

Identification, morphology, and nutrient composition of edible fungi and insects in Myanmar

Identificación, morfología y composición nutricional de los hongos e insectos comestibles de Myanmar

DOI: 10.53499/sfjeasv4n3-002

Received in: May 1st, 2024

Accepted in: Jun 30th, 2024

Wah Wah Linn

M.Sc Magwe University, Myanmar
Forest Protection Section, Forest Research Institute, FRI Campus, Yezin, Nay Pyi Taw,
Mandalay Region. Myanmar
wahwahlinn48@gmail.com

Deliver Htwe

M.Sc, Yangon University, Myanmar
Forest Protection Section, Forest Research Institute, FRI Campus, Yezin, Nay Pyi Taw,
Mandalay Region. Myanmar
htwe.deliver@gmail.com

Wai Wai Than

M.Sc, Institute of Forestry, Myanmar
Forest Protection Section, Forest Research Institute, FRI Campus, Yezin, Nay Pyi Taw,
Mandalay Region. Myanmar
waiwaikyaw2007@gmail.com

ABSTRACT

Myanmar consumes fungi and insect as a food and medicinal purposes. People collect them for household consumption and local trade. Myanmar well known edible fungi and insects, but lacking record systematically, analyze their nutrition and publication. Research focused on species identification, nutrition; and awareness for human health. Fungi, mushroom, puffball, and ant, bee, cicada, cricket, wasp, dung beetle and worm were collected according to the seasonal available. Moisture, Crude Protein (CP), Dry Matter (DM), Organic Matter (OM), Ether Extract (EE), were analyzed using the Kjeldahl method; Mineral elements such as Ca, Mg, Na, Fe were analyzed by Atomic Absorption Spectrophotometer. Nutrition papers were referred with finding results. Insects were highly nutritious than fungi, CP of fungi 7.88-34 % existing were compared to insects had 70 %. Protein contents of them were greater than livestock except Jew's Ear Fungi. Mineral elements were some lower and some more than other research findings. The nutrients assumed to provide human physiology and health. Further survey with marketing, some more nutrition analysis (carbohydrate, amino acids, vitamins etc.) would be necessary that can be attracted and have a potential for all level of Myanmar people as well as to be a partial reduction of poverty.

Keywords: edible, fungi, insects, identification, nutrition.

RESUMEN

Myanmar consume hongos e insectos como alimento y con fines medicinales. La gente los recoge para el consumo doméstico y el comercio local. Myanmar conoce bien los hongos e insectos comestibles, pero carece de registros sistemáticos, análisis de su nutrición y publicación. La investigación se centra en la identificación de especies, nutrición y concienciación sobre la salud humana. Se recolectaron hongos, setas, globos y hormigas, abejas, cigarras, grillos, avispa, escarabajos peloteros y gusanos según la estación del año. La humedad, la proteína bruta (PB), la materia seca (MS), la materia orgánica (MO) y el extracto etéreo (EE) se analizaron mediante el método Kjeldahl. Los elementos minerales como Ca, Mg, Na y Fe se analizaron con un espectrofotómetro de absorción atómica. Se consultaron documentos sobre nutrición con los resultados obtenidos. Los insectos eran más nutritivos que los hongos; el contenido en PC de los hongos oscilaba entre el 7,88 y el 34%, mientras que el de los insectos era del 70%. Su contenido en proteínas fue superior al del ganado, excepto en el caso de los hongos oreja de judío. Elementos minerales eran algunos más bajos y algunos más que otros resultados de la investigación. Los nutrientes asumidos para proporcionar la fisiología humana y la salud. Sería necesario realizar más estudios de comercialización y análisis nutricionales (hidratos de carbono, aminoácidos, vitaminas, etc.) para atraer a la población de Myanmar de todos los niveles y reducir parcialmente la pobreza.

Palabras clave: comestibles, hongos, insectos, identificación, nutrición.

1 INTRODUCTION

Myanmar and many countries consume some of fungi and insects as a food and medicine. Worldwide at least insects 1,400 species have been recorded as human food (FAO, Regional Office for Asia and the Pacific. Bangkok, Thailand 2010). In Southwest China, over 200 species of wild fungi are commercially traded (Anthony B. Cunnighan and Xuefei Yang. 2011). The consuming is not only the delicious food but also the nutrient supplementary food. Currently, although Myanmar well known edible fungi are about 30 species and edible insects are about 20 species (M. M. Thaung, 2007) but have not yet recorded systematically in Myanmar.

