges resort, Chiangmai	Benjarong	15-06-2013	Yes
471	***Gymnopus* sp.**			BZ2013-124	On soil	Doi tung, Chiangrai	Benjarong	15-06-2013	Yes
472	***Gymnopus* sp.**	15-1692		DMS14-170	Soil	DMS, Chiang rai	Anan	23-07-2014	
473	***Gymnopus* sp.**	15-1738		DMS14-216	Wood	DMS, Chiang rai	Asanka	15-08-2014	
474	***Gymnopus* sp.**	15-1792		DMS14-270	Dead leaf	DMS, Chiang rai	Anan	12-09-2014	
475	***Gymnopus* sp.**	15-1794		DMS14-272	Dead leaf	DMS, Chiang rai	Anan	12-09-2014	
476	***Hebeloma* sp.**			K2013075	Soil	MRC	Anan	29-07-2013	
477	***Hebeloma* sp.**	14-0921		MRC-36B	Soil	Mae Tang water research station	Boontiya Chuankid	31-07-2014	
478	***Heinemanomyces splendidissima***			K2013085	Soil	Mea Tang watered research center	Anan	30-07-2013	
479	***Helvella* sp.**			DMS-336	On soil	DMS, Chiangrai	Samantha	20-08-2013	
480	***Helvella macrocarpa***			DMS-429	On soil	DMS, Chiangrai	Samantha	02-09-2013	
481	***Hexagonia* sp.**	13-0723		AKK 096	Wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	Yes
482	***Hexagonia* sp.**	13-0692		AKK 097	Wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
483	***Hohenbuehelia* sp.**		13-0891	BZ2013-017	On wood	Lordges resort, Chiangmai	Benjarong	12-06-2013	Yes
484	***Hydnum* sp.**	15-1704		DMS14-182	Soil	DMS, Chiang rai	Anan	26-07-2014	
485	***Hydnum* sp.**			K2013083	Soil	MRC Temple, Chiangmai	Olivea	30-07-2013	
486	***Hygrocybe coccineocrenata***	13-0670		AKK 040	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
487	***Hygrocybe* sp.**	13-0752		AKK 052	Soil	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
488	***Hygrocybe* sp.**			K2013065	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
489	***Hymenochaetaceae***			DMS-408	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
490	***Hypholoma* sp.**			DMS-357	On dead wood	DMS, Chiangrai	Samantha	20-08-2013	
491	***Hypholoma* sp.**	15-1769		DMS14-247	Wood	DMS, Chiang rai	Anan	08-09-2014	
492	***Inocybe* sp.**	13-0716		AKK 053	Decay wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
493	***Inocybe* sp.**			AKK 054	Decay wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
494	***Inocybe* sp.**	13-0685		AKK 126	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
495	***Inocybe* sp.**			K2013067	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
496	***Inocybe* sp.**			K2013078	Soil	MRC	Anan	29-07-2013	
497	***Inocybe* sp.**		13-0518	LT 2013-002	Soil	DMS, Chiangrai	Thatsanee	27-05-2013	Yes
498	***Inocybe* sp.**			K2013078	Soil	MRC	Anan	29-07-2013	
499	***Inocybe* sp.**			KK-11	Soil	Khun Kone Waterfall	Samantha	28-06-2-13	
500	***Inocybe* sp.**			KK-12	Soil	Khun Kone Waterfall	Samantha	28-06-2-13	
501	***Inocybe* sp.**			DMS-302	On soil	DMS, Chiangrai	Samantha	03-08-2013	
502	***Inocybe* sp.**			DMS-303	On soil	DMS, Chiangrai	Samantha	03-08-2013	
503	***Inocybe* sp.**			DMS-334	On soil	DMS, Chiangrai	Samantha	20-08-2013	
504	***Inocybe* sp.**			DMS-352	On soil	DMS, Chiangrai	Samantha	20-08-2013	
505	***Inocybe* sp.**			DMS-376	On soil	DMS, Chiangrai	Samantha	24-08-2013	
506	***Inocybe* sp.**			DMS-377	On soil	DMS, Chiangrai	Samantha	24-08-2013	

507	***Inocybe* sp.**		DMS-382	On soil	DMS, Chiangrai	Samantha	24-08-2013	
508	***Inocybe* sp.**		DMS-404	On soil	DMS, Chiangrai	Samantha	28-08-2013	
509	***Inocybe* sp.**		DMS-411	On soil	DMS, Chiangrai	Samantha	28-08-2013	
510	***Inocybe* sp.**		DMS-422	On soil	DMS, Chiangrai	Samantha	02-09-2013	
511	***Inocybe* sp.**		DMS-437	On soil	DMS, Chiangrai	Samantha	02-09-2013	
512	***Inocybe* sp.**		DMS-461	On soil	DMS, Chiangrai	Samantha	06-09-2013	
513	***Inocybe* sp.**		DMS-479	On soil	DMS, Chiangrai	Samantha	10-09-2013	
514	***Inocybe* sp.**		DMS-493	On soil	DMS, Chiangrai	Samantha	14-09-2013	
515	***Inocybe* sp.**		DMS14-97	On soil	DMS, Chiangrai	Asanka	27-06-2014	
516	***Inocybe sp.***	18-0857	DSK-26B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-07-2014	
517	***Laccaria* sp.**		K2013064	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
518	***Laccaria* sp.**		K2013068	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
519	***Laccaria* sp.**		K2013069	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
520	***Laccaria laccata***		KK-09	Soil	Khun Kone Waterfall	Samantha	28-06-2-13	
521	***Laccaria* sp.**		DMS-341	On soil	DMS, Chiangrai	Samantha	20-08-2013	
522	***Laccaria* sp.**		DMS-427	On soil	DMS, Chiangrai	Samantha	02-09-2013	
523	***Laccaria* sp.**		DMS-453	On soil	DMS, Chiangrai	Samantha	06-09-2013	
524	***Laccaria* sp.**		DMS-473	On soil	DMS, Chiangrai	Samantha	10-09-2013	
525	***Laccaria* sp.**		DMS-478	On soil	DMS, Chiangrai	Samantha	10-09-2013	
526	***Laccaria* sp.**		DMS-480	On soil	DMS, Chiangrai	Samantha	10-09-2013	
527	***Laccaria* sp.**		DMS-505	On soil	DMS, Chiangrai	Samantha	18-09-2013	
528	***Laccaria* sp.**		DMS-520	On soil	DMS, Chiangrai	Samantha	23-09-2013	
529	***Laccaria* sp.**	15-1668	DMS14-146	Soil	DMS, Chiang rai	Anan	14-09-2014	
530	***Laccaria* sp.**	15-1751	DMS14-229	Soil	DMS, Chiang rai	Anan	04-09-2014	
531	***Laccaria* sp.**	15-1772	DMS14-250	Soil	DMS, Chiang rai	Anan	0-0/9-2014	
532	***Lactarius* sp.**	13-0660	AKK 045	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
533	***Lactarius* sp.**	13-0699	AKK 136	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
534	***Lactarius* sp.**		DMS-310	On soil	DMS, Chiangrai	Samantha	03-08-2013	
535	***Lactarius* sp.**		DMS-319	On soil	DMS, Chiangrai	Samantha	15-08-2013	
536	***Lactarius volemus***		DMS-339	On soil	DMS, Chiangrai	Samantha	20-08-2013	
537	***Lactarius* sp.**		DMS-344	On soil	DMS, Chiangrai	Samantha	20-08-2013	
538	***Lactarius* sp.**		DMS-347	On soil	DMS, Chiangrai	Samantha	20-08-2013	
539	***Lactarius* sp.**		DMS-348	On soil	DMS, Chiangrai	Samantha	20-08-2013	
540	***Lactarius* sp.**		DMS-349	On soil	DMS, Chiangrai	Samantha	20-08-2013	
541	***Lactarius* sp.**		DMS-366	On soil	DMS, Chiangrai	Samantha	24-08-2013	
542	***Lactarius* sp.**		DMS-379	On soil	DMS, Chiangrai	Samantha	24-08-2013	
543	***Lactarius* sp.**		DMS-387	On soil	DMS, Chiangrai	Samantha	24-08-2013	
544	***Lactarius* sp.**		DMS-388	On soil	DMS, Chiangrai	Samantha	24-08-2013	
545	***Lactarius gracilis***		DMS-400	On soil	DMS, Chiangrai	Samantha	28-08-2013	
546	***Lactarius subgenus Russularia* sp.**		DMS-403	On soil	DMS, Chiangrai	Samantha	28-08-2013	
547	***Lactarius* sp.**		DMS-419	On soil	DMS, Chiangrai	Samantha	02-09-2013	
548	***Lactarius subgenus Russularia* sp.**		DMS-435	On soil	DMS, Chiangrai	Samantha	02-09-2013	
549	***Lactarius* sp.**		DMS-436	On soil	DMS, Chiangrai	Samantha	02-09-2013	
550	***Lactarius volem***		DMS-438	On soil	DMS, Chiangrai	Samantha	02-09-2013	
551	***Lactarius* sp.**		DMS-445	On soil	DMS, Chiangrai	Samantha	06-09-2013	
552	***Lactarius* sp.**		DMS-446	On soil	DMS, Chiangrai	Samantha	06-09-2013	
553	***Lactarius* sp.**		DMS-471	On soil	DMS, Chiangrai	Samantha	10-09-2013	
554	***Lactarius* sp.**		DMS-496	On soil	DMS, Chiangrai	Samantha	14-09-2013	
555	***Lactarius deliciosus***		DMS-535	On soil	DMS, Chiangrai	Samantha	27-09-2013	
556	***Lactarius* sp.**		DMS-541	On soil	DMS, Chiangrai	Samantha	27-09-2013	
557	***Lactarius* sp.**		DMS-558	On soil	DMS, Chiangrai	Samantha	01-10-2013	
558	***Lactarius* sp.**	15-1565	DMS14-43	On soil	DMS, Chiangrai	Anan	11-06-2014	
559	***Lactarius* sp.**		K14-19	On soil	DMS, Chiangrai	Anan	17-06-2014	Yes

560	***Lactarius* sp.**	15-1591		DMS14-69	On soil	DMS, Chiangrai	Anan	20-06-2014	
561	***Lactarius* sp.**	15-1594		DMS14-72	On soil	DMS, Chiangrai	Anan	20-06-2014	
562	***Lactarius* sp.**	15-1607		DMS14-84	On soil	DMS, Chiangrai	Anan	24-06-2014	
563	***Lactarius* sp.**	15-1607		DMS14-85	On soil	DMS, Chiangrai	Anan	24-06-2014	
564	***Lactarius* sp.**	15-1608		DMS14-86	On soil	DMS, Chiangrai	Anan	24-06-2014	
565	***Lactarius* sp.**	15-1629		DMS14-107	On soil	DMS, Chiangrai	Asanka	27-06-2014	
566	***Lactarius* sp.**	15-1630		DMS14-108	On soil	DMS, Chiangrai	Asanka	27-06-2014	
567	***Lactarius sp.***	14-0848		DSK-11B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
568	***Lactarius* sp.**			DMS14-43	Soil	DMS, Chiang rai	Anan	11-06-2014	
569	***Lactarius* sp.**			DMS14-69	Soil	DMS, Chiang rai	Anan	20-06-2014	
570	***Lactarius* sp.**			DMS14-72	Soil	DMS, Chiang rai	Anan	20-06-2014	
571	***Lactarius* sp.**			DMS14-84	Soil	DMS, Chiang rai	Anan	24-06-2014	
572	***Lactarius* sp.**	15-1646		DMS14-124	Soil	DMS, Chiang rai	Anan	05-07-2014	
573	***Lactarius* sp.**	15-1647		DMS14-125	Soil	DMS, Chiang rai	Anan	05-07-2014	
574	***Lactarius* sp.**	15-1681		DMS14-159	Soil	DMS, Chiang rai	Anan	23-07-2014	
575	***Lactarius* sp.**	15-1696		DMS14-174	Soil	DMS, Chiang rai	Anan	26-07-2014	
576	***Lactarius* sp.**	15-1723		DMS14-201	Soil	DMS, Chiang rai	Lou	15-08-2014	
577	***Lactarius* sp.**	15-1724		DMS14-202	Soil	DMS, Chiang rai	Lou	15-08-2014	
578	***Lactarius* sp.**	15-1729		DMS14-207	Soil	DMS, Chiang rai	Asanka	15-08-2014	
579	***Lactarius* sp.**	15-1739		DMS14-217	Soil	DMS, Chiang rai	Asanka	15-08-2014	
580	***Lactarius* sp.**	15-1742		DMS14-220	Soil	DMS, Chiang rai	Linda	15-08-2014	
581	***Lactarius* sp.**	15-1743		DMS14-221	Soil	DMS, Chiang rai	Linda	15-08-2014	
582	***Lactarius* sp.**	15-1749		DMS14-227	Soil	DMS, Chiang rai	Anan	04-09-2014	
583	***Lactarius* sp.**	15-1764		DMS14-242	Soil	DMS, Chiang rai	Anan	04-09-2014	
584	***Lactarius* sp.**	15-1731		DMS14-209	Soil	DMS, Chiang rai	Asanka	15-08-2014	
585	***Lactifuus* sp.**			DMS-460	On soil	DMS, Chiangrai	Samantha	06-09-2013	
586	***Lactifuus* sp.**			DMS-543	On soil	DMS, Chiangrai	Samantha	27-09-2013	
587	***Laetiporus* sp.**		12-0546	LT 001	Decay hardwood	Doi Mae Salong, CR	Thatsanee/ Phongeun	13-06-2012	Yes
588	***Laetiporus* sp.**		12-0547	LT 002	Living tree	Doi Mae Salong, CR	Thatsanee/ Phongeun	01-06-2012	Yes
589	***Laetiporus* sp.**		12-0548	LT 003	Decay hardwood	MRC, CM	Phongeun	14-06-2009	Yes
590	***Laetiporus* sp.**		13-0521	LT 2013-005	Dead wood		Samantha	02-07-2013	Yes
591	***Laetiporus* sp.**		13-0522	LT 2013-006	Wood	-	Samantha	-	
592	***Laetiporus* sp.**		13-0523	LT 2013-007	Living tree	-	Phongeun	-	Yes
593	***Laetiporus* sp.**	15-1748		DMS14-226	Wood	DMS, Chiang rai	Linda	15-08-2014	
594	***Leotia* sp.**			DMS-350	On soil	DMS, Chiangrai	Samantha	20-08-2013	
595	***Leotia* sp.**			DMS-351	On soil	DMS, Chiangrai	Samantha	20-08-2013	
596	***Leotia* sp.**			DMS-392	On soil	DMS, Chiangrai	Samantha	28-08-2013	
597	***Leotia* sp.**			DMS-431	On soil	DMS, Chiangrai	Samantha	02-09-2013	
598	***Leucocoprinus* sp.**			DMS-425	On soil	DMS, Chiangrai	Samantha	02-09-2013	
599	***Leucocoprinus* sp.**		14-0591	MFU04	Soil	Mae Tang water research station	Kritsana	23-06-2014	Yes
600	***Lentinus polychorus***			DT-02	Dead wood	Doi Tung, Chiang rai	Samantha	25-06-2013	Yes
601	***Lentinus squarrulosus***			DT-03	Dead wood	Doi Tung, Chiang rai	Samantha	25-06-2013	Yes
602	***Lentinus zehari***			DT-04	Dead wood	Doi Tung, Chiang rai	Samantha	25-06-2013	Yes
603	***Lentinus* sp.**	13-0732		AKK 083	Dead wood	TTL, Chiangmai	Kritsana, Thatsanee, Anan	12-06-2013	Yes
604	***Lentinus* sp.**	13-0729		AKK 085	Dead wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
605	***Lentinus* sp.(pink)**			K2013007	Sawdust bag	MFU	Anan	06-05-2013	
606	***Lentinus* sp.**			K2013087	Soil	Mea Tang watered research center	Anan	30-07-2013	
607	***Lentinus* sp.**		13-0888	BZ2013-012	On soil	Doi Pui, Chaingrai	Marc	12-06-2013	Yes
608	***Lentinus squarrosulus***		13-0893	BZ2013-019	On wood	Lordges resort, Chiangmai	Benjarong	12-06-2013	Yes
609	***Lentinus polychrous***		13-0894	BZ2013-020	On wood	Lordges resort, Chiangmai	Kritsana, Thatsanee, Anan	12-06-2013	Yes
610	***Lentinus* sp.**		13-0899	BZ2013-050	On wood	MFU	Benjarong	14-06-2013	Yes
611	***Lentinus* sp.**		13-0902	BZ2013-058	On wood	Doi Pui, Chaingrai	Benjarong	14-06-2013	Yes
612	***Lentinus* sp.**	15-1707		DMS14-185	Wood	DMS, Chiang rai	Lou	15008-2014	

613	***Lenzites elegans***	13-0702		AKK 141	Decay wood	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
614	***Lepiota* sp.**	13-0686		AKK 120	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
615	***Lepiota* sp.**	13-0653		AKK 123	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
616	***Lepiota* sp.**			K2013047	Soil	MFU	Anan	10-07-2013	
617	***Lepiota* sp.**			K2013054	Soil	MFU	Anan	18-07-2013	
618	***Lepiota* sp.**			K2013066	Soil	MRC Temple, Chiangmai	Anan	28-07-2013	
619	***Lepiota purpuracepes***			MFU-19	Soil	MFU	Samantha	14-06-2-13	
620	***Lepiota* sp.**		13-0810	AK-007	On soil	MFU	Kritsana	27-06-2013	Yes
621	***Lepiota* sp.**		13-0901	BZ2013-052	On soil	DMS, Chiangrai	Benjarong	14-06-2013	Yes
622	***Lepiota* sp.**			DMS14-50	On soil	DMS, Chiangrai	Anan	11-06-2014	
623	***Lepiota sp.***	14-0868		MFU-1B	Soil	MFU	Boontiya	20-06-2014	
624	***Lepiota sp.***	14-0869		MFU-2B	Soil	MFU	Boontiya	20-06-2014	
625	***Lepiota* sp.**	15-1572		DMS14-50	Soil	DMS, Chiang rai	Anan	11-6-2014	
626	***Lepiota* sp.**	15-1727		DMS14-205	Soil	DMS, Chiang rai	Asanka	15-08-2014	
627	***Lepiota* sp.**	15-1761		DMS14-239	Soil	DMS, Chiang rai	Anan	04-09-2014	
628	***Lepista* sp.**			MFU-11	Leaf litter	MFU	Samantha	14-06-2-13	Yes
629	***Lepista* sp.**		13-0898	BZ2013-046	On soil	MFU	Benjarong	14-06-2013	Yes
630	***Lycoperdon* sp.**		14-1068	AK14-34	Soil	MFU	Kritsana	11-07-2014	Yes
631	***Lycoperdon* sp.**		14-1069	AK14-38	Soil	MFU	Kritsana	11-07-2014	Yes
632	***Lycoperdon* sp.**	15-1659		DMS14-137	Soil	DMS, Chiang rai	Anan	14-07-2014	
633	***Macrolepiota* sp.**	13-0710		AKK 094	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
634	***Macrolepiota* sp.**			K2013021	Soil	MFU	Saowaluk	17-06-2013	yes
635	***Macrolepiota* sp.**			K2013033	Soil	Dr.Hyde's Farm	Dr. Hyde	10-07-2013	Yes
636	***Macrolepiota* sp.**			MFU-07	Leaf litter	MFU	Samantha	10-06-2013	Yes
637	***Macrolepiota* sp.**			TS-01	Soil	Mae Lao training centre	Samantha	13-06-2-13	
638	***Macrolepiota* sp.**			TS-02	Soil	Mae Lao training centre	Samantha	13-06-2-13	
639	***Macrolepiota* sp.**			MFU-13	Leaf litter	MFU	Samantha	14-06-2-13	
640	***Macrolepiota* sp.**			KK-01	Dead wood	Khun Kone Waterfall	Samantha	28-06-2-13	
641	***Macrolepiota* sp.**			K14-43	On soil	DMS, Chiangrai	Anan	21-06-2014	Yes
642	***Macrolepiota* sp.**	15-1669		DMS14-147	Soil	DMS, Chiang rai	Anan	17-07-2014	
643	***Marasmiellus* sp.**			DMS-428	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
644	***Marasmiellus* sp.**			DMS-440	On soil	DMS, Chiangrai	Samantha	02-09-2013	
645	***Marasmiellus* sp.**			DMS-483	On dead wood	DMS, Chiangrai	Samantha	10-09-2013	
646	***Marasmiellus* sp.**	15-1625		DMS14-103	Dead leaf	DMS, Chiang rai	Asanka	27-06-2014	Yes
647	***Marasmius* sp.**	13-0697		AKK 111	Decay wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	Yes
648	***Marasmius* sp.**	13-0652		AKK 139	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
649	***Marasmius* sp.**	13-0646		AKK 140	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
650	***Marasmius* sp.**			KKW-02	Leaf litter	Khun Kone Waterfall	Samantha	13-06-2013	
651	***Marasmius* sp.**			KKW-06	Dead leaf litter	Khun Kone Waterfall	Samantha	13-06-2-13	
652	***Marasmius* sp.**			DT-12	Dead leaf litter	Doi Tung	Samantha	25-06-2-13	
653	***Marasmius* sp.**			DMS-383	On leaf litter	DMS, Chiangrai	Samantha	24-08-2013	
654	***Marasmius* sp.**			DMS-390	On leaf litter	DMS, Chiangrai	Samantha	24-08-2013	
655	***Marasmius* sp.**			DMS-525	On dead wood	DMS, Chiangrai	Samantha	27-09-2013	
656	***Marasmius* sp.**		13-0887	BZ2013-011	Leaf litter	DMS, Chiangrai	Samantha	12-06-2013	Yes
657	***Marasmius* sp.**		13-0892	BZ2013-018	Leaf litter	Lordges resort, Chiangmai	Benjarong	12-06-2013	Yes
658	***Marasmius pulcherripes***		13-0906	BZ2013-091	Leaf litter	Mushroom Foundation Research, Chiangmai	Benjarong	15-06-2013	Yes
659	***Marasmius* sp.**			BZ2013-120	Leaf litter	Doi Pui, Chaingrai	Benjarong	15-06-2013	Yes
660	***Marasmius* sp.**			BZ2013-121	Leaf litter	Doi Pui, Chaingrai	Benjarong	15-06-2013	Yes
661	***Marasmius* sp.**			BZ2013-122	Leaf litter	Doi Pui, Chaingrai	Benjarong	15-06-2013	Yes
662	***Marasmius* sp.**			DMS-383	On leaf litter	DMS, Chiangrai	Samantha	24-08-2013	
663	***Marasmius* sp.**			DMS-390	On leaf litter	DMS, Chiangrai	Samantha	24-08-2013	
664	***Marasmius* sp.**			DMS-525	On dead wood	DMS, Chiangrai	Samantha	27-09-2013	
665	***Marasmius* sp.**	15-1528		DMS14-06	On dead leaf	DMS, Chiangrai	Anan	10-05-2014	

666	***Marasmius* sp.**	15-1538	DMS14-16	On soil	DMS, Chiangrai	Anan	27-05-2014	
667	***Marasmius* sp.**	15-1545	DMS14-23	On soil	DMS, Chiangrai	Anan	3-06-2014	
668	***Marasmius* sp.**	15-1584	DMS14-62	On dye leaf	DMS, Chiangrai	Anan	16-06-2014	
669	***Marasmius* sp.**		K14-07	On dry leaf	DMS, Chiangrai	Anan	17-06-2014	
670	***Marasmius* sp.**	15-1624	K14-18	On dry leaf	DMS, Chiangrai	Anan	17-06-2014	
671	***Marasmius* sp.**	15-1625	DMS14-102	On dry leaf	DMS, Chiangrai	Asanka	27-06-2014	Yes
672	***Marasmius* sp.**	5-1626	DMS14-103	On dry leaf	DMS, Chiangrai	Asanka	27-06-2014	Yes
673	***Marasmius* sp.**		DMS14-104	Om dry leaf	DMS, Chiangrai	Asanka	27-06-2014	Yes
674	***Marasmius sp.***	14-0852	DSK-21B	Dead wood	Doi Sa Ket	Boontiya Chuankid	30-06-2014	
675	***Marasmius* sp.**	15-1670	DMS14-148	Dead leaf	DMS, Chiang rai	Anan	17-07-2014	
676	***Marasmius* sp.**	15-1691	DMS14-169	Dead leaf	DMS, Chiang rai	Anan	23-07-2014	
677	***Marasmius* sp.**	15-1694	DMS14-172	Dead leaf	DMS, Chiang rai	Anan	23-07-2014	
678	***Marasmius* sp.**	15-1705	DMS14-183	Dead leaf	DMS, Chiang rai	Anan	26-07-2014	
679	***Marasmius* sp.**	15-1725	DMS14-203	Dead leaf	DMS, Chiang rai	Lou	15-08-2014	
680	***Megacollebia***	15-1599	DMS14-77	On soil	DMS, Chiangrai	Anan	20-06-2014	
681	***Microporus* sp.**		DMS-492	On dead wood	DMS, Chiangrai	Samantha	14-09-2013	
682	***Microporus* sp.**		DMS-552	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
683	***Microporus* sp.**	15-1737	DMS14-215	Soil	DMS, Chiang rai	Asanka	15-08-2014	
684	***Micropsalliota* sp.**		TS-05	Soil	Mae Lao training centre	Samantha	13-06-2-13	
685	***Micropsalliota* sp.**		TS-06	Soil	Mae Lao training centre	Samantha	13-06-2-13	
686	***Micropsalliota* sp.**		MFU-15	Soil	MFU	Samantha	14-06-2-13	Yes
687	***Micropsalliota* sp.**		MFU-17	Soil	MFU	Samantha	14-06-2-13	
688	***Micropsalliota* sp.**		DT-05	Soil	Doi Tung	Samantha	25-06-2-13	
689	***Micropsalliota* sp.**		DT-06	Dead leaf litter	Doi Tung	Samantha	25-06-2-13	
690	***Micropsalliota* sp.**		KK-10	Soil	Khun Kone Waterfall	Samantha	28-06-2-13	
691	***Micropsalliota* sp.**		DMS-373	On soil	DMS, Chiangrai	Samantha	24-08-2013	
692	***Micropsalliota* sp.**		DMS-423	On soil	DMS, Chiangrai	Samantha	02-09-2013	
693	***Micropsalliota* sp.**		DMS-514	On soil	DMS, Chiangrai	Samantha	23-09-2013	
694	***Micropsalliota* sp.**		DMS-373	On soil	DMS, Chiangrai	Samantha	24-08-2013	
695	***Micropsalliota* sp.**	14-0842	DSK-5B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
696	***Micropsalliota sp.***	14-0851	DSK-16B	Soil	Doi Sa Ket	Boontiya	30-06-2014	
697	***Micropsalliota* sp.**	14-0878	MFU-12B	Soil	MFU	Boontiya	22-07-2014	
698	***Micropsalliota* sp.**	14-0819	MFU-13B	Soil	MFU	Boontiya	22-07-2014	
699	***Micropsalliota* sp.**	14-0882	MFU-16B	Soil	MFU	Boontiya	22-07-2014	
700	***Micropsalliota* sp.**	14-0887	MRC-1B	Soil	MRC, Chingmai	Boontiya	28-07-2014	
701	***Micropsalliota* sp.**	14-0899	MRC-13B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
702	***Micropsalliota* sp.**	14-0904	MRC-18B	Soil	Pangsadet water management	Boontiya	30-07-2014	
703	***Micropsalliota* sp.**	14-0917	MRC-32B	Soil	Mae Tang water research station	Boontiya	31-07-2014	
704	***Mycena* sp.**	13-0647	AKK 121	Leaf	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
705	***Mycena* sp.**		KK-02	Dead wood	Khun Kone Waterfall	Samantha	28-06-2-13	
706	***Mycena* sp.**		DMS-343	On soil	DMS, Chiangrai	Samantha	20-08-2013	
707	***Oligoporus* sp.**	13-0650	AKK 095	Decay wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
708	***Ophiocordyceps nutens***		DMS-509	On soil	DMS, Chiangrai	Samantha	18-09-2013	
709	***Oudemansiella* sp.**			Dead wood	DMS, Chiangrai	Kritsana	26-05-2013	
710	***Oudemansiella* sp.**			Dead wood	DMS, Chiangrai	Thatsanee	26-05-2013	
711	***Oudemansiella* sp.**		DMS-416	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
712	***Oudemansiella* sp.**		DMS-416	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
713	***Oudemansiella* sp.**	15-1524	DMS14-02	Soil	DMS, Chiang rai	Anan	10-05-2014	Yes
714	***Oudemansiella* sp.**	15-1526	DMS14-04	Soil	DMS, Chiang rai	Anan	10-05-1900	Yes
715	***Oudemansiella* sp.**	15-1544	DMS14-22	Soil	DMS, Chiang rai	Boontiya	03-06-2014	Yes
716	***Oudemansiella* sp.**	15-1578	DMS14-56	Soil	DMS, Chiang rai	Anan	16-06-2014	
717	***Oudemansiella* sp.**	15-1579	DMS14-57	Soil	DMS, Chiang rai	Anan	16-06-2014	
718	***Oudemansiella* sp.**	15-1662	DMS14-140	Soil	DMS, Chiang rai	Anan	14-07-2014	

719	***Oudemansiella* sp.**	15-1684		DMS14-162	Soil	DMS, Chiang rai	Anan	23-07-2014	
720	***Oudemansiella* sp.**	15-1730		DMS14-208	Soil	DMS, Chiang rai	Asanka	15-08-2014	
721	***Oudemansiella* sp.**	15-1735		DMS14-213	Soil	DMS, Chiang rai	Asanka	15-08-2014	
722	***Panaeolus* sp.**			MFU-21	Cow dung	Paddy fields near by MFLU	Samantha	22-06-2-13	
723	***Perenniporia minutissima***		14-1078	AK-MRC-29	Wood	Ban Tapha, Chiangmai	Hontori	31-07-2014	Yes
724	***Phlebopus* sp.**			MFU-18	Soil	MFU	Samantha	14-06-2-13	
725	***Phlebopus* sp.**			DMS-369	On soil	DMS, Chiangrai	Samantha	24-08-2013	
726	***Phlebopus* sp.**			DMS-369	On soil	DMS, Chiangrai	Samantha	24-08-2013	
727	***Phlebopus potentosus***			K14-02	On soil	DMS, Chiangrai	Leela	21-05-2014	Yes
728	***Phlebopus potentosus***			K14-03	On soil	DMS, Chiangrai	Samantha	27-05-2014	Yes
729	***Phylloporus* sp.**			DMS-380	On soil	DMS, Chiangrai	Samantha	24-08-2013	
730	***Phylloporus* sp.**	15-1612		DMS14-90	On soil	DMS, Chiangrai	Anan	24-06-2014	
731	***Phylloporus* sp.**	15-1618		DMS14-96	Soil	DMS, Chiang rai	Asanka	27-06-2014	
732	***Pleurotus* sp.**			DT-01	Soil	DMS, Chiangrai	Samantha	25-06-2013	yes
733	***Pleurotus* sp.**			DT-05	Soil	DMS, Chiangrai	Samantha	25-06-2013	
734	***Pleurotus gigateus***			K2013061	Soil	MRC Temple, Chiangmai	Samantha	28-07-2013	
735	***Pleurotus giganteus***			K2013081	Soil	MRC Temple, Chiangmai	Anan	30-07-2013	
736	***Pleurotus* sp.**			KKW-04	Dead wood	Khun Kone Waterfall	Samantha	13-06-2013	
737	***Pleurotus giganteus***			DMS-407	On soil	DMS, Chiangrai	Samantha	28-08-2013	
738	***Pleurotus* sp.**			DMS-414	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
739	***Pleurotus* sp**	15-1523		DMS14-01	On dead wood	DMS, Chiangrai	Anan	06-05-2014	Yes
740	***Pleurotus* sp**	15-1527		DMS14-05	On dead wood	DMS, Chiangrai	Anan	10-05-2014	Yes
741	***Pluteus* sp.**			KK-03	Dead wood	Khun Kone Waterfall	Samantha	28-06-2-13	
742	***Pluteus* sp.**			KK-04	Dead wood	Khun Kone Waterfall	Samantha	28-06-2-13	
743	***Pluteus* sp.**		13-0900	BZ2013-051	On soil	DMS, Chiangrai	Benjarong	14-06-2013	Yes
744	***Pluteus* sp.**	15-1620		DMS14-98	On soil	DMS, Chiangrai	Asanka	27-06-2014	
745	***Polypore***				Soil	DMS, Chiangrai	Kritsana, Thasanee, Anan	04-06-2013	
746	***Polypore* sp.**	13-0724		AKK 057	Hardwood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
747	***Polypore* sp.**	13-0719		AKK 058	Wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
748	***Polypore* sp.**			AKK 061	On log	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
749	***Polypore* sp.**	13-0731		AKK 067	Hardwood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
750	***Polypore* sp.**	13-0717		AKK 081	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
751	***Polypore* sp.**	13-0690		AKK 137	Wood decay	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
752	***Polypore* sp.**		12-0676	LT-12-081	Decay hardwood	Doi Inthanon, CM	Thatsanee	03-11-2012	Yes
753	***Polypore* sp.**		12-0678	LT-12-082	Soil	Doi Inthanon, CM	Thatsanee	03-11-2012	Yes
754	***Polypore* sp.**			DMS-441	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
755	***Polypore favolus***	15-1525		DMS14-03	On dead wood	DMS, Chiangrai	Anan	10-05-2014	
756	***Polypore* sp.**	15-1540		DMS14-18	On dead wood	DMS, Chiangrai	Anan	27-05-2014	
757	***Polypore* sp.**	15-1541		DMS14-19	On dead wood	DMS, Chiangrai	Anan	27-05-2014	
758	***Polypore* sp.**	15-1548		DMS14-26	On soil	DMS, Chiangrai	Anan	03-06-2014	
759	***Polypore* sp.**	15-1553		DMS14-31	On dead wood	DMS, Chiangrai	Anan	03-06-2014	
760	***Polypore* sp.**	15-1554		DMS14-32	On dead wood	DMS, Chiangrai	Anan	03-06-2014	
761	***Polypore* sp.**	15-1597		DMS14-75	On dead wood	DMS, Chiangrai	Anan	20-06-2014	
762	***Polypore* sp.**	15-1602		DMS14-80	On dead wood	DMS, Chiangrai	Anan	20-06-2014	
763	***Polypore* sp.**			K14-33	On dead wood	DMS, Chiangrai	Anan	21-06-2014	
764	***Polypore* sp.**	15-1611		DMS14-89	On dead wood	DMS, Chiangrai	Anan	24-06-2014	
765	***Polypore* sp.**	15-1583		DMS14-61	On dead wood	DMS, Chiangrai	Anan	16-06-2014	
766	***Polypore* sp.**	15-1621		DMS14-99	On dead wood	DMS, Chiangrai	Asanka	27-06-2014	
767	***Polypore* sp.**	15-1643		DMS14-121	Soil	DMS, Chiang rai	Anan	02-07-2014	
768	***Polypore* sp.**	15-1674		DMS14-152	Wood	DMS, Chiang rai	Anan	17-07-2014	
769	***Polypore* sp.**	15-1676		DMS14-154	Wood	DMS, Chiang rai	Anan	17-07-2014	
770	***Polypore* sp.**	15-1681		DMS14-161	Wood	DMS, Chiang rai	Anan	23-07-2014	
771	***Polypore* sp.**	15-1714		DMS14-192	Wood	DMS, Chiang rai	Lou	15-08-2014	

