TAXONOMIC STUDY ON TEN WILD MUSHROOMS FROM LOIKAW TOWNSHIP IN KAYAH STATE

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Abstract

The taxonomic studies on wild mushrooms from Loikaw Township, Loikaw District in Kayah State have been undertaken. The study area is located between N' 19º 14' 22" - 19º 59' 45" and E' 97º 7' 0.9" - 97º 31' 33". The wild mushrooms were collected from June to September, 2017. The 10 species of 9 genera belonging to 6 families and 3 order were collected, preserved, classified, identified and described. The collected species were identified as *Coprinus disseminatus* (Pers.) Gray, *Macrolepiota konradii* (Huijsman ex. P. D. Orton) M. M. Moser, *Amanita caesarea* (Scop.) Per., *Amanitopsis vaginata* (Bull.) Roze., *Hygrocybe ceracea* (Sowerby) P. Kumm., *Termitomyces schimperi* (Pat.) R. Heim, *Boletus pulverulentus* Opat., *Lactarius clarkeae* Cleland., *Lactarius volemus* (Fr.) Fr. and *Russula virescens* (Schaeff.) Fr. The growing habitats of *Coprinus disseminatus* (Pers.) Gray. was on the decayed woods and the others were on the soil. All species were edible. An artificial key to the studied species was constructed and presented.

Keywords: Taxonomic of wild mushrooms, Loikaw Township, Kayah State, edible.

Introduction

Mushrooms are fungi, generally considered to be lower forms of life, belonging to plant kingdom. There are about 45,000 known species of fungi and about 2000 of them are considered edible (Nair 1990). Mushrooms of one kind or another are to be found at almost every season but they occur in greatest abundance after showery weather in the months of July, August and September. Among the fungi, commonly known as mushrooms are the puffballs, club fungi, coral fungi, hedgehog fungi, truffles, trembling fungi,

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morels, stinkhorns, tube-bearing fungi and the gilled fungi or agarics. Fungi possessing no chlorophyll, must like animals, depend for their nourishment upon living or dead organic matters (Thomas 1948).

Fungi belong to the class of plants known as Cryptogams. The vegetable kingdom is divided into two great groups: one, flowering plants or phanerograms, which is characterized by forming seeds, the other, flowerless plants, cryptograms, which reproduced by spores (Ramsbottom 1923). Most fungi will grow between 0º and 35ºC, but optimum temperatures lies in the range of 20-30ºC. The ability of many fungi withstand extremely low temperatures as low as -195ºC. (Alexopoulos 1962).

Fungi are classified according to the way in which the spores are arranged. Basidiomycetes include mushrooms, toadstools, bracket fungi, fairly clubs. Basidiomycetes are characterized by having their spores borne, usually in fours, on the outside of basidia. Ascomycetes include morals, truffles, cup fungi, ergot and are characterized by having their spores usually in eights, borne within asci (Ramsbottom 1923).

The Basidiomycota contains at least 30,000 different species worldwide and includes many of our most familiar fungi. Fungi were not made of cellulose, like plants, but of chitin. They did not contain chlorophyll and could not use sunlight to convert carbon dioxide into sugars (Roberts & Evan 1950). Some basidiomycetes produce one or more other types of spore in addition to basidiospores. There are about 525 genera and 13,500 species (Smith 1979).

In Myanmar, mushrooms of Karen State was studied by Ku Yin Myint (1983). In 1987, Thida Saint presented mushrooms of Taunggyi and Kalaw areas. In 2010, Kyi Kyi Win studied on the systematic studies of mushrooms in Pyay District and phytochemical investigation of *Dictyophora indusiata* (pers) Fish. In 2014, Khin Sandi Pyone Cho presented the taxonomic study on mushrooms growing in Mandalay. In 2015, Aye Aye Maw presented taxonomic studies on wild mushrooms from Monywa District. Taxonomic studies on wild mushrooms from Southern Shan State was studied by Ohnmar Htwe (2017). Although many researchers had done the wild mushrooms flora

in Myanmar, the taxonomic studies on wild mushrooms have not been undertaken in Kayah State. Therefore, this study was carried out for this research work.

The aim and objectives of this study were to collect, classify and identify the morphological characteristics of the wild mushrooms from Loikaw Township, to study their detailed taxonomic characteristics and distribution, and to fulfill the scientific information in the compilation of the mushroom flora in Myanmar.