Many insects have found a place in the diets of the Burmese, Karens, Chins, Kachins, Shans, Talaiings and others. Between 150 and 200 species of edible insect are consumed in Southeast Asia.

The nutrients of mushrooms contained Carbohydrate, Protein and Fats. Mushrooms also appear to be a good source of Vitamins including (A, B, C, D, K) (Anthony & Zhu. L. Yang. 2011).

Insects have been well-recognized worldwide as nutritious food, insects provide – Proteins (amino acids such as methionine, cysteine, lysine, and threonine), Carbohydrate,

Fats, Some minerals (calcium, iron, zinc, phosphorous), Some essential vitamins – vitamin A, B complex, C (Capinera, 2004; Johnson, 2010; Xiaoming et al., 2010).

Therefore, this research is necessary to identification, morphology and to study the composition nutrients, awareness of advantages for human health. The research will provide the people for fungi and insects consuming, approach to processing and marketing as well as to be a partial reduction of poverty.

2 OBJECTIVES

- ✚ To record scientifically the edible fungi and insects in Myanmar.
- ✚ To study the nutrient value of edible fungi and insects in Myanmar.
- ✚ To awareness the nutrient value of edible fungi and insects as a supplementary food, partially income for the rural people.

3 MATERIALS AND METHODS

- Edible fungi and insects were collected from consumption areas
- Photograph the natural finding or in the local market
- Record the initial weight of the collected samples
- Record the morphology
- Air Drying the specimen
- Weigh the dried specimen
- Wet digestion method for (Ca, Mg, Na, Fe) and apparatus used is Atomic Absorption Spectrophotometer, Nov AA 400.
- Gravimetric methods for Moisture
- Kjeldahl method (Forest 2020 digester and Foss 2100 Kjelttec distillation unit) for CP
- Gerhardt method for EE
- AOAC, 1990 for DM, OM

4 LITERATURE REVIEW

Many mushrooms or the 'fruit of fungi' are extremely valuable products that are utilized both for their medicinal properties and as food. In many of the world's tropical and temperate forests they are the primary source of income for the people who live there. In southwest China, over 200 species of wild fungi in 64 genera are an essential resource

for many small enterprises collectors of highly-prized mushrooms. Yet the increased demand for timber and rapid expansion of forestry had destroyed the natural habitat of many fungi, unbalancing both forest economics and ecology (Dr Anthony B. Cunningham and Xuefei Yang 2011).

M. M. Thaug (2007) described that *Astraeus hygrometricus*(Pers.) (Vernacular: In-Oo = Dipterocarpus Ball) was terrestrial and associated with Dipterocarpus trees.

www.academia.edu mentioned the *Astraeus hygrometricus* had proximate composition a (% dry wt.) of edible ectomycorrhizal fungi are Protein (from 0.08 to 14.7), Fat (from 0.18 to 4.4), Ca (2.4mg/g), Mg (1.6mg/g) and Fe (3254mg/kg).

Auricularia auricula-judae, known as the Jew's ear, wood ear, jelly ear or by a number of other common names, is a species of edible *Auriculariales* fungus found worldwide. The fruiting body is distinguished by its noticeably ear-like shape and brown colour; it grows upon wood. Today, the fungus is a popular ingredient in many Chinese dishes, such as hot and sour soup, and also used in Chinese medicine. It is also used in Ghana, as a blood tonic. <https://en.wikipedia.org/wiki/Auricularia>.

Mineral element content of *Auricularia auricula-judae* (mg/kg of dry matter) are Ca (1.6×10^4), Mg (0.2×10^4) and Na (0.8×10^4). General chemical composition of this species and other edible fungus(g/100 g of dry matter) are Protein (from 0.4 to 12.5) and Fat (from 0.2 to 1.7). [https://www.researchgate.net/publication/Chemical Composition and Nutritional Value of the Mushroom *Auricularia auricula-judae*](https://www.researchgate.net/publication/Chemical%20Composition%20and%20Nutritional%20Value%20of%20the%20Mushroom%20Auricularia%20auricula-judae).

Calvatia is a genus of puffball mushrooms. Most species in the genus *Calvatia* are edible when young, though some are best avoided, which has a very pungent odor. <https://en.wikipedia.org/wiki/Calvatia>. *Calvatia gigantea* contains proteins (34.37%), and carbohydrates (51.97%) the most abundant compounds. <http://www.dl.begellhouse.com>. Mineral nutrients of *Calvatia gigantea* mushrooms contained Ca 630, Fe 10.7, Na 0.18 and Mg 150. <http://www.academicjournals.org>.

Cantharellus is a genus of popular edible mushrooms, commonly known