772	***Polypore* sp.**	15-1726		DMS14-204	Wood	DMS, Chiang rai	Lou	15-08-2014	
773	***Polypore* sp.**	15-1733		DMS14-211	Wood	DMS, Chiang rai	Asanka	15-08-2014	
774	***Polypore* sp.**	15-1756		DMS14-234	Wood	DMS, Chiang rai	Anan	04-09-2014	
775	***Polypore*sp.**	15-1759		DMS14-237	Wood	DMS, Chiang rai	Anan	04-09-2014	
776	***Polypore* sp.**	15-1791		DMS14-269	Wood	DMS, Chiang rai	Anan	12-09-2014	
777	***Polypore* sp.**	15-1793		DMS14-271	Wood	DMS, Chiang rai	Anan	12-09-2014	
778	***Ploypore* sp.**	15-1796		DMS14-274	Wood	DMS, Chiang rai	Anan	12-09-2014	
779	***Polypore* sp.**	15-1798		DMS14-276	Wood	DMS, Chiang rai	Anan	12-09-2014	
780	***Polypore* sp.**	15-1799		DMS14-277	Wood	DMS, Chiang rai	Anan	12-09-2014	
781	***Polypore* sp.**	15-1699		DMS14-177	Wood	DMS, Chiang rai	Anan	26-07-2014	
782	***Polypore* sp.**	15-1784		DMS14-262	Wood	DMS, Chiang rai	Anan	08-09-2014	
783	***Polyporus grammocephalus***	13-0712		AKK 089	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
784	***Polyporus grammocephalus***	13-0657		AKK 119	Wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
785	***Polyporus* sp.**			DT-10	Dead wood	Doi Tung	Samantha	25-06-2-13	
786	***Polyporus* sp.**			DMS-301	On dead wood	DMS, Chiangrai	Samantha	03-08-2013	
787	***Polyporus* sp.**			DMS-321	On dead wood	DMS, Chiangrai	Samantha	15-08-2013	
788	***Polyporus* sp.**			DMS-322	On dead wood	DMS, Chiangrai	Samantha	15-08-2013	
789	***Polyporus* sp.**			DMS-328	On soil	DMS, Chiangrai	Samantha	15-08-2013	
790	***Polyporus* sp.**			DMS-386	On dead wood	DMS, Chiangrai	Samantha	24-08-2013	
791	***Polyporus* sp.**			DMS-405	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
792	***Polyporus* sp.**			DMS-439	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
793	***Polyporus* sp.**			DMS-443	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
794	***Polyporus* sp.**			DMS-454	On dead wood	DMS, Chiangrai	Samantha	06-09-2013	
795	***Polyporus* sp.**			DMS-455	On dead wood	DMS, Chiangrai	Samantha	06-09-2013	
796	***Polyporus* sp.**			DMS-463	On dead wood	DMS, Chiangrai	Samantha	06-09-2013	
797	***Polyporus* sp.**			DMS-464	On dead wood	DMS, Chiangrai	Samantha	06-09-2013	
798	***Polyporus* sp.**			DMS-555	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
799	***Polyporus* sp.**			DMS-560	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
800	***Polystictus* sp.**			DMS-330	On dead wood	DMS, Chiangrai	Samantha	15-08-2013	
801	***Polystictus* sp.**			DMS-332	On dead wood	DMS, Chiangrai	Samantha	20-08-2013	
802	***Polystictus* sp.**			DMS-398	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
803	***Polystictus* sp.**			DMS-399	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
804	***Polystictus* sp.**			DMS-434	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
805	***Polystictus* sp.**			DMS-442	On dead wood	DMS, Chiangrai	Samantha	02-09-2013	
806	***Polystictus* sp.**			DMS-456	On dead wood	DMS, Chiangrai	Samantha	06-09-2013	
807	***Psathyrella* sp.**		14-1079	AK-MRC-33	Soil	Ban Tapha, Chiangmai	Kritsana	31-07-2014	Yes
808	***Psathyrella* sp.**			KKW-05	Dead wood	Khun Kone Waterfall	Samantha	13-06-2013	
809	***Psathyrella* sp.**			DMS-329	On soil	DMS, Chiangrai	Samantha	15-08-2013	
810	***Psathyrella* sp.**			DMS-331	On soil	DMS, Chiangrai	Samantha	15-08-2013	
811	***Psathyrella* sp.**		14-0595	AK14-09	Dead wood	DMS, Chiang rai	Kritsana	24-06-2014	Yes
812	***Psathyrella* sp.**		14-1079	AK-MRC-33	Soil	Ban Tapha, Chiangmai	Kritsana	31-07-2014	Yes
813	***Psathyrella* sp.**	15-1695		DMS14-173	Soil	DMS, Chiang rai	Anan	26-07-2014	
814	***Psilocybe* sp.**			MFU-14	Leaf litter	MFU	Samantha	14-06-2-13	
815	**Puffball**		14-0592	MFU06	Soil	Mae Tang water research station	Kritsana	23-06-2014	Yes
816	***Pulveroboletus* sp.**			DMS-308	On soil	DMS, Chiangrai	Samantha	03-08-2013	
817	***Pulveroboletus* sp.**			DMS-503	On soil	DMS, Chiangrai	Samantha	18-09-2013	
818	***Ramaria* sp.**	13-0706		AKK 079	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
819									
	***Ramaria* sp.**	13-0704		AKK 134	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
820	***Ramaria* sp.**	13-0676		AKK 144	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	15-06-2013	
821	***Ramaria* sp.**			DMS-487	On soil	DMS, Chiangrai	Samantha	14-09-2013	
822	***Ramaria* sp.**			DMS-497	On soil	DMS, Chiangrai	Samantha	14-09-2013	
823	***Ramaria* sp.**			DMS-519	On soil	DMS, Chiangrai	Samantha	23-09-2013	

824	***Russula* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
825	***Russula* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
826	***Russula* sp.**			Soil	DMS, Chiangrai	Kritsana, Thatsanee, Anan	04-06-2013
827	***Russula* sp.**	13-0688	AKK 034	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
828	***Russula* sp.**	13-0674	AKK 035	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
829	***Russula* sp.**	13-0668	AKK 036	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
830	***Russula* sp.**	13-0658	AKK 037	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
831	***Russula* sp.**	13-0662	AKK 039	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
832	***Russula* sp.**	13-0666	AKK 046	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
833	***Russula* sp.**	13-0673	AKK 047	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
834	***Russula* sp.**	13-0661	AKK 050	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013
835	***Russula* sp.**	13-0739	AKK 066	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013
836	***Russula* sp.**	13-0720	AKK 082	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013
837	***Russula alboareolata***		AKK 115	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013
838	***Russula* sp.**	13-0655	AKK 130	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
839	***Russula* sp.**	13-0700	AKK 143	Soil	Sideways at CM-LP (2)	Kritsana, Thatsanee, Anan	15-06-2013
840	***Russula* sp.**		DMS-335	On soil	DMS, Chiangrai	Samantha	20-08-2013
841	***Russula* sp.**		DMS-355	On soil	DMS, Chiangrai	Samantha	20-08-2013
842	***Russula* sp.**		DMS-359	On soil	DMS, Chiangrai	Samantha	24-08-2013
843	***Russula* sp.**		DMS-362	On soil	DMS, Chiangrai	Samantha	24-08-2013
844	***Russula* sp.**		DMS-364	On soil	DMS, Chiangrai	Samantha	24-08-2013
845							
	***Russula* sp.**		DMS-370	On soil	DMS, Chiangrai	Samantha	24-08-2013
846	***Russula* sp.**		DMS-371	On soil	DMS, Chiangrai	Samantha	24-08-2013
847	***Russula* sp.**		DMS-374	On soil	DMS, Chiangrai	Samantha	24-08-2013
848	***Russula* sp.**		DMS-385	On soil	DMS, Chiangrai	Samantha	24-08-2013
849	***Russula* sp.**		DMS-447	On soil	DMS, Chiangrai	Samantha	06-09-2013
850	***Russula* sp.**		DMS-477	On soil	DMS, Chiangrai	Samantha	10-09-2013
851	***Russula* sp.**		DMS-490	On soil	DMS, Chiangrai	Samantha	14-09-2013
852	***Russula* sp.**		DMS-531	On soil	DMS, Chiangrai	Samantha	27-09-2013
853	***Russula* sp.**		DMS-532	On soil	DMS, Chiangrai	Samantha	27-09-2013
854	***Russula* sp.**		DMS-539	On soil	DMS, Chiangrai	Samantha	27-09-2013
855	***Russula* sp.**		DMS-540	On soil	DMS, Chiangrai	Samantha	27-09-2013
856	***Russula* sp.**		DMS-546	On soil	DMS, Chiangrai	Samantha	01-10-2013
857	***Russula* sp.**		DMS-559	On soil	DMS, Chiangrai	Samantha	01-10-2013
858	***Russula* sp.**		DMS-340	On soil	DMS, Chiangrai	Samantha	20-08-2013
859	***Russula* sp.**	15-1532	DMS14-10	On soil	DMS, Chiangrai	Anan	19-05-2014
860	***Russula* sp.**	15-1535	DMS14-13	On soil	DMS, Chiangrai	Anan	27-05-2014
861	***Russula* sp.**	15-1542	DMS14-20	On soil	DMS, Chiangrai	Anan	03-06-2014
862	***Russula* sp.**	15-1587	DMS14-65	On soil	DMS, Chiangrai	Anan	16-06-2014
863	***Russula* sp.**		KK-08	Soil	Khun Kone Waterfall	Samantha	28-06-2-13
864	***Russula* sp.**	15-1609	DMS14-87	On soil	DMS, Chiangrai	Anan	24-06-2014
865	***Russula* sp.**	15-1627	DMS14-105	On soil	DMS, Chiangrai	Asanka	27-06-2014
866	***Russula* sp.**	15-1628	DMS14-106	On soil	DMS, Chiangrai	Asanka	27-06-2014
867	***Russula* sp.**	14-0891	MRC-5B	Soil	MRC, Chingmai	Boontiya	28-07-2014
868	***Russula* sp.**	15-1641	DMS14-119	Soil	DMS, Chiang rai	Anan	02-07-2014
869	***Russula* sp.**	15-1663	DMS14-141	Soil	DMS, Chiang rai	Anan	14-07-2014
870	***Russula* sp.**	15-1666	DMS14-144	Soil	DMS, Chiang rai	Anan	14-07-2014
871	***Russula* sp.**	15-1672	DMS14-150	Soil	DMS, Chiang rai	Anan	17-07-2014
872	***Russula* sp.**	15-1703	DMS14-181	Soil	DMS, Chiang rai	Anan	26-07-2014
873	***Russula* sp.**	15-1715	DMS14-193	Soil	DMS, Chiang rai	Lou	15-08-2014
874	***Russula* sp.**	15-1745	DMS14-223	Soil	DMS, Chiang rai	Linda	15-08-2014
875	***Russula* sp.**	15-1746	DMS14-224	Soil	DMS, Chiang rai	Linda	15-08-2014

876	***Russula* sp.**	15-1758		DMS14-236	Soil	DMS, Chiang rai	Anan	04-09-2014	
877	***Russula* sp.**	15-1774		DMS14-252	Soil	DMS, Chiang rai	Anan	08-09-2014	
878	***Russula* sp.**	15-1775		DMS14-253	Soil	DMS, Chiang rai	Anan	08-09-2014	
879	***Russula* sp.**	15-1776		DMS14-254	Soil	DMS, Chiang rai	Anan	08-09-2014	
880	***Russula* sp.**	15-1787		DMS14-265	Soil	DMS, Chiang rai	Anan	12-09-2014	
881	***Russula* sp.**	15-1788		DMS14-266	Soil	DMS, Chiang rai	Anan	12-09-2014	
882	***Russula* sp.**	15-1800		DMS14-278	Soil	DMS, Chiang rai	Anan	12-09-2014	
883	***Schizophyllum* sp.**		14-0601	AK14-33	Fruit of difterocapus	3 kg from Thranthing lodge	Kritsana	01-07-2014	
884	***Scleroderma* sp.**		14-0600	AK14-31	Soil	3 kg from Thranthing lodge	Kritsana	01-07-2014	Yes
885	***Scleroderma* sp.**		14-1067	AK14-32	Soil	3 kg from Thranthing lodge	Kritsana	01-07-2014	Yes
886	***Scleroderma* sp.**			DMS-491	On soil	DMS, Chiangrai	Samantha	14-09-2013	
887	***Scleroderma* sp.**			DMS-542	On soil	DMS, Chiangrai	Samantha	27-09-2013	
888	***Scleroderma* sp.**			DMS-354	On soil	DMS, Chiangrai	Samantha	20-08-2013	
889	***Scleroderma* sp.**	15-1534		DMS14-12	On soil	DMS, Chiangrai	Anan	19-05-2014	
890	***Scleroderma* sp.**	15-1588		DMS14-66	On soil	DMS, Chiangrai	Anan	16-06-2014	
891	***Scleroderma* sp.**			K14-17	On soil	DMS, Chiangrai	Anan	17-06-2014	
892	***Scleroderma* sp.**			K14-41	On soil	DMS, Chiangrai	Anan	21-06-2014	
893	***Scleroderma* sp.**			DMS14-88	On soil	DMS, Chiangrai	Anan	24-06-2014	
894	***Scleroderma* sp.**			DMS14-12	Soil	DMS, Chiang rai	Anan	19-05-2014	
895	***Scleroderma* sp.**	15-1633		DMS14-111	Soil	DMS, Chiang rai	Anan	02-07-2014	
896	***Scleroderma* sp.**	15-1640		DMS14-118	Soil	DMS, Chiang rai	Anan	02-07-2014	
897	***Scleroderma* sp.**	15-1686		DMS14-164	Soil	DMS, Chiang rai	Anan	23-07-/2014	
898	***Scleroderma* sp.**	15-1741		DMS14-219	Soil	DMS, Chiang rai	Asanka	15-08-2014	
899	**Singerocybe sp.**	15-1773		DMS14-251	Soil	DMS, Chiang rai	Anan	08-09-2014	
900	***Strobilomyces* sp.**			DMS-353	On soil	DMS, Chiangrai	Samantha	20-08-2013	
901	***Strobilomyces*sp.**			DMS-368	On soil	DMS, Chiangrai	Samantha	24-08-2013	
902	***Strobilomyces* sp.**			DMS-513	On soil	DMS, Chiangrai	Samantha	23-09-2013	
903	***Stropharia* sp.**			MFU-20	Cow dung	Paddy fields near by MFLU	Samantha	22-06-2-13	
904	***Stropharia* sp.**			DMS-323	On soil	DMS, Chiangrai	Samantha	15-08-2013	
905	***Termitomyces* sp.**			K2013071	Soil	MRC	Olivea	29-07-2013	
906	***Termitomyces* sp.**			MFU-16	Soil	MFU	Samantha	14-06-2013	
907	***Termitomyces* sp.**			DMS-315	On soil	DMS, Chiangrai	Samantha	03-08-2013	
908	***Termitomyces* sp.**			DMS-450	On soil	DMS, Chiangrai	Samantha	06-09-2013	
909	***Termitomyces* sp.**			DMS-470	On soil	DMS, Chiangrai	Samantha	10-09-2013	
910	***Termitomyces* sp.**			DMS-518	On soil	DMS, Chiangrai	Samantha	23-09-2013	
911	***Termitomyces* sp.**			DMS-537	On soil	DMS, Chiangrai	Samantha	27-09-2013	
912	***Termitomyces* sp.**	14-0897		MRC-11B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
913	***Termitomyces* sp.**	15-1655		DMS14-133	Soil	DMS, Chiang rai	Anan	14-07-2014	
914	***Termitomyces* sp.**	15-1728		DMS14-206	Soil	DMS, Chiang rai	Asanka	15-08-2014	
915	***Termitomyces* sp.**	15-1763		DMS14-241	Soil	DMS, Chiang rai	Anan	04-09-2014	
916	***Thelephora* sp.**			DT-07	Soil	Doi Tung	Samantha	25-06-2-13	
917	***Trametes* sp.**			DMS-550	On dead wood	DMS, Chiangrai	Samantha	01-10-2013	
918	***Tremella* sp.**	13-0740		AKK 055	Wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
919	***Tremella* sp.**			DMS-412	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
920	***Trogia* sp.**			DT-09	Dead wood	Doi Tung, Chiang rai	Samantha	25-06-2013	
921	***Trogia* sp.**			DMS-402	On dead wood	DMS, Chiangrai	Samantha	28-08-2013	
922	***Tylopilus* sp.**			KKW-01	Soil	Dominated by Pinus caesia	Samantha	13-06-2013	
923	**Unknown**	13-0671		AKK 030	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
924	**Unknown**	13-0664		AKK 032	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
925	**Unknown**	13-0675		AKK 041	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
926	**Unknown**	13-0659		AKK 049	Soil	Doi Pui, Chiangrai	Kritsana, Thatsanee, Anan	08-06-2013	
927	**Unknown**	13-0733		AKK 056	Wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
928	**Unknown**	13-0735		AKK 062	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	

929	**Unknown**	13-0722		AKK 063	Living tree	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	
930	**Unknown**	13-0718		AKK 068	Decay wood	MKPW, Chiangmai	Kritsana, Thatsanee, Anan	11-06-2013	
931	**Unknown**	13-0711		AKK 071	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	
932	**Unknown**	13-0721		AKK 073	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	
933	**Unknown**			AKK 074	Soil	3 km from TTL	Kritsana, Thatsanee, Anan	11-06-2013	
934	**Unknown**	13-0728		AKK 076	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
935	**Unknown.**	13-0730		AKK 091	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	
936	**Unknown**	13-0738		AKK 092	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
937	**Unknown**	13-0714		AKK 099	Decay wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	Yes
938	**Unknown**	13-0689		AKK 102	On soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
939	**Unknown**	13-0727		AKK 105	Decay wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
940	**Unknown**	13-0681		AKK 108	Soil	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
941	**Unknown**	13-0737		AKK 112	Wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
942	**Unknown**	13-0678		AKK 113	Wood	CP, Lampang	Kritsana, Thatsanee, Anan	13-06-2013	
943	**Unknown**	13-0691		AKK 116	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
944	**Unknown**	13-0684		AKK 118	Wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
945	**Unknown**	13-0687		AKK 122	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
946	**Unknown**	13-0682		AKK 124	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
947	**Unknown**	13-0693		AKK 127	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
948	**Unknown**	13-0694		AKK 128	Soil	Sideways at CM to LP	Kritsana, Thatsanee, Anan	14-06-2013	
949	**Unknown**			AKK 129	-	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
950	**Unknown**	13-0743		AKK 131	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
951	**Unknown**	13-0734		AKK 132	Wood	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
952	**Unknown**	13-0703		AKK 133	Wood	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
953	**Unknown**	13-0701		AKK 135	Soil	Sideways at CM to LP (2)	Kritsana, Thatsanee, Anan	15-06-2013	
954	**Unknown**			K2013006	Soil	MFU	Anan	06-05-2013	yes
955	**Unknown**			K2013019	Soil	MFU	Anan	17-06-2013	
956	**Unknown**		13-0519	LT 2013-003	Wood	DMS, Chiangrai	Benjarong	30-05-2013	Yes
957	**Unknown**		13-0520	LT 2013-004	Dead wood	DMS, Chiangrai	Thatsanee	04-06-2013	Yes
958	**Unknown**		13-0807	AK-004	Decay wood	Sideways at CM to LP	Kritsana, Thatsanee, Anan	12-06-2013	Yes
959	**Unknown**		13-0811	AK-008	On soil	MFU	Kritsana	27-06-2013	Yes
960	**Unknown**		13-0895	BZ2013-024		DMS, Chiangrai	Benjarong	12-06-2013	Yes
961	**Unknown**	15-1543		DMS14-21	On soil	DMS, Chiangrai	Anan	03-06-2014	
962	**Unknown**	15-1546		DMS14-24	On soil	DMS, Chiangrai	Anan	03-06-2014	
963	**Unknown**	15-1547		DMS14-25	On soil	DMS, Chiangrai	Anan	03-06-2014	
964	**Unknown**	15-1549		DMS14-27	On soil	DMS, Chiangrai	Anan	03-06-2014	
965	**Unknown**	15-1550		DMS14-28	On soil	DMS, Chiangrai	Anan	03-06-2014	
966	**Unknown**	15-1551		DMS14-29	On soil	DMS, Chiangrai	Anan	03-6-2014	
967	**Unknown**	15-1558		DMS14-36	On soil	DMS, Chiangrai	Anan	07-06-2014	
968	**Unknown**	15-1559		DMS14-37	On soil	DMS, Chiangrai	Anan	07-06-2014	Yes
969	**Unknown**	15-1562		DMS14-40	On soil	DMS, Chiangrai	Anan	07-06-2014	Yes
970	**Unknown**			K14-06	On soil	Dr. Hyde's Farm	K.D. Hyde	12-06-2014	Yes
971	**Unknown**	15-1582		DMS14-60	On dead wood	DMS, Chiangrai	Anan	16-06-2014	
972	**Unknown**			K14-23	On dead wood	DMS, Chiangrai	Anan	17-06-2014	
973	**Unknown**	15-1601		DMS14-79	On soil	DMS, Chiangrai	Anan	20-06-2014	
974	**Unknown**	14-0846		DSK-9B	Soil	Doi Sa Ket	Boontiya	30-6-2014	
975	**Unknown**	14-0849		DSK-14B	Soil	Doi Sa Ket	Boontiya	30-6-2014	
976	**Unknown**	14-0850		DSK-15B	Soil	Doi Sa Ket	Boontiya	30-6-2014	
977	**Unknown**	14-0853		DSK-22B	Dead wood	Doi Sa Ket	Boontiya	30-6-2014	
978	**Unknown**	14-0854		DSK-23B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
979	**Unknown**	14-0855		DSK-24B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
980	**Unknown**	14-0856		DSK-25B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
981	**Unknown**	14-0858		DSK-27B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	

982	**Unknown**	14-0859		DSK-28B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
983	**Unknown**	14-0860		DSK-29B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
984	**Unknown**	14-0861		DSK-30B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
985	**Unknown**	14-0862		DSK-31B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	02-7-2014	
986	**Unknown**	14-0863		DSK-34B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	2-7-2014	
987	**Unknown**	14-0864		DSK-35B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	2-7-2014	
988	**Unknown**	14-0865		DSK-36B	Soil	Baan Mae-kampong, Chiang Mai	Boontiya	2-7-2014	
989	**Unknown**	14-0870		MFU-3B	Soil	MFU	Boontiya	20-6-2014	
990	**Unknown**	14-0888		MRC-2B	Soil	MRC, Chingmai	Boontiya	28-07-2014	
991	**Unknown**	14-0889		MRC-3B	Soil	MRC, Chingmai	Boontiya	28-07-2014	
992	**Unknown**	14-0905		MRC-19B	Soil	Pangsadet water management	Boontiya	30-07-2014	
993	**Unknown**		14-0598	AK14-16	Dead wood	DMS, Chiang rai	Kritsana	24-06-2014	Yes
994	**Unknown**		14-1081	AK-MRC-45	Soil	Maesae, Chiangmai	Kritsana	31-07-2014	Yes
995	**Unknown**	15-1636		DMS14-114	Soil	DMS, Chiang rai	Anan	02-07-2014	
996	**Unknown**	15-1644		DMS14-122	Soil	DMS, Chiang rai	Anan	02-07-2014	
997	**Unknown**	15-1645		DMS14-123	Soil	DMS, Chiang rai	Anan	02-07-2014	
998	**Unknown**	15-1651		DMS14-129	Soil	DMS, Chiang rai	Anan	05-07-2014	
999	**Unknown**	15-1654		DMS14-132	Soil	DMS, Chiang rai	Anan	14-07-2014	
1000	**Unknown**	15-1671		DMS14-149	Soil	DMS, Chiang rai	Anan	17-07-2014	
1001	**Unknown**	15-1673		DMS14-151	Soil	DMS, Chiang rai	Anan	17-07-2014	
1002	**Unknown**	15-1700		DMS14-178	Wood	DMS, Chiang rai	Anan	26-07-2014	
1003	**Unknown**	15-1702		DMS14-180	Soil	DMS, Chiang rai	Anan	26-07-2014	
1004	**Unknown**	15-1706		DMS14-184	Soil	DMS, Chiang rai	Anan	26-07-2014	
1005	**Unknown**	15-1709		DMS14-187	Soil	DMS, Chiang rai	Lou	15-08-2014	
1006	**Unknown**	15-1710		DMS14-188	Soil	DMS, Chiang rai	Lou	15-08-2014	
1007	**Unknown**	15-1718		DMS14-196	Soil	DMS, Chiang rai	Lou	15-08-2014	
1008	**Unknown**	15-1732		DMS14-210	Wood	DMS, Chiang rai	Asanka	15-08-2014	
1009	**Unknown**	15-1740		DMS14-218	Soil	DMS, Chiang rai	Asanka	15-08-2014	
1010	**Unknown**	15-1752		DMS14-230	Soil	DMS, Chiang rai	Anan	04-09-2014	
1011	**Unknown**	15-1753		DMS14-231	Soil	DMS, Chiang rai	Anan	04-09-2014	
1012	**Unknown**	15-1757		DMS14-235	Soil	DMS, Chiang rai	Anan	04-09-2014	
1013	**Unknown**	15-1766		DMS14-244	Wood	DMS, Chiang rai	Anan	04-09-2014	
1014	***Xerocomus* sp.**			DMS-522	On soil	DMS, Chiangrai	Samantha	23-09-2013	
1015	***Xerula* sp.**			DMS-313	On soil	DMS, Chiangrai	Samantha	03-08-2013	
1016	***Xerula* sp.**			DMS-317	On soil	DMS, Chiangrai	Samantha	15-08-2013	
1017	***Xerula* sp.**			DMS-384	On soil	DMS, Chiangrai	Samantha	24-08-2013	
1018	***Xerula* sp.**			DMS-395	On soil	DMS, Chiangrai	Samantha	28-08-2013	
1019	***Xerula* sp.**			DMS-406	On soil	DMS, Chiangrai	Samantha	28-08-2013	
1020	***Xerula* sp.**			DMS-451	On soil	DMS, Chiangrai	Samantha	06-09-2013	
1021	***Xerula* sp.**		13-0905	BZ2013-062	On wood	Doi Pui, Chaingrai	Benjarong	15-06-2013	
1022	***Xerula* sp.**			BZ2013-123	Leaf litter	DMS, Chiangrai	Benjarong	15-06-2013	Yes
1023	***Xerula* sp.**			BZ2013-125	On wood	DMS, Chiangrai	Benjarong	15-06-2013	
1024	***Xerula* sp.**	14-0893		MRC-7B	Soil	MRC, Chingmai	Boontiya	28-07-2014	
1025	***Xerula* sp.**	14-0896		MRC-10B	Soil	Doi Pha Deng temple, Chiangmai	Boontiya	29-07-2014	
1026	***Xerula* sp.**	14-0919		MRC-34B	Soil	Mae Tang water research station	Boontiya	31-07-2014	

1.2 Mushrooms from which we have obtained cultures

We have attempted to isolate cultures from the fresh collections and have successfully isolated 200 strains in 43 genera (Table 3)

Table 3 Strains isolated

Genus	Collections	Cultures	Genus	Collections	Cultures
Agaricus	148	62	*Leotia*	4	-
Agrocybe	3	2	*Leucocoprinus*	2	1
Amanita	81	-	*Lentinus*	13	11
Amaruderma	4	-	*Lenzites*	1	-
Armillaria	2	2	*Lepiota*	14	2
Astraeus	3	2	*Lepista*	2	1
Auricularia	9	3	*Lycoperdon*	3	3
Boletus	65	-	*Macrolepiota*	10	4
Boletellus	3	-	*Marasmiellus*	4	1
Cantharellus	3	-	*Marasmius*	33	9
Clavaria	5	-	*Megacollebia*	1	-
Calvatia	1	-	*Microporus*	3	-
Clarkeinda	1	1	*Micropsalliota*	20	1
Clavulina	2	-	*Mycena*	3	-
Claudopus	1	1	*Oligoporus*	1	-
Clitocybe	2	-	*Ophiocordyceps*	1	-
Clitopilus	8	7	*Oudemansiella*	13	3
Coltricia	5	-	*Panaeolus*	1	-
Coprinus	11	3	*Perenniporia*	1	1
Cortinarius	12	-	*Phlebopus*	5	2
Craterellus	2	-	*Phylloporus*	3	-
Crepidotus	13	5	*Pleurotus*	9	3
Creterellus	10	-	*Pluteus*	4	1
Cup fungi	1	-	*Polyporus*	55	3
Cyattus	1	1	*Polystictus*	7	-
Daldinia	1	-	*Psathyrella*	2	2
Dictyophora	2	-	*Psilocybe*	1	-
Entoloma	33	6	Puff ball	1	1
Favolus	1	-	*Pulveroboletus*	2	-
Filoboletus	2	2	*Ramaria*	6	-
Fomes	1	-	*Russula*	60	-
Ganoderma	21	7	*Schizophyllum*	1	1
Geastrum	3	-	*Scleroderma*	16	2
Gomphus	1	-	*Singerocybe*	1	-
Gymnopilus	8	1	*Strobilomyces*	3	-
Gymnopus	8	3	*Stropharia*	2	1
Hebeloma	2	-	*Termitomyces*	11	-
Heinemanomyces	1	-	*Thelephora*	1	-
Helvella	2	-	*Trametes*	1	-
Hexagonia	2	1	*Tremella*	2	-
Hohenbuehelia	1	1	*Trogia*	2	-
Hydnum	2	-	*Tylopilus*	1	-
Hygrocybe	3	-	Unknown	91	13
Hymenochaetaceae	1	-	*Xerocomus*	1	-
Hypholoma	2	-	*Xerula*	12	1
Inocybe	25	1			
Laccaria	15	-			
Lactarius	53	1			
Lactifuus	2	-			
Laetiporus	8	5			
Total	**596**	**119**	**Total**	**430**	**67**

1.3 Indentification

1.3.1 Examples of mushroom studies

We have carefully studied more than 200 mushrooms from the 1,047 collections and 40 examples are given below. Many of there are being prepared for publication.