Materials and Methods

The study areas of wild mushrooms from Loikaw Township, Kayah State were situated between 19º 14' 22" N to 19º 59' 45" N Latitude and 97º 7' 0.9" E to 97º 31' 33" E longitude. The elevation of Loikaw is 899 meter above the sea level.

The fresh specimen of wild mushrooms were collected from Htee Se Khar Waterfall, Kyauk Taung village, Padangay village and Law Pi Ta village of Loikaw Township, Kayah State from June to September, 2017. The wild mushrooms which were growing on grassland, meadows, decomposing organic matters, hollow and rotten tree trunks were collected.

All the fresh specimens were recorded with photographs to get their actual habit and noted their fruiting characteristics. The collection, preservation and the spores print tecnique were followed by Krieger & Schaffer (1967) and Pacionic (1981). The fleshy matured specimens were selected for the preparation of spores print. The stipe was firstly removed by cutting it off as close as possible to the point of attachment of cap. It is obtained by placing a cap with the hymenium facing down on a sheet of white paper or a piece of glass-slide. A blow can then serve as a cover after a few hours, a layer of the spores was deposited. Finally real colour of the spores was determined by spores print.

The collected specimens were preserved in Formalin-Acetic acid-Alcohol (FAA) by the ratio of 5: 5: 90. Some of the dried specimens were placed in plastic bags and plastic bottles. Classification and identification of

the collected specimens were done by referring the literature; Bessey (1952), Krieger & Schaffer (1967), Coker & Couch (1969), Keizer (1998). An artificial key to the studied species was also constructed and presented. The herbarium specimens were numbered and deposited at the herbarium room of Department of Botany, University of Mandalay for the references and other scientific studies.

Results

Ten species of 9 genera belonging to 6 families and 3 orders were collected from four study areas of Loikaw Township in Kayah State. The morphological and spores characters of those species were classified and identified. The list of collected species and their comparable morphological characteristics were presented in Table 1- 2 and Figure 1-10.

Table 1. List of collected wild mushroom species from Loikow Township

Class	Sub-Class	Order	Family	No.	Scientific Name
Basidio-mycetes	Homobasidio-mycetidae	Agaricales	Agaricaceae	1.	*Coprinus disseminatus* (Pers.) Gray
				2.	*Macrolepiota konradii* (Hujjsman ex. P.D. Orton) M. M. Moser
			Amanitaceae	3.	*Amanita caesarea* (Scop.) Per.
				4.	*Amanitopsis vaginata* (Bull.) Roze.
			Hygrophoraceae	5.	*Hygrocybe ceracea* (Sowerby) P. Kumm.
			Lyophyllaceae	6.	*Termitomyces schimperi* (Pat.) R. Heim
		Boletales	Boletaceae	7.	*Boletus pulverulentus* Opat.
				8.	*Lactarius clarkeae* Cleland.
				9.	*Lactarius volemus* (Fr.) Fr.
		Russulales	Russalaceae	10.	*Russula virescens* (Schaeff.) Fr.

Table 2. Comparable morphological characteristics of wild mushrooms from Lowikaw Township

No.	Scientific Name	Growing Habitat	Edible/ Inedible	Cap			Gills / Pores	
				Colour	Shape	Umbonate	Colour	Attachment
1.	*Coprinus disseminatus* (Pers.) Gray	decay woods	edible	white to pale grey	campanulate	present	grayish-brown	free
2.	*Macrolepiota konradii* (Hujjsman ex. P.D. Orton) M. M. Moser	soil	edible	white	expanded	sligthly present	white	free
3.	*Amanita caesarea* (Scop.) Per	soil	edible	orange-red	expanded convex	absent	yellow	free
4.	*Amanitopsis vaginata* (Bull.) Roze.	soil	edible	leaden-brown	expended	absent	white	free
5.	*Hygrocybe ceracea* (Sowerby) P. Kumm.	soil	edible	pale-orange	convex	absent	pale-yellow	free
6.	*Termitomyces schimperi* (Pat.) R. Heim	soil	edible	white	convex expanded	present	white	free
7.	*Boletus pulverulentus* Opat.	soil	edible	dark-brown	convex	absent	yellow	adnate
8.	*Lactarius clarkeae* Cleland.	soil	edible	orange-brown	convex to depressed	absent	creamy-white	Adnate to decurrent
9.	*Lactarius volemus* (Fr.) Fr.	soil	edible	orange-brown	convex with depression	absent	Golden-yellow brown	decurrent
10.	*Russula virescens* (Schaeff.) Fr.	soil	edible	dull green	globose	absent	white	free

