CHAPTER 2

Comparative Morphological Characteristics of *Amanita* mushrooms in Chiang Mai Community Forests

2.1 Introduction

Amanita Pers. is a large genus that is common in Thailand, composed of edible and poisonous species (Table1.2, Chapter 1). Edible species, *Amanita caesarea, A. hemibapha, A. princeps,* and *A. cheapangiana*, are used as food for Thai people. Shepherd and Totterdell (1988) indicated that *Amanita* is one of the most simply to identify of all the agaric genera. However, species identification is regularly difficult without the use of a microscopic characteristics. Since the invention and spread of the PCR, different DNA fingerprinting methods have been introduced for the assessment the genetic relationships among taxonomically related organisms (Kårén *et al*., 1997). Vicente *et al*.(2002) used Amplified Ribosomal DNA Restriction Analysis (ARDRA) for the analysis of the phenetic relationship relationships among several Spanish *Amanita* species. This technique is based on the comparison of the electrophoretic profiles obtained after the digestion of the ITS1-5.8S-ITS2 region with different restriction endonucleases. Nuclear rDNA genes have been widely employed for inferring taxonomic and phylogenetic relationships on a wide range of organisms, recently including genus *Amanita* (Yang and Oberwinkler, 1998; Drehmel *et al*., 1999). Although rDNA sequence analysis or Amplified Ribosomal DNA Restriction Analysis (ARDRA) has been widely applied for the molecular typing of fungi (including *Amanita* species) isolated in the field study (Kårén *et al*., 1997). It is conceivable but still more expensive sequencing technologies. The morphological classification can be very useful as the primary method of mycorrhizal classification, when used in conjunction with molecular techniques (Sakakibara *et al*., 2002)

However, in cases of *Amanita* mushroom poisoning that the physicians must be rescued and recovered the patient within the few hours. They need to know the poisonous species for decision and therapy the patient. The mushroom field guide or pictorial mushroom field guide was the low cost alternative choices for using as tools in symptom diagnosis of patient and identification the pieces of poisonous mushroom by mycologist. Some species of this genus are poisonous mushrooms and they are

looklike edilbe species that causes Thai people dead every year (Table 1.3,Chapter 1). There is a need to accurately define edible, poisonous and other mushrooms in Thailand where wild mushrooms are traditionally collected from forests for consuming. This chapter focused on the distribution of edible and poisonous species of *Amanita* mushrooms in Chiang Mai community forests for comparing the differences of morphological characteristics of *Amanita* mushrooms. The taxonomic key of *Amanita* mushrooms from Bas (1969) were used. Bas (1969) devided the *Amanita* mushrooms to two subgeneus, *Lepidella* and *Amanita* (Table 1.1 Chapter 1). Subgenus *Lepidella* consists of four sections; *Amidella, Lepidella, Phalloideae* and *Validae.* Subgenus *Amanita* consist of two sections; *Amanitae* and *Vaginatae.*

2.2 Materials and Methods

2.2.1 Field surveys of *Amanita* mushrooms

Study sites

The study sites were undertaken in Chiang Mai community forests, Doi Saket, Mae Orn, Mae Rim, Mae Wang, and San Kamphang districts. Their were selected as according to the types of forest (mixed deciduous, dry dipterocarp, moist evergreen, hill evergreen, and dry evergreen / pine forest) and the sites recommended by the experienced mushroom collectors in each community. Each study site was investigated at least three times per month from June 2003 to August 2005. The local wild mushroom collectors who experienced in wild mushrooms collecting in each studied sites were invited for co-surveying and confirmed the local names of *Amanita* mushrooms species in each study sites.

Sampling collection

Only the *Amanita* mushrooms were surveyed and collected in Chiang Mai community forest. Whole Fruiting bodies were collected by using a chisel, removing the adhering soil or debris with the brush, wrapping the specimen with the low cost paper and placed it on a basket. Each collection consisted of young, mature and old individuals where possible. The following information was recorded i.e. species, local name, macroscopic and microscopic characteristics of fruiting body (brief description), collected date, substratum, habitat, relative air humidity, soil moisture,

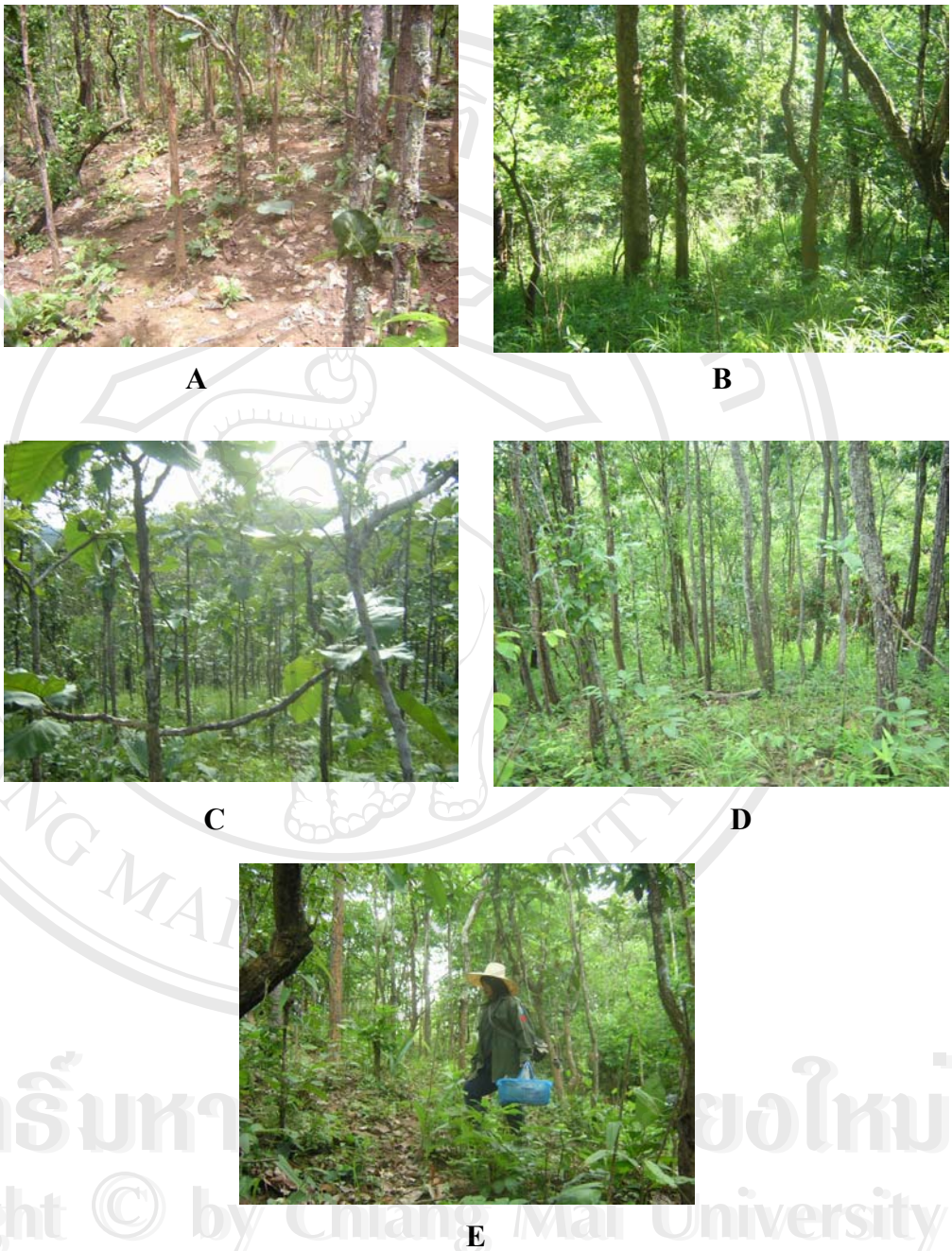
air temperature, altitude, location, soil pH and light intensity at the ground level. The *Amanita* mushrooms were classified and identified to genus and species using conventional morphological methods (Bas, 1969; Singer, 1986). Color was coded according to Petersen (1996) and Anonymous (1994).