1. *Chlorophyllum molybdites* (Meyer: Fr.) Massee (Figure 1)

Pileus 70-110 mm, globose to subglobose when young, expanding to convex, plano-convex, with low umbo, with straight margin; glabrous at umbo, broken around umbo, with patches toward margin, with radially fibrillose background, light brown to brown (7D5-6) at unbo and patches, background orange-white (6A2) around umbo and white at margin; margin fibrillose, fringed, with lamellae exceeding when mature. *Lamellae* free, broad, crowded, white when young, dull green (27D3) when mature; lamella edge eroded. *Stipe* 60-85 x 10-12 mm, widening downward base, 18-23 mm at base, white to yellowish-white (4A2), smooth, hollow. *Annulus* descending, with cuff around stipe, movable, white, underside concolorous with umbo. *Context* in pileus and stipe white, turning brownish-orange (7C5). *Smell* carrot-liked. *Taste* not observed. *Spore print* grayish-green (27C3-4).

Figure 1. *Chlorophyllum molybdites*

2. *Macrolepiota velosa* Vellinga & Zhu L. Yang (Figure 2)

Pileus 100 -120 mm diam, slightly globose when young,, expanding to hemispherical, parabolic to campanulate with wide umbo, straight margin, center with round to star shape or calotte,10-15 mm diam, with uplifted margin, dark brown (8F4) to dark, with dark brown (8F4) warts or squamules around center toward margin, squamules long around marginal zone, with uplift tip, with orange write (5A2) radially fibrillose, background, with white to orange (5A2) white remnant partial veil at center and somewhere on surface, in mature sample 4-6 grooves, with splits margin, exceeding lamellae, fringe. *Lamellae* free, white, remote from stipe, ventricose, 13 mm wide with white fine-floccose at lamellae sufaceand marginal edge, turning brownish orange at edge, 4-5 lamellulae, closed to crowded. *Stipe* 145 x 8-10 mm, long cylindrical, with wider at base, with bulb, 20 mm wide, white, smooth, yellowish white(4A2) fibrillose at apex, with brown (7E4) fibrillose at base zone. *Annulus* ascending, movable, with cuff, white to cream at upper side, greyish orange (5B3) under side, thick, with broken brownish beige (6E3) margin. Volva white, membranous. *Context* in piles white, 4 –6 mm wide, in stipe white. *Odor* vitamin B. *Taste* mild, sweet.

Figure 2. *Macrolepiota velosa*

3. *Pleurotus giganteus* (Berk.) Karunarathna & K.D. Hyde (Figure 3)

Pileus 100-110 mm in diameter, strongly convex to applanate becoming slightly depressed in the centre, dark brown (7F5), towards the margin light brown camel (6D4), grayish orange (5B4) at the marginal area, at centre fibrillose-scaly, surface initially uniformly dark, fuscous brown, fulionous or black, then fading with age to pale ochraceous or yellowish brown (E8), with a darker centre although sometimes remaining dark, dry, distrupted into small, indefinite, radial, innate squamulus, overlain by scanty, pale grey or blackish, verrucose-floccose, concentrically arrange remnants of the veil; margin strongly involute then straight, thin, slightly sulcate-striate. *Lamellae* moderately crowded with lamellulae of five lengths, decurrent, slightly interveined and anastomosing over the stipe apex, 2-3 mm broad, white to cream colour (3A2); edge entire, pale ochraceous or yellowish brown (5E8). *Stipe* 6.5-7 × 0.7-0.8 cm at the apex, 6.5-7 × 1.0-1.1 cm at the base, fusiform, with radicating base, up to 10-12 cm long, solid, with surface concolorous with the pileus, paler at the apex, finely tomentose with indefinite zones of paler velar remnants in the early stages; veil thin, floccose, pale to dark brown (6F6), soon reduced to floccose remnants but never forming an annulus on the stipe.

Figure 3. *Pleurotus giganteus*

4. *Boletellus emodensis* (Berk.) Singer (Figure 4)

Basidiomata medium-sized. *Pileus* 4.5–9 cm in diameter, convex to applanate; surface dry, purple to dull crimson, usually fading to pale fawn in age, finely tomentose when young, then cracking into large squamules; margin at first extended into a false veil and covering the pores, then splitting radially, appendiculate with false veil remnants; context 0.8–1.1 cm thick in the center of pileus, yellowish, cyanescent strongly and rapidly when injured. Hymenophore poroid, yellow, cyanescent strongly and rapidly when injured, depressed around apex of stipe; pores 0.1–0.2 cm in diameter, simple, angular. *Stipe* central, 6–8 × 0.8–1 cm, cylindric, solid, firm; surface dry, fibrous, concolorous with the pileus, but apex yellowish; base usually enlarged and villous with white mycelium; *context* yellow, cyanescent strongly and rapidly when injured. *Annulus* absent.

Figure 4. *Boletellus emodensis*

5. *Marasmius pellucidus* Berk. & Broome (Figure 5)

Pileus 15-50(-98) mm diam, obtusely conical to convex or campanulate when young, expanding to broadly convex, broadly campanulate, plano-campanulate or nearly plane in age, often with a shallow central depression; disc smooth to rugulose or reticulate; margin striate to rugulose-striate or rugulose-sulcate, pellucid, initially decurved, in age decurved to upturned, wavy or undulate; surface hygrophanous, glabrous, moist to dry, dull; disc ivory, cream (4A3), pale orange white (5A2-3), or pale brownish grey (6C3); margin white, ivory, buff, pale yellowish white (4A2) or cream (4A3), in age entire pileus often dingy white and pellucid. *Context* thin (0.5-1 mm), pliant, white. *Lamellae* adnate to shallowly adnexed, non-collariate, close to subdistant or distant (12-20(-26)) with 3-5 series of lamellulae, narrow (0.5-2 mm, rarely up to 4 mm broad), sometimes not reaching pileus margin, often anastomosing and intervenose, white to ivory, pale yellowish white (4A2) or cream (4A3); edges even, non-marginate. *Stipe* (20-)40-112 × (1-)2-3 mm, central, terete or sometimes once-cleft, ±equal, sometimes wavy, cartilaginous or pliant, tough, fistulose, sometimes twisted-fibrous, dull, dry, apex minutely pruinose, base pruinose or furfuraceous to appressed-fibrillose, non-insititious, arising from dense creamy white mycelium; apex white to pale yellowish white (4A2), centrally greyish orange (5B4), brownish yellow (5C5-6) or brownish orange (6C5-7), base brown (7D-E5-8), reddishbrown (8D-E4-8), or dark brown (7-8F5-8). *Odor* mild, somewhat sweet, like Marasmius oreades. *Taste* not distinctive.

Figure 5. *Marasmius pellucidus*

6. *Marasmius pseudopellucidus* Wannathes, Desjardin & Lumyong (Figure 6)

Pileus 10-40 mm diam., broadly conical to convex with a slightly depressed disc and reflexed margin in age, pellucid-striate, pruinose, dull, disc pale yellow, margin white, fading to white overall. *Contex*t off-white, thin. *Lamellae* adnate, close (19-22) with 2-3 series of lamellulae, narrow, intervenose in age, white, nonmarginate. *Stipe* 16-50 × 1-2 mm, central, cylindrical, hollow, subvelutinous to velutinous, non-insititious, apex white, base light orange (5B5). *Odor* sweet. *Taste* not distinctive.

Figure 6. Basidiomata of *Marasmius pseudopellucidus*

7. *Marasmius haematocephalus* forma *atrovioleceus* Singer (Figure 7)

Pileus 4-18 mm diam., obtusely conical to convex, umbonate, sometimes with a rugulose disc, striate to sulcate, pruinose to finely velutinous, dull, dark purple (14F7) to dark magenta (13F7) overall when young, in age disc dark violet to grayish violet (14C4) and margin pinkish purple to violet. Context purplish white (14A3), thin. *Lamellae* adnexed, distant (7-12), narrow to broad (1-2 mm), purplish pink (14A3), non-marginate, non-intervenose. *Stipe* 13-30 × 0.2-0.5 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex purplish white, base dark brown. *Odor and taste* not distinctive.

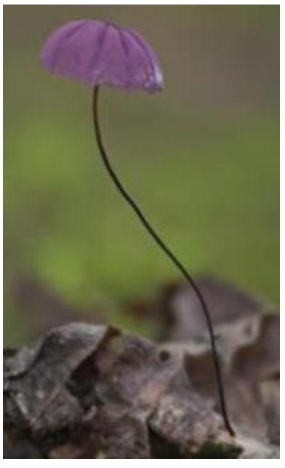


Figure 7. Basidiomata of *Marasmius haematocephalus* forma *atrovioleceus*

8. *Laetiporus sulphureus* (Fr.) Murr. (Figure 8)

Laterally substipitate to sessile, semicircular to fan shaped, imbricate clusters, smooth, angular, sulphureus to citric yellow color. Fruiting body pileate, annual, single or more commonly as large fruiting bodies, semicircular to fan- shaped, applanate, up to 20 cm. Basidiocarps is vary considerably in shape, size and color, is easily recognized by bring orange to yellow color pileus. Context is fleshy and soft white to chalky, fading to pale brown with age. *Basidiospores*, ellipsoid to avoid, hyaline, smooth 5-8 x 5 µm. Dimitic of hyphal system. Pore 3-5 mm in diameter, and pore surface has yellow when fresh, pale brown to dark brown on dry. None clamp connection and sterile elements. Stalk is absent. *Spore* 5-7 µm, spore print has white color, broadly elliptical to nearly round shape. Tube layer, bring orange to sulphur yellow when fresh and drying to buff and less orange up to 4 mm thick.

Figure 8. *Laetiporus sulphureus*

9. *Ganoderma lucidum* (Polyporales) (Figure 9)

Ganoderma lucidum is a polypore mushroom that is soft (when fresh), corky, and flat, with a conspicuous red-varnished, kidney-shaped cap grows up to 30 cm and, depending on specimen age, white to dull brown pores underneath. It lacks gills on its underside and releases its basidiospores through fine pores, leading to its morphological classification as a polypore. Microscopically characterized by more or less elliptical, sometimes with a truncated end basidiospores and dimitic hyphal systems.

Figure 9. *Ganoderma lucidum*

10. *Ganoderma applanatum* (Polyporales) (Figure 10)

The fruiting bodies of G. *applanatum* grow up to 30–40 centimeters (12–16 in) across, hard, woody-textured, inedible; they are white at first but soon turn dark red-brown. When it releases spores, this large bracket fungus colors the surrounding area with dense brown dust. A specialty of this fungus lies in its ability to be as a drawing medium for artists. When the surface is rubbed or scratched with a sharp implement, it changes from light to dark brown, producing visible lines and shading. This tough, inedible bracket lives for many years, developing noticeable annual growth ridges on the upper surface. Microscopically this species is identified by basidiospores with ellipsoid, truncated at one end, double walled series of pillars between walls inner wall rough and outer wall smooth.

Figure 10. *Ganoderma applanatum*

11. ***Agaricus floculocipes*** (Figure 11)

Pileus 3.8 mm diam., palabolic when young and convex when old, squamose, white, light yellow at centre and hair are brownish. *Lamella* 1.4 x 0.5 cm diam, free, close and narrow. *Stipe* 6 x 0.6 cm. clavate, strigous, yellowish white to yellow light margin pinkish purple to violet.

Figure 11. *Agaricus floculocipes*

12. ***Lepiota* sp.** (Figure 12)

Lepiota sp. in young fruing body. *Pileus* convex smooth surface but has small hairy dark brown in the centrally and chasing down with violet brown; margin white, not striate. *Lamella* white free, narrow with close lamellulae, often edges even. *Stipe* 4.8 x 0.4-0.6 mm, central, equal to clavate on base, surface dry, fibrous, yellowish white and after touch become to yellow with the pelius of the apex and base. *Anuulus* Pendecut (hanging) or single edged.

Figure 12. *Lepiota* sp.

13. *Agaricus* sp. nov. (Hedhomkaw) (Figure 13)

Pileus 30 – 70 mm diam, papabolic when young the convex to flat, smooth surface white to yellowish white. *Lamella* free, crowed, narrow, pinkish brown to brownish orange. Stipe clavate, smooth, white. *Ordor*. almond. *Annulus* pendant (hanging).

Figure 13. *Agaricus* sp. nov. (Hedhomkaw)

14. *Inocybe fastigiata* (J.C. Sch. Fr.) Quélet (Figure 14)

Innocybe fastigiata *Pileus* 66 mm diam, conical becaming plan to umbolate with prominent central knob; dark brown to brown fibrillose, cap edge upturning, often split. *Lamella* crowded, adnexed to adnate, attached becoming nearly free, close, broad, equal, light brown with white edges and then they turn olive-brown. *Stipe* 66 x 7 mm diam, central, equal, smooth and silky, sometime slightly fibrous towards the base.

Figure 14. *Inocybe fastigiata*

15. *Tremella fuciformis* (Tremellales) (Figure 15)

Basidiomes are gelatinous, watery white, up to 7.5 cm (3 ins) across (larger in cultivated specimens), and composed of thin but erect, seaweed-like, branching fronds, often crisped at the edges. Tremella fuciformis is a parasitic yeast, and grows as a slimy, mucous-like film until it encounters its preferred hosts, various species of Annulohypoxylon (or possibly Hypoxylon) fungi, whereupon it then invades, triggering the aggressive mycelial growth required to form the fruitbody. Microscopically characterized by its clamped hyphae which occur in a dense gelatinous matrix; haustorial cells arise on the hyphae, producing filaments that attach to and penetrate the hyphae of the host; tremelloid (ellipsoid, with oblique to vertical septa) basidia and ellipsoid, smooth basidiospores.

Habitat: fruit bodies are typically found on dead, attached or recently fallen branches of broadleaf trees

Locality: Doi Mae Salong, Chiang Rai

Figure 15. Fresh basidiomata of *Tremella fuciformis* on the field

16. *Termitomyces microcarpus* (Lyophyllaceae) (Figure 16)

Fully grown pileus of *T. microcarpus* is about 2 cm diameter, plano-umbonate, with a high spiniform perforatorium; surface dark brown at centre, white elsewhere and paling toward margin, smooth and glabrous, striate and radially rimose; margin straight and splitting fissile. Lamellae are free, up to 1 mm wide, white, and crowded, with lamellulae. Stipe is 4 cm long, 0.3 cm diam., central and cylindrical, slender; surface pale grey, smooth and glabrous, longitudinally striate, lacking both an annulus and other velar remnants, solid, fibrous. Pseudorhiza more than 10 cm long, cylindrical, slender; surface pale grey, smooth and glabrous; solid and fibrous. Context of pileus is white, fleshy, inflated, hyaline and thin-walled.

Habitat: as a group on ground, termite mounds, the soil which covered with rich leaf-litter and dead wood, the base of the stipe has long pseudorrhiza which goes in deep soil. This group of mushrooms is the food source for a subfamily of termites, the Macrotermitinae, who enjoy an obligate symbiosis with the genus similar to that between Atta ants and Attamyces mushrooms. Despite this their spore transfer is mainly by shedding from mushrooms, which protrude from the termite mounds.

Locality: Khun Kone waterfall, Chiang Rai

Figure 16. Fresh basidiomata of *Termitomyces microcarpus* on the field

17. *Leucocoprinus fragilissimus* (Agaricaceae) (Figure 17)

The cap of the fruit body is up to 4.5 cm (1.8 in) wide, bell-shaped when young and growing to convex in maturity. It has a pale yellow colour that fades with age, and white gills. The narrow stalk is between 1 and 3 mm thick and very fragile.

Habitat: found on living and dead stems, usually low on the stem or on roots and trunks.

Locality: Mushroom Research Centre, Chiang Mai

Figure 17. Fresh basidiomata of *Leucocoprinus fragilissimus* on the field

18. *Stereum ostrea* (Stereaceae) (Figure 18)

The fruiting body is 1–7 cm (0.39–2.8 in) wide, shaped like a shell and thin. Its surface can be hairy or smooth at the very first, growing smoother with age. The concentric zones can have a variety of colors - ranging from yellowish red to a dark brown. If algae grow on it, the color can change to green. The flesh is very thin and too tough to eat, with no distinct odor. The fungus lacks a stem. The underside is smooth and lacks pores, white to gray or a reddish brown shade in color.

Habitat: It is a plant pathogen, growing on hardwood tree barks, especially oak, and decaying parts. It leaves white deposits in these places. It grows individually, but in a dense manner.

Locality: Doi Mae Salong, Chiang Rai

Figure 18. Fresh basidiomata of *Stereum ostrea* on the field

19. Pleurotus ostreatus (Figure 19)

Pileus size: 20-50 mm, white- pale orange, surface: smooth, shape: shell, Margin: straight, gill misc: crowded, attachment: adnate, color

Stipe size: 10 mm x 2, 2, 2 mm, Shape: equal, Surface: smooth and fibrillose white)

Location: Doi Mae Salong

Habitat: Dead wood

Figure 19. Fresh fruiting body in the field and scale.

20. ***Xerula*** **sp.** (Figure 20)

Pileus size: 130 mm, Shape: depressed, Surface: middle big black spot, rim wood line brown, wet and smooth magin: straight, attachment: free, spacing: unequal yellowish brown *Stipe* size: 170 mm x (13 mm, 15 mm, 17 mm, 30 mm), yellowish white to yellowish brown shape: radicating, surface: small hair brown

Location: Doi Mae Salong

Habitat: Soil

Figure 20. Fresh fruiting body in the field and scale in the laboratory

21. ***Amanita*** **sp**. (Figure 21)

Pileus size: 30-45 mm, shape: palabolic, surface: smooth and fibrillose at rim yellowish brown- light brown. *Stipe* size: 100-160 mm, shape: claveted, surface: fibrillose gill size: 35 mm x 0, 7, 0 mm, margin: decurved, attachment: free, color: white, volva shape: saccat (thin layer), hollow in stipe, color: white

Location Doi Mae salong

Habitat: Soil

Figure 21. Fresh fruiting body in the field and compare size with coin

22. *Rusula* sp. (Figure 22)

Pileus size: 60-70 mm, yellowish white, shape: depress, surface: fribilose, magin: decurved, attachment: adnate, Spot color: light yellow. *Stipe* size: 45 mm x (17, 18, 0.7 mm), shape: ventricose futiform, surface: fribilose, color: yellowish white

Location: Doi Mae Salong

Habitat: Soil

Figure 22. Fresh fruiting body in the field and compare size with coin

23. *Boletellus* sp. (Figure 23)

Pileus size: 60 mm, shape: hamispharic, surface: rimose, color of pileus are reddish bond to reddish orange, whe cut the color in side pileus pastle yellow then become to greenish white to greenish gray. *Stipe* size: 100 mm x (20, 14, 12, 20) mm, shape: equal with abruptly bulbous base, surface: peronate, color on surface of stipe: brownish orange, light brown but color inside the stipe pastel yellow when cut the colour become to greenish white to greenish gray. This boletus sp. has pore shape circle with the colour olive yellow

Location: Doi Mae Salong

Habitat: Soil

Figure 23. Fresh fruiting body in the field

24. *Boletus* sp.

(Figure 24)

Pileus size: 70-200 mm, shape: convex, surface: velvet in the surface with the color: coffee - raw umber but inside color is pastle yellow. *Stipe size*: 40-100 mm x 20, 30, 50 mm, shape: clavete, surface: wooden the color of the stip both of inside and outside also same with the surface coffee, raw umber. Pore shape: circle

Location: Doi Mae Salong

Habitat: Soil

Figure 24. Fresh fruiting body in the field and scale in the laboratory

25. *Macrolepiotan dolichaula* (Figure 25)

Basidiomata: medium to large sized pileus (6-16cm) in diameter, ovoid to hemispherical when young becomes convex to Plano convex after maturity. White to whitish when crowded but looks geryish orange when scattered. *Lamellae*: free, crowded, white when young, cream colored when mature. *Stipe*: whitish, sub cylindrical, hollow, fibrous. *Annulus*: ascending, whitish membranous, simple, big, brownish patchy squamule underside, movable when mature. *Context*: white to whitish. *Stipe*: whitish, sub cylindrical, hollow. *Taste*: mild to indistinct.

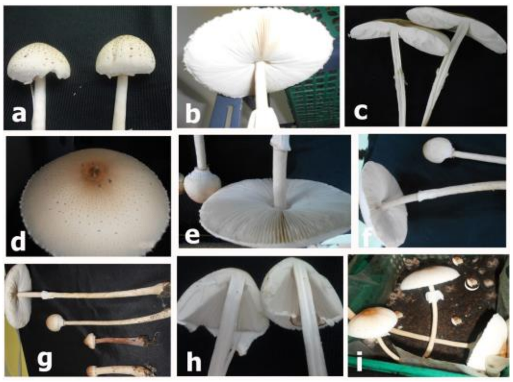


Figure 25. Fresh fruiting body of *Macrolepiota dolichaula* in the laboratory

26. *Agaricus* sp. (Figure 26)

Pileus 70 mm, obtusely ovoid at first expanding convex, dark-brown (7F7) covered in brown fibrous scales, with straight margin. Stipe 100-110 x 10-20 mm, dark-brown (7F7) with brown fibrous scales, white annulus, large and stick with stipe. Gills free with reddish-white (7A2) and crowded. Context in pileus and stipe white, when brushing. Taste and spore not observed. Habitat in coniferous and deciduous woods found in rain season.

Figure 26. Fresh basidiomata of *Agaricus* sp in the laboratory

27. *Agrocybe* sp (Figure 27)

Pileus 75 mm, convex, becoming more expanded in age; butter yellow-maize (4A5-6). Gills adnate or with a decurrent tooth, close, narrow to medium-broad, edges even to fringe; sunburn-cinnamon (6D5-6). Stipe 8 x 45 mm, yellowish white (4A2), solid or spongy, sub-bulbous; white above, brownish below; finely hairy and veil copious. Habitat on humus debris in mixed woods found in rain season

Figure 27. Fresh basidiomata of *Agrocybe* sp in the field

28. *Agaricus* sp. (Figure 28)

Pileus 40-90 mm, obtusely ovoid at first expanding convex, red haired or brown (6C4, 6E4) covered in brown fibrous scales, with straight margin. Stipe 70-120 x 10-15 mm, white with finely hair, white annulus, large and stick with stipe. Gills free, white, dark-brown (7F8) in age and crowded. Context in pileus and stipe white, when brushing. Taste and spore not observed. Habitat in grassland under the tree found in rain season.

Figure 28. Fresh basidiomata of *Agaricus* sp. in the field and laboratory

29. *Agaricus crocopeplus* (Figure 29)

Pileus shield shaped 4 cm, orange colored (6A8) with cottony tufts and patches, stronger orange than the cap surface. Stipe 0.5 x 4 cm, also with orange (6A8) tufts, tapering to the base which has a small bulb and hollow. Gills free with dark-brown (6F6) spore. Not edible. Found on compost or leaf in rain season.

Figure 29. Fresh basidiomata of *Agaricus crocopeplus* in the field and laboratory

30. *Clarkeinda trachodes* (Figure 30)

Pileus 80 mm, globose to subglobose when young, expanding to convex, plano-convex, with low umbo, with straight margin; glabrous at umbo, broken around umbo, with patches toward margin, with radially fibrillose background, light brown to brown (7D4) at unbo and patches, white background and margin; margin fibrillose, fringed, with gills exceeding when mature. Gills free, broad, crowded, white when young, dull green (27D3) when mature; lamella edge eroded. Stipe 110 x 113 mm, white to yellowish-white (4A2), smooth, hollow. Annulus descending, with cuff around stipe, movable, white, underside concolorous with umbo. Context in pileus and stipe white, turning brownish-orange (7C5). Spore print grayish-green (14D4).

Figure 30. Fresh basidiomata of *Clarkeinda trachodes* in the field and laboratory

31. *Agaricus* sp.

(Figure 31)

Pileus size: 40- 50 mm shape parabolic when young, convex when mature, surface at pileus are appress squmulose and small dots at centre color brown(7E6), background is white color. Margin of gill decurve, attachment is free and gill spacing is crowded color of gill dark brown color (7E8). Stipe size 80- 90 mm x 3- 4 mm, shape claveted- bulbous, surface stiggrose color at stipe is brown. When test with KOH reagent change color to brown. Collected from Mae Suai, Chiang Rai growing on the soil. Collector by Anan Thawthong

Figure 31. Fresh basidiomata of *Agaricus* sp. in the field

32. ***Agaricus*** **sp.** (Figure 32)

Pileus size is 20-40 mm, parabolic when young, convex when mature. Surface are smooth and has little squmulose white color. Margin is incurve and attachment is free. Before mature has thin layer cover under gill. The gill spacing is crowded and brownish grey (7C2) color. Stipe size 30- 50 mm x 4-5 mm, shape equal bulbous, surface are minutely and pubescent white (1A1) color. Stipe size 45 mm x 4-5 mm, shape of stipe is equal bulbous thin layer cover gill, surface minutely or pubescent white 1A1 color. KOH reagent yellow color, collected from Mae Suay, Chiang Rai by Anan Thawthong.

Figure 32. Fresh basidiomata of *Agaricus* sp. in the feild

33. ***Agaricus*** **sp.** (Figure 33)

Pileus size is 23- 30 mm shape is parabolic when young, convex and umbonate when mature. Surface of pileus are small hair and squmulose, color of background surface is brown (6B8) and at rim of pileus is light brown (6E5) to white1A1. Magin of gill is decurve and attachment is free. Gill spacing is crowded and dark brown (6E8) color. Stipe size 50 mm x 3 mm, shape is equal and small hair surface, fragile texture and brownish grey to brownish orange color.KOH reagent activity photo brown (9F8) color. Odor like fruity. Collect from Mae Suay district Chiang Rai, it growing on the soil collected by Anan Thawthong.

Figure 33. Fresh basidiomata of *Agaricus* sp. in the field

34. ***Agaricus*** **sp.** (Figure 34)

Pileus size 70 mm, shape of pileus is convex, surface are squamulose, crease in center, crack around pileus and softy texture. Color of pileus is orange white5A2. Magin is decurve and attachment is free. Gill spacing is crowded and dark brown color 6F8. Stipe sizes 75 mm x 9- 10 mm, shape of stipe are equal, stightly tapered at the base. Surface is softy and mark when touch. Shape of ring is apical and partial veil still intact, orange grey color. KOH reagent reaction is yellowish white. The odor is like a fish sauce, change color when texture inside oxidation in the air to pinkish - orange. KOH reaction is yellowish grey – yellowish white. Collect from Mae Suay Chiang Rai. It growing on the soil mix with rock collected by Anan

Figure 34. Fresh basidiomata of *Agaricus* sp. in the feild

35. ***Agaricus*** **sp.** (Figure 35)

Pileus size 30-35 mm, shape of pileus are convex and little depress when mature and parabolic when young. Magin is decurve and attachment is free. Surface on pileus are uplifted squlmulose and fragile. Color of pileus is rew umber 5F8. Gill spacing is crowded and brownish orange 6C3 color. Stipe size 55 mm x 7- 10 mm. shape claveted, hollow inside size 0.2 cm. When young has thin layer cover the gill. Surface of stipe is uplifted squlmulose and grayish orange color 6D4- 6D3. KOH reaction is light orange. Odor fish sauce or mushroom fermented. Collection from Mae Suay Chiang Rai on the soil by Anan Thawthong

Figure 35. Fresh basidiomata of *Agaricus* sp. in the laboratory

36. ***Agaricus*** **sp.** (Figure 36)

Pileus size 15-20 mm, shape is parabolic when young. Surface are flake, small point on pileus. Color of background on pileus is orange white 5A2 and the point on pileus is opaline green 25C4 color. Magin of pileus is decurve and attachment is free. Gill spacing is crowded and pinkish color. Stipe size 70-110 mm x 7- 20 mm, shape is claveted. Surface are smooth, fibrillose and fragile texture. Color is orange white 5A2. Odor is phenol. Collect from Mae Fah Luang University on the soil by Anan Thawthong.

Figure 36. Fresh basidiomata of *Agaricus* sp. in the feild

37. ***Agaricus*** **sp.** (Figure 37)

Pileus size 80- 100 mm, shape is convex when mature and parabolic when young. Surface are flake and small point on pileus. Color is white- orange white 6A1- 6A2. Magin is decurve and attachment is free. Thin layer 2 layer covers under gill before mature stage. Gill spacing is crowded and pinkish – brown 8E8 color. Stipe size 100- 120 mm x 8- 12 mm. Shape of stipe is claveted and surface are striped, streak, not smooth and orange grey 6B2. Odor is phenol. Collected from Mae Fah Luang University on the soil by Samantha Karunarathna

Figure 37. Fresh basidiomata of *Agaricus* sp. in the laboratory

38. *Entoloma* sp. (Figure 38)

Pileus size 33 mm, shape is plane to convex. Surface are smooth with greynish brown on the surface and dark brown in the centre of surface. Magin is straight with crenate cap margin. Gill ventricose, subdistant, unequal, eroded and attachment is adanate. Stipe size 44 mm central. Shape of stipe is claveted inside of stipe is terete and surface are longitudinally striante. Collected from Maesuai district, Chiangrai on the soil.

Figure 38. Fresh basidiomata of *Entoloma* sp. in the feild

39. *Geastrum* sp. (Figure 39)

The fruiting bodies of this species at first in size 11 – 200 mm x 10 – 180 mm when young then peridum splitting into 5 – 8 rays with thick and freshy rays with pale yellow to light yellow. Color of rays is greynish yellow. Spore sac sessile 11 – 17 mm x 12 – 16 mm is round and smooth, brownish orange. Spore inside white when young and black when old. Collected from Mae Fah Luang University on the soil.

Figure 39. Fresh basidiomata of *Geastrum* sp. in the feild

40. ***Clitopilus*** **sp.** (Figure 40)

Pileus size 9- 71 mm, shape is plane when yomg and depressed when old. Surface are moist and sticky. Color is white 6A1. Texture is fibrillose. Magin is little decurved when yond and decurved to incurved attachment is short decurrent, narrow, avehe rage, even to fimbriate, unequal, crowned and color of gill is orange white when yong and mature. Stipe, central size is 58 mm. Shape of stipe is flexuas and surface has fibrous, and yellowish white. Odor is of fresh flour. Collected from Maesuai district, Chiangrai on the soil.

Figure 40. Fresh basidiomata of *Clitopilus* sp. in the field

1.4 Taxonomy

1.4.1 *Auricularia mesenterica*

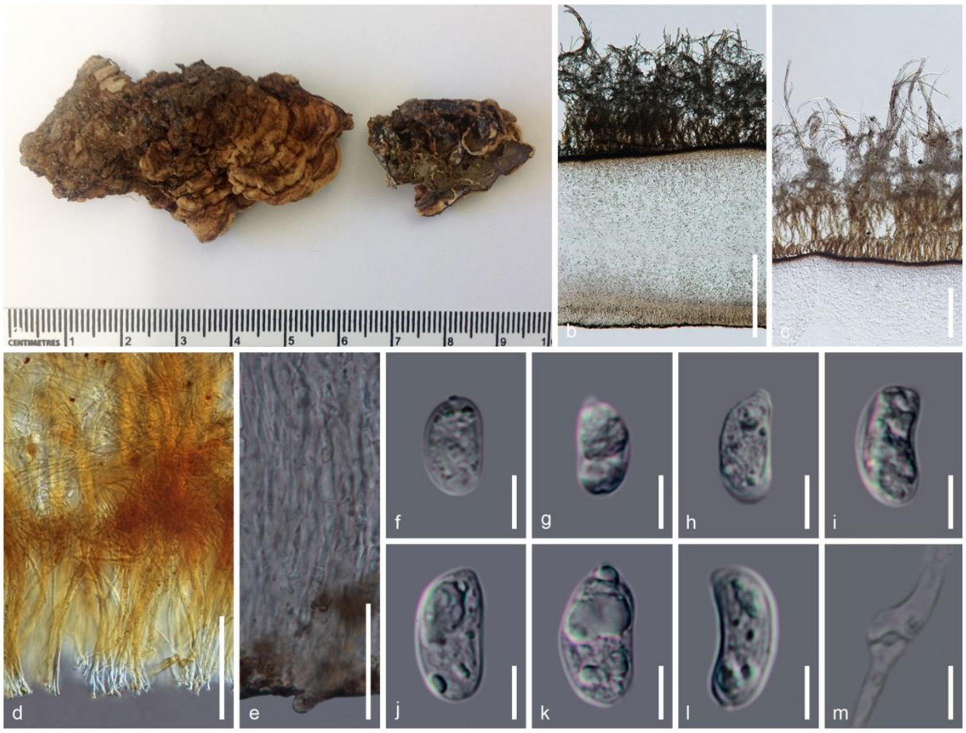


Figure 41. *Auricularia mesenterica*. a. Basidiocarp. b. Cross-section. c. Abhymenial hairs. d. Close-up of abhymenial hairs e. Close-up of hymenial layer. f–l. Basidiospores. m. Clamp connection of hyphae. Scale bars: b=500 µm, c=250 µm, d=100, e=25 µm, f–m=5 µm.