Table 2. Continued

No.	Scientific Name	Stipe				Spore			
		Shape	colour	hollow/ solid	annulus or ring	Colour	shape	texture	size (µm)
1.	*Coprinus disseminatus* (Pers.) Gray	slender	white	hollow	absent	dark-brown	elliptic	smooth	6-7.2×4.8-4.8
2.	*Macrolepiota konradii* (Huijsman ex. P.D. Orton) M. M. Moser	equal	white	hollow	present	white	ovoid	smooth apical germ pore	8.4-11.4×6-7.2
3.	*Amanita caesarea* (Scop.) Per	unequal	yellow	hollow	present	white	elliptic	smooth	6-7.2×6-6
4.	*Amanitopsis vaginata* (Bull.) Roze.	equal	white	hollow	absent	white	globose	smooth	8.4-12×6-8.4
5.	*Hygrocybe ceracea* (Sowerby) P. Kumm.	slender	white	hollow	absent	white	elliptic	smooth	8.4-10.8×4.8-6
6	*Termitomyces schimperi* (Pat.) R. Heim	unequal	white	solid	present	pink	elliptic	smooth	6-7.2×3.6-4.8
7.	*Boletus pulverulentus* Opat.	equal	reddish brown	solid	absent	olive-brown	fusiform	smooth	7.2-9.6×4.8-6
8.	*Lactarius clarkeae* Clenland.	unequal	orange-brown	solid	absent	white	globose	rough	6-8.4×6-7.2
9.	*Lactarius volemus* (Fr.) Fr.	equal	orange brown	solid	absent	white	globose	rough	7.2-7.2×7.2-7.2
10	*Russula virescens* (Schaeff.) Fr.	unequal	white	solid	absent	white	globose	smooth	6-7.2×4.8-6

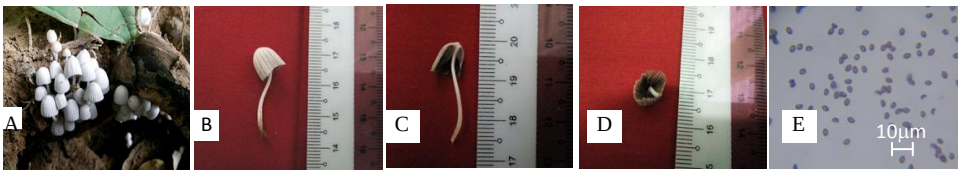

Figure 1. *Coprinus disseminatus* (Pers.) Gray. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

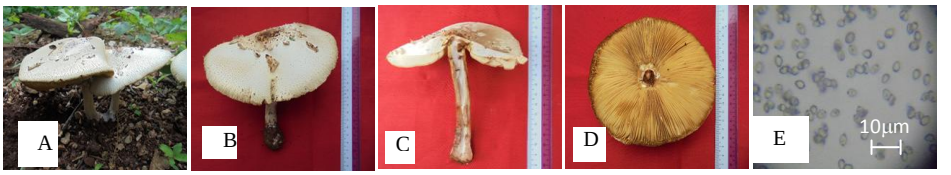

Figure 2. *Macrolepiota konradii* (Hujjsman ex. P.D. Orton) M. M. Moser (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

Figure 3. *Amanita caesarea* (Scop.) Per. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

Figure 4. *Amanitopsis vaginata* (Bull.) Roze. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

Figure 5. *Hygrocybe ceracea* (Sowerby) P. Kumm. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

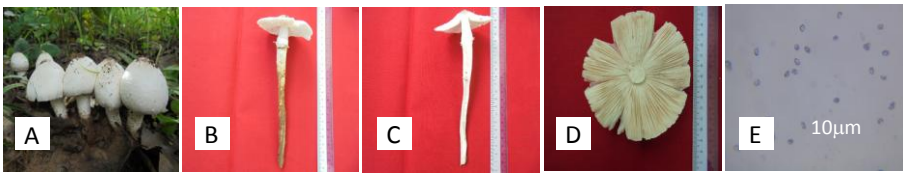

Figure 6. *Termitomyces schimperi* (Pat.) R. Heim. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