Basidocarp caps were sized into categories after methods of Bas (1969):

- very small caps up to 3 cm wide,
- small > 3-5 cm wide,
- medium > 5-9 cm wide,
- large > 9-15 cm wide,
- very large > 15 cm.

The amyloid reaction of the spores was examined in Melzer's reagent (see recipe in Appendix B). Spore size was determined by measuring the diameter of ten spores. The following lists were the main references used:-

1. Colored illustrations of mushrooms of Japan Vol. 1-2 (Imazeki & Hongo, 1998a; Imazeki & Hongo, 1998b)
2. Edible and poisonous mushroom in Thailand (Rachabunditayasathan, 1996)
3. Fungi of Japan (Imazeki et al., 1988)
4. Identification of the larger fungi (Watling, 1973)
5. Mushrooms of North America (Phillips, 1991)
6. Mushrooms of Thailand (Chandrasrikul, 1998)
7. The Audubon Society Field Guide to North American Mushrooms (Lincoff, 1989).
8. The great encyclopedia of mushrooms (Kaufmann & Bremse, 1999)
9. The mushrooms and toadstools of Britain and North-western Europe (Bon, 1987)



A **B**

C **D**

E

Figure 2.1 Chaing Mai community forest in (A) Doi Saket, (B) Mae Orn, (C) Mae Rim, (D) Mae Wang, and (E) San Kamphaeng District

Table 2.1 Description of Chiang Mai community forest

Chiang Mai Community Forest,	Elevation* (m)	Description
Doi Saket	400	It is a dipterocarp forest consisting of *Shorea obtusa, Shorea siamensis, Dipterocarpus obtusifoius* and *Quercus kerrii*. The Soil is a sandy loam.
Mae Orn	350 - 400	It is a dry diptercarp forest consisting of *Shorea abtusa, S. siamensis, Dipterocarpus obtusifolius, D. tuberculatus* and *Imparata cylindrica*. The soil is a sandy loam
Mae Rim	950 - 1000	It is a primary evergreen forest consisting of *Castonopsis acuminatissima,C. tribuloides, Baccaurea sapida, Styrax apricus, Cleidion spiciflorum, Calamus kerrianus, Dendrocalamus stictus, Bambusa longispatha* and *Pandanus penetrans*. The soil is loamy and high in organic matter.
Mae Wang	350 - 400	It is a dry diptercarp forest consisting of *Shorea abtusa, Dipterocarpus obtusifolius, D. tuberculatus and Imparata cylindrica.* The soil is a sandy loam.
San Kam Phaeng	350 - 400	It is a dry diptercarp forest consisting of *Shorea abtusa, S. siamensis, Dipterocarpus obtusifolius, D. tuberculatus* and *Imparata cylindrica*. The soil is a sandy loam.

* m = metre from sea levels

2.2.2 Comparative morphological characteristics of *Amanita* mushrooms in Chiang Mai community forests

Amanita mushrooms, edible and poisonous species in 2.2.1, were used to comparing morphological characteristics based on similarity in each species of *Amanita* mushrooms. The general morphological characteristics such as diameter of cap, color, shape, size, gill, stripe, spore dimension, spore print, annulus, volva, and bulb were descripted and compared for discriminating the differences of morphological characteristics between edible and poisonous species.

2.2.3 Construction of database of *Amanita* mushroom in Chiang Mai community Forests

The recorded information of the diversity of *Amanita* mushrooms in Chiang Mai community forests such as the data related to its species, habitat, macroscopic and microscopic characteristics of fruiting body were used to design databases (Appendix C) and to create the relational databases (Figures 2.2, and 2.3) by using database management software, Microsoft Accesss. The database management system program was developed and designed end-user interface by using Microsoft Access and Microsoft Visual Basic as the tools (Appendix D, software manual).