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

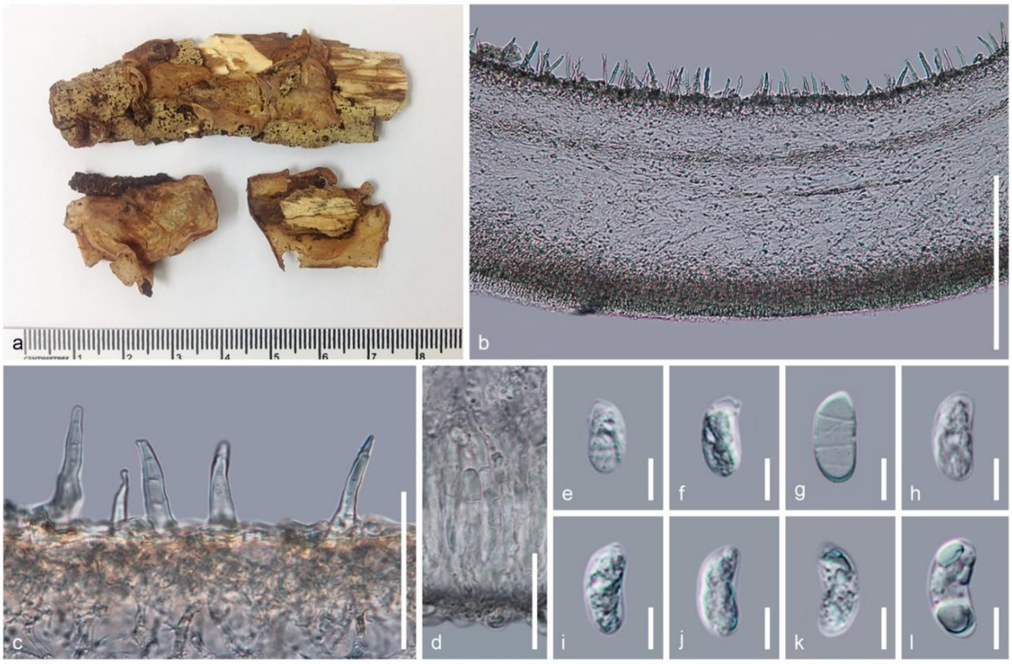


Figure 42. *Auricularia thailandica*. a. Basidiocarp. b. Cross-section. c. Abhymenial hairs. d. Close-up of hymenial layer. e–l. Basidiospores. Scale bars: b=250 µm, c=50 µm, d=25 µm, e–m=5 µm.

1.4.3 *Auricularia cornea*

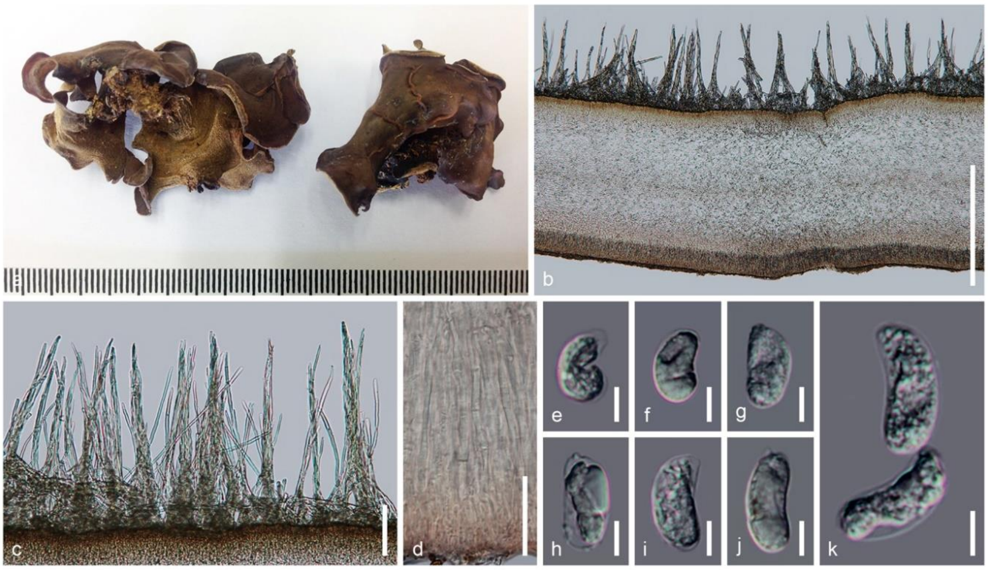


Figure 42. *Auricularia cornea*. a. Basidiocarp. b. Cross-section. c. Abhymenial hairs. d. Close-up of hymenial layer. e–k. Basidiospores. l. Clamp connection of hyphae. Scale bars: b=500 µm, c 100 µm, d 25 µm, e–k 5 µm.

Part 2
Molecular analysis

***DNA extraction, polymerase chain reaction and sequencing**:* DNA was extracted from dried mushroom samples using Biospin Fungus Genomic DNA Extraction Kit (Bioer Technology Co., Ltd., Hangzhou, P.R. China). The genomic DNA was then used as the template in the amplification of the rRNA gene. For this, the PCR reaction was carried out in 50 µl consisting of 25mM $MgCl_2$, 10 Mg-free buffer, 2.5 µM dNTPs, 1.5 µM primers, 1.5 unit of *Taq* Polymerase and appropriate volume of sterile dd water. The primers used were ITS1-F (CTTGGTCATTTAGAGGAAGTAA) (Gardes & Bruns, 1993), ITS1 (TCCGTAGGTGAACCTGCGG) and ITS4 (TCCTCCGCTTAGATAT-GC) (White, Bruns, Lee & Taylor, 1990). The PCR conditions were as follows: 94°C for 5 min. in denaturation step, followed by 35 cycles of 94°C for 30 sec., 55°C for 30 sec., and 70°C for 45 sec. The products were then sent to Shanghai Sangon Biological Engineering Technology & Services Co., Ltd.) for sequencing. All new sequences were deposited in GenBank.

Table 4. Sequence data obtained and genes sequenced

Collection and species	Sequence data			Collection and species	Sequence data		
	ITS	LSU	SSU		ITS	LSU	SSU
Amanita sp.		√		*Auricularia* sp. MFU 395	√		√
Amanita sp.		√		*Auricularia* sp. MFU 396	√		√
Amanita volvata	√			*Auricularia* sp. MFU 397	√		
Amanita yuaniana		√		*Auricularia* sp. MFU 398	√	√	
Amanita areolata	√			*Auricularia* sp. MFU 399	√		√
Amanita rhoadsii		√		*Auricularia* sp. MFU 400	√		√
Amanita onusta large		√		*Auricularia* sp. MFU 401		√	
Amanita macrocarpa	√			*Auricularia* sp. MFU 402	√	√	
Amanita manicata	√			*Auricularia* sp. MFU 403	√	√	
Amanita manicata	√	√		*Auricularia* sp. MFU 404			√
Amanita manicata	√	√		*Auricularia* sp. MFU 405	√		√
Amanita griseofolia	√	√		*Auricularia* sp. MFU 407	√		√
Amanita citrine	√	√		*Auricularia* sp. MFU 408			√
Amanita pseudoporphyria	√			*Auricularia cornea* PDD 103780	√	√	
Amanita vaginata	√			*Clarkeinda trachodes*	√	√	
Amanita flavorubescens	√	√		*Clitopilus* sp.	√		
Amanita rimosa	√	√		*Clitopilus* sp.	√		
Amanita spissacea	√	√		*Clitopilus* sp.	√		
Amanita muscaria	√	√		*Clitopilus* sp.	√		
Amanita aff. Princeps	√	√		*Gymnopilus lepidotus*	√	√	
Amanita phalloides	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√			*Lentinus* sp.	√	√	
Agaricus sp.	√	√		*Lentinus* sp.	√	√	
Armillaria tabescens	√	√		*Lentinus* sp.	√	√	

Auricularia mesenterica MFU 393	√			*Lentinus* sp.	√	√	
A. auricula judae MFU 394	√		√	*Lentinus* sp.	√	√	
Auricularia sp. MFU 409	√		√	*Lentinus* sp.	√	√	
Auricularia sp. MFU 410	√			*Lepista sordida*	√	√	
Auricularia sp. MFU 411	√	√		*Oudemansiella* sp.		√	
Auricularia sp. MFU 412	√	√		*Oudemansiella* sp.		√	
Auricularia sp. MFU 413	√	√		*Oudemansiella* sp.		√	
Auricularia sp. MFU 414	√		√	*Oudemansiella radicata*	√	√	
Auricularia sp. MFU 415	√			*Oudemansiella pudens*		√	
Auricularia sp. MFU 417	√		√	*Oudemansiella pudens*		√	
Auricularia sp. MFU 418	√		√	*Oudemansiella radicata*	√		
Auricularia sp. MFU 419	√			*Oudemansiella radicata*	√	√	
Auricularia sp. MFU 421	√		√	*Pleurotus* sp.	√	√	
Auricularia sp. MFU 422			√	*Pleurotus* sp.	√	√	
Auricularia sp. MFU 423	√			*Pleurotus* sp.	√	√	
Auricularia sp. MFU 424	√			*Pleurotus* sp.	√	√	
Auricularia sp. MFU 425	√			*Pleurotus* sp.	√	√	
Auricularia sp. MFU 427	√			*Pleurotus* sp.	√	√	
Auricularia sp. MFU 428	√	√		*Psathyrella* sp.		√	
Auricularia sp. MFU 429	√	√		*Xerula melanotricha*		√	
Auricularia cornea	√			*Xerula radicata*		√	
Auricula judae	√	√		*Xerula* sp.		√	
Auricularia mesenterica	√	√		*Xerula* sp.		√	
Auricularia cornea PDD 92296	√	√		*Xerula* sp.		√	
Auricularia cornea PDD 92640	√	√		*Xerula* sp.		√	
Auricularia cornea PDD 93654	√	√		*Xerula* sp.		√	
Auricularia cornea PDD 97684	√	√		*Xerular* sp.		√	
Auricularia cornea PDD 93644		√		*Xerula* sp.		√	
Auricularia sp. PDD 94825		√					

Result of phylogenytic analysis

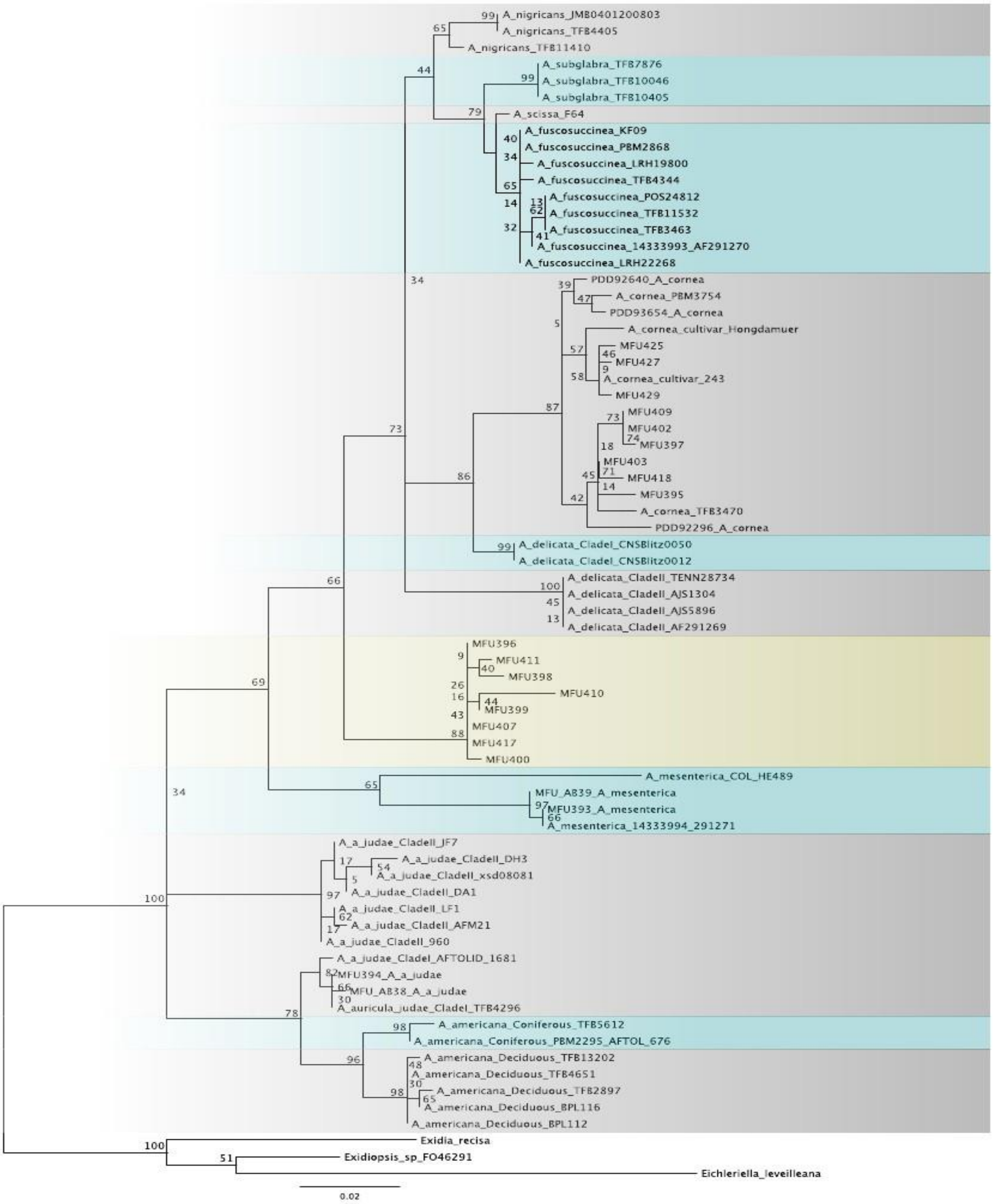


Figure 43. 71 ITS sequences were analyzed in this in this study. 24 sequences were newly produced and 47 sequences were downloaded from Genebank. Twelve clades were recovered in the ML analysis of ITS data. According to the molecular analysis *A. nigricans*, *A. fuscosuccinea*, *A. mesenterica*, *A. subglabra* and new species were recoverd as monophyletic. *A. auricula-judae, A. delicata*, and *A. americana* were recovered as paraphyletic or polyphyetic.

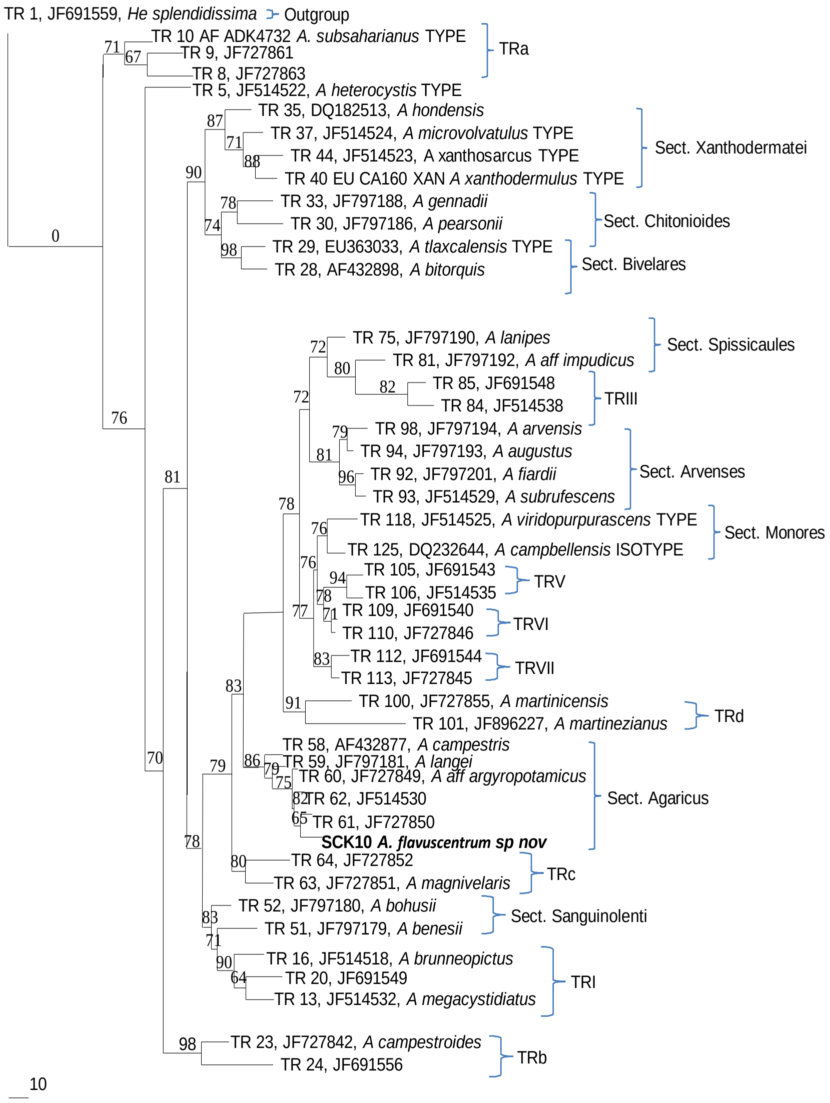


Figure 44. Maximum parsimony phylogram showing the phylogenetic position of *Agaricus flavuscentrum* sp. nov. with some selected *Agaricus* species from the sections *Bivelares, Chitonioides, Xanthodermatei, Sanguinolenti, Agaricus, Spissicaules, Arvenses, Minores* and *Tropical* sections (Zhao et al. 2011) based on ITS rDNA sequences. Data were analysed with random addition sequence, unweighted parsimony and gaps were treated as missing data. Values above the branches are parsimony bootstrap (≥ 50%). The tree is rooted with cf. *He. splendidissimus*.

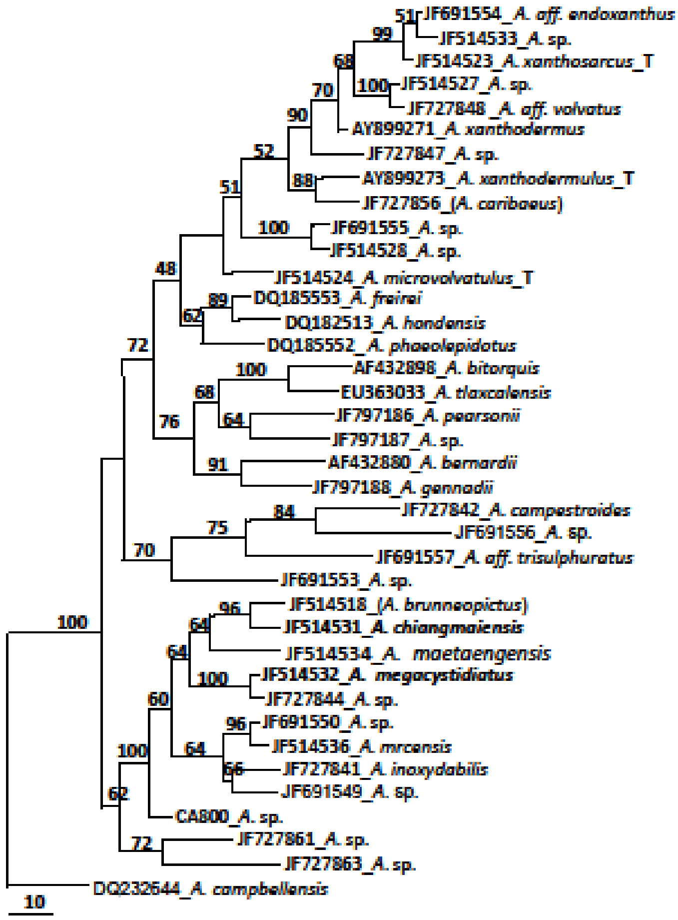


Figure 45. Maximum parsimony phylogram showing the phylogenetic position of *Agaricus megacystidiatus* sp. nov. and *A. chiangmaiensis* sp. nov. with some selected *Agaricus* species from the sections *Bivelares, Chitonioides, Xanthodermatei*, *Sanguinolenti*, *Agaricus, Spissicaules*, *Arvenses*, *Minores* and *Tropical* sections (Zhao et al. 2011) based on ITS rDNA sequences. Data were analysed with random addition sequence, unweighted parsimony and gaps were treated as missing data. Values above the branches are parsimony bootstrap (≥ 50%). The tree is rooted with *A. campbellensis.*

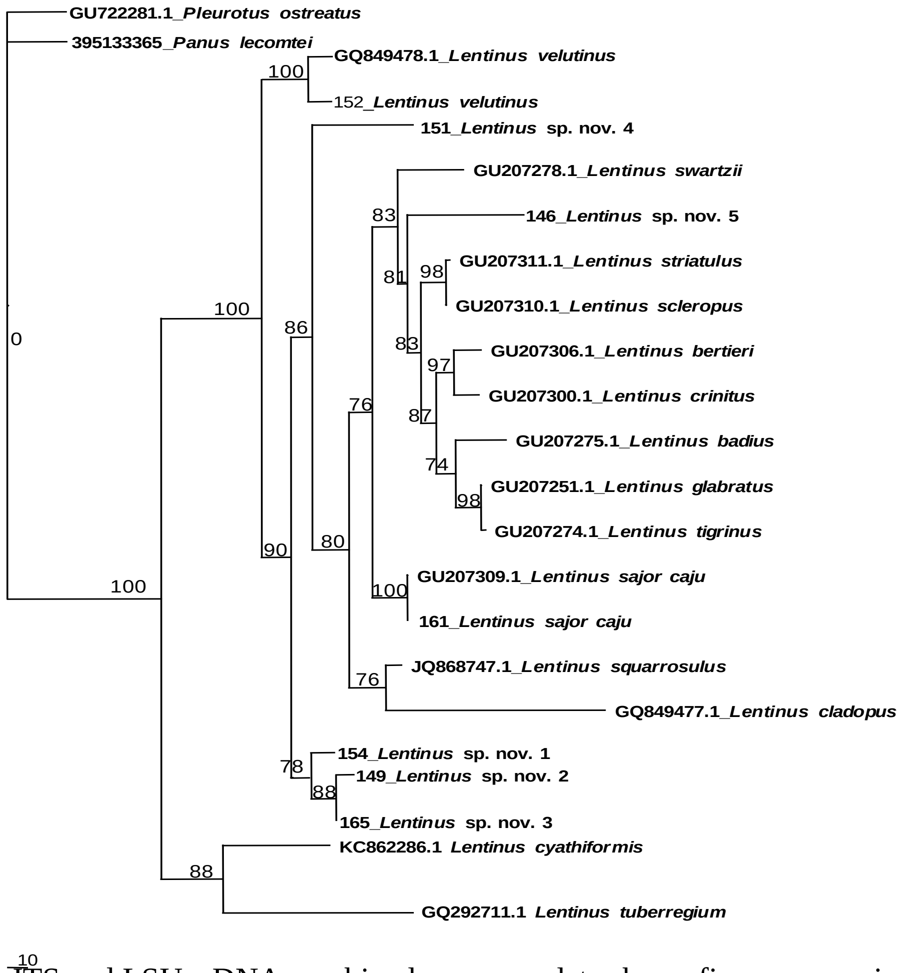


Figure 46. ITS and LSU r-DNA combined sequence data shows five new species of *Lentinus* from northern Thailand. Bootstrap values more than 50% are stated on the nodes of the tree

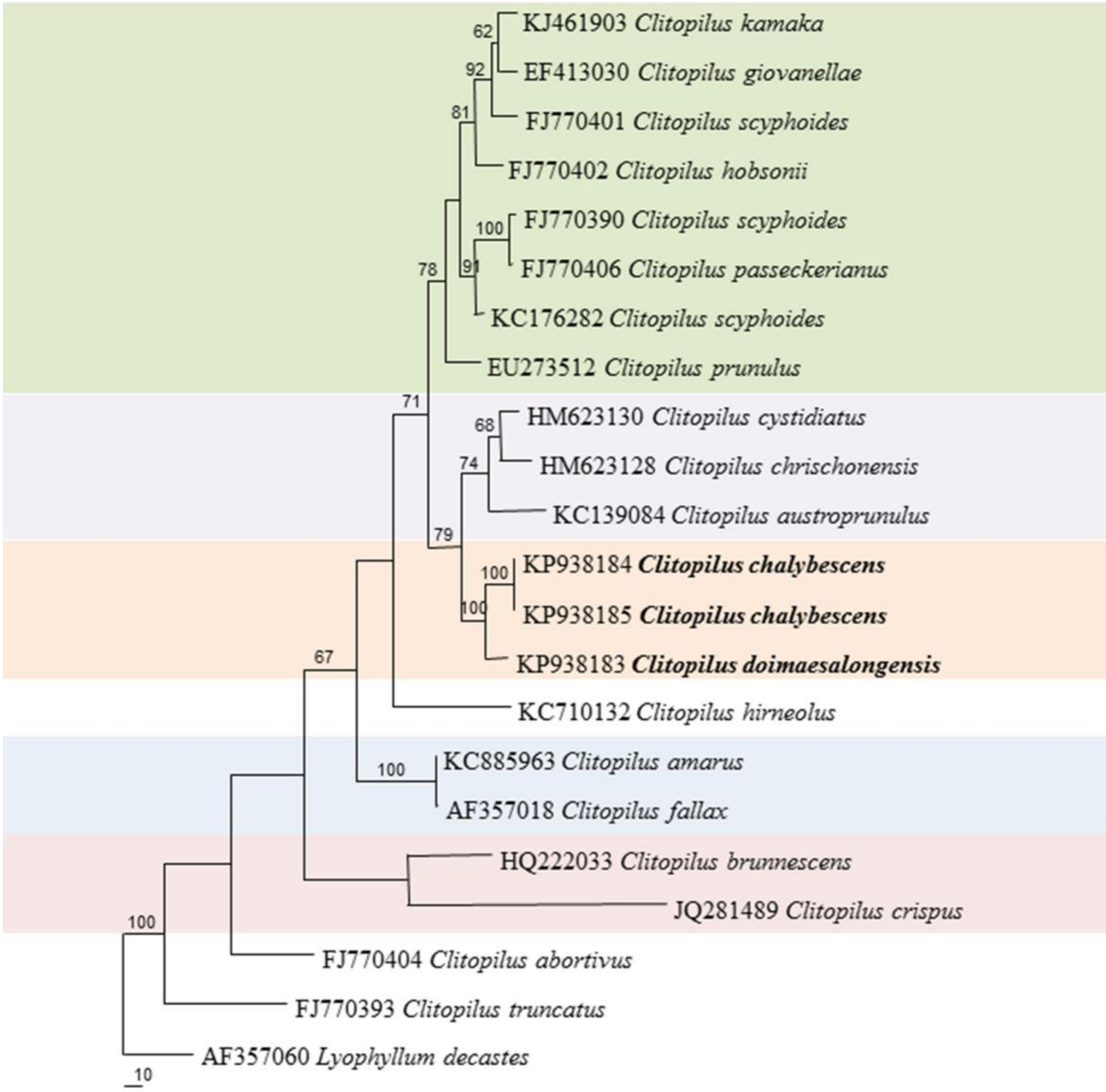


Figure 47. Maximum parsimony phylogram showing the phylogenetic position of *C. doimaesalongensis* sp. nov. with some selected *Clitopilus* species from GenBank based on ITS rDNA sequence data. Data were analyzed with random addition sequence, unweighted parsimony and gaps were treated as missing data. Values above the branches are parsimony bootstrap (≥ 50%). The tree is rooted with Lyophyllum decastes.

Part 3
Characterization of bioactive compounds from mushrooms

We have been characterizing compounds of the fungi we have collected and have written a review of medicinal compound from mushrooms and submitted a paper descibing a new compound to the Journal of Natural Products.

1. To establish chemical properties of selected cultivatable Thai species of *Agaricus*

The potential health promoting benefits in *A. subrufescens* have been emphasized in several reports and include tumor growth reduction, antimicrobial, immunostimulatory and anti-allergy effects. Therefore the objective of this part of the study was to establish bioactive compound, parental and hybrid *A. subrufescens* strains from various isolates originating from Thailand, France and Brazil including parental and hybrid strains.

The strains were inoculated to ZM/2 liquid media (YM 6.3 Glucose 0.4%, malt extract 1%, yeast extract 0.4%, tap water: adjusted to 6.3 pH). Culture media were poured and the pH was adjusted prior to autoclaving. The 200 ml for ZM/2 were inoculated with mycelial plugs of approximately 0.5 mm diameter cut from an actively growing mycelia colony of eight strains of parental and hybrid strains of *Agaricus subrufescens*. All cultures were incubated at 25 °C on a rotary shaker at 140 rpm in darkness. Growth of mycelia was extracted for HPLC analysis after incubation for about 1-2 months.

Strains

The strains of *Agaricus subrufescens* from different origins including from Thailand, Brazil and France and the hybrid strain were used for this study as follows (Table 5).

Table 5 Strains of culture for study

Strains	Species	Origin
WC837 (CA454)	*Agaricus subrufescens*	Parental of Brazilian strain
CA487	*Agaricus subrufescens*	Parental of French strain
CA918	*Agaricus subrufescens*	Parental of Thai strain
CA918-075 X CA454-4	*Agaricus subrufescens*	Hybrid of Thai and Brazilian
CA918-076 X CA454-4	*Agaricus subrufescens*	Hybrid of Thai and Brazilian
CA918-075 X CA487-35	*Agaricus subrufescens*	Hybrid of Thai and French
CA918-075 X CA487-100	*Agaricus subrufescens*	Hybrid of Thai and French
CA918-076 X CA487-35	*Agaricus subrufescens*	Hybrid of Thai and French

Mycelium extraction

Mycelia of all strains were extraction by acetone and ethyl acetate as follows,

Mycelia+media was transferred to tubes and centrifuged at 5000 rpm about 5 min
(For separate mycelium and supernatant in centrifuge tube).

⇩

The supernatant was transferred to new tube.

⇩

The mycelium tube was extracted with acetone
and incubated in ultrasonic bate for 30 min for two time. Then filtrate with paper

⇩

After filtration, the extracts were evaporated
at 400 mbar at 40°C until little the extract left.

⇩

Water was added in to flasks and extracted with ethyl acetate (EA).

⇩

The extract (EA part) was fill thought Sodium sulfate decahydrate
and was evaporated at 200 mbar 40°C.

⇩

After dry all. Methanol 1000 µl was added in flask.

⇩

The extract of mycelium was transfer into vials.
The crude extract of mycelium was used for HPLC analysis.