Figure 7. *Boletus pulverulentus* Opat. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

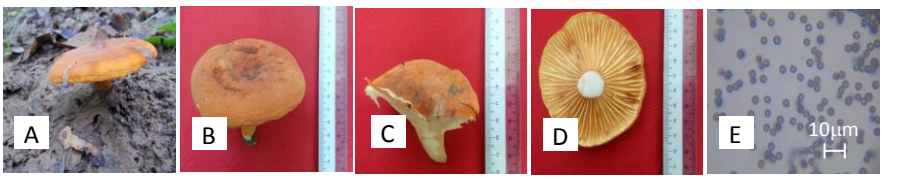

Figure 8. *Lactarius clarkeae* Cleland. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

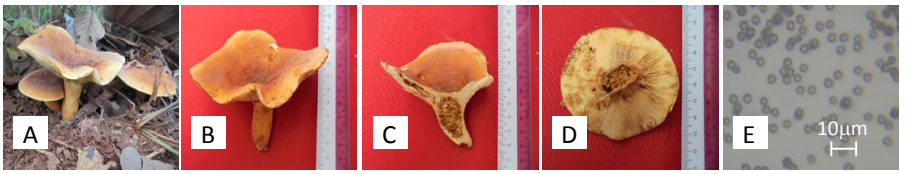

Figure 9. *Lactarius volemus* (Fr.) Fr. (A. Growing habitat, B. Fruiting body ilateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

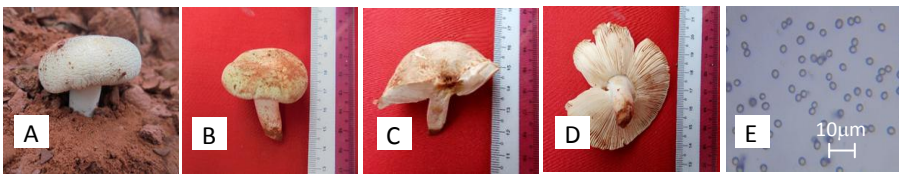

Figure 10. *Russula virescens* (Schaeff.) Fr. (A. Growing habitat, B. Fruiting body in lateral view, C. Fruiting body in longitudinal section, D. Pileus in lower view, E. Spores)

An Artificial Key to the Studied Species

1. Stipe hollow ---------- 2
1. Stipe solid ---------- 6
   2. Umbo present ---------- 3
   2. Umbo absent ---------- 4
3. Cap campanulate; gills white to pale grey ----1. *Coprinus disseminates*
3 Cap expended; gills white ----------9. *Macrolepiota konradii*
   4. Ring present; stipe yellow---------- 3. *Amanita caesarea*
   4. Ring absent; stipe white ---------- 5
5. Spore globose; cap leaden brown ---------- 4. *Amanitopsis vaginata*
5. Spore elliptic; cap pale orange ---------- 5. *Hygrocybe ceracea*
   6. Ring present; spore elliptic ----------6. *Termitomyces schimperi*
   6. Ring absent; spore fusiform and globose ----------7
7. Cap orange brown; spore rough ----------8
7. Cap dark-brown and dull green; spore smooth ----------9
   8 Stipe unequal; gills creamy white ----------8. *Lactarius clarkeae*
   8. Stipe equal; gills golden yellow brown --------4. *Lactarius volemus*
9. Cap convex; gills yellow, adnate ----------7. *Boletus pulverulentus*
9. Cap globose; gills white, free ----------10. *Russula virescens*

Discussion and Conclusion

In the present study, the taxonomic studies on ten species of wild mushrooms from Loikaw Township in Kayah State were undertaken. The fresh specimen of wild mushrooms were collected from Htee Se Khar Waterfall, Kyauk Taung village, Padangay village and Law Pi Ta village, Loikaw Township from June to September, 2017.