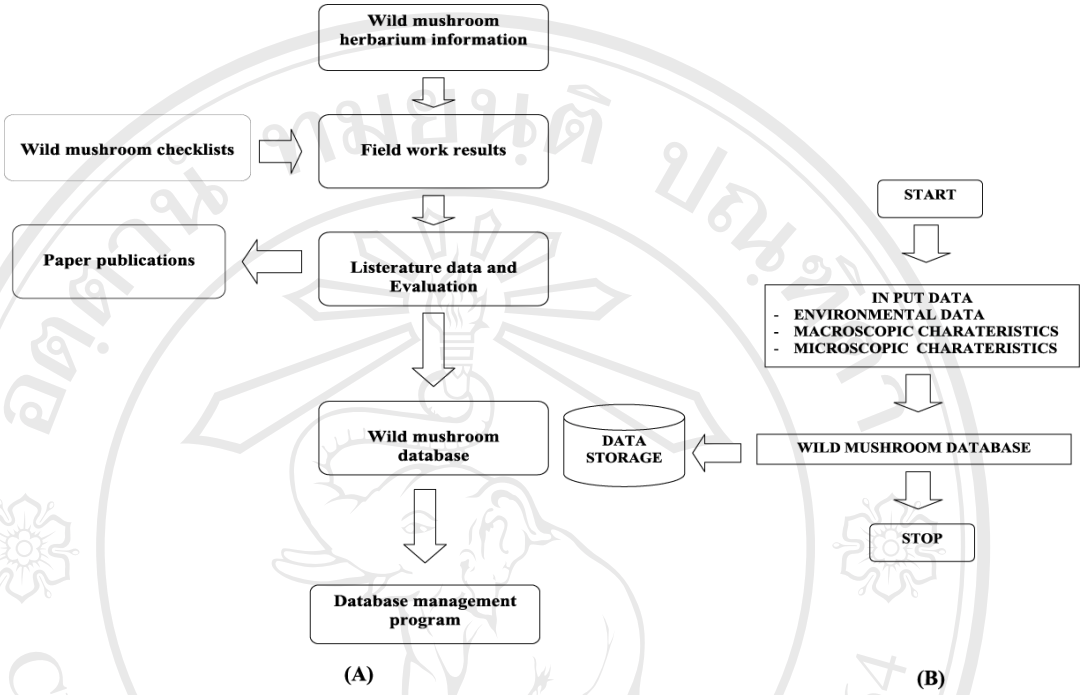


Figure 2.2 **(A)** Simple scheme of information flow in the wild mushroom database of Chiang Mai community forests ; **(B)** Flowchart : procedure for input a mushroom data into wild mushroom database

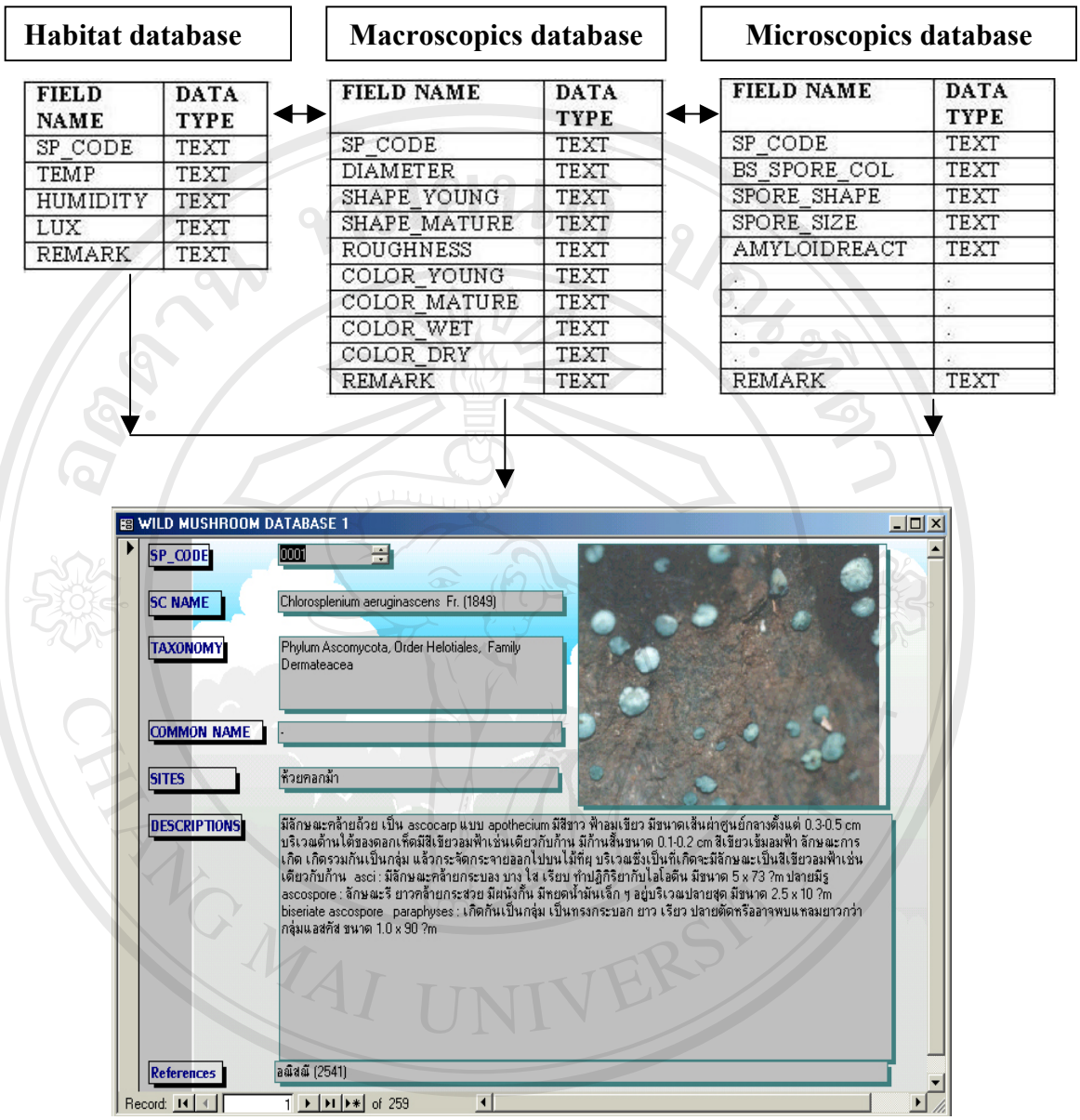


Figure 2.3 Relationship-diagram of relational data field (SP_CODE, in each database) for using to link raw data of wild mushroom database and input database form for using to input raw data of wild mushroom database