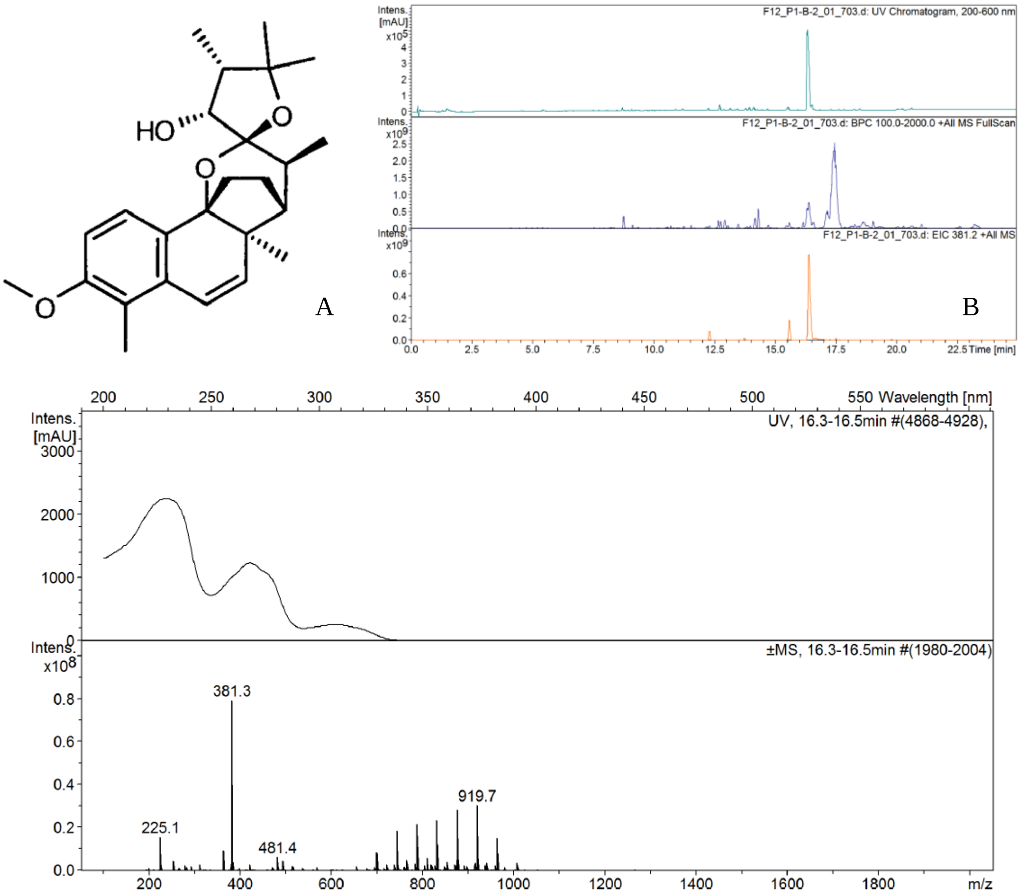
Results

HPLC analysis

The extract of *A. subrufescens* eight strains including parental and hybrid strains amount 100µl of each strain was investigate the secondary metabolites with HPLC-MS. These mushrooms were producing the potential compound "Blazeispirol A" in ZM/2 medium (Table 6).

Table 6 Crude extracts of Blazeispirol A in ZM/2 media

Species	Strain	Origin	Compound	Crude extracts (mg)
A. subrufescens	CA454	Brazilian (Parental strain)	Blazeispirol A	7.2 mg
A. subrufescens	CA487	French (Parental strain)	Blazeispirol A	35.6 mg
A. subrufescens	CA918	Thai (Parental strain)	Blazeispirol A	12.3 mg
A. subrufescens	CA918-075XCA454-4	ThaiXBrazilian (Hybrid strain)	Blazeispirol A	11.6 mg
A. subrufescens	CA918-076XCA454-4	ThaiXBrazilian (Hybrid strain)	Blazeispirol A	11 mg
A. subrufescens	CA918-075XCA487-35	ThaiXFrench (Hybrid strain)	Blazeispirol A	13.9 mg
A. subrufescens	CA918-075XCA487-100	ThaiXFrench (Hybrid strain)	Blazeispirol A	13.5 mg
A. subrufescens	CA918-076XCA487-35	ThaiXFrench (Hybrid strain)	Blazeispirol A	17.5 mg



C

Figure 48. A) Compound structure of Blazeispirol A,(2S,3S,3'R,4R,4S',4aR,10bR)-4,4',4a,5'-tetrahydro8- methoxy-3,4',4a,5',5',7-hexamethyl-sporo [4,10b-ethano-10bH-naphtho [1,2-b]pyran-2(3H),2'9(3'H)-furan]-3'-ol, CAS RN: 221115-51-1 (Grothe et al, 2012) produced by *A. subrufescens*. B) and C) Analysis of HPLC-MS chromatogram of *A.subrufescens* strain CA487 as French parental strain that produced the highest crude extract of Blazeispirol A.

2. To establish chemical properties of selected cultivatable Thai species of *Agaricus* fruiting body extraction

Strains

The dry fruiting body of *Agaricus subrufescens* that we have successfully cultivated in Thailand including Thai parental, Hybrid strains and dry mycelium were used for this study as follows (Table7)

Table 7 Strains of culture for study

Strains	Species	Origin
CA918 (A1)	*Agaricus subrufescens*	Parental of Thai strain
CA918-076 X CA454-4 (A2)	*Agaricus subrufescens*	Hybrid of Thai and Brazilian
CA918-132 X CA454-4 (A3)	*Agaricus subrufescens*	Hybrid of Thai and Brazilian
CA918-075 X CA487-35 (A4)	*Agaricus subrufescens*	Hybrid of Thai and French
A5	*Agaricus* sp.	Dry mycelium

Dry fruit-body extraction

Mycelia of all strains were extracted by methanol and ethyl acetate as follows,
The fruiting bodies (0.5g) tube was extracted with methanol
and incubated in ultrasonic bate for 30 min for two times. Then filtered with paper

⇩

After filtration, the extracts were evaporated
at 200 mbar at 40°C until little the extract remained.

⇩

Water was added to flasks and extracted with ethyl acetate (EA).

⇩

The extract (EA part) was fill thought Sodium sulfate decahydrate
and was evaporated at 200 mbar 40°C.

⇩

After drying 1000 µl of methanol was added to the flasks.

⇩

The extract of mycelium was transferred into vials.
The crude extract of mycelium was used for HPLC analysis.

Result

HPLC analysis

The extract of five strains of *Agaricus subrufescens* which included parental and hybrid strains were 2.5mg/ml for 100µl for each strain investigated for secondary metabolites with HPLC. We found that these mushrooms produced the compound "Blazeispirol"

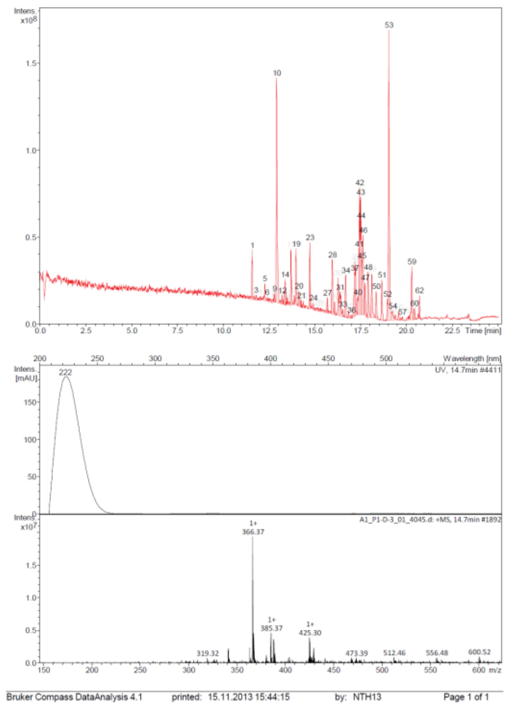
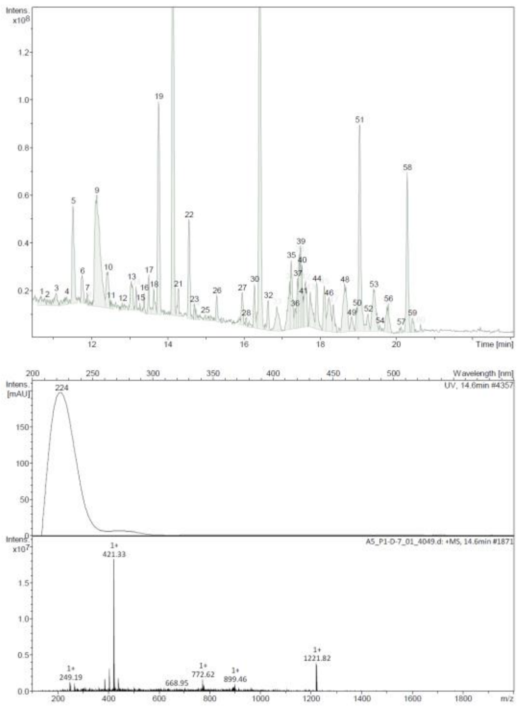


Figure 49. A) and B) Analysis of HPLC chromatogram of *A.subrufescens* strain CA918 as Thai parental strain that produced a crude extract of Blazeispirol D. C) Compound structure of Blazeispirol D (2S, 3S, 3'R, 4R, 4'S, 4aR, 10bR)-4,4',4a,5'- tetrahydro-3,4',4a.5',5',7 hexamethyl spiro[4,10b-ethano-10bH-naphtho[1,2-b]pyran-2(3H),2'(3'H)-furan]-3'8-diol CAS RN: 348111-17-1 (Grothe et al, 2012) produced by *A. subrufescens*.



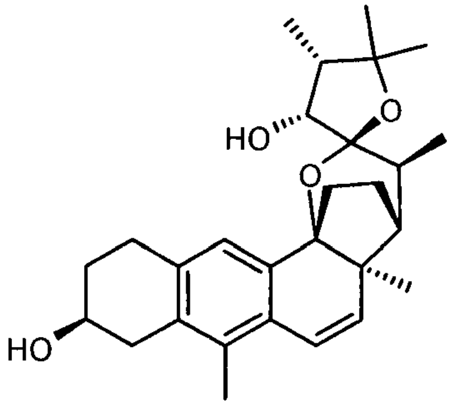


Figure 50. A) and B) Analysis of HPLC chromatogram of *Agaricus* sp.(dry mycelium) strain that produced a crude extract of BlazeispirolX 2S,3S,3’R,4R,4’D,4aR,9S,12bR)-4,4’,4a,5’8,9,10,11-Octahydro-3,4’,4a,5’,5’,7-hexamethyl-spiro[4,12b-ethano-12bH-anthra[1,2-b]pyran-2(3H),2’(3’H)-furan]3’,9-diol CAS RN: 292158-91-9 (Grothe et al, 2012) produced by *A. subrufescens*.

Conclusion

The fruit-bodies of *A. subrufescens* (parental and hybrid strains) that are being cultivated in Thailand as well as dried mycelium were investigated by HPLC. We found that all the fruit-bodies of *A. subrufescens* (parental and hybrid strains) have the potential to produce blazeispirols as previously found, and confirmed that the major component of this complex is “Blazeispirol D”. All strains produced the compound “Blazeispirol D” confirming phylogeny parallels of this secondary metabolite production. A strain of *Agaricus subrufescens* (dried mycelium) produced Blazeispirol X and also Blazeispirol A, while Blazeispirol A was produced in small amounts in the liquid culture crude extract

3. To establish biochemical properties of other mushrooms

The structure elucidation of two compounds from *Gymnopus* sp. is completed (Figure 66, 67, Table 8). We have submitted the manuscript to the Journal of Natural Products

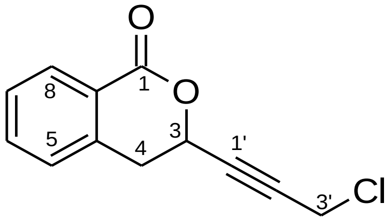


Figure 51. Gymnopus A

Table 8 NMR spectroscopic data of gymnopus 28 in [D_4]methanol (^{1}H at 700 MHz, ^{13}C at 175 MHz)

#	13C (ppm)	mult	1H (ppm)	mult.	COSY	HMBC
1	166.1	qC				
3	69.2	CH	5.52	m	4a, 4b	1, 4, 4a, 1'/2'
4	34.4	CH2	3.39	dd; 16.6, 4.5	3, 4b	3, 4a, 5, 8a, 1', (1)
			3.32	dd; 16.6, 7.1	3, 4a	3, 4a, 5, 8a, 1', (1)
4a	139.7	qC				
5	129.1	CH	7.39	d; 7.7	6	4, 7, 8a, (4a, 6)
6	135.5	CH	7.64	td; 7.7(x2), 1.2	5, 7	4a, 8, (5/7, 8a)
7	129.0	CH	7.46	brt; 7.7	6, 8	5, 8a, (4a, 8)
8	130.4	CH	8.02	dd; 7.7, 1.2	7	1, 4a, 6, (4, 5/7)
8a	125.7	qC				
1'	83.1	qC				
2'	83.1	qC				
3'	30.3	CH2	4.24	d; 1.7	(3)	3, 1'/2', (4)

Gymnopus 28: colorless, amorphous powder, [□□□□D -0.17 ° (c 1, MeOH); UV (MeOH) □$_{max}$ 235 (3.55), 281 (2.53); IR (neat) cm^{-1}; ^{1}H NMR, ^{13}C NMR, HSQC, COSY, HMBC data see Table; HR-ESI-MS *m/z* 221.0365 $[M+H]^+$ (calcd for $C_{12}H_{10}O_2Cl$, 221.0364).

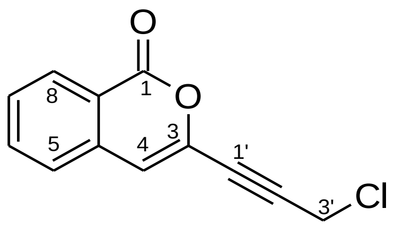


Figure 52. Gymnopus B

Table 9 NMR spectroscopic data of gymnopus 42 in [D_4]methanol (^{1}H at 700 MHz, ^{13}C at 175 MHz)

#	13C (ppm)	mult	1H (ppm)	mult.	COSY	HMBC
1	163.1	qC				
3	138.2	qC				
4	113.8	CH	7.02	s	(8, 3')	3, 5, 8a, 1'
4a	137.8	qC				
5	127.6	CH	7.60	brd	6	4, 7, 8a, (1)
6	136.5	CH	7.82	td; 7.6 (x2), 1.2	5, 7, (8)	4a, 8, (5, 8a)
7	130.8	CH	7.62	td; 7.6 (x2), 1.2	6, 8	5, 8a, (6)
8	130.4	CH	8.24	brd	7, (6)	1, 4a, 6
8a	122.7	qC				
1'	79.1	qC				
2'	89.8	qC				
3'	30.6	CH2	4.55	s	(4)	3, 4, 1', 2'

Gymnopus 42: colorless, amorphous powder, UV (MeOH) □$_{max}$ 232 (3.78), 251 (sh), 285 (3.70), 297 (3.68), 326 (3.23); IR (neat) cm^{-1}; ^{1}H NMR, ^{13}C NMR, HSQC, COSY, HMBC data see Table; HR-ESI-MS *m/z* 219.0208 [M+H]$^+$ (calcd for $C_{12}H_8O_2Cl$, 219.0207).

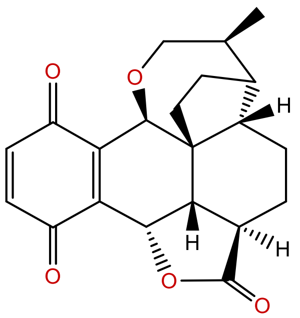
A chlorinated isocoumarine with an acetylenyl side chain and its 3,4-dihydro derivative, named gymnopalynes A (1) and B (2), were isolated from cultures of a basidiomycete originating from the rain forest of Northern Thailand. The producing organism was identified as a species of *Gymnopus* (Marasmiaceae). Their structures were elucidated by spectroscopic methods including UV/Vis and NMR spectroscopy as well as high resolution mass spectrometry as 3-(3-chloroprop-1-yn-1-yl)-1*H*-isochromen-1-one (1) and 3-(3-chloroprop-1-yn-1-yl)-3,4-dihydro-1*H*-isochromen-1-one (2). The absolute stereochemistry of 2 was assigned as *S* by CD spectroscopy. Both compounds showed weak to moderate antimicrobial and much more pronounced cytotoxic activities.

4. Gymnopalynes A and B, Chloropropynyl-isocoumarin Antibiotics from Cultures of the Basidiomycete *Gymnopus* sp.

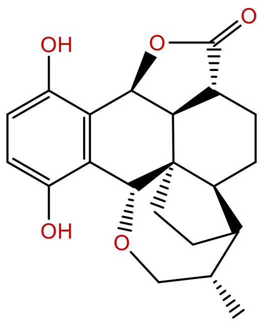
The Xerula strain yielded the antifungal antibiotic, Oudemansin A, which was produced in good yield in 10 litre scales. However, this compound is already known from taxonomically relatedbasidiomycetes and these results can therefore unfortunately not be published.

The interesting strains were already identified. For example, a new Hohenbuehelia sp., this fungus is able to trap and kill nematodes in mycelia culture. In addition, pleurotin, leucopleurotin and dihydropleurotic acid were isolated from the mycelia cultures of Thai Hohenbuehelia sp.,

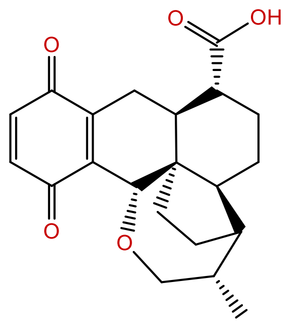
Minor amounts of a new antibiotic with a highly interesting chemical structure (proposed from preliminary results of NMR studies by Dr. Surup) were obtained from a Deconia species. The amounts so far obtained, however, are not yet sufficient for a full structure elucidation, including determination of the absolute stereochemistry and an extensive biological characterisation.



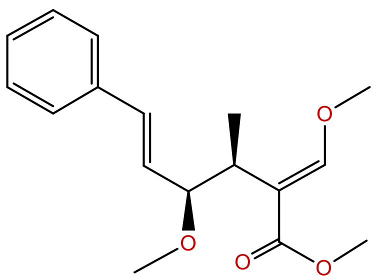
Pleurotin



Leucopleurotin



Dihydropleurotinic Acid

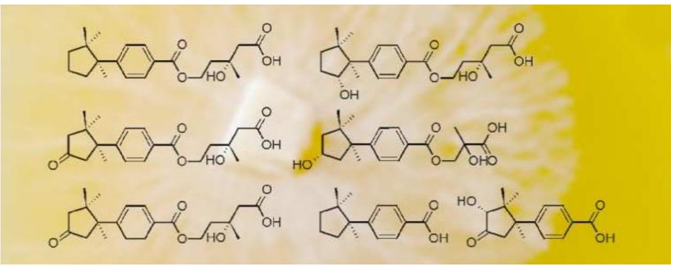


Oudemansin A

Figure 53. Known antibiotics identified from Thai mushrooms.

5. **Deconins A - E – Unprecedented Cuparenic acid / Mevalonic Acid Conjugates from Basidomycete Deconica sp. 471**

Deconicasp. 471 was isolated from a fruiting body collected at Doi Mae Salong in Chiang Rai Province, Northern Thailand. Morphological studies and sequencing of the nucleotide sequences of 18S rDNA, internal transcribed spacers (ITS), and large subunit ribosomal RNA gene (LSU) indicated that strain 471 represents a new species in the genus Deconica.5This genus was erected by Nordeloos et al. 2009 for the basidiomycetes of family Strophariaceae that were formerly placed in the genus Psilocybe but do not produce hallucinogenic alkaloids of the psilocybin type and constitute a yet widely unknown sister group of Psilocybe sensu stricto. The crude extracts from submerged cultures of Deconicasp. 471 showed antimicrobial activities against Gram-positive bacteria, i. e. Bacillus subtilis and Staphylococcus aureus. Bioactivityguided fractionation by RP-HPLC, using B. subtilis as the indicator organism, led to the isolation of the novel antimicrobial metabolite 1that constitutes the active principle.



Seven new natural products were isolated from cultures of a new *Deconica* species originating from the rain forest of Northern Thailand. Their structures were elucidated as four mevalonic acid conjugates (1-4) and as conjugates of 2,3-dihydroxy-2-methyl propionic acid (5), ent-cuparenic acid (6), and of its 10-hydroxy-11-oxo derivative (7) by spectroscopic methods, degradation and derivatization with Mosher’s acid. The integration of an unmodified mevalonic acid entity is unprecedented for natural products.

Part 4
Mushroom growing
Initial attempts to grow new mushrooms

1. Domestication of *Agaricus subrufescens* Thai wild strain and hybrid strain on rice straw compost media

Agaricus subrufescens was first published by C.H. Peck and it has also been found in South America, Brazil in 1960. The Brazilian mushroom is commonly referred as *A. blazei*. It was a newly introduced mushroom to Thailand (Wisitrassameewong et al., 2011). Due to the significant almond fragrance and the conventional taste, *Agaricus subrufescens* is commonly known as almond mushroom (Kerrigan, 2005). In the 19th & 20th centuries, before the discovery of Brazilian; this mushroom was cultivated and consumed by the population. *A. subrufescens* produces various kinds of bio active compounds, while it is popular as a medicinal food having a potential in preventing a series of diseases such as cancer, diabetes, hyperlipidaemia, arteriosclerosis and cronic hepatitis. (Jumes et al., 2010; Liu et al., 2008; Mizuno et al., 1990). This concentrates a significant consumer attraction towards *A. subrufences*.

1.1. Production of *Agaricus subrufescens* Thai wild strain
Materials and methods
Preparing spawn

Agarius Subrufences was isolated from fruit body using tissue culture method and was grown in compost extract agar (CEA) in petridish. After mycelium fully covered the petridish, sogum (spawn media) were admitted to soak in tap water for a period of 24 hours. Then it was boiled. 100 g of boiled sogum were filled to Erlenmeyer flask. Next all flasks were sterilized 20 minutes under 121°C of temperature and at 15 atm of pressure. CEA together with the mycelium was added to the sogum under lamina airflow. After growing in sogum, the mycelium was inoculated to sterilized compost

Preparing the growing media

Mainly, the production of compost media was done using rice straw. Rice straws were facilitated with calcium carbonate, urea, rice bran, di ammonium phosphate, gypsum and water; in appropriate time intervals, while the compost pile was capsized periodically for the ariation process. This compost sterilized for 6 hours maintaining the temperature level 65–70°C. Media were arranged and packed in clean plastic baskets each basket contained 5kg.

Results:

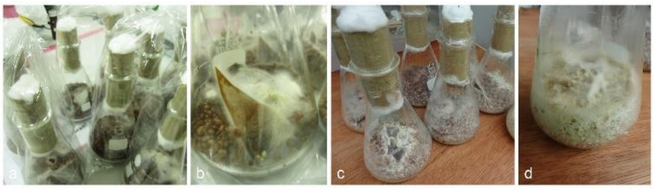


Figure 54. Spawn preparation of *A. subrufescens* CA918b (Wild strain of Thailand) in Erlenmeyer flask. **a b**. partially covered by mycelium on sorghum after 10 days **c d**. fully covered by mycelium on sorghum after 20days.

Figure 55. Growth of mycelium of *A. subrufescens* CA918b (Wild strain of Thailand) after 38 days in baskets. **a c** fully covered by mycelium. **b d e f** partially covered by mycelium.

Figure 56. Harvest of *A. subrufescens* CA918b. **top raw** Basket no:4 **bottom raw** basket no:2 weight of harvest mentioned in right hand side.

Table 10 Harvest of *A. subrufescens* CA918b.

No. of Days after inoculation	Basket no:	No: of fruiting bodies	Weight
Day 48	4	1	13.72 g
Day 51	4	1	13.26 g
Day 52	4	2	25.86 g
Day 52	2	2	34.77 g
Day 54	1	3	64.56 g

1.2. Production *Agaricus subrufescens* hybrids on rice straw compost media

Agaricus subrufescens is cultivated artificially using compost fertilizer media, and new Thai-French and Thai-Brazilian hybrids have been introduced through the hybridization of *A. subrufescens*, at INRA in France. In this study, the harvesting of the newly introduced CA 918-075 × CA 487-100 (Thai-French hybrid strain) and CA 918-132 × CA 454-4 (Thai-Brazilian strain) on rice straw compost media, is being examined.

Materials and methods

Preparing spawn

Agaricus subrufescens Thai-French and Thai-Brazilian hybrids were grown in Potato dextrose agar (PDA) media. Sorghum were admitted to soak in tap water for a period of 24 hours. Then, they were sterilized for 20 minutes. PDA together with the mycelium was added to the sorghum. After growing in sorghum, the mycelium was placed in the sterilized compost media.

Preparing the growing media.

Mainly, the production of compost media was done using rice straw. Rice straws were facilitated with calcium carbonate, urea, rice bran, diammonium phosphate, gypsum and water; in appropriate time intervals, while the compost pile was turned periodically for the aeration process. The matured compost media were arranged and packed in containers, 5kg per each and were pasteurized for 6 hours maintaining the temperature level 45 – 50°C.

Compost media was prepared with 1% of the prepared spawn (temperature: 30.3 C/ relative humidity: 42%). Four baskets of Thai-French hybrid (TF1, TF2, TF3 and TF4), four baskets of Thai-Brazilian hybrid (TB1, TB2, TB3 and TB4) and four baskets (1, 2, 3 and 4) each including only compost media; were prepared. After spawning; steps baskets were observed and temperatures and relative humidity levels monitored in the mushroom growing house.

Preparing the casing layer

Soil fertilized with organic compounds, rough sand, and tap water were used in order to prepare the casing layer. The casing layer was prepared using organic soil 70%+ sand 30% + water (v/v). Subsequently the casing was applied and completely covered the mycelium growing mycelium and scratched to prevent overlaying.

Observations in 1st crop

The germination process commenced subsequently 2 days (26.2°C, 63%) after spawning. The relative growth of the Thai-French hybrid to the Thai-Brazilian hybrid was quicker. TF1, TF2 and TF4 were completely colonized, and the other spawn buckets were partially grown in 15 days (28.4°C, 56%) after spawning. Twenty-nine days (27.4°C, 68%) after spawning (after 8 days of placing the casing layer) TF 1, TF2, TF4, TB1 were entirely covered with the mycelium, and TF 3, TB 2, TB 3, TB4 were partially covered.

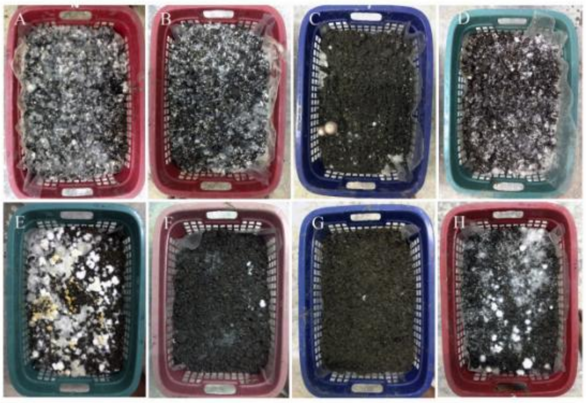


Figure 57. Mushroom trays (after 46 days from inoculation) A:TF1 CC, B:TF2 CC, C:TF3 NC Two fruiting bodies were observed, D:TF4 CC, E:TB1 CC, F:TB2 PC, G:TB3 NC, H:TB4 CC.

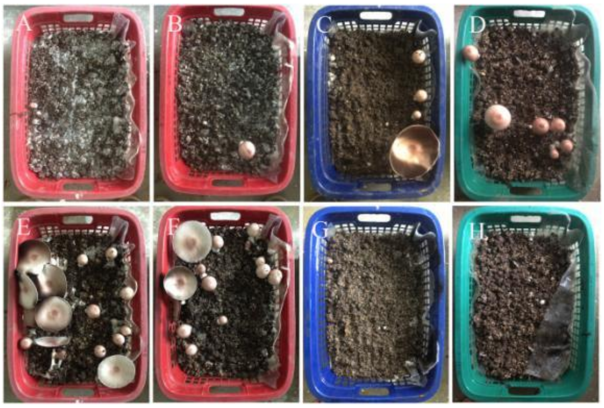


Figure 58. After 49 days from inoculation A:TF1, B:TF2, C:TF3, D:TF4, After 59 days from inoculation E:TF1, F:TF2, G:TF3, H:TF4

Figure 59. A: TF1 and TF2, B: Harvest of Thai-French hybrid after 59 days.
Abbreviations: CC, Completely covered by the mycelium; PC, Partially covered by the mycelium; NC, Not covered by the mycelium.

Data and calculations (Table 11)

Table 11 Data of day, number of fruiting bodies and weight

Days after inoculation	Number of fruiting bodies	Weight (g)
46	2	20.63
49	13	184.86
59	31	567.34
Total	46	772.83

Data were obtained for only one cropping cycle (Table 12)

Table 12 Data were obtained for only one cropping cycle

Data	Result
Total weight of compost	20 kg
Total weight of harvest	772.83 g
Yield per 1kg of compost	38.64 g/kg
Area of a tray	0.135 m^2
Total area of 4 trays	0.54 m^2
Yield per $1m^2$	1.4 kg/m^2

Observations in 2^{nd} crop

For the hybrids strains of *Agaricus subrufescens* have been introduced through the hybridization of *A. subrufescens*, by the INRA in France. In this studied were used rice straw based compost media were cultivated 3 crops that shown the strain CA918-076 x CA487-35 in the second crop had the highest yield with the yield 56.92 g (per kg of compost) were produced the fruiting bodies after inoculated 18 days in the controlled environmental in the room during cultivation at the temperature 25.2 ± 1.83 and humidity 93.0 ± 3.12 and strain CA918-076 x CA454-4 (TxB) with the yield 55.41 g (per kg of compost).In the first crop CA918-076 x CA454-4 (TxB) and CA918-075 x CA487-35 were produced the fruiting bodies after inoculated 53 and 42 days and with the yield 29.18 and 9.86 g (per kg of compost), respectively at the temperature 26.6 ± 0.98 and humidity 91.6 ± 2.34.

Figure 60. The fruiting bodies of 4 hybrid strains of *Agaricus subrufescens* were cultivated on the based compost media in Northern Thailand

Conclusion:

Both of *Agaricus subrufescens* Thai wild strain and hybrid strain can be successfully cultivated on compost media in Thailand.

2. Domestication of *Lepista sordida* on rice straw compost media

Lepista sordida (Schum.: Fr.) Sing is a kind of edible and medicinal mushroom. Two diterpenes named lepistal and lepistol were isolated from mycelial submerged culture with the activity to induce differentiation in human leukaemia cells (Mazur et al., 1996). The intracellular polysaccharides were also isolated from mycelial submerged show the antioxidant activities via noticeable scavenging activities on superoxide anion, hydroxyl radical and 2,2-diphenyl-1-picryl-hydrazyl (DPPH) radical (Zhong et al., 2013). Moreover three new 3, 6-dioxygenated diketopiperazines, lepistamides A–C as well as diatretol isolated from the mycelial solid cultures from fruiting bodies of *L. sordida* (Chen, Wu, Ti, Wei, & Li, 2011). Polysaccharides from the fruiting bodies of *L. sordida* have been more interested in recent year as it may has potential stimulate immune system such as hepatoprotective, anti-ulcer and antitumor (Qiao et al., 2009; Sun, 2011). Miao et al., 2013 have demonstrated a potential antitumor of polysaccharide from the fruiting bodies named LSPc1 on Hep-2 human laryngocarcinoma in vitro via mitochondrial caspase dependent pathway plays a very important role in LSPc1-induced cancer apoptosis. However, now a day there is no reports available in the literature regarding the cultivation isolation and structural elucidation of polysaccharides in both fruiting bodies and mycelial submerged culture of *L. sordida* from Thailand. Hence, our further work is isolation of bioactive compounds from fruit bodies and mycelial submerged culture of *L. sordida* Thai wild strain which has been already established as mushroom cultivatable as well as further optimisation yield production by using hybrid stain technologies.

Material and methods

Preparing the growing mycelium

Stock pure cultures of *Lepista sordida* which grew well on Potato Dextrose Agar (PDA) were used for this experiment.

Figure 61. *Lepista sordida*

Figure 62. Mother spawn

Preparing the spawn

Sterilized sorghum grains and seeds were prepared and inoculated with mycelium to prepare mother spawn (Figure 62)

Preparing the medium composition

Rice straw preparation

The rice straw as main substances is mixed with rice bran and additives (urea, ammonium phosphate and gypsum) to produce compost.

Saw dust preparation

Sawdust bags were prepared and autoclaved and inoculated with 3 g of fungus spawn in a laminar flow and placed in the mushroom growing room.

Results

The mycelium completely covered the contents of the bags but the mycelium did not produce any fruiting body and in the compost the mycelium can be produced the fruiting bodies (Figure 64).

Figure 63. The growth of mycelium in bags after 24 days and after 42 days in the baskets

Figure 64. The fruiting bodies of *Lepista sordida* were produced from the mycelium.

Conclusion:

Lepista sordida was grown in the both of sawdust in bag and compost media in the basket so, it can be successfully cultivated on compost media but in the sawdust bag the mycelium completely covered in the bags but the mycelium did not produce any fruiting body.