Among them, 9 species were gill mushrooms type and 1 species, *Boletus pulverulentus* Opat. was pore mushrooms type. In Loikaw Township, the 4 species collected from Htee Se Khar Waterfall were *Coprinus disseminatus* (Pers.) Gray, *Amanita caesarea* (Scop.) Pers., *Lactarius volemus* (Fr.) Fr. and *Russula virescens* (Schae. ff.). One species, *Amanitopsis vaginata* (Bull.) Roze. was collected from Kyauk Taung village. *Hygrocybe ceracea* (Sowerby) P. Kumm, *Termitomyces schimperi* (Pat.), R. Heim, *Boletus pulverulentus* Opat. and *Lactarius clakeae* Cleland. were collected from Padangay village. *Macrolepiota konradii* (Hujjsman ex. P. D. Orton) M. M. Moser was collected in Law Pi Ta village.

The growing habits of the fruiting bodies vary in the studied species. The 4 species such as *Amanita caesarea* (Scop.) Pers., *Amanitopsis vaginata* (Bull.) Roze., *Lactarius clakeae* Cleland. and *Russula virescens* (Schaeff.) Fr. were growing as the single fruiting bodies. The 6 species such as *Coprinus disseminatus* (Pers.) Gray, *Macrolepiota konradii* (Hujjsman ex. P. D. Orton) M. M. Moser, *Hygrocybe ceracea* (Sowerby) P. Kumm., *Termitomyces schimperi* (Pat.) R. Heim, *Boletus pulverulentus* Opat. *Lactarius volemus* (Fr.) Fr. were growing as the aggregated fruiting bodies. The present findings were agreed with the solitary and group growing habits which mentioned by Phillips (2006).

The 9 species such as *Macrolepiota konradii* (Hujjsman ex P. D. Orton) M. M. Moser, *Amanita caesarea* (Scop.) Per, *Amanitopsis vaginata* (Bull.) Roze, *Hygrocybe ceracea* (Sowerby) P. Kumm., *Termitomyces schimperi* (Pat.) R. Heim, *Boletus pulverulentus* Opat., *Lactarius clarkeae* Cleland., *Lactarius volemus* (Fr.) Fr. and *Russula virescens* (Schaeff.) Fr. were growing

on the soil. One species, *Coprinus disseminatus* (Pers.) was growing on the decayed woods. These findings were agreed with Koon (1990).

The 3 wild mushrooms species, *Coprinus disseminatus* (Pers.) Graw, *Macrolepiota konradii* (Hujjsman Ex. P. D. Orton) M. M. Moser, and *Termitomyces schimperi* (Pat.) R. Heim, were present the umbo on the cap. The others 7 species, *Amanita caesarea* (Scop.) Pers, *Amanitopsis vaginata* (Bull.) Roze., *Hygrocybe ceracea* (Sowerby) P. Kumm., *Boletus pulverulentus* Opat., *Lactarius clakeae* Cleland, *Lactarius volemus* (Fr.) Fr. and *Russula virescens* (Schae. ff.) Fr. were absent umbo on the cap.

Various cap shapes were also observed in this study areas. These were campanulate in *Coprinus disseminatus* (Pers.) Gray; ovate and expanded in *Macrolipiota konrandii* (Hujjsman ex. P. D. Orton) M. M. Moser.; expanded convex in *Amanita caesarea* (Scop.) Per.; bell-shaped to expaneded in *Amanitopsis vaginata* (Bull.) Roze.; convex expanded in *Termitomyces schimperi* (Pat.) R. Heim; convex in *Hygrocybe ceracea* (Sowerby) P. Kumm. and *Boletus pulverulentus* Opat., convex to centre depressed in *Lactarius clarkeae Cleland*, and convex with depression in *Lactarius volemus* (Fr.) Fr. and globose to convex in *Russula virescens* (Schaeff.) Fr. These findings were agreed with Largent (1973).

Gills were free in *Coprinus disseminatus* (Pers.), Gray, *Macrolepiota konradii* (Hujjsman ex. P. D. Orton) M. M. Moser, *Amanita caesarea* (Scop.) Pers., *Amanitopsis vaginata* (Bull.) Roze., *Hygrocybe ceracea* (Sowerby) P. Kumm., *Termitomyces schimperi* (Pat.) R. Heim. and *Russula virescens* (Schaeff.) Fr. The pores of *Boletus pulverulentus* Opat. were adnate and the gills of *Lactarius clarkeae* Cleland. were adnate to decurrent and *Lactarius volemus* (Fr.) were decurrent. These findings were agreed with Phillips (2006).