2.3 Results

2.3.1 *Amanita* mushrooms in Chiang Mai community forests

Forty two species of *Amanita* were found in 5 Chiang Mai community forest in Doi Saket, Mae Orn, Mae Rim, Mae Wang, and San Kamphaeng Districts were identified by using conventional taxomomic keys (Bas, 1979) (Table 2.1 and Figure A1- A51 in Appendix A). Some species were collected in different locations. *Amanita* includes two subgenera, *Lepidella* and *Amanita*. Subgenus *Lepidella* has sections *Amidella, Lepidella, Phalloideae,* and *Validae*. Subgenus *Amanita* has section *Amanita* and *Vaginatae*. Subgenus Lepidella, section *Amidella* (*Amanita avellaneosquamosa*) was collected in Mae Rim and Mae Wang Districts. Section *Lepidella* (*A. castanopsis, A. cokeri, A. gymnopus, A. hongoi, Amanita* sp., *A. thiersii, A. virginea* and *A. virgineoides*) were commonly found in all study areas. *A. gymnopus* was found only in Mae Orn and San Kamphaeng Districts. *A. thiersii* is rare in Mae Orn and Mae Wang Districts. *A. arocheae A. phalloides, A. verna, A. virosa, A. subjunquillea,* and *A. pseudoporphyria* are in section *Phalloides.* All of them are rare and scattered in the 5 study areas.

Section *validae* (*A. xanthella, A. brunnescens, A. fritillaria* and *A. spissacea*) are rare and scattered in some study areas. Subgenus *Amanita*, sections *Amanita* and *Vaginatae*, are mophologiclly related, sharing features such as the whitsh, yellowish, gleyish or cream colour of the fruiting body, spore shapes and non-amyloid spores. Only 6 species in section *Amanita* (*A. obsita, A. sychnopyramis, A. farnosa, A. siamensis, A. cecilliae* and *A. concentrica*) were found in some study areas. *A. farinosa* and *A. concentrica* are rare in Mae Wang District. Section *Vaginatae,* viz. *A. angustilamellata, A. battarae, A. caesarea, A. calopus, A. chepangiana, A. fuligineodisca, A.fulva, A. griseofolia, A. hemibapha, A. huijsmanii, A. longistriata, A. ovalispora, A. princeps, A. spreta, Amanita* sp.1, and *A. vaginata,* were commonly in all study areas.

Most of the edible species of *Amanita* were named locally by the local mushroom collectors such as Hed Kai Kao (*A. chepangiana*), Hed Kai Laung (*A. hemibapha*), and Hed Kai Kao (*A. princeps*). Some of the poisonous species such as Hed Kai Han Theen Dhum (*A. phalloides*) , Hed Kai Han Theen Dhum (*A. verna*) ,

and Hed Kai Han Theen Dhum (*A. virosa*) has general local names (the names are not specify to each species)

in each study area. It found that 76 % of *Amanita* species (32 species) had no local name were not eaten and unutilized in the study area. Only species in section *Vaginatae,* viz. *A. angustilamellata, A. caesarea, A. chepangina, A. fulva, A. hemibapha, A. princeps, A. vaginata* had known local names while *A. caesarea, A. chepangiana, A. hemibapha,* and *A. princeps* were eaten. All poisonous species were in section *Phalloideae,* viz. *A. phalloides, A. verna,* and *A. virosa.* All have the same " Hed Kai Han Dteen Dton, Hed Dteen Dum". The other species in section *Phalloidae*, the local people did not interest and had no local name.

The forest type in Doi Saket, Mae Orn, Mae Wang, and San Kam Phaeng Districts community forests is deciduous dipterocarp oak seasonal hardwood forest (Maxwell, 2004). Only the community forest in Mae Rim district is a primary evergreen forest. The numbers of *Amanita* species in 5 areas of Chiang Mai community forests in Doi Saket, Mae Rim, Mae Orn, Mae Wang, and San Kam Phaeng were 19, 25, 24, 35 and 28 species, respectively. Each study area differed in the number of *Amanita* species, the poisonous species (*Amanita phalloides, A. verna*, and *A. virosa*) were rarely found in all 5 study areas and are a risk for inexperienced local mushroom collectors. Knowledge about poisonous mushrooms should be availble to people for preventing mushoom poisoning. These community forests provide natural food resources (bamboo shoots, edible wild mushrooms, vegetables, fruits, herb) and income of local people.

The experience of local mushroom collectors about knowledges related to edible and poisonous mushrooms has been transferred by parents or experienced local mushroom collectors to the young people.

Table 2.2 List of *Amanita* species collected in 5 areas of Chiang Mai community forest in Doi Saket, Mae Orn, Mae Rim, Mae Wang and San Kamphaeng districts. (- / + = absent / presence)

Subgenus/ Section	Species	Study areas*				
		DK	MO	MR	MW	SK
Lepidella						
Amidella	*Amanita avellaneosquamosa*	-	+	-	+	-
Lepidella	*Amanita castanopsis*	-	-	+	+	+
	Amanita cokeri	+	+	+	+	+
	Amanita gymnopus	-	-	+	-	+
	Amanita hongoi	+	+	+	+	+
	Amanita sp.	-	-	-	+	-
	Amanita thiersii Bas	-	-	+	+	-
	Amanita virginea	+	+	+	+	+
	Amanita virgineoides	+	+	+	+	+
Phalloideae	*Amanita arocheae*	-	+	-	-	-
	Amanita phalloides # 1	-	-	-	+	+
	Amanita phalloides # 2	-	-	-	-	+
	Amanita phalloides # 3	+	-	+	-	+
	Amanita phalloides # 4	-	+	-	-	-
	Amanita phalloides # 5	-	-	-	+	-
	Amanita verna # 1	+	+	-	-	+
	Amanita verna # 2	+	-	+	+	-
	Amanita verna # 3	-	+	-	-	+
	Amanita virosa # 1	-	-	-	+	-
	Amanita virosa # 2	-	-	-	+	+
	Amanita subjunquillea	-	+	+	+	-
	Amanita pseudoporphyria	+	-	-	-	+

Table 2.2 (continued)