3. Optimal cultural conditions and cultivation of wild edible species of *Macrolepiota dolichaula*

Macrolepiota dolichaula is a terrestrial and saprophytic, known to grow solitary to scattered on the decay litter layer of the soil. It belongs to genus *Macrolepiota* in family Agaricaceae (Ge et al. 2010). It is widely distributed in China (Chi 1948), East Africa (Pegler 1977), Australia (Grguriuonic 1997), Vietnam (Yang 2000), India (Kumari and Atri, 2014) and Northern Thailand (Ge et al. 2010). The nutritional analysis carried out by (Kumari and Atri, 2014) on this mushroom showed that it is rich in protein, fiber, moisture and carbohydrate contents. It also contents appreciable quantities of phenolic, flavonoids and carotenoids. Alkaloid contents (0.103mg/g) of this mushroom are higher than Schizophyllum commune, Polyporus species (Qui and Lui 2000) and termitophilous mushrooms (Kumari and Atri 2012). The presence of alkaloids in the extract and relatively high protein and carbohydrates contents in *M.dolichaula* sample is an indication that this mushroom is of pharmacological importance (Stanield 1995) and good for human consumptions.

The purpose of this study is to provide the growth requirements including the methods used in optimizing cultural and cultivation conditions for domestication of wild tropical cultivable mushroom *Macrolepiota dolichaula*.

Materials and methods

Fungal collection and isolation and preparation media

Specimen was collected from Bandu Chiang Rai during rainy season. The morphological characters and the ecology of the mushroom was studied and recorded. Dried specimens were made and deposited in the herbarium, in Mae Fah Luang University. Code was obtained as "MFU-13-0517". A tissue was isolated from the core of the fruiting body and isolated on MEA (malt agar extract) medium for 8 days. Growth rate of mycelium was evaluated based on colony diameter, mycelial dry weight density every after 2 days for eight days. The experiment was conducted in triplicates.

Effects of media

Nine different media MEA (malt extract agar), CMA (corn meal agar), OMA (oat meal agar), PDA (potato dextrose agar), SDA (sabouraud dextrose agar), RBAE (rice bran agar extract), RSAE (straw agar extract), COAE (coconut agar extract), CAE (compost agar extract) were used to determine the mycelial growth of *M.dolichaula*. All the media used for the fungal isolation were sterilized at 15 psi for 15 minutes at 121ºC and were supplemented with amoxicillin (50mg/liter). Aseptically 25 ml of media was poured into each plate (9cm in diameter). A 6 mm diameter mycelia plug was removed from the edge of the colony (10days old) *M.dolichaula* culture grown on MEA and placed in the center of each agar plate containing the optimized media, then incubated at 30°C for 8 days. Colony morphology, colony diameter were recorded every after 2 days interval during incubation as fungal colony reached the edge of petridish (9 cm diameter) within 10 days. In addition the medium was melted and washed away with hot water, leaving the fungal mycelium, which was dried for 24 hours and weighed.

Effects of different temperature

The best medium was used for evaluation at different temperature (16°C, 18°C, 25°C, 30°C and 35°C). The fungal cultures were incubated for 8 days. The best temperature for promoting mycelial growth was identified by dry weight determination and colony diameter.

Effects of different pH for the mycelia growth

The best medium and the best temperature were used to determine the optimal pH. The pH 4, 5.5, 6, 7, 8 and 9 was adjusted with 1N HCl and 1N NaOH using pH Meter before autoclaving. All cultures were incubated at 30°C. The best pH for optimal mycelial growth was evaluated by dry weight determination and colony diameter every 2 days for 8 days.

The effects of different substrate for spawn production

The agricultural waste namely rice straw (RS), rice bran (RB), saw dust (SD), rice hull (RH), soybean (SB) and sorghum(S) were chopped and soaked in water over night and boiled in water at 80°C-100°C for 5-10 minutes. The excess water was removed by drying the substrate till the moisture content was at 60%. 40g of each substrate was transferred into 4 ounce media bottle. The bottles with media were sterilized at 121°C in 15 psi for 15 minutes. The substrates in the bottles were cooled and inoculated centrally with 9 mycelial plugs of approximately 6 mm removed from the edge of 10 days old culture. The culture was incubated at 30°C for 14 days. The growth rate was estimated from the linear expansion of mycelia growing through the medium every after 2 days and the mycelium density after 14 days. Inoculated bottles with each medium were used as control.

Substrate composition, mushroom cultivation and fructification

The main cultivation substrate for the production of fruiting bodies of this mushroom was the rice straw. Supplements like urea, calcium carbonate, calcium sulphate, and ammonium phosphate and rice bran were added. The second phase compost was sterilized at 60°C for 6 hours. Five kg of compost having pH of 7.5 and humidity 60-70% was used for spawning. The compost was inoculated with 2% spawn in relation to the weight of the compost and incubated at (25°C-30°C with relative humidity 70-80% for three weeks in the incubation room. After 3 week the mycelia fully covered the basket at 25°C to 30°C and 80-90%. 2.5cm of casing layer consisting of soil and nutrients having pH-7.2 was applied evenly after 21 days. The casing layer was fully covered by the mycelium after 10 days at 25-30°C and the primordial stage was seen after 36 days.

Result

Effects of cultural media on mycelial growth

In this study nine different media were selected, among the different cultural media, the best colony diameter as well as the mycelial dry density of *M. dolichaula* was observed when the isolates were grown on MEA (malt agar extract)

The effects of temperature on the mycelia growth of *M. dolichaula*

The optimum mycelia growth of *M. dolichaula* takes place at between 25ºC- 30°C. The growth of mycelium gradually increased proportionally to a rise in temperature to 30°C. However the statistical analysis indicated no significant difference in mycelia growth between 25°C-30°C.

Effects of pH on the mycelia growth

Among the various pH values selected for this studies (pH-4, 5.5, 6, 7, 8, 9), the optimum pH for the mycelial growth of *M. dolichaula* occurred at pH 7. However the statistical analysis indicated no significant difference in mycelial growth between pH (5.5, 6, 8 and 9). This result shows that mycelium of *M. dolichaula* can occur at wide range of pH (pH 5.5, 6, 7, 8, 9).

Growth of *M. dolichaula* on various agro wastes for inoculum production

The highest mycelia extension and mycelial density was observed in sorghum after two weeks. However the statistical analysis showed no significant difference between sorghum and soya bean. Sorghum and soya bean have larger surface area (Tinoco et al. 2001) compared to other substrates. Increase in ventilation within sorghum and soya bean result in improved respiration by the mycelia. Hence significantly higher mycelial growth and density was observed (Narh et al. 2011).

Fructification

For the fructification of *M. dolichaula* rice straw compost was prepared. The primordial were seen after two weeks of applying casing layer. After a week the primordial developed into mature fruiting bodies at 25°C-28°C in 90-95% humidity. The cropping period was started after 5-6 weeks at 25-30°C. The growing cycle lasted for 5 weeks, with the percentage yield of 30-40%. The mature fruiting bodies were collected and described and the descriptions were recorded. The maximum and minimum size of pileus was 25 cm and 6 cm in diameter respectively. The maximum length of the stipe was 25 cm long. Microscopic features e.g. basidia, ceilocystidia and spores were described in detail.

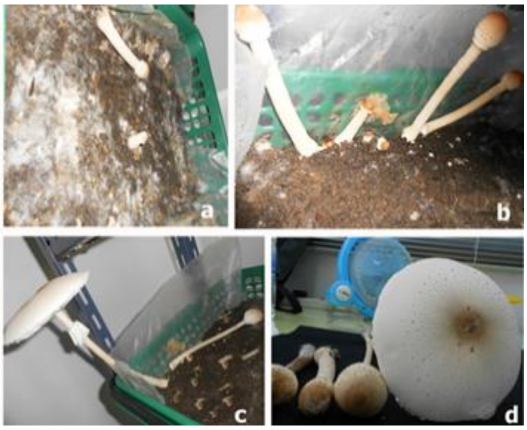


Figure 65. a. primordial stage, b. fruiting bodies in young stage, c. fruiting body in mature stage, d. harvested fruiting bodies.

Conclusion:

The optimum for the mycelium growth of *M. dolichaula* was grown on MEA media with pH range between pH 5.5-9 and incubated at 25-30˚C. Moreover, for the fructification of *M. dolichaula* can be successfully cultivated on compost media.

4. Culture condition, inoculum production and domestication of wild tropical strains of *Laetiporus sulphurous*

Table 13 Strains of *Laetiporus sulphureus*

No.	Mushroom species	MFLUCC cord
1.	*Laetiporus sulphureus*	MFLUCC 12- 0546
2.	*Laetiporus sulphureus*	MFLUCC 12- 0547

Material and Methods

Mushroom collection and mycelial cultivation

Wild mushrooms were collected from the Doi Mae Salong, Chiang Rai, Thailand. All specimens were examined under a compound microscope and descriptions based on macrocharacters. Pure cultures were isolated from the sterile internal fungal tissues, cut and removed to PDA medium**,** and incubated at 30°C. After 3 to 4 days, the agar surface was covered with a white mycelium as a pure culture. The cultures are deposited at Mae Fah Luang University Culture Collection (MFLUCC).

Results

First and second cultivations (Table 14)

Table 14 The result *Laetiporus sulphurous* cultivation

Strain	Result
L. sulphureus 1	**Compost:** Not successful **Sawdust:** When covering around 70% of the bag, they were contaminated
L. sulphureus 2	**Compost:** Not successful **Sawdust:** When covering around 70% of the bag, they became contaminated
G. applanatum (control)	**Compost:** Not successful **Sawdust:** Can produce the fruiting bodies

Figure 66. Time course the mycelial (a)- (c) the mycelia cover of *L. sulphureus* sp. (d)- (f) the mycelial cover the bags of *Ganoderma* sp. (g) immature of fruiting bodies at 1.2 months (h)- (j) Mature of fruiting bodies at 3 months.

Third cultivation (Table 15)

Table 15 Results of third *Laetiporus sulphurous* cultivation attempt

Strain	Results
Laetiporus sulphureus 1	**Sawdust:** mycelium did not grow well, but faster than the first time
Laetiporus sulphureus 2	**Sawdust:** mycelium did not grow well, but faster than the first time
Ganoderma applanatum (control)	**Sawdust:** mycelium grew very well

Figure 67. Time course the mycelial (a)- (c) the mycelia cover of *L. sulphureus* sp.1 (d)- (f) the mycelial cover the bags of *L. sulphureus* sp.1 (g)- (h) the mycelia cover of *Ganoderma* sp. (i) unplug the cover of *Ganoderma* sp. at 2 weeks.

Improvement of cultivation of wild tropical strains of *Laetiporus sulphurous.*

Four strains of mushrooms were used;

L. sulphureus 001 collected in 2012 (MFLUCC 12-0546)
L. sulphureus 002 collected in 2012 (MFLUCC 12-0547)
L. sulphureus 003 collected in 2013 (MFLUCC 13-0521)
Ganoderma sp. collected in 2012 (MFLUCC 12-0527)

Materials and Methods

Stock pure cultures

Laetiporus sulphureus and *Ganoderma* sp. were collected from Doi Mae Salong, Chiang Rai Thailand. The tissue was removed on the PDA medium, the plate were incubated at 30°C. Stock pure cultures were maintained on Potato Dextrose Agar (PDA) medium.

Spawn production

The grains of sorghum were cleaned manually to remove inert matter, stubble and debris. The cleaned grains were thoroughly washed and soaked in tap water for 18-24 hours. The cleaned dry grains were filled in to bottles and autoclaved two times under 121˚C for 15min. After cooling, the mycelia from the cultures with a piece of PDA medium were inoculated to sorghum grain medium. The grains invaded by mycelia were used as spawn after the mycelium invaded all over the grain medium inside the bottles.

Determination of spawn running

The growth of mycelium (linear length) in each bag was measured by a measuring ruler after 10 days intervals. Using this data, spawn run rate (cm/2 days) was determined for all the strains of mushrooms.

Sawdust substrate preparation: compositions of sawdust substrate

Table 16 The formula compositions of sawdust substrate

Treatment	Volume
Sawdust	100kg
Rick husk	250g
$CaCO_3$	200g
Gypsum	200g
EM solution (10 cc dilute with 200 ml of water)	30 cc
Rice bran	3 kg
Pumice	200g
Molasses solution (10 cc dilute with 200 ml of water)	30 cc

Treatment 1

The sawdust substrate was mixed thoroughly with water and the moisture content checked by squeezing substrate medium by hand. 700g of medium was filled into polypropylene bags, each bag was closed with plastic rings, tied with a rubber band and clean cotton plug placed on the top to prevent contamination and autoclaved under 121^{o}C, 15 psi, for 15 min. Approximate 25g of spawn was placed on surface under sterilized conditions and incubated in a dark chamber.

Treatment 2

According from the table, all of compositions were mixed thoroughly excepted rice husk, then sawdust substrate were mixed thoroughly with water and the moisture content checked by squeezing substrate medium by hand. 700g of medium was filled into polypropylene bags, and cover with 5g of rice husk, each bag was closed with plastic rings, tie with a rubber band and clean cotton plug on the top to prevent contamination, autoclaved under 121^{o}C, 15 psi, for 15 min. Approximately 25g of spawn was placed on the surface of the bags under sterilized condition and incubated in a dark chamber.

Results

Treatment 1

Figure 68. The sawdust substrate was incubated for 1 month. The spawn fully covered the surface of bag but the mycelial did not grown throughout the bag.

Treatment 2

All strain were inoculated for 15 days. In this composition, mycelia can grow better than in other compositions.

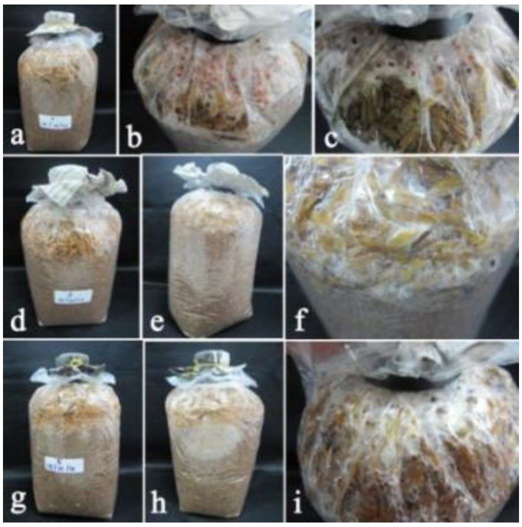


Figure 69. The mycelium were growth on the substrate after inoculated for 15 days. a-c. *L. sulphureus* strain MFLUCC 12-0546 d-f. *L. sulphureus* strain MFLUCC 12-0547 g-i. *L. sulphureus* strain MFLUCC 13-0521.

Figure 70. Time courses the fruiting bodies of *Ganoderma* sp. strain MFLUCC 12-0527 (control). (a)-(c) immature of fruiting bodies at 1.2 months, (d)-(e) mature of fruiting bodies at 3 months.

Conclusion:

The three *L. sulphureus* strain were cultivated in the sawdust bag with several formulas and methods in the results shown that in the treatment 1 and 2 (Figure 68 and 69) the mycelium can be grown fully covered the surface of bag but did not produce fruiting bodies and *Ganoderma* sp. was cultivated as a control.

5. Optimal condition to cultivation *Agaricus* sp. (new species) (Hedhomkaw)

Material and methods

In this examination was used *Agaricus* culture code MFLU 13-0116

Find out suitable media of *Agaricus* sp.

Find out the best media for growth on compost extract agar, PDA (Potato dextrose agar), MEA (Malt extract agar), OMA (Oat malt agar), CMA (Corn milk agar), CBM (Complex basal media), and MS (Mulasaki and Skoog) then sub culture mycelium in the media and all cultures were incubated at 25 °C for 25 days.

Find out pH and temperature of *Agaricus* sp.

Test the pH in substrate for find range of pH to test the pH effect to the mycelium growth. pH in the soil then use pH nearly point to growing mycelium. pH at the soil is 5 and then use pH for test as 4, 5, 6, and 7 in this test adjust pH in the media by 1H HCL and 1N KOH. Subculture on PDA media then keeps incubated at 25 °C for 28 days observe every 7 days.

Find out Carbon and Nitrogen source

Test carbon use Fructose, Glucose, Galactose, Malt extract (3% w/v each C source), Nitrogen source use KNO3, Peptone, Yeast extract (3.55% w/v each N source) and then adjust pH 6 with 1N HCl and 1N KOH. Incubated at 30°C check the mycelium growth every 5 days for 25 days.

Find out suitable grain media.

Preparation grain media

Grain media use 5 type barley, bean, millet, rice husk and sorghum. The grains clean dust and bad seeds then soak overnight (12 hour). Grain media boil 10-15 minute until seed shell broken or seed soft when squeeze it. After that dry it's until without water then fill to bottle size 6 oz for 50 grams. Sterilize at 121 C pressure 15 lbs per sq. inch for 20 minute.

Inoculation culture to spawn

Myceliums of Agaricus sp. (Hed Hom Kaw) on PDA adjust pH 6 add fructose: yeast extract ratio 1:1 incubated at 30 °C 20-30 days. Subculture the mycelium section 4 prices per plate, use 1 price of mycelium put in to the grain bottle in the middle of bottle. Spawn incubated at 30 °C in the dark and diameter every 3 days.

The mycelium in difference grain media growing very slowly in millet and sorghum, cannot grow in rice, growing fast in barley and kidney beans, but the best one for mycelium was growth barley it can grow 3 cm while kidney beans can grow only 2 cm

Inoculate spawn to compost basket

Compost basket 5 kg per basket and inoculated with 2% of spawn. Mix well spawns together with compost. Cover surface of compost with plastic bag and kept the basket in the mushroom growing house.

Conclusion:

In this experiment *Agaricus* sp. (Hedhomkaw) was suitable to grow on PDA media incubated at temperature between 30-35 °C, add carbon source is fructose and nitrogen source is peptone. The best grain media for *Agaricus* sp. is barley media. For cultivation could not get the fruiting bodies.

6. Optimal culture conditions for the cultivation of *Clitopilus* sp. strain MFLUCC 13-0809

Material and methods

The collection and fungal isolates

Clitopilus sp. strain MFLUCC 13-0809 was collected from Chiang Mai, Thailand. The mycelium was grown on potato dextrose agar (PDA) and incubated at 25 C˚ for 10 days. Tissue of pure culture was deposited in Mae Fah Luang Culture collection (MFLUCC). Dried specimens were deposited in the Mae Fah Luang University herbarium.

Suitable condition for growing mycelium

Effect of media

A mycelium plug of Clitopilus sp. strain MFLUCC 13-0809. Grow on PDA for 10 days. It was grow on five difference media including potato dextrose agar (PDA), malt extract agar (MEA), corn meal agar (CMA), sabouraud dextrose agar (SDA), yeast extract malt extract agar (YMA). All cultures were incubated at 25 C˚. Colony radial growth rate and dry weight were measured every 3 day for 12 days.

Effect of temperatures

SDA media plates were inoculated with 0.5 mm in diameter of mycelium plug for determining growth on a range of temperature. All cultures were incubated at 20, 25, 30 and 35 C˚. Colony radial growth rate and dry weight were measured every 3 day for 12 days.

Effect of pH

The pH of SDA media for mycelial growth were adjusted separately to pH4, pH 5, pH 6 , with 1N HCL and pH 7 and pH 8 , with 1N NaOH. Each pH were inoculated with 0.5 mm in diameter of mycelium plug. All cultures were incubated at 25 °C. Colony radial growth rate and dry weight were measured every 3 day for 12 days

Growth of *Clitpilus* sp. on based compost media

The spawn was prepared by using sorghum and they were inoculated by strains of *Clitopilus* sp. Also one strain of *Clitopilus* sp. in the compost was completely colonized with the mycelium then was covered with the pasteurized soil casing layer

Figure 71. The compost was completely colonized with the mycelium then was covered with the pasteurized soil casing layer

Improvement of *Clitopilus* sp. strain MFLUCC 13-0809

The compost formula was adjust after finished in the process. The compost was transferred in to the bag and inoculated by mother spawn, then inoculated bag was incubated at 28 ˚C and observation and record data. Figure ()

Figure 72. a) Compost was inoculated by spawn b) The mycelium were growth on the substrate after inoculated for 10 days

Conclussion:

In this study on the different cultural media the growth of mycelium was determined as well as the mycelial dry density of *clitopilus* sp. The mycelium was grow best on SDA at between 20˚C – 35 ˚C with the pH7 – pH8. For the cultivation both of in the basket and bag can't successful to get the fruiting body.

7. Cultivating new species of *Auricularia* on sawdust and wood logs.

Cultivating on sawdust media
Materials and Methods

Following components were mixed together and water was added into the mixture.

Sawdust, Rice bran, Brewer's yeast, Pumice, Calcium carbonate, Molasses, Effective microorganisms. Then mixture was filled into plastic bags and ends were covered by cotton. Next bags were autoclaved 121 ^{o}C, 15 atm at 20 minutes. Spawns were inoculated after 24 hours. Inoculated sawdust bags were placed on racks and incubated.

Results:

Figure 73. a *Auricularia thailandica* growing in sawdust bags **b.** close up of growing primodia of *Auricularia thailandica*.

8. Developing *Agaricus bisporus* strain, which can fructify at 25˚C by hybridizing three warm temperature *A. bisporus* strains.

Agaricus bisporus (J.E. Lange) Imbach known as table mushroom or button mushroom is the most cultivated and consumed edible mushroom throughout the world (Giri & Prasad, 2007). It is a leaf litter white rotting edible basidiomycete fungus, which naturally occurs in grasslands, fields and meadows across Europe and North America (Jagadish et al., 2009). It contributes about 40% of the total world production of mushroom (Largeteau et al., 2011). *A. bisporus* could be considered as a functional food with antitumor (Adams et al., 2007) antiproliferative (Yu et al.,1999) antimicrobial and anti-oxidative activity (Jagadish et al., 2009). It can be found boiled on pizzas and casseroles, stuffed mush- rooms, raw on salads, and in various forms in a variety of dishes.

Button mushroom has been grown in caves at 14-16 ˚C during two centuries. Since the 1980s, artificial growing houses replace caves, and cultivation conditions are standardized. A 16-19 ^{0}C temperature is recommended during the fruiting period. Although *A. bisporus* is the most cultivated edible fungus worldwide, its potential ability to fruit at higher temperature has received little attention except two studies. Wang et al., (2003, 2004), Umar & Van Griensven

(2000). In tropical countries such as Thailand climatic chambers are required for cultivating *A. bisporus*. Inside these chambers mushroom has been growing under controlled conditions. Cost of production *A. bisporus* is high due to maintnce controlled conditions. High selling price is restricted consumption of button mushroom and therefore it is a luxury food. In this project we are trying to develop *A. bisporus* strain can be fructify at 25 ^{0}C by hybrding three *A. bisporus* varieties. In here *A. bisporus* var. *burnettii* (tetrasporic variety) from Sonoran desert in the Coachella Valley in USA will be hybridized with two bisporic varieties of *A. bisporus* var. *bisporus* from Greece and Iran.

Agaricus bisporus California tetrasporic strain, Greece and Israel bisporic strains are being hybridized. The first step of this experiment is to obtaining fruiting bodies from three strains in order to produce spores (Table 17). *A. bisporus* strains were obtained from INRA (Bordeaux, France.). Preparation of subcultures and spawn from these strains on compost and agar media have already been finished, and it is expected to inoculate these spawns to the compost media in the next month.

Table 17 Collected locations and the types of the *Agaricus* strains grown for hybridization.

Species	Strain	Tropical countries
Agaricus bisporus	Tetrasporic	California
Agaricus bisporus	Bisporic	Greece
Agaricus bisporus	Bisporic	Israel

Materials and Methods

Agaricus bisporus var. *burnettii* will be grown in compost media and fruiting bodies will be obtained at 25 C. Spores will be collected via spore prints. Spores will allow to be germinating in complete medium and germinated spores will be isolated using single spore isolation technique. Isolated spores (homokariyons) will be grown in compost extract agar. Among them 8 homokariyons will be selected randomly. Homokariyons with MAT1 and MAT2 allele will be selected through matting test of selected homokariyons. After select 2 different matting types of tetrasporic homokariyons spawns will be prepared using them. The spores of other two *A. bisporus var. bisporus* strains (Greece and Israel) will be inoculated to spawn of tetrasporic homokariyons separately. Then spawns will be inoculated in to compost and will be incubated at 25 ˚C. Fruiting bodies will be obtained. Fruiting bodies will be analysed using suitable molecular markers to confirm hybrids.

Work plan of the experiment.

Key Steps of the experiment	Tasks	Progress
1. Obtain parental homokariyons of *A. bisporus* California tetrasporic strain. (Parental strain I)	1.1. Isolate *A. bisporus* California tetrasporic strain from natural basidiomata and subculture in an artificial growth media.	Done. Code of isolate: Bs 738.
	1.2. Inoculate Bs 738 to grain media for preparing spawns.	Done.

	1.3. Inoculate Bs 738 spawns to compost media.	Done
	1.4. Obtain *A. bisporus* California tetrasporic basidiomata and get the spore print of it.	Done
	1.5. Select two sexually compatible homokariyons by matting tests.	Done
2. Obtain spore print of *A. bisporus* Greece (Parantal strain II) and Israel (Parantal strain III) bisporic strains.	2.1. Isolate *A. bisporus* Greece and Israel bisporic strain from natural basidiomata and subculture in an artificial growth media.	Done. Code of isolates: Bs 661 (Greece strain) and Bs 586 (Israel strain)
	2.2. Inoculate Bs 661 and Bs 586 to grain media for preparing spawns.	Done
	2.3. Inoculate Bs 661 and Bs 586 spawns to compost media.	Done
	2.4. Obtain *A. bisporus* Greece (Bs 661) and Israel (Bs 586) bisporic basidiomata and get the spore print of it.	On going
3. Cross between Parental strains I × II and I × III.	3.1. Preparing spawns of two homokariyons of Bs 738 on grain media.	
	3.2. Spores of Bs 661 and Bs 586 mix with Bs 738.	
	3.3. Inoculate spores+spawns mixture to compost media.	
	3.4. Obtain *A. bisporus* hybrid basidiomata.	
4. Confirmation test and publications.	4.1. Confirm hybrids using suitable genetic markers.	
	4.2. Publish results of the experiment.	

Results:
For preparing spawns of selected homokariyons of Bs 738, were sub cultured on CEA.

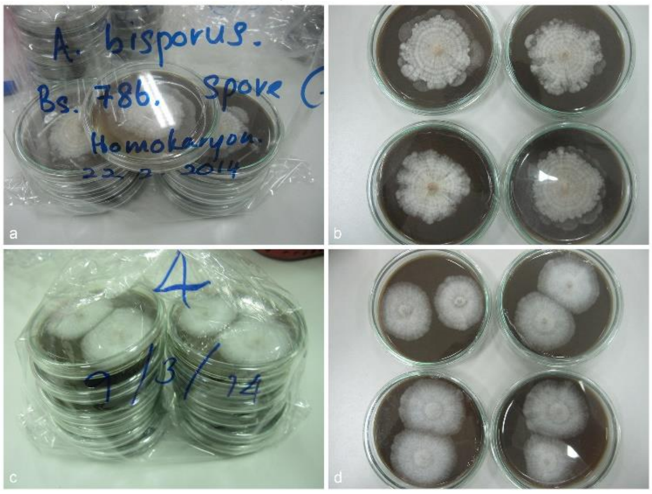


Figure 74. a b isolated homokaryon (spore no:5) growing on CEA. c d isolated homokaryon (spore no:4) growing on CEA.

Two other *A. bisporus* strains (Bs 586 & Bs 661) were also sub cultured on CEA and spawns were prepared on sogum.

Figure 75. a b spawns of Bs 586 (Israel bisporic stain). c d Bs 661 (Greece bisporic strain) on compost extract agar (CEA).

Problems and modifications:

In this experiment upto to step 2.3. in table 1 has successfully completed. But obtain *A. bisporus* Greece (Bs 661) and Israel (Bs 586) bisporic basidiomata is a problematic due to contamination of compost.

Following modifications were done to avoid contamination of compost.

1. **Increase the time and number if terms of sterilization of compost.**

Generally compost is sterilized one time at 60^{o} C—70^{o} C, 3 hours. We increased the time up to 4 to 6 hours. Also we sterilized compost consecutively 2 times.

Results: This step didn't help to avoid contaminations.

2. **In door small scale composting using artificial compost fermenter.**

Materials and Methods:

Rice straws were cut into small pieces (3-8 cm). They were soaked 24 hours in tap water. Kept another 24 hours to get drained. Moisture content of drained straws was measured according to Nielsen (2003). Following materials were mixed together and filled in to three separate chambers. Rice straw, Calcium carbonate 1% , Urea - 1%, Rice bran -5%, Di ammonium phosphate (18:46:0) 2%, Gypsem (Calcium sulphate) 3 %. Hot water constantly supplied into fermenter to maintain constant temperature in rice straw.

Results: In this fermenter, airflow was not occurred properly. Due to this compost was contaminated by anaerobic fungi.

3. **Spawns of two *Agaricus bisporus* strains (Bs 661 and Bs 586) were prepared and this step is doing repeatedly.**

Results: Due to the contamination of compost this method didn't show success.

4. **Direct inculcation of mycelium to compost.**

Materials and Methods:

A. bisporus (Bs 661, Bs 586) ware subcultured in compost extract agar in 90 mm petri dishes. After fully grown mycelium was directly inoculated to compost (without preparing spawns) in small scale boxes which contained sterilized compost 1kg.

Figure 76. Small-scale trays which contained 1kg of compost are prepared and incubation in temperature controlled incubator at 25^{o} C.

Results: waiting for results.