The stipe shapes were equal in *Macrolepiota konradii* (Hujjsman ex. P. D. Orton) M. M. Moser, *Amanitopsis vaginata* (Bull.) Roze, *Boletus purverulentus* Opat. and *Lactarius volemus* (Fr.) Fr. The stipe shapes of *Termitomyces schimperi* (Pat.) R. Heim., *Amanita caesarea* (Scop.) Pers.,

Lactarius clarkeae Cleland, *Russula virescens* (Schaeff.) Fr. were unequal. *Coprinus disseminatus* (Pers.) Gray, and *Hygrocybe ceracea* (Sowerby). P. Kumm were slender. The hollow stipes were observed in *Coprinus disseminatus* (Pers.) Gray, in *Macrolepiota konradii* (Hujjsman ex. P. D. Orton) M. M. Moser, *Amanita caesarea* (Scop.) Pers., *Amanitopsis vaginata* (Bull.) Roze. and *Hygrocybe ceracea* (Sowerby) P. Kumm. The remaining 5 species were solid stipes.

The spores colour were dark-brown in *Coprinus disseminatus* (Pers.) Gray, pink in *Termitomyces schimperi* (Pat.) R. Heim., olive brown in *Boletus pulverulents* Opat. and white in *Macrolepiota konradii* (Hujjsman ex. P. D. orton) M. M. Moser, *Amanita caesarea* (Scop.) Pers, *Amanitopsis vaginata* (Bull.) Roze., *Hygrocybe ceracea* (Sowerby) P. Kumm., *Lactarius clakeae* Cleland, *Lactarius volemus* (Fr.) Fr. and *Russula virescens* (Schae. ff.) Fr. These findings were agreed with Moore and Sullivan (2014). All of the studied species were edible. These findings were agreed with Groves (1979).

Some wild mushroom species from this Loikaw areas were also found in Karen State, Mon State, Southern Shan State, Mandalay area, Taungyi and Kalaw areas, Pyay District and Monywa Distinct. These are *Coprinus disseminatus* (Pers.) Gray, *Amanita caesarea* (Scop.) Per., *Lactarius volemus* (Fr.) Fr., *Russula virescencs* (Schaeff.) Fr. in Karen State (Ku Yin Myint 1983); *Coprinus disseminates* (Pers.) Gray. and *Amanitopsis vaginata* (Bull.) Roze. in Thaton District, Mon State (Thandar Soe 2013); *Coprinus disseminatus* (Pres.) Gray, *Aminita caesarea* (Scop.) Per., *Amanitopsis vaginata* (Bull.) Roze., *Lactarius volemus* (Fr.) Fr. and *Russula virescens* (Schaeff.) Fr. in Southern Shan State (Ohnmar Htwe 2017); *Coprinus disseminatus* (Pers.) Gray, *Amanita caesarea* (Scop.) Per., *Amanitopsis vaginata* (Bull.) Roze., *Termitomyces schimperi* (Pat.) R. Heim, *Lactarius volemus* (Fr.) Fr., *Russula virescens* (Schaeff.) Fr. in Taungyi and Kalaw areas (Thida Saint 1987); *Termitomyces schimperi* (Pat.) R. Heim. in Mandalay (Khin Sandy Phyone Cho 2014); *Coprinus disseminatus* (Pers.) Gray, *Amanita caesarea* (Scop.) Per., *Amanitopsis vaginata* (Bull.) Roze., *Termitomyces schimperi* (Pat.) R. Heim, in Pyay District (Kyi Kyi Win 2010) and *Coprinus*

disseminatus (Pers.) Gray, *Amanita caesarea* (Scop.) Per., *Termitomyces schimperi* (Pat.) R. Heim. and *Lactarius volemus* (Fr.) Fr. in Monywa District (Aye Aye Maw 2015).

Therefore, it would be concluded that the present study was one of the systematic records of wild mushrooms to be used by researchers in various fields of studies. This study will be provided the partial fulfillment of the information on the wild mushrooms distribution in Loikaw Township, in Kayah State and will be beneficial to accomplish the mushroom flora in Myanmar.

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