Subgenus/ Section	Species	Study areas*				
		DK	MO	MR	MW	SK
Lepidella						
Validae	*Amanita xanthella*	-	+	-	-	-
	Amanita brunnescens	-	-	-	+	-
	Amanita fritillaria	-	+	-	-	+
	Amanita spissacea	-	-	+	-	+
Amanita						
Amanita	*Amanita obsita*	-	-	+	+	+
	Amanita sychnopyramis	-	-	+	-	+
	Amanita farinosa	-	-	-	+	-
	Amanita siamensis	-	+	-	+	+
	Amanita cecilliae	-	-	-	+	+
	Amanita concentrica	-	-	-	+	-
Vaginatae	*Amanita angustilamellata*	+	+	+	+	+
	Amanita battarae	+	-	-	+	-
	Amanita caesarea	+	+	+	+	+
	Amanita calopus	-	-	+	+	-
	Amanita chepangiana # 1	+	+	+	+	+
	Amanita chepangiana # 2	+	+	+	+	+
	Amanita chepangiana # 3	-	-	+	-	+
	Amanita chepangiana # 4	-	-	+	-	+
	Amanita fuligineodisca	-	-	-	+	-
	Amanita fulva	-	-	-	+	-
	Amanita griseofolia	+	+	+	+	+
	Amanita hemibapha	+	+	+	+	+
	Amanita huijsmanii	+	-	-	+	+

Table 2.2 (continued)

Subgenus/ Section	Species	Study areas*				
		DK	MO	MR	MW	SK
Vaginatae	*Amanita longistriata*	-	+	-	+	+
	Amanita ovalispora	+	+	+	+	+
	Amanita princeps	+	+	+	+	+
	Amanita spreta	+	+	+	+	+
	Amanita sp.1	-	-	-	+	-
	Amanita vaginata	+	+	+	+	+
Total 42 species		19	25	24	35	28

***** DK = Doi Saket, MO = Mae Orn, MR = Mae Rim, MW = Mae Wang, and SK = San KamPhaeng

2.3.2 Comparative morphologicl characteristics of *Amanita* mushrooms in Chiang Mai community forest

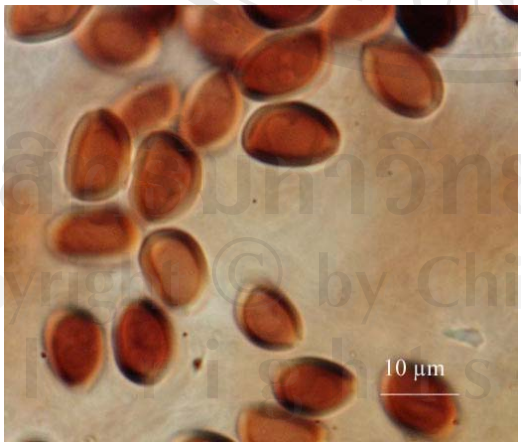
Amanita caesarea A. cheapangiana, A. hemibapha, , and *A. princeps* are the popular edible species of *Amanita* mushrooms in Thailand. They are in section *Vaginatae*, subgenus *Amanita*. The stages of growth and development (immature stage, mature stage) of *Amanita* mushrooms were harvested for consuming or sale in local market by local people or local mushroom collectors. As mentions above, in immature stage of all *Amanita* species are ovoid form and look like all species. It is very possible to misidentify by local people who may be collect the immature stage of poisonous species such as *A. phalloides, A. verna,* and *A. virosa.* However, mature stage of edible and poisonous species may be similar in some morphological characteristics (i.e. shape, size, color, etc.)of them which caused to death of Thai people from poisonous *Amanita* mushroom in Thailand. As mention in the introduction, the comparative morphological characteristics of edible and poisonous species were used as primary tools for supporting primary symptom diagnosis or coping with decision to therapy the mushroom poisoning patient by physicians.