Appendix B

Table of total publications
Published/in press (Submitted)/in prep

Table of publications

No.	Publications	SCI imfact factor	Number of citations
Published			
1	Mortimer PE, **Karunarathna SC**, Li QH, Gui H, Yang XQ, Yang XF, He J, Ye L, Guo JY, Li HL, Sysouphanthong P, Zhou DQ, Xu JC, **Hyde KD**. 2012. Prized edible Asian mushrooms: ecology, conservation and sustainability. Fungal Diversity. 56(1): 31-47	**IF = 5.319**	**16**
2	**Thongbai B**, Surup F, Mohr K, Kuhnert E, **Hyde KD**, and Marc Stadler M, 2013. Gymnopalynes A and B, Chloropropynyl-isocoumarin Antibiotics from Cultures of the Basidiomycete *Gymnopus* sp, Journal of Natural Products 76: 2141-2144.	**IF = 3.798**	**6**
3	Silva D, Rapior S, Sudarman E, Stadler M, Xu J, Alias SA, **Hyde KD**, 2013. Bioactive metabolites from macrofungi: ethnopharmacology, biological activities and chemistry. Fungal Diversity 62:1–40.	**IF = 6.938**	**13**
4	**Wisitrassameewong K**, Nuytinck J, **Hyde KD** and Verbeken. 2014. A, *Lactarius* subgenus *Russularia* (Russulaceae) in Southeast Asia: 1. Species with very distant gills. Phytotaxa 158 (1): 023–042.	**IF = 1.376 (2013 / 2014)**	**3**
5	**Karunarathna SC**, Guinberteau J, **Chen J**, Vellinga EC, Zhao RL, **Chukeatirote E**, **Hyde KD** and Callac P. 2014. Two new species in *Agaricus* Tropical clade I. Chiang Mai J. Sci. 41(4): 771-780.	**IF = 0.371**	**3**
6	**Thongklang N**, Hoang E, Estradac AER, Sysouphanthonga P, Moinardb M, **Hyde KD**, Kerrigand RW, Foulongne-Oriolb M and Callac P. 2014. Evidence for diverse amphithallic lifestyles and broad geographical hybridization potential among *Agaricus subrufescens* isolates from Brazil, France and Thailand. Fungal Biology 118: 1013-1023.	**IF = 2.13**	**0**
7	**Thongklang N**, Nawaz R, Jie Chen J, Zhao R, **Hyde KD**, Khalid AN, Parra L, Hanif M and **Callac P**. 2014. Morphological and molecular characterization of three *Agaricus* species from tropical Asia (Pakistan, Thailand) reveals in section *Xanthodermatei*. Mycologia. 106(6) : 14-76.	**IF = 2.218**	**1**
8	**Thawthong A**, Karunarathna SC, Thongklang N, Chukeatirote E, Kakumyan P, Chamyuang S, Leela Rizal LM, Mortimer PE, Xu J, Callac P and **Hyde KD**. 2014. Discovering and domesticating wild tropical cultivatable mushrooms. Chiang Mai J. Sci. 41(4). 731-764.	**IF = 0.371**	**4**
9	**Luangharn T, Hyde KD,** Chukeatirote E. 2014. Proximate Analysis and Mineral Content of *Laetiporus sulphureus* Strain MFLUCC 12-0546 from Northern Thailand. Chiang Mai J. Sci. 41(4). 765-770.	**IF = 0.418**	**1**
10	**Guo J**, Mortimer PE, Karunarathna SC, Xu J, **Hyde KD**, 2014. Phylogenetic diversity of *Russula* from Xiao-Zhongdian, Yunnan, China, inferred from Internal Transcribed Spacer sequence data. Chiang Mai J. Sci. 41(1): 34-45.	**IF = 0.371**	**1**

No.	Publications	SCI impact factor	Number of citations
11	**Li H**, Mortimor PE, Karunarathna SC, Xu J, **Hyde KD**, 2014. New species of *Phallus* from a subtropical forest in Xishuangbanna, China. Phytotaxa 163 (2): 91–103.	**IF = 1.376 (2013 / 2014)**	**0**
12	**Ye L**, Mortimer PE, Xu J, Karunarathna SC, **Hyde KD**, 2014. The genus *Phylloporus* (Boletaceae, Boletales), from Mekong river basin (Yunnan Province, China), Chiang Mai J. Sci. 41(1): 45-55.	**IF = 0.418**	**0**
13	**Bandara AR,** Rapior S, Bhat DJ, Kakumyan P, Chamyuang S, Hyde KD. 2014. *Polyporus umbellatus*, a medicinal mushroom with multiple developed health-care products as food, medicine and cosmetic. Cryptogamie Mycologie 36(1): 3-42.	**IF = 1.15**	**0**
14	**Thongklang N,** Sysouphanthong P., Callac P. & **Hyde K.D.** 2014. First cultivation of *Agaricus flocculosipes* and a novel Thai strain of *A. subrufescens*. Mycosphere, 5 (6), 814–820.	**SCI**	**-**
15	**Klomklung N**, Karunarathna SC, Chukeatirote E and Hyde KD, 2014. Optimal conditions of mycelia growth of three wild edible mushrooms from northern Thailand. Acta Biologica Szegediensis. 58(1). 39-43.	**-**	**-**
16	**Luangharn T**, Karunarathna SC, **Hyde KD** and Chukeatirote E. 2014. Optimal conditions of mycelia growth of *Laetiporus sulphureus* sensu lato. Mycology. 5(4). 221-227.	**-**	**-**
17	Wisitrassameewong K, Nuytinck J, Hampe F, **Hyde KD**, Verbeken A. 2014. *Lactarius* subgenus *Russularia* (Russulaceae) in South-East Asia: 2. Species with remarkably small basidiocarps. Phytotaxa. 188(4): 181-197.	**IF = 1.376 (2013 / 2014)**	**1**
18	**Chen J**, Zhao R, Parra LA, Guelly AK, Kesel AD, Rapior S, **Hyde KD**, Chukeatirote E, Alva P and Callac P, 2015. *Agaricus* section *Brunneopicti*: a phylogenetic reconstruction with description of five new taxa. Phytotaxa 192(3): 145-168.	**IF = 1.376 (2013 / 2014)**	**1**
19	Surup F, **Thongbai B,** Kuhnert E, **Hyde KD**, Stadler M. 2015. Deconins A-E: Cuparenic and Mevalonic or Propionic Acid Conjugates from the Basidiomycete *Deconica* sp. 471. Journal of Natural Products. 78: 934-938.	**IF = 3.798**	**0**
20	**Bandara AR**, Chen J, Karunarathna S, **Hyde KD** & Kakumyan P. 2015. *Auricularia thailandica* sp. nov. (*Auriculariaceae, Auriculariales*) a widely distributed species from Southeastern Asia. Phytotaxa, 208(2), 147-156.	**IF = 1.376 (2013 / 2014)**	**0**
21	Wang ZR, Parra LA, Callac P, Zhou JL, Fu WJ, Dui SH, **Hyde KD**, Zhao RL. 2015. Edible species of *Agaricus* (Agaricaceae) from Xinjiang Province (Western China). Phytotaxa. 202(3): 185-197.	**IF = 1.376 (2013 / 2014)**	**0**

No.	Publications	SCI impact factor	Number of citations
22	Liu JK, **Hyde KD**, Jones EBG, Ariyawansa HA, Bhat DJ, Boonmee S, Maharachchikumbura SSN, McKenzie EHC, Phookamsak R, Phukhamsakda C, Shenoy BD, Abdel-Wahab MA, Buyck B, Chen J, Chethana KWT, Singtripop C, Dai DQ, Dai YC, Daranagama DA, Dissanayake AJ, Doilom M, souza MJD, Fan XL, Goonasekara ID, Hirayama K, Hongsanan S, Jayasiri SC, Jayawardena RS, **Karunarathna SC**, Li WJ, Mapook A, Norphanphoun C, Pang KL, Perera RH, Peršoh D, Pinruan U, Senanayake IC, Somrithipol S, Suetrong S, Tanaka K, Thambugala KM, Tian Q, Tibpromma S, Udayanga D, Wijayawardene NN, Wanasinghe D, Wisitrassameewong K, Zeng XY, Abdel-Aziz FA, Adamčík S, Bahkali AH, Boonyuen N, Bulgakov T, Callac P, Chomnunti P, Greiner K, Hashimoto A, Hofstetter V, Kang JC, Lewis D, Li XH, Liu XZ, Liu ZY, Matsumura M, Mortimer PE, Rambold G, Randrianjohany E, Sato G, Sri-Indrasutdhi V, Tian CM, Verbeken A, Brackel WV, Wang Y, Wen TC, Xu JC, Yan JY, Zhao RL & Camporesi E. 2015. Fungal diversity notes 1 – 110: taxonomic and phylogenetic contributions to fungal species. Fungal Diversity (2015) 72:1 – 197.	**IF = 6.221**	**5**
23	Wisitrassameewong K, Nuytinck J, Le HT, De Crop E, Hampe F, **Hyde, KD**, Verbeken A. 2015. *Lactarius* subgenus *Russularia* (Russulaceae) in South-East Asia: 3. new diversity in Thailand and Vietnam. Phytotaxa. 207(3). 215-241.	**IF = 1.376 (2013 / 2014)**	**1**
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Prized edible Asian mushrooms: ecology, conservation and sustainability

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Abstract Mushrooms can be found in forests worldwide and have long been exploited as resources in developed economies because of their important agro-industrial, medicinal and commercial uses. For less developed countries, such as those within the Greater Mekong Subregion, wild harvesting and mushroom cultivation provides a much-needed alternative source of income for rural households. However, this has led to over-harvesting and ultimately environmental degradation in certain areas, thus management guidelines allowing for a more sustained approach to the use of wild mushrooms is required. This article addresses a selection of the most popular and highly sought after edible mushrooms from Greater Mekong Subregion: *Astraeus hygrometricus, Boletus edulis, Morchella conica, Ophiocordyceps sinensis, Phlebopus portentosus, Pleurotus giganteus, Termitomyces eurhizus, Thelephora ganbajun, Tricholoma matsuake,* and *Tuber indicum* in terms of value, ecology and conservation. The greatest threat to these and many other mushroom species is that of habitat loss and over-harvesting of wild stocks, thus, by creating awareness of these issues we wish to enable a more sustainable use of these natural products. Thus our paper provides baseline data for these fungi so that future monitoring can establish the effects of continued harvesting on mushroom populations and the related host species.

Keywords Mushroom species · Greater Mekong Sub-region · Medicinal foods · Non-timber forest products

Introduction

Mushrooms are highly prized for their value as nutritional (Chang and Buswell 1996; Chang and Miles 2004; Carlile and Watkinson 1994) and medicinal foods (Chang and

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Note

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Gymnopalynes A and B, Chloropropynyl-isocoumarin Antibiotics from Cultures of the Basidiomycete *Gymnopus* sp.

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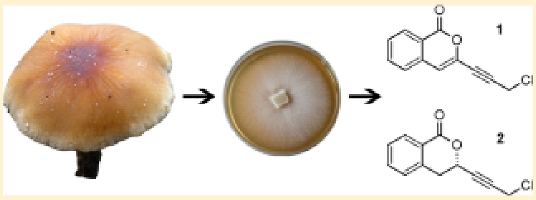
Supporting Information

ABSTRACT: A chlorinated isocoumarin with an acetylenyl side chain and its 3,4-dihydro derivative, named gymnopalynes A (**1**) and B (**2**), were isolated from cultures of a basidiomycete originating from the rain forest of Northern Thailand. The producing organism was identified as a species of *Gymnopus* (Marasmiaceae). Their structures were elucidated by spectroscopic methods including UV/vis and NMR spectroscopy as well as high-resolution mass spectrometry as 3-(3-chloroprop-1-yn-1-yl)-1*H*-isochromen-1-one (**1**) and 3-(3-chloroprop-1-yn-1-yl)-3,4-dihydro-1*H*-isochromen-1-one (**2**). The absolute stereochemistry of **2** was assigned as *S* by CD spectroscopy. Both compounds showed weak to moderate antimicrobial and pronounced cytotoxic activities.



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Bioactive metabolites from macrofungi: ethnopharmacology, biological activities and chemistry

Dilani D. De Silva · Sylvie Rapior · Enge Sudarman · Marc Stadler · Jianchu Xu · S. Aisyah Alias · Kevin D. Hyde

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Abstract Exploration of natural sources for novel bioactive compounds has been an emerging field of medicine over the past decades, providing drugs or lead compounds of considerable therapeutic potential. This research has provided exciting evidence on the isolation of microbe-derived metabolites having prospective biological activities. Mushrooms have been valued as traditional sources of natural bioactive compounds for many centuries and have been targeted as promising therapeutic agents. Many novel biologically active compounds have been reported as a result of research on medicinal mushrooms. In this review, we compile the information on bioactive structure-elucidated metabolites from macrofungi discovered over the last decade and highlight their unique chemical diversity and potential benefits to novel drug discovery. The main emphasis is on their anti-Alzheimer, anti-diabetic, anti-malarial, anti-microbial, anti-oxidant, anti-tumor, anti-viral and hypocholesterolemic activities which are important medicinal targets in terms of drug discovery today. Moreover, the reader's attention is brought to focus on mushroom products and food supplements available in the market with claimed biological activities and potential human health benefits.

Keywords Medicinal mushrooms · Anti-oxidant · Anti-tumor · Anti-HIV · Anti-microbial · Anti-viral · Hypocholesterolemic · Anti-diabetic · Anti-Alzheimer · Anti-malarial · Food supplements

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Lactarius subgenus *Russularia* (Russulaceae) in Southeast Asia: 1. Species with very distant gills

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Abstract

This article introduces four new species of *Lactarius* subgenus *Russularia* from Southeast Asia with descriptions and illustrations of macromorphological and microscopic characters. *Lactarius laccarioides* and *L. sublaccarioides* were discovered in Northern Thailand, and *L. pasohensis* and *L. stubbei* in Malaysia. These four species share some striking macroscopic features that are unique in the subgenus: distant gills and a very thin-fleshed and deeply striate to sulcate pileus, which gives them the aspect of *Laccaria* species in the field. Molecular analysis of the ITS gene region shows that these four species are not as closely related within *Lactarius* subgenus *Russularia* as their similar appearance in the field would suggest.

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Two New Species in *Agaricus* Tropical Clade I

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ABSTRACT

As part of our efforts to study the saprobic mushrooms in Asia we have collected numerous taxa of the genus *Agaricus* in northern Thailand. It is likely that more than 40 new species occur in this region and many are potentially edible or medicinal. A recent phylogenetic study revealed that most species of this region belong to exclusively tropical clades of which the largest one, TR I, was suspected to represent section *Brunneopicti*. In this paper we introduce two new species as *Agaricus chiangmaiensis* and *A. megacystidiatus* based on fresh collections in addition to collections previously classified in two putative species of clade TR I. The new species are described and illustrated with line drawings and photographs and compared with similar taxa. *Agaricus chiangmaiensis* shows affinities with *A. brunneopictus*. However, taxonomical investigation on more species will be necessary to characterize the clade TRI and to clarify to what extend it would represent the section *Brunneopicti*.

Keywords: biodiversity, edible, taxonomy, tropics

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Evidence for amphithallism and broad geographical hybridization potential among *Agaricus subrufescens* isolates from Brazil, France, and Thailand

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ABSTRACT

Agaricus subrufescens is a cultivated edible and medicinal mushroom. Its known geographical distribution encompasses the Americas, Europe, Oceania, and Asia. The objective of this study was to assess mating compatibility and interfertility of strains originating from Brazil, France, and Thailand. Progeny of each strain were analyed with codominant molecular markers. Multilocus genotype tests revealed that the three strains were amphithallic with percentages of heterokaryotic single spore progenies of 75 % for the Thai strain and around 40 % for the Brazilian and French strains. In mating tests *A. subrufescens* had a multiallelic unifactorial system of sexual incompatibility. The three parent strains were interfertile based on experimental pairings of single-spore isolates, the recovery of hybrid heterokaryons from compatible matings, and the ability of hybrids to produce mushrooms and fertile spores. This biological approach supports the inclusion of the European strains within the species and the extension of the geographical distribution range to Asia. Our data should help to develop breeding strategies and to better manage and exploit the diversity existing in *A. subrufescens*.

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Morphological and molecular characterization of three *Agaricus* species from tropical Asia (Pakistan, Thailand) reveals a new group in section *Xanthodermatei*

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Abstract: The genus *Agaricus* is known for its medicinal and edible species but also includes toxic species that belong to section *Xanthodermatei*. Previous phylogenetic reconstruction for temperate species, based on sequence data of nuc rRNA gene (rDNA) internal transcribed spacers (ITS), has revealed two major groups in this section and a possible third lineage for *A. pseudopratensis*. Recent research in *Agaricus* has shown that classifications need improving with the addition of tropical taxa. In this study we add new tropical collections to section *Xanthodermatei*. We describe three species from collections made in Pakistan and Thailand and include them in a larger analysis using all available ITS data for section *Xanthodermatei*. *Agaricus bisporiticus* sp. nov. and *A. fuscopunctatus* sp. nov. are introduced based on molecular and morphological studies, whereas *A. microvolvatulus* is recorded for the first time in Asia. Specimens from Thailand however have a much larger pileus than the type specimens from Congo. In maximum likelihood (ML) and maximum parsimony (MP) phylogenetic analyses these three species cluster with *A. pseudopratensis* from the Mediterranean area and *A. murinocephalus* recently described from Thailand. In *Agaricus* section *Xanthodermatei* this new group is monophyletic and receives low bootstrap support whereas the two previously known groups receive strong support. Within the new group, the most closely related species share some traits, but we did not find any unifying morphological character; however the five species of the group share a unique short nucleotide sequence. Two putatively toxic species of section *Xanthodermatei* are now recognized in Pakistan and six in Thailand.

Key words: basidiomycota, morphology, new species, phylogeny, tropical biodiversity

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Introduction

Agaricus L. is a genus of saprobic fungi of the order Agaricales that includes species of nutritional and medicinal interest, such as the button mushroom (*A. bisporus* [J.E. Lange] Imbach) and the almond mushroom (*A. subrufescens* Peck, syn. *A. blazei* sensu Heinemann; Wisitrassameewong et al. 2012). Zhao et al. (2011) recognized 386 species in genus *Agaricus*; this number now exceeds 400 in that at least 23 novel species were described from Europe (Parra et al. 2011, Parra 2013), Thailand (Chen et al. 2012; Zhao et al. 2012, 2013) and Australia (Lebel and Syme 2012, Lebel 2013). Although almost half of these 400 species are tropical it remains certain that many more undescribed species are present than in temperate areas. For instance we have collected more than 50 new species in Thailand that are waiting further study and formal description (Zhao et al. 2011). This is also probably the case in Pakistan where only 20 species of *Agaricus* have been recorded so far (Ahmad et al. 1997, Sultana et al. 1997).

Because *Agaricus* is a familiar genus whose species are collected for consumption, it is important to know which species could be toxic. All or most of the toxic species of the genus belong to *Agaricus* sect. *Xanthodermatei* Singer. Members of this section are

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Contributed Paper

Discovering and Domesticating Wild Tropical Cultivatable Mushrooms

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ABSTRACT

Tropical regions have the potential to be one of the richest sources of cultivatable fungal species. Even though there has been considerable research on the taxonomy and phylogeny of these mushrooms, there has been far less research on their domestication. The purpose of this paper is to review and detail the methods we have used for the discovery and domestication of wild tropical mushrooms. As it is difficult to cultivate mycorrhizal species we have mainly concentrated on saprobic species. Methods include collection, isolation, spawn production and fruiting body production testing in sawdust and compost media. We also discuss a semi-industrial approach of inoculating wild edible mushroom spawn into the natural environment to produce seasonal mushrooms. We have collected and isolated numerous strains of species of wild mushrooms and present initial results on domestication attempts. It is hoped to be able to introduce these to the mushroom growing industry in the future.

Keywords: cultivatable mushrooms, domestication, edible mushrooms, fungal species, mushroom spawn, mushroom compost

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Proximate Analysis and Mineral Content of *Laetiporus sulphureus* Strain MFLUCC 12-0546 from Northern Thailand

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ABSTRACT

Laetiporus sulphureus, a member of the fungal class *Aphyllophorales* (Polypores) of the Basidiomycota, is widely distributed in tropical countries. In this article, chemical composition and nutritional quality of the Thai *L. sulphureus* mushroom were investigated. Protein, fat, crude fibre and carbohydrate concentrations were 6.91, 1.70, 6.43, and 71.74% dry weight, respectively. Mineral contents were determined as mg/kg dry weight for Fe (2.28), Zn (1.20), Mn (0.35), Cu (0.14), Na (11.01), Ca (2.59), and Mg (1.09).

Keywords: *Laetiporus sulphureus*, edible mushroom, nutritional data, element composition

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Phylogenetic Diversity of *Russula* from Xiaozhongdian, Yunnan, China, Inferred from Internal Transcribed Spacer Sequence Data

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Abstract

In this study, we provide the first diversity assessment, based on the phylogenetic analysis of ITS sequence data, of the ectomycorrhizal genus *Russula* in an important alpine ecosystem. The area studied, a remote sustainable farmland/forestry habitat on the south of Tibetan Plateau, located in Xiaozhongdian, Northwest Yunnan, China, is critical to the east and southeast Asian ecosystem balance. Twenty *Russula* species were recovered, with *Russula cyanoxantha* being most common species. Conifer forests (*Picea likiangensis* and *Pinus densata*) and birch forests (*Betula platyphylla*) have similar species diversity, which is higher than in mixed forests (*Picea likiangensis*, *Betula platyphylla*, *Lyonia* and *Rhododendron decorum*), suggesting the preferred hosts of *Russula* are *Picea likiangensis*, *Pinus densata* and *Betula platyphylla*.

Keywords: alpine ecosystem, diversity, ITS, phylogeny, *Russula*

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New species of *Phallus* from a subtropical forest in Xishuangbanna, China

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Abstract

Seven collections of *Phallus* species were made in surveys of a subtropical forest in Xishuangbanna in Yunnan Province, China, during the wet season of 2012. Macro and micro characters, together with nrITS sequence data, were used to separate the collections into three species. *Phallus mengsongensis* and *P. serrata* are introduced as species new to science, while a further *Phallus* species is described, but not formally introduced, due to paucity of material. Macro and micro descriptions, colour photographs, line drawings and nrITS phylogenetic data for all three species are provided, which are discussed in relation to similar species in these genera.

Key words: nrITS, Phallaceae, phylogeny, taxonomy

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The Genus *Phylloporus* (*Boletaceae, Boletales*), from Mekong River Basin (Yunnan Province, China)

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ABSTRACT

The genus *Phylloporus* is a gilled bolete and a typical ectomycorrhizal mushroom which forms mycorrhizal associations with woody Fagaceae or Pinaceae. Collections of *Phylloporus* were made from Xiaozhongdian (Shangri-La), Haitang (Baoshan) and Mengsong (Xishuangbanna) from May to October 2012. Morphology and sequence analysis revealed that the *Phylloporus* collections belonged to seven groups and five species: *P. imbricatus* (Xiaozhongdian, Shangri-La), *P. pachcystidiatus* and *P. yunnanensis* (Haitang, Baoshan), *P. rubiginosus* (Mengsong, Xishuangbanna) and *P. megacystidiatus* sp. nov (Mengsong, Xishuangbanna). In this paper we introduce one new *Phylloporus* species: *Phylloporus megacystidiatus* sp. nov., and new record *P. rubiginosus* for the first time in Yunnan Province, China. The new species and the new record are described and illustrated with drawings and color photos. Also the species and new record are compared with similar taxa.

Keywords: biodiversity, ectomycorrhizal fungi, medicinal fungi, *Phylloporus*

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Polyporus umbellatus, an Edible-Medicinal Cultivated Mushroom with Multiple Developed Health-Care Products as Food, Medicine and Cosmetics: a review

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Abstract – *Polyporus umbellatus* is a medicinal mushroom belonging to the family *Polyporaceae* which forms characteristic underground sclerotia. These sclerotia have been used in Traditional Chinese Medicine for centuries and are used to treat edema and promote diuretic processes. Over the past few decades, researchers have found this taxon to contain many bioactive compounds shown to be responsible for antitumor, anticancer, antioxidant, free radical scavenging, immune system enhancement and antimicrobial activities. Due to its promising medicinal value, *P. umbellatus* is used as an ingredient in many medicinal products and food supplements. Thus demand for *P. umbellatus* has increased. To supply the high global demand, *P. umbellatus* is cultivated under natural or industrial conditions. In this review we discuss optimal conditions for the cultivation and culture of *P. umbellatus*. We also focus on the medicinal uses of *P. umbellatus*, the diversity of bioactive metabolites with various pharmacological properties and the medicinal products of great interest for health care or as alternative drugs.

Anticancer / Antimicrobial / Antioxidant / Antitumor / Bioactive molecules / Immunity / Medicinal mushroom / Polysaccharides / Steroid

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First cultivation of *Agaricus flocculosipes* and a novel Thai strain of *A. subrufescens*

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Abstract

Agaricus flocculosipes and *A. subrufescens* are edible species that belong to section *Arvenses* of the genus *Agaricus*. *Agaricus subrufescens* (almond mushroom) is known to produce bioactive compounds with medicinal properties, such as anti-cancer and anti-tumor activity and fruiting bodies are also edible and nutritious. *Agaricus subrufescens* is presently cultivated in Brazil, China, Japan, Taiwan and some European countries for use as foods and nutraceuticals. *Agaricus flocculosipes* is a newly described species currently known only from Thailand, Mayotte Island and China. Species of *Agaricus* have high potential for cultivation as many species are edible and have medicinal properties. Herein we report the first cultivation of *A. flocculosipes* and a Thai strain of *A. subrufescens*. The strains were isolated from wild sporocarps and subcultured on compost extract agar medium. Standard compost based on wheat straw and horse manure was used as the cultivation substrate. A comparative study of the cultivation of one strain of *A. flocculosipes* and two strains of *A. subrufescens* from France and Thailand was carried out with four replicates trays. The mushroom spawn was inoculated into the compost and incubated at 25 °C. The mycelia fully covered and grew throughout the media after incubation for two weeks. A casing layer made up of sand, peat and lime (1:1:1) was applied. Fruiting phase was performed at 25 °C and 95% humidity. The first primordia of the French and Thai strains of *A. subrufescens* occurred after the casing layer was added at days 12 and 24, respectively. Yields were obtained from both strains of *A. subrufescens*. The yield of the Thai strain (85.90 ± 27.06 g kg^{-1}) was lower than that of the French strain (178.56 ± 68.28 g kg^{-1}) in the first production cycle lasting 34 days. The first primordia of *A. flocculosipes* formed at day 32 after casing, and the strain produced only a few fruit bodies (1.04 ± 0.95 g kg^{-1}). Further research is needed to develop suitable agriculture wastes and regimes for growing these mushrooms and for increasing production yields so that these strains and species can be industrialized.

Keywords – *Agaricus* – edible mushroom – fruiting test – mushroom growing

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ARTICLE

Optimal conditions of mycelial growth of three wild edible mushrooms from northern Thailand

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ABSTRACT In this study, three wild mushrooms namely *Lentinus connatus*, *L. roseus*, and *Pleurotus giganteus* were selected to study if they could be domesticated. Initially, the fruiting bodies of the three mushrooms were collected from forests in northern Thailand and morphologically characterized. In this paper we report the optimal *in vitro* culture conditions of three wild mushrooms. Among seven culture media tested for the optimal mycelial growth of three wild mushrooms, black bean agar, red bean and soy bean agar were the best for the mycelial growth of *L. connatus*, *L. roseus* and *Pleurotus giganteus*, respectively. The mushroom mycelia were able to grow at temperatures ranging from 20-30 °C, with optimal growth temperatures of 30 °C and 25 °C for *Lentinus* and *Pleurotus* species, respectively. The optimum pH range observed for mycelial growth was 5.0 - 7.0. **Acta Biol Szeged 58(1):39-43 (2014)**

KEY WORDS

Lentinus connatus
Lentinus roseus
optimal growth
Pleurotus giganteus
wild mushroom

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Optimal conditions of mycelia growth of *Laetiporus sulphureus* sensu lato

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Laetiporus sulphureus is an edible wood-rotting basidiomycete, growing on decaying logs, stumps, and trunks of many deciduous and coniferous tree species. This fungus produces relatively large striking yellowish or orange-coloured bracket-like fruitbodies. *L. sulphureus* is widely consumed as a nutritional food because of its fragrance and texture. In this study, two *L. sulphureus* strains, MFLUCC 12-0546 and MFLUCC 12-0547, isolated from Chiang Rai, Thailand, were investigated for optimal conditions of mycelia growth. Potato dextrose agar and malt extract agar were observed as the favourable medium for mycelia growth. The optimum pH and temperature for the mushroom mycelia were 6–8 and 25–30°C, respectively.

Keywords: edible mushroom; *Laetiporus sulphureus*; optimal conditions

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Agaricus section *Brunneopicti*: a phylogenetic reconstruction with descriptions of four new taxa

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Abstract

Agaricus is a genus of saprobic basidiomycetes including species of nutritional and medicinal interest. Historically the temperate species have been grouped into eight classical sections. Recent phylogenetic analyses however, revealed that two-thirds of the tropical taxa do not cluster in these sections, but form exclusively tropical clades. Seven (TR I to TR VII) strongly supported tropical clades have been revealed and it was hypothesized that clade TR I might represent *Agaricus* section *Brunneopicti*. This section was initially characterized by the presence of punctiform squamules, the remains of the veil, on the pileus and stipe. The present morphological study and phylogenetic ML, MP and Bayesian analyses based on ITS1+2 sequences show that clade TR I corresponds to *Agaricus* section *Brunneopicti* and includes 16 taxa grouped in four strongly supported subclades and two isolated branches. The six species with punctiform squamules which initially characterized the section constitute one of these subclades. We propose the new replacement name *Agaricus brunneopunctatus* for the illegitimate name *Agaricus brunneopictus*. All 16 species are discussed, full descriptions are provided for five, among them, *A. brunneosquamulosus*, *A. niveogranulatus*, *A. sordidocarpus* and *A. toluenolens* are described as new species. We also report on certain members of section *Brunneopicti* traits which generally characterize species belonging to other sections. These shared characters raise the issue of their origin and complicate the systematics and the identification of the tropical *Agaricus* species. An artificial dichotomous key is presented for species identification. Section *Brunneopicti* is the first reconstructed section of tropical *Agaricus*. Its known geographical distribution range is strictly palaeotropical. We predict that the species richness of other somewhat forgotten or new tropical sections will also increase in coming years.

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Note

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Deconins A–E: Cuparenic and Mevalonic or Propionic Acid Conjugates from the Basidiomycete *Deconica* sp. 471

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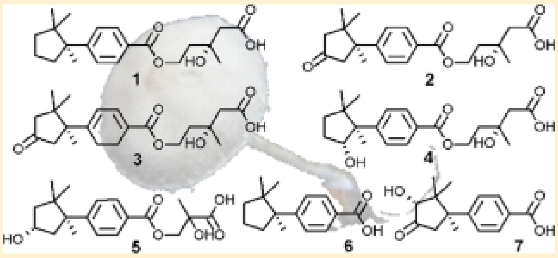
Supporting Information

ABSTRACT: Bioassay-guided fractionation of antibacterial extracts from cultures of a basidiomycete from Northern Thailand, which represents a new species of the genus *Deconica*, yielded the terpenoid deconin A (**1**), whose structure was elucidated by spectral methods (NMR, HRMS) as a cuparenic/mevalonic acid conjugate. The absolute configuration of **1** was determined after saponification and comparison of specific rotations of the resulting cuparenic acid and mevalonolactone with authentic standards and literature data. Six minor congeners (**2**–**7**) were isolated and identified, and their antimicrobial and cytotoxic effects are reported. Compounds **1**–**4** are the first natural products featuring an unmodified mevalonic acid residue as a building block.



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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

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Edible species of *Agaricus* (Agaricaceae) from Xinjiang Province (Western China)

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Abstract

Agaricus is a genus of macrofungi containing species with high edible and medicinal values. A survey of *Agaricus* species carried out around the Ebinur Lake, in Xinjiang Province of China, in 2012, yielded 19 collections that exhibited a red discolouration when bruised. Morphological and phylogenetic comparison with species of five sections of *Agaricus* possessing the red discolouration trait showed that the specimens belonged to four species. Two species, *A. sinodeliciosus* sp. nov. and *A. bitorquis* in section *Bivelares* and *A. desjardinii* sp. nov. and *A. padanus* in section *Nigrobrunnescentes*, both sections being monophyletic. The two new species proposed are described and illustrated and all species are compared with similar taxa or previous records. *Agaricus padanus* is reported outside Italy for the first time. All species are edible and consumed by locals, and appear to be adapted to relatively dry, cold and sandy habitats. Like *A. bitorquis*, *A. sinodeliciosus* produces large, delicious semihypogeous basidiomata in such conditions; it is therefore a good potential candidate for domestication and industrial production.

Keywords: taxonomy, phylogeny, ITS, cultivatable mushrooms

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Fungal diversity notes 1–110: taxonomic and phylogenetic contributions to fungal species

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Abstract This paper is a compilation of notes on 110 fungal taxa, including one new family, 10 new genera, and 76 new species, representing a wide taxonomic and geographic range. The new family, *Paradictyoarthriniaceae* is introduced based on its distinct lineage in Dothideomycetes and its unique morphology. The family is sister to *Biatriosporaceae* and *Roussoellaceae*. The new genera are *Allophaeosphaeria* (*Phaeosphaeriaceae*), *Amphibambusa* (*Amphisphaeriaceae*), *Brunneomycosphaerella* (*Capnodiales* genera *incertae cedis*), *Chaetocapnodium* (*Capnodiaceae*), *Flammeascoma* (*Anteagloniaceae*), *Multiseptospora* (*Pleosporales* genera *incertae cedis*), *Neogaeumannomyces* (*Magnaporthaceae*), *Palmiascoma* (*Bambusicolaceae*), *Paralecia* (*Squamarinaceae*) and *Sarimanas* (*Melanommataceae*). The newly described species are the *Ascomycota Aliquandostipite manochii*, *Allophaeosphaeria dactylidis*, *A. muriformia*, *Alternaria cesenica*, *Amphibambusa bambusicola*, *Amphisphaeria sorbi*, *Annulohypoxylon thailandicum*, *Atrotorquata spartii*, *Brunneomycosphaerella laburni*, *Byssosphaeria musae*, *Camarosporium aborescentis*, *C. aureum*, *C. frutexensis*, *Chaetocapnodium siamensis*, *Chaetothyrium agathis*, *Colletotrichum sedi*, *Conicomyces pseudotransvaalensis*, *Cytospora berberidis*, *C. sibiraeae*, *Diaporthe thunbergiicola*, *Diatrype palmicola*, *Dictyosporium aquaticum*, *D. meiosporum*, *D. thailandicum*, *Didymella cirsii*, *Dinemasporium nelloi*, *Flammeascoma bambusae*, *Kalmusia italica*, *K. spartii*, *Keissleriella sparticola*, *Lauriomyces synnematicus*, *Leptosphaeria ebuli*, *Lophiostoma pseudodictyosporium*, *L. ravennicum*, *Lophiotrema eburnoides*, *Montagnula graminicola*, *Multiseptospora thailandica*, *Myrothecium macrosporum*, *Natantispora unipolaris*, *Neogaeumannomyces bambusicola*, *Neosetophoma clematidis*, *N. italica*, *Oxydothis atypica*, *Palmiascoma gregariascomum*, *Paraconiothyrium nelloi*, *P. thysanolaenae*, *Paradictyoarthrinium tectonicola*, *Paralecia pratorum*, *Paraphaeosphaeria spartii*, *Pestalotiopsis digitalis*, *P. dracontomelon*, *P. italiana*, *Phaeoisaria pseudoclematidis*, *Phragmocapnias philippinensis*, *Pseudocamarosporium cotinae*, *Pseudocercospora tamarindi*, *Pseudotrichia rubriostiolata*, *P. thailandica*, *Psiloglonium multiseptatum*, *Saagaromyces mangrovei*, *Sarimanas pseudofluviatile*, *S. shirakamiense*, *Tothia spartii*, *Trichomerium siamensis*, *Wojnowicia dactylidicola*, *W. dactylidis* and *W. lonicerae*. The *Basidiomycota Agaricus flavicentrus*, *A. hanthanaensis*, *A. parvibicolor*, *A. sodalis*, *Cantharellus luteostipitatus*, *Lactarius atrobrunneus*, *L. politus*, *Phylloporia dependens* and *Russula cortinarioides* are also introduced.