A. immature stage

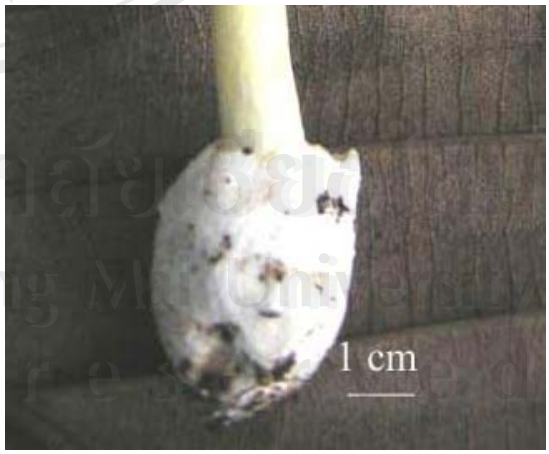
B. mature stage

C. pileus; striate (0.2-0.4R), non-appendiculate

D. free lamellae and annulus

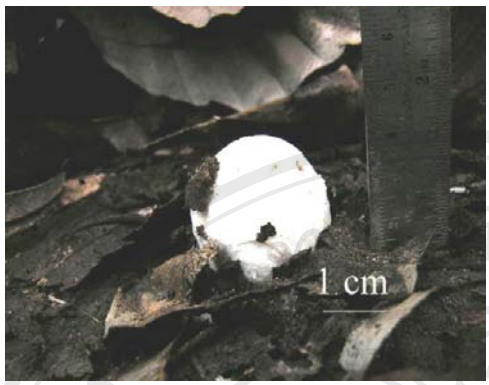


E. non-amyloid spores



F. saccate volva

Figure 2.4 Morphological characteristics of *Amanita caesarea*

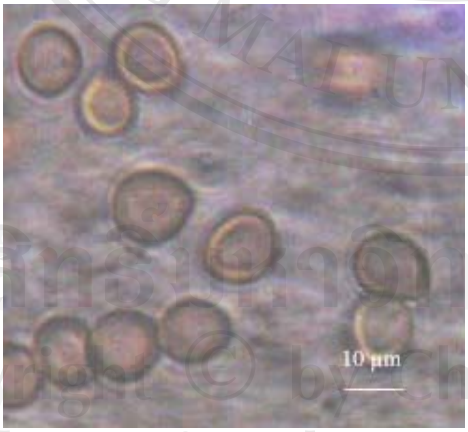


A. immature stage

B. mature stage

C. pileus; striate(0.2R), non- appendiculate

D. lamellae free



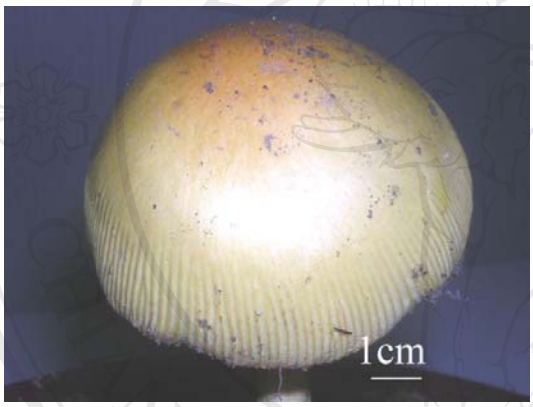
E. non-amyloid spores

F. saccate volva

Figure 2.5 Morphological characteristics of *Amanita cheapangiana*

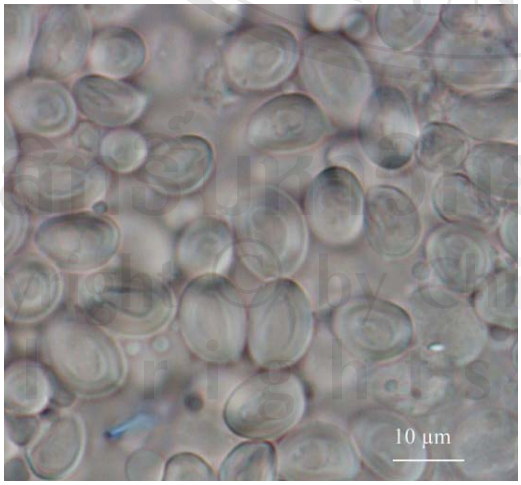
A. immature stage

B. mature stage



C. pileus, striate(0.2-0.4R), non-appendiculate

D. lamellae free



E. non-amyloid spores

F. saccate volva

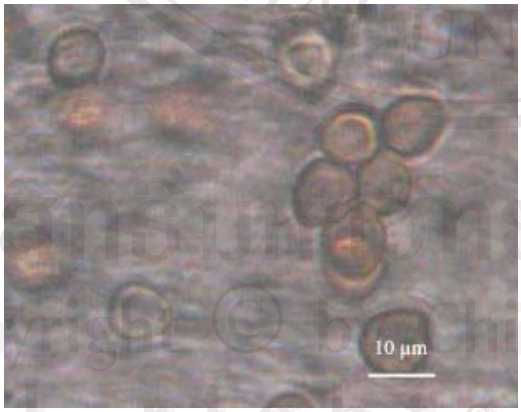
Figure 2.6 Morphological characteristics of *Amanita hemibapha*

A. immature stage

B. mature stage

C. pileus; striate (0.2 R), non-appendiculate

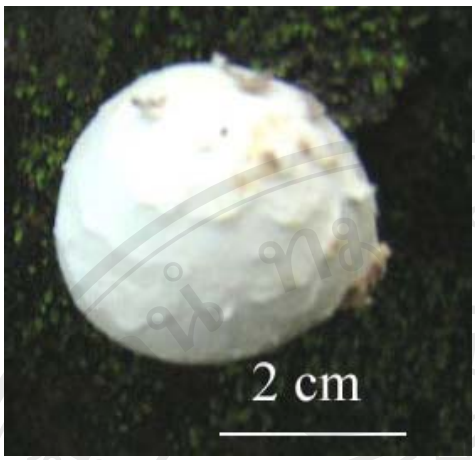
D. lamellae free



E. non-amyloid spores

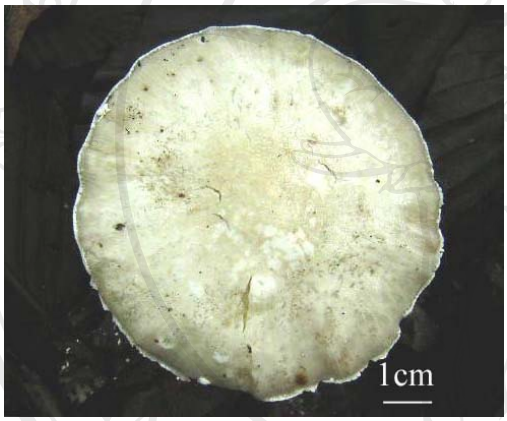
F. saccate volva

Figure 2.7 Morphological characteristics of *Amanita princeps*



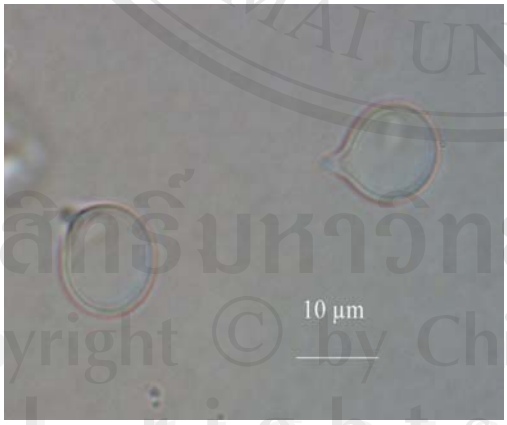
A. immature stage

B. mature stage



C. pileus; non-striate, appendiculate

D. lamellae free



E. amyloid spores

F. limbate volva

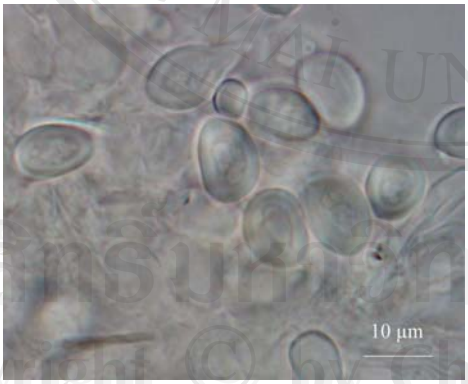
Figure 2.8 Morphological characteristics of *Amanita phalloides*

A. immature stage

B. mature stage

C. pileus; non-striate, appendiculate

D. lamellae free



E. amyloid spores

F. solid stipe and limbate volva

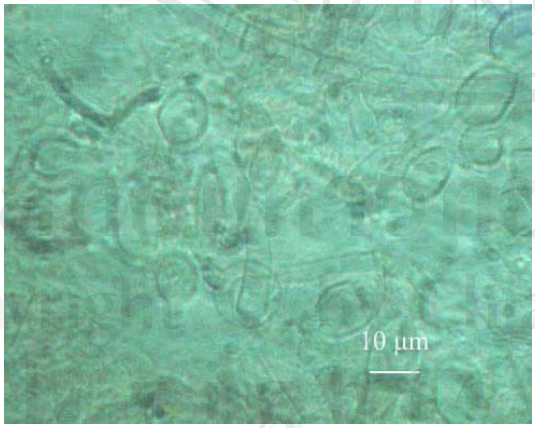
Figure 2.9 Morphological characteristics of *Amanita verna*

A. immature stage

B. mature stage

C. pileus; non-striate, appendiculate

D. lamellae free



E. amyloid spores

F. limbate volva

Figure 2.10 Morphological characteristics of *Amanita virosa*

Table 2.3 comparative morphological characteristics of edible and poisonous species of *Amanita* mushrooms

Morphological characteristics	Edible species	Poisonous species
Fruiting bodies		
Size	5.0 – 12.5 cm	5.0 – 15.0 cm
Shape	convex, viscid, smooth, no warts,	convex, smooth, no warts,
Color	cream, white, yellow, at times discoloring in age to cream on disc,	Grey, light brown, white at times discoloring in age to black on disc,
Margin	striate (0.1-0.2R),	non-striate
Margin edge	non-appendiculate	appendiculate
Lamellae	Free or attached to stalk by a line; white	Free or attached to stalk by a line; white
Stipe, color	white	white
Size	7.0 – 16.0 x 0.8-2.0 cm	7.0 – 16.0 x 0.8-2.5 cm
shape	enlarging downwad to basal bulb; smooth to floccose	enlarging downwad to basal bulb; smooth to floccose;
Annulus, color	white	white
Position	Superior, pendant, membranous, persistent	Superior, pendant, membranous, persistent
Volva, color	White, membranous, persistent,	White, membranous, persistent,
Size	3.0 –6.0 x 2.5 – 5.0 cm	3.0 –6.0 x 2.5 – 5.0 cm
shape	saclike	limbate
Spore print	White spore print	White spore print
dimension	7.5-13.5 x 7.0-11.0 µm	8.0-11.0 x 7.0-11.0 µm
shape	elliptical	elliptical
melzer' reaction	non amyloid	amyloid
Clamp connection	present	absent

Note: edible species such as *A. caesurae, A. chepangiana, A. hemibapha* and *A. princeps*. Poisonous species such as *A. phalloides, A. virosa* and *A. verna*

Some morphological characteristics of *Amanita* species such as *Amanita caesurae* (Figure 2.4) *A. cheapangina* (Figture 2.5), *A. hemibapha* (Figture 2.6), *A. princeps* (Figture 2.7), *A. phalloides* (Figture 2.8), *A. verna* (Figture 2.9) and *A. virosa* (Figture 2.10), were illustrated and summarized in Table 2.3. All of edible species(*Amanita caesarea, A. cheapangina, A. hemibapha* and *A. princeps*) were classified in section *Vaginatae* and differed distinctly in some morphological characteristics from poisonous speceis (*A. phalloides, A. verna* and *A. virosa*). It found that the edible species had distinctly the striate margin (0.1-0.4 R), non – appendiculate margin along the cap, non-amyloid spore, and sac-like volva which these characteristics were absent in poisonous species. The poisonous species had the non-striate, appendiculate margin along the cap, limbate volva, strongly odor, and amyloid spore.

The clamp connection was illustated in Figture 2.11. This characteristic was found at bases of basidia in both subgenus (*Lepidella* and *Amanita*). The clamp connection was presented at the base of basidia of the members of *Lepidella* section such as *Amanita cokeri, A. gymnopus A. hongoi, A. virginea,* and *A. virgineoides*. The edible species, *Amanita caesarea, A. cheapangiana, A. hemibapha,* and *A. princeps*, were presented clamp connection at the base of basidia. This characteristic was not found in *Phalloidae* section such as *Amanita arocheae, A. phalloides, A pseudoporphyria, A. subjunquillea,* and *A. verna*. For *A. virosa*, clamp connection was not observed in this study.

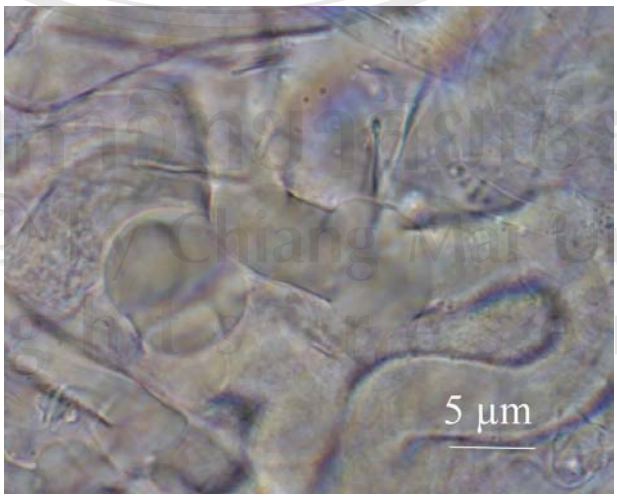


Figure 2.11 Clamp connection of *Amanita hongoi* (*Lepidella* section)

2.3.3 Database construction of *Amanita* mushrooms in Ching Mai community Forests

The databases (Figures 2.3, and 2.12) was constructed and developed the database management system for managing the related information of *Amanita* mushrooms and for more convenient in searching and learning. This database has 51 records of *Amanita* mushrooms in Chiang Mai community forests. Addition, 258 records of non-*Amanita* mushroomand in Doi Suthep-Pui National Park were added in the databases for using as local references.