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Lactarius subgenus *Russularia* (Russulaceae) in South-East Asia: 3. new diversity in Thailand and Vietnam

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Abstract

Lactarius subgenus *Russularia* is a dominant group of milkcaps in Southeast Asia. This paper reveals the large diversity of the subgenus, with eight new species and one known species being described from montane evergreen and coniferous forests. All new species are supported by both morphological and molecular data, the latter using Maximum likelihood and Bayesian analysis based on the ITS region. Complete macro- and micro-morphological descriptions and illustrations are given. A key to the new taxa is provided. *Lactarius chichuensis* is reported for the first time from Thailand.

Keywords: Russulales, identification, ectomycorrhizal fungi, biodiversity

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Proximate analysis and mineral constituents of *Macrolepiota dolichaula* and soils beneath its fruiting bodies

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Abstract

The nutritional quality of *Macrolepiota dolichaula* (strain MFLUCC 13-0579) grown in orchard soils was investigated. Proximate analysis showed *M. dolichaula* fruiting bodies to contain 27% protein, 38% carbohydrates, 15% fiber, 2% lipid, 10% ash and 8% moisture. The energy value was calculated as 286 KJ per 100 g dry weight of mushroom. The content of seven essential minerals in this mushroom, as well as top soils (0–5 cm) below the mushrooms were explored. In addition, the bioaccumulation potential of minerals in the fruiting bodies were calculated as a ratio between the mineral concentration in the mushrooms and the soil concentration were studied. Mineral contents were Fe (15.94 in mushrooms; 5.77 in soil), Na (5.83; 2.78), Cu (1.94; 0.64), Zn (1.69; 0.99) and Mg (0.99; 0.61), Mn (0.81; 2.21) and Ca (0.34; 14.58) for mg/100 g dry weight. The bioconcentration factors (BCF), showed that this mushroom is efficient in the absorption of Fe, Na, Zn and Mg which are low in soils (BCF > 1), while Ca, and Mn are poorly absorbed in its fruiting bodies, although the Ca and Mn contents in soils were high (BCF < 1). Based on this study, it can be concluded that *M. dolichaula* is a good dietary source of essential nutrients and minerals which are found within the acceptable limits for human consumption.

Key words – Cultivated mushroom – minerals bioaccumulation – nutritional supplements

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Optimal mycelial conditions and spawn production for the domestication of *Macrolepiota deters*

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Abstract

Macrolepiota detersa is an edible saprobic basidiomycota, known to grow solitary to scattered on decayed litter layers. This mushroom produces a relatively large striking basidiomata containing light brown detachable squamules on the white pileal background. In this study, *M. detersa* MFLUCC 13-0901 and SIMA 13266, isolated from Chiang Rai, Thailand was investigated for optimal conditions for mycelial growth and spawn production. Among nine cultural media tested, MEA (malt extract agar) was the best medium. This fungus was able to grow at a wide ranges of temperature and pH values. The optimal temperature and pH for the mycelial growth were at 30 ºC and pH 7.0 or 8.0 respectively. Among nine different selected substrates for spawn preparation, barley and red sorghum were the best media. Spawn were obtained after 14 days following inoculation.

Keywords: *Macrolepiota detersa*, mycelial growth, spawn production

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Proximate Analysis and Antimicrobial Activity of Cultivated *Macrolepiota dolichaula* Strain MFLUCC-13-0579

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Abstract

Macrolepiota dolichaula, an edible white spored gilled mushroom, is widely distributed in tropical and temperate countries. In this study, nutritional quality of *M. dolichaula* strain MFLUCC-13-0579 cultivated in compost was investigated. Proximate analysis of dry weight of *M. dolichaula* showed a composition of 25.53% protein, 44.37% carbohydrate, 14.17% fiber, 1.17 % lipid and 5.19% ash with energy of 299.06 kJ/g mushroom. In addition, the antimicrobial activities from fresh mushroom, dry mushroom and mycelial extracts showed significant activities against *Micrococcus luteus* and *Staphylococcus aureus*. Based on this study, it can be concluded that *M. dolichaula* is a good source of nutrients and posses some antimicrobial activities.

Keywords: antimicrobial activity, edible mushroom, *Macrolepiota*, proximate nutritional data

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We acknowledge Mae Fah Luang University, Thailand Research Fund grant - Taxonomy, Phylogeny and biochemistry of Thai Basidiomycetes (BRG 5580009) and the Royal Civil Service Commission of Bhutan for financial support.

Optimization condition for cultivation of *Agaricus subrufescens* hybrid strains

Kritsana Jatuwong[1,2], Pattana Kakumyan[2,*], Sunita Chamyuang[2], Ekachai Chukeatirote[1,2] , Kevin D. Hyde[1,2]

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Abstract

Agaricus subrufescens is edible mushroom, one of the most important medicinal mushroom with high potential to treat many diseases. Several strains of *A. subrufescens* have been cultivated throughout the world, especially in Brazil. *A. subrufescens* hybrid strain in this study has been bred by the INRA, France. This study investigated the optimum conditions for the cultivation of *A. subrufescens* hybrid strains in Northern Thailand. The suitable conditions for mycelium growth on compost extract agar were established in terms of temperature and pH. The results revealed that the optimum temperature and pH for mycelial growth were 25–30°C and pH 7–9, respectively. Two hybrid strains of *A. subrufescens* CA 918–076 x CA 454–4 and CA 918–076 x CA 487–35 were selected and cultivated on compost media. The ingredients of the compost were consisted of rice straw (200 kg), rice bran (10 kg), urea (2 kg), ammonium sulfate (4 kg), calcium carbonate (2 kg), calcium sulfate (6 kg) and water. The result showed that two hybrid strains, could be cultured using this rice straw compost. Fruiting bodies were produced after 2 months with a yield of 56.92 and 42.30 g /kg of compost, respectively.

Keywords: *Agaricus subrufescens*, compost, hybrid strains, mushroom cultivation

Acknowledgements

This work was supported by Thailand Research Fund (Grant No. BRG5580009). The authors gratefully thank to mushroom research farm (Ban Pongprabath, Chiang Rai) for providing their facility to cultivate the mushroom.

Optimization conditions, antibacterial and antioxidant activities of *Clitopilus chalybescens*

Kritsana Jatuwong[1,2], Kevin D Hyde[1,2], Sunita Chamyuang[1,2], Kenji Matsui[3,4] and Pattana Kakumyan[1,2*]

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Abstract

The aim of this work was to study the effect of media, temperature and pH on the mycelial growth of *Clitopilus chalybescens* strain MFLUCC 13–0809 collected from Lampang, Thailand. The antioxidant and antibacterial activities from the crude mycelial extracts were evaluated. The study indicated that the optimal medium, pH and temperature were observed on yeast extract agar (YEA) pH 5 to 7, and 20–29˚C, respectively. For antibacterial activities, crude extracts from mycelium slightly inhibited the growth of Gram positive bacteria (*Bacillus subtilis, Staphylococcus aureus* and *Micrococcus luteus*), but no activities were observed on Gram negative bacteria (*Pseudomonas aeruginosa* and *Escherichia coli*). Antioxidant assay indicated that the crude extract had noticeable scavenging activity on 2,2-diphenyl-1-picryl-hydrazyle (DPPH) radical. The results suggest that the crude extract from this mushroom.

Keywords: *Clitopilus*, optimal condition, antibacterial activity, antioxidant activity.

5. Acknowledgement

We are grateful to Thailand Research Fund grant "Taxonomy, Phylogeny and biochemistry of Thai Basidiomycetes (BRG 5580009)" for providing support for this study. Institute of Excellence in Fungal Research, Mae Fah Luang University is also thanked for giving all the necessary assistance for this study.

Appendix C

Poster and Oral presentation

The poster was presented on the "Fungal Biodiversity and Biotectnology" at Mae Fah Luang University, Chiang Rai 10^{th} – 12^{th} January 2014.

Cultivation of *Agaricus subrufescens* hybrid strains on rice straw based compost media

Kritsana Jatuwong[1,2], Puttana Kakumyan[2], Ekachai Chukeatirote[1,2], Sunita Chamyuang[2], Kevin D. Hyde[1,2]
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Abstract

Agaricus subrufescens Peck (synonyms = *A. blazei*, *A. brasiliensis*) is an edible and medicinal mushroom. It is also commonly known as the "almond mushroom" due to its almond-like smell. *A. subrufescens* originated from Brazil has been introduced to many countries for cultivation such as China and Japan for its medicinal uses. Previous reports have shown that the hybrid strains of *A. subrufescens* could be made between Thai-French and Thai-Brazilian strains. In this study, we aim to investigate suitable condition for cultivation of *A. subrufescens* hybrid strains in Northern Thailand. Two *A. subrufescens* hybrid strains were selected and cultivated using compost media. The ingredients of the compost used were as follows: rice straw (200 kg), rice bran (10 kg), urea (2 kg), ammonium sulfate (4 kg), calcium carbonate (2 kg), calcium sulfate (6 kg) and water. Our study showed that two hybrid strains (CA 918-076 x CA 454-4 and CA 918-076 x CA 487-35) could be cultured using this rice straw compost. Their fruiting bodies were produced after cultivation for 2 months with a yield of 56.92 and 42.29 g/kg of compost for the strains CA 918-076 x CA 487-35 and CA 918-076 x CA 454-4, respectively.

Keywords : *Agaricus subrufescens*, hybrid strains, compost, mushroom cultivation

Introduction

Mushrooms are known as nutritional food normally contains protein and all the essential amino acids and also show to be a good source of vitamins (Chang and Buswell, 1996 ;Farnet *et al.*, 2013). Moreover, that as well as food values and a source of biologically active compounds mushrooms were used for pharmacological effects as medicines (Hobbs, 1995), therefore there have been cultivated. *Agaricus subrufescens* Peck (synonyms = *A. blazei*, *A. brasiliensis*), is belong to Basidiomycete fungus. It is also called the medicinal mushroom or almond mushroom (Zied *et al.*, 2012) due to its almond-like smell. It was first cultivated in the last 1800s in eastern North America and described by C.H. Peck in 1893, New York state botanist (Kerrigan, 2005) in the 1960s in Brazil. It is a popular market mushroom as extensively cultivated in Brazil and in oriental countries such as Japan or China (Farnet *et al.*, 2013).In this study *A. subrufescens* which the hybrids strain obtained from INRA in France, were cultivated using compost media prepared in Chiang Rai, Thailand.

Material and Methodology

Material

The *Agaricus subrufescens* Thai-French and Thai-Brazilian hybrids strains used in this study obtained from the INRA in France.

2 hybrid strains of *Agaricus subrufescens*.

- CA918-076 x CA454-4 Thai-Brazilian hybrid strain
- CA918-076 x CA487-35 Thai-French hybrid strain

Methodology

1. Growing mycelium.

The *A. subrufescens* Thai-French and Thai-Brazilian hybrids strains used in this study were grown in compost extract medium and incubated at 25°C.

2. Spawn production.

Sorghum were washed, cleaned, and soaked in water for 24 hours, then washed 1-2 time before boiled for 15 minutes. After draining the excess water, the grains were sterilized then inoculated with the mycelium and incubated at 25 °C to obtain the spawn.

3. Preparing the growing media.

Mainly, compost media was done using rice straw. Rice straw was composited with calcium carbonate, urea, rice bran, di ammonium phosphate, gypsum and water, while the compost stack was capsized intermittently for the aeration process. These compost media were sterilized for 6, then placed in containers, 5 kg per each. Compost media was inoculated with 2% (w/w) of the prepared spawn incubated at 25 °C for 1 month . After spawning and casing; they were followed daily in observing the baskets and examining the temperature level including relative humidity of the mushroom growing house.

4. Preparing the casing layer

The casing layer was prepared using rice husk ash 80% + rice husk 10% + soil 10% and then sterilized at 121 °C for 15 minutes. The casing was applied to the surface of fully colonized mycelium to a depth of 1 inc.

Result and discussions

The hybrids strains of *A. subrufescens* have been introduced through the hybridization of *A. subrufescens*, by the INRA in France. In this studied rice straw was used as based compost media for cultivation. The result showed that the Thai – France strain (CA918-076 x CA487-35) are the highest yield with 56.92 g /kg of compost. The strain was produced the fruiting bodies after casing 18 days in the controlled environmental. While the fruiting bodies Thai-Brazilian strain (CA918-076 x CA454-4) produced 42.92 g/kg of compost (Thongklang, *in prep.*). The result showed some different from the previous result by INRA the cultivated these mushroom in France. They could obtain 47.78 and 68.93 g/kg of compost for Thai – France strain and Thai-Brazilian strain, respectively.

Figure 1. The fruiting bodies of *A. subrufescens*.

Table 1. Comparison of *A. subrufescens* yield between Thai-Brazilian and Thai-French hybrid strain

Strains	Total weight of compost (kg)	Total weight (g)	Yields (g of fruiting body/kg of compost)
CA918-076 x CA454-4	5 kg	211.48	42.29
CA918-076 x CA487-35	5 kg	284.62	56.92

Conclusion

Thai – France strain and Thai-Brazilian strain could be grow in Chiang Rai, Thailand using Thai rice straw compost. However, the yield of the production should be improved.

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Acknowledgments

We are grateful to the Thailand Research Fund (Grant No. BRG5580009) for financially supported. We also thank to mushroom research farm (Ban Pongpraburk, Chiang Rai) for their facility to cultivated the mushroom.

BRG5580009

The poster was presented at the "The 26th Annual Meeting of the Thai Society for Biotechnology and International Conference" at 26th – 29th November 2014, Mae Fah Luang Univesity, Chiang Rai, Thailand.

Optimization condition for cultivation of *Agaricus subrufescens* hybrid strains

Kritsana Jatuwong,1,2 Pattana Kakumyan,2,* Sunita Chamyuang,2 Ekachai Chukeatirote1,2 and Kevin D. Hyde1,2
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Abstract

Agaricus subrufescens is edible mushroom, one of the most important medicinal mushroom with high potential to treat many diseases. Several strains of *A. subrufescens* have been cultivated throughout the world, especially in Brazil. *A. subrufescens* hybrid strain in this study has been bred by the INRA, France. This study investigated the optimum conditions for the cultivation of *A. subrufescens* hybrid strains in Northern Thailand. The suitable conditions for mycelium growth on compost extract agar were established in terms of temperature and pH. The results revealed that the optimum temperature and pH for mycelial growth were 25–30°C and pH 7–9, respectively. Two hybrid strains of *A. subrufescens* CA 918–076 x CA 454–4 and CA 918–076 x CA 487–35 were selected and cultivated on compost media. The ingredients of the compost were consisted of rice straw (200 kg), rice bran (10 kg), urea (2 kg), ammonium sulfate (4 kg), calcium carbonate (2 kg), calcium sulfate (6 kg) and water. The result showed that two hybrid strains, could be cultured using this rice straw compost. Fruiting bodies were produced after 2 months with a yield of 56.92 and 42.30 g /kg of compost, respectively.

Keywords: *Agaricus subrufescens*, compost, hybrid strains, mushroom cultivation

Introduction

Agaricus subrufescens Peck. (1893) is called almond mushroom due to its almond odor (Firenzuoli et al., 2008; Zied et al., 2012). *A. subrufescens* was first cultivated in the late 1800s in Eastern North America and described by Peck C.H. in 1893 (Kerrigan, 2005). It was firstly isolated in the 1960s in Brazil (Farnet et al., 2013). It is a popular mushroom market as extensively cultivated in Brazil and in oriental countries such as Japan or China (Farnet et al., 2013). In addition, *A. subrufescens* is popular as a medicinal food having a potential to teat many common diseases such as arteriosclerosis, cancer, diabetes, cronic hepatitis and hyperlipidaemia (Hobbs, 1991) Mizuno et al., 1990; Firenzuoli et al., 2008; Liu et al., 2008; James et al., 2010). Llarena-Hernandez et al. (2013) could obtain the hybrid strain between the Brazilian and European strains after investigated the hybridization. The hybrid strains were improved in term of yield and quality for developing new cultures under European growing conditions and also a new hybrid named H1X1 was patented in USA (Kerrigan and Wach, 2008). In this study *A. subrufescens* hybrid strains provided by N. Thongklang (Thongklang et al. 2014) obtained from INRA, France, were optimized and cultivated using compost media prepared in Chiang Rai, Thailand.

Methodology

Strains of mushroom

Table 1: Cultivars used in this study

Code in this study	Origin code	Origin	Type
Hybrid	Thai and Brazilian	CA918-075 X CA454-4	T1xB
Hybrid	Thai and Brazilian	CA918-076 X CA454-4	T2xB
Hybrid	Thai and French	CA918-075 X CA487-35	T1xF
Hybrid	Thai and French	CA918-076 X CA487-35	T2xF
Thai wild strain	Parental of Thai strain	CA918	T

Effect of temperature

All pure culture isolates were grown on compost extract media in triplicate and incubated at 16, 20, 25, 30 and 35°C. Mycelial growth was evaluated by determination of dry weight and colony radius every 2 days for 10 days.

Effect of pH

The initial pH of the media was adjusted separately by 1N HCl or 1N NaOH to pH 4, 5, 6, 7, 8 and 9. A 0.5 mm-diameter plug of mycelium was inoculated on centre of plate. All culture media were incubated at 30°C. Mycelial growth was evaluated by determination of dry weight and colony radius every 2 days for 10 days.

Spawn production

The sorghum were washed, cleaned and soaked in distilled water for 24 hours, then washed 1-2 times before boiled for 15 minutes. After draining the excess water, the grains were sterilized, cooled down to room temperature, then inoculated with the mycelium and incubated at 25°C for 14 days or until completely colonized.

Mushroom cultivation

The compost media base on rice straw as main substrate was mixed with calcium carbonate, urea, rice bran, di ammonium phosphate, gypsum and water, followed by pasteurization for 6 hours by maintaining the temperature at 45–60°C. Allow the compost to cool down to room temperature before applying the spawn 20 g of colonized grain/kg compost. A 5 kg of the mixture was placed in plastic tray (35x25x20 cm). The inoculated compost was incubated at 25°C with relative humidity at 91–95 % for the beginning of colonization. The completely colonized compost was then covered with the pasteurized casing with 2.5 inch layer. The number and fresh weight of fruiting bodies were recorded after casing. The experiments were performed with five replicated per strain and cultivation condition.

Statistical analysis

The experiment using statistical analysis and significant differences were determined by Tukey's test with a significance level $p \leq 0.05$ followed by post-hoc test in a one-way ANOVA analysis using SPSS version11.5 program.

Results

Effect of temperature and pH

In this study, the optimal temperature for mycelial growth was found at 25 and 30°C (Table2) and the result showed that optimal pH for mycelial growth was range between 7 to 9 for all *A. subrufescens* hybrid strain except Thai wild strain that could grow all tested pH range. Its growth was not different between the pH (Table2).

Table 2: Average mycelial growth rate of *A. subrufescens* strains cultivated on compost extract agar under various condition for 10 days.

Temperature (°C)	Growth rate (cm of mycelial radius)*				
	T1xB	T2xB	T1xF	T2xF	T
16	2.37	1.83	2.37	2.07	2.03
20	3.0	3.03	4.03	3.90	2.73
25	7.37	7.23	7.33	6.37	6.67
30	7.23	7.37	7.77	7.00	6.27
35	1.67	1.07	1.43	1.33	0
pH					
4	4.23	6.67	4.77	3.93	6.73
5	3.03	6.03	4.33	3.97	6.77
6	3.03	3.43	6.07	6.17	6.93
7	3.83	3.87	7.03	6.03	6.90
8	3.83	6.03	6.77	6.30	6.83
9	6.23	3.87	6.03	6.43	6.87

* Within a column, values followed by the same letter are not different at $p \leq 0.05$ by Tukey's test.

Figure 1: Mycelium growth on compost extracted media when incubated at 25°C (1) and 30°C (2) for 10 days. A) strain T1xB, B) strain T2xB, C) strain T1xF, D) strain T2xF and E) strain T.

Table 3: Dry weight of mycelium grown on compost extract agar under various condition for 10 days.

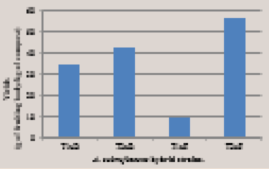
Temperature (°C)	Dry weight (mg)*				
	T1xB	T2xB	T1xF	T2xF	T
16	3.87	3.37	10.10	7.47	3.03
20	8.23	7.27	10.77	14.73	12.27
25	32.07	31.23	38.03	32.33	40.03
30	43.07	34.83	33.07	30.33	47.37
35	4.33	3.33	3.03	3.33	0

pH	Dry weight (mg)*				
	T1xB	T2xB	T1xF	T2xF	T
4	14.03	16.27	12.27	11.73	12.83
5	10.03	13.90	20.10	12.23	12.07
6	17.17	27.80	70.27	28.70	17.73
7	26.03	30.17	77.03	28.23	18.43
8	23.37	23.13	70.07	28.33	18.33
9	27.07	27.80	73.37	28.33	17.43

* Within a column, values followed by the same letter are not different at $p \leq 0.05$ by Tukey's test.

Mushroom cultivation

In this studied, *A. subrufescens* strains are presented in Table 1 were used for cultivation on rice straw based material of compost media. The result is showed in Figure 2 that the Thai – France strain (T2xF) gave the highest yield of fruiting bodies with 56.92 g /kg compost. The strain was produced the fruiting bodies after casing 18 days in the controlled conditions.



Conclusions

The results from this study demonstrated that *A. subrufescens* can grow at the temperature range between 25–30°C and initial pH range between 6–9. Fruiting body of those strains can be produced by using rice straw compost prepared in Chiang rai, Thailand. However, the yield of the production should be improved to reach a commercial scale.

References

[illegible]

Acknowledgement

[illegible]

BRG5580009

Invitted speaker entitled "Domesticating Wild Mushrooms" RGJ-Ph.D. Congress XIV at Jomtein Palm Beach Resort, Pattaya, Chonburi on 6 April 2013.

RGJ-Ph.D. Congress XIV: Oral Presentation Schedule

		Fibrosis Patients		
16.25 - 16.40	S3-06	Improvement of Wild Thai *Agaricus subrufescens* Strain for Cultivation	น.ส. นริษฎา ทองกลาง	Ms. Naritsada Thongklang (RGJ-Industry)
16.40 - 16.55	S3-07	Class 1 Integrons and Virulence Genes in *Salmonella enterica* Isolates from Pork and	น.ส. เวชสิริ วรรณประสาท	Ms. Wechsiri Wannaprasat
6 April 2013	**S3: Biological Science** (*Venue: Marine II*)			
	Chairpersons:	***Prof. Kevin D. Hyde and Prof. Somboon Tanasupawat***		
08.30 - 08.50	Invited Lecture	**S3-L5: Prof. Kevin D. Hyde**, "Domesticating Wild Mushrooms"		
08.50 - 09.05	S3-08	Systematic Conservation Planning for Terrestrial Vertebrates Currently Outside of Thail	น.ส. นฤมล ตันติพิษณุ	Ms. Naruemon Tantipisanuh
		Protected Areas: A Bayesian Network Approach		
09.05 - 09.20	S3-09	A Phylogenetic Re-evaluation of the Plant Pathogenic Genus *Phyllosticta*	น.ส. เสาวณีย์ วิคี	Ms. Saowanee Wikee
09.20 - 09.35	S3-O10	Germination Process as Bio-modification Starch to Reduce Retrogradation	น.ส. วารุณี คุปต์กาญจนากุล	Ms. Warunee Kupkanchanakul
		Germinated Brown Rice Starches		
09.35 - 09.50	S3-O11	Specific Protein Target of Goniothalamin	นาย ธเนศ โสภณนิธิประเสริฐ	Mr. Thanet Sophonnithiprasert
09.50 - 10.10	**Coffee Break**			
	Chairpersons:	***Prof. Kentaro Kodama and Assoc. Prof. Rasana Wongratanacheewin***		
10.10 - 10.30	Invited Lecture	**S3-L6: Prof. Kentaro Kodama**, "Potential of *Saccharomyces cerevisiae* Isolated from a Marine Environment as a Microbial Resource"		
10.30 - 10.50	Invited Lecture	**S3-L7: Prof. Nicola J. Williams**, "*Campylobacter* Interactions with the Chicken, the Environment and the Food Chain- Efforts to Understand a Complicated Bacterium"		
10.50 - 11.05	S3-O12	Identification of Novel Natural Compounds that Activate PXR and CAR and Inhibit	น.ส. สุธิชา กฤตยารักษ์สกุล	Ms. Suticha Kittayaruksakul
11.05 - 11.20	S3-O13	Protective Effect of Melatonin against Dexamethasone-induced Oxidative Stress,	น.ส. วิลาสินี สุวรรณจ่าง	Ms. Wilasinee Suwanjang
		dependent Death Processes and Mitochondrial Dynamics in Neuronal Cells		
11.20 - 11.35	S3-O14	Biological Factors Affect the Distribution of *Burkholderia pseudomallei* in Soils	น.ส. โชติมา โพธิทรัพย์	Ms. Chotima Potisap
11.35 - 11.50	S3-O15	SigmaE Regulon under Oxidative Stress and Predicted SigmaE Promoter Motifs from	นาย ศิโรจน์ จิตประสูตวิทย์	Mr. Siroj Jitprasutwit
		pseudomallei		
11.50 - 13.00	**Lunch**			

BRG5580009

Invited speaker in the 4th Medical Science Academic Annual Meeting on the topic “Key to becoming a successful researcher” on 26 December 2013.

กำหนดการ โครงการ The 4th Medical Science Academic Annual Meeting
วันที่ 25 – 27 ธันวาคม 2556 อาคารคณะวิทยาศาสตร์การแพทย์

วันพุธที่ 25 ธันวาคม 2556

12.30 – 13.00 น.	ลงทะเบียน (เฉพาะนิสิตมหาวิทยาลัยนเรศวรที่นำเสนองานแบบโปสเตอร์) โถงใต้สโลปคณะวิทยาศาสตร์การแพทย์
13.00 – 16.00 น.	นำเสนอโปสเตอร์รอบคัดเลือก สำหรับนิสิตระดับปริญญาตรีคณะวิทยาศาสตร์การแพทย์ มหาวิทยาลัยนเรศวร

วันพฤหัสบดีที่ 26 ธันวาคม 2556

08.15 – 08.30 น.	ลงทะเบียน หน้าห้อง MD 234
08.30 – 08.45 น.	ชมวิดิทัศน์แนะนำคณะวิทยาศาสตร์การแพทย์
08.45 – 09.15 น.	รายงานวัตถุประสงค์การจัดโครงการ โดย รองศาสตราจารย์ ดร.เสมอ ถาน้อย คณบดีคณะวิทยาศาสตร์การแพทย์ กล่าวเปิดโครงการโดยศาสตราจารย์ ดร.สุจินต์ จินายน อธิการบดีมหาวิทยาลัยนเรศวร
09.15 – 09.30 น.	การมอบรางวัลนักวิจัยดีเด่น รางวัลภาควิชาตีพิมพ์สูงสุด และทุนสนับสนุนการศึกษาระดับบัณฑิตศึกษา คณะวิทยาศาสตร์การแพทย์ มหาวิทยาลัยนเรศวร
09.30 – 10.00 น.	การบรรยายพิเศษ หัวข้อ "Keys to becoming a successful researcher" โดย Prof. Kevin D. Hyde ผู้อำนวยการสถาบันความเป็นเลิศทางการวิจัยด้านเห็ดและรา มหาวิทยาลัยแม่ฟ้าหลวง
10.15 – 12.00 น.	**การนำเสนอผลงานแบบบรรยาย โดยนิสิตสหกิจศึกษาต่างประเทศ และนิสิตบัณฑิตศึกษา** ห้อง MD 234 (แม่ข่าย) และ ห้อง MD 233 (ลูกข่าย) **(ภาคภาษาอังกฤษ)**
12.00 – 13.00 น.	พักรับประทานอาหารกลางวัน
13.00 – 15.00 น.	**การนำเสนอผลงานแบบบรรยาย** ห้อง MD 232 นิสิตระดับบัณฑิตศึกษา ห้อง MD 233 นิสิตระดับปริญญาตรี : ผลงานด้านวิทยาศาสตร์การแพทย์ ห้อง MD 234 นิสิตระดับปริญญาตรี : ผลงานด้านจุลชีววิทยาและปรสิตวิทยา
15.00 – 17.00 น.	**การนำเสนอผลงานแบบโปสเตอร์ของนิสิตระดับปริญญาตรี**

วันศุกร์ที่ 27 ธันวาคม 2556

08.30 – 08.45 น.	ลงทะเบียน หน้าห้อง MD 234
08.45 – 11.00 น.	**การนำเสนอผลงานแบบบรรยาย** (ต่อ) ห้อง MD 232 นิสิตระดับบัณฑิตศึกษา ห้อง MD 233 นิสิตระดับปริญญาตรี : ผลงานด้านวิทยาศาสตร์การแพทย์ ห้อง MD 234 นิสิตระดับปริญญาตรี : ผลงานด้านจุลชีววิทยาและปรสิตวิทยา
11.00 – 11.30 น.	**ประชาสัมพันธ์หลักสูตรบัณฑิตศึกษา คณะวิทยาศาสตร์การแพทย์**
11.30 – 12.00 น.	**พิธีมอบรางวัลการนำเสนอผลงาน พร้อมปิดโครงการ** โดย รองศาสตราจารย์ ดร.เสมอ ถาน้อย คณบดีคณะวิทยาศาสตร์การแพทย์ ห้อง MD 234 (แม่ข่าย)

หมายเหตุ : 1. กำหนดการอาจมีการเปลี่ยนแปลงได้ตามความเหมาะสม
2. อาหารว่างและเครื่องดื่มรับประทานได้ที่มุม coffee corner

Invited speaker in the forthcoming second International Conference on Integration of Science and Technology for Sustainable Development (ICIST) on November 28-29, 2013 at the Faculty of Agriculture, KMITL, Bangkok, Thailand on the topic "Amazing time to study fungi"

The Second International Conference on
Integration of Science and Technology for Sustainable Development
(ICIST)

"Biological Diversity, Food and Agricultural Technology"

AATSEA

Faculty of Agriculture, KMITL, Bangkok, Thailand
November 28-29, 2013

September 24, 2013

Dr. Kevin Hyde
Mae Fa Luang University
Muang, Chiang Rai 57100
Thailand

Dear Dr. Hyde

In behalf of the Organizing Committee, we cordially invite you to be one of the Plenary Speakers in the forthcoming Second International Conference on Integration of Science and Technology for Sustainable Development (ICIST) to be held on November 28-29, 2013 at the Faculty of Agriculture, KMITL, Bangkok, Thailand. It will be an honor if you could come and share with us your expertise and wisdom on "Amazing time to study fungi".

ICIST 2013 is organized by the Faculty of Agricultural Technology of King Mongkut Institute of Technology Ladkrabang and the Association of Applied Technologies of Southeast Asia in cooperation with Pathways International Philippines to serve as a venue for knowledge exchange and discussion among those seeking new visions and insights in multidisciplinary fields and to initiate international network among academic members, researchers and scholars in science and technology working towards sustainable development.

We hope that you favorably consider our invitation.

Very truly yours,

Kasem Soytong

Assoc. Prof. Dr. Kasem Soytong
Chair, Organizing Committee ICIST 2013
President, Association of Agricultural Technology in Southeast Asia
www.ijat-aatsea.com