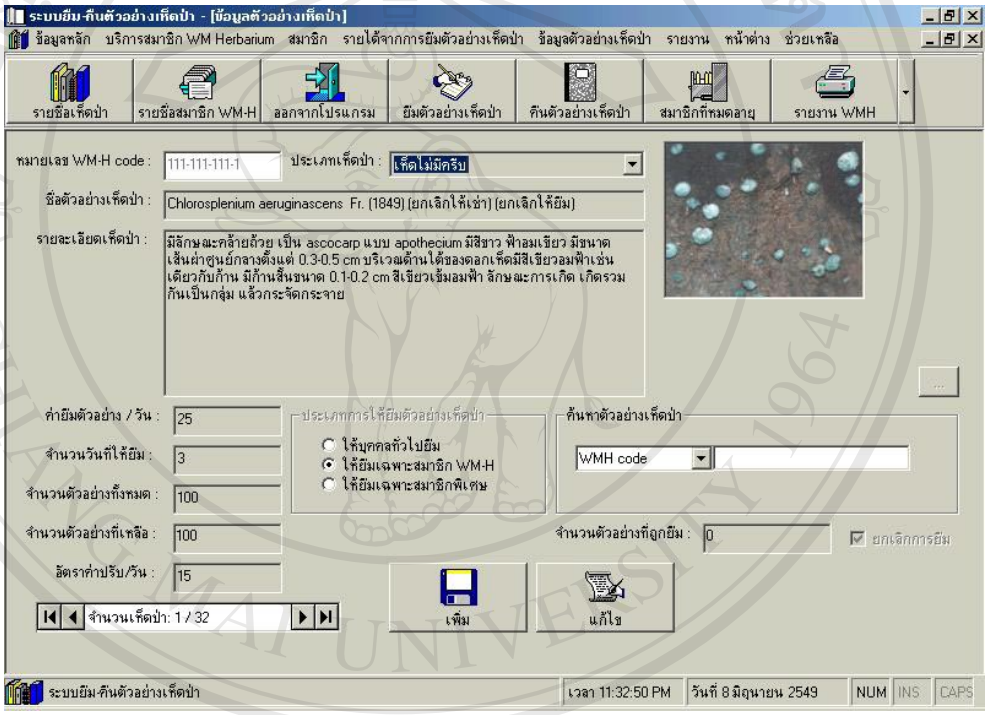


Figure 2.12 *Amanita* and non-*Amanita* mushrooms databases and management software

The wild mushrooms information in Thailand were insufficient and most of the local people known very little about the poisonous wild mushrooms. Thus, the wild mushroom databases and pictorial short-cut key software will be distributed to the knowledge-based learning centers, schools, and local libraries for informing local people about poisonous wild mushrooms. Further work, involves transferring the database and software to webpages-patterns(http://www.thaimushroom.com) for public, use.

2.4 Discussion

Forty two species of *Amanita* mushrooms in 5 Chiang Mai community forests in Doi Saket, Mae Orn, Mae Rim, Mae Wang, and San Kamphaeng Districts were identified to 2 subgenera *Lepidella* and *Amanita*. Subgenus *Leppidella* has 4 sections such as section *Amidella* (*Amanita avellaneosquamosa*), section *Lepidella* (*A. castanopsis, A. cokeri, A. gymnopus, A. hongoi, Amanita* sp., *A. thiersii, A. virginea,* and *A. virgineoides*), section *Phalloides* (*A. arocheae, A. phalloides, A. verna, A. virosa, A. subjunquillea,* and *A. pseudoporphyria*), and section *Validae* (*A. xanthella, A. brunnescens, A. fritillaria,* and *A. spissacea*). Subgenus *Amanita* has two sections such as section *Amanita* (*A. obsita, A. sychnopyramis, A. farinosa, A. siamensis, A. cecilliae,* and *A. concentrica*), and section *Vaginatae* (*A. angustilamellata, A. battarae, A. caesarea, A. calopus, A. chepangiana, A. fuligineodisca, A.fulva, A. griseofolia, A. hemibapha, A. huijsmanii, A. longistriata, A. ovalispora, A. princeps, A. spreta, Amanita* sp.1, and *A. vaginata*).

This study found 42 species of *Amanita,* but only 4 species of edible species were used by the locals and 32 species had no local name and were not eaten. Three poisonous species, *A. phalloides, A. verna,* and *A. virosa*, had the same local name. More than 50 species were found and still unidentified (data not shown), some of them look like the poisonous species in section *Phalloideae,* e.g. *A. phalloides, A. subjunquillea, A. verna,* and *A. virosa*. There are some deadly species in China that are macroscopically similar to *A. verna, A. exitialis* Zhu,Yang and Li (Yang *et al*., 2001), *A. oberwinklerrana* Zhu, (Yang and Doi, 1999), and *A. subjunquillea* var. alba Zhu, (Yang , 1997). As mentioned by Yang *et al*.(2000), more than 50 species of *Amanita* were found in China. The distribution of *Amanita* is world wide and with more than 500 species (Yang *et al.*, 2000; Tulloss, 2001).

Type locations of *Amanita* are from Japan, China, Indonesia, Malaysia peninsula, Nepal, Singapore, and Thailand. *Amanita* habitats in these countries has similar climate and vegetation that similar to Thailand. The same families of host trees occur in Thailand as in the regions where many *Amanita* species were described from Yang (1997). Although some *Amanita* species are edible, a number are very poisonous. In the early rainy season in Thailand, there are always report of poisonings by *A. verna* or other poisonous mushrooms (Chaiear *et al*., 1999) that kill people in

Lao and Cambodia. There are mushrooms poisonings reports in the *Weekly Epidermiological Surveillance Report* by the Bureau of Epidermiology, Department of Disease Control, Ministry of Public Health, Thailand, (Table 1.3 Chapter 1). In spite of these poisonings, *Amanita* remains a popular mushroom for local people in Thailand. *Amanita caesarea*, *A. chepangiana*, *A. hemibapha,* and *A. princeps* are very common in local Thai markets during the rainy season. The well known deadly species, *A. phalloides, A. verna,* and *A. virosa*, were found in this study.

Inquiries from local people who prefer to eat *Amanita* mushrooms, indicate that they will not stop eating various species in this genus so there is a need for more public information on the identification of edible and poisonous species and preventing.

The comparative morphological characteristics of edible and poisonous species are in Table 2.3. Edible species differ from poisonous species by the presence the striate on the cap margin, non-appendiculate margins, and non-amyloid spores. Poisonous species have non-striate along cap margins, appendiculate margins, amyloid spores, and no clamp connection at the base of the basidia. *Amanita phalloides, A. verna, A. virosa* and its Asian look-alikes differ from *A. cheapangiana*, by lacking striations along the pileal margins, having appendiculate margins, and attenuate lamellulae, having a bulb at the stipe base with a comparatively short limbate (not saccate) volva, and having amyloid spores (Breitenbach *et al*., 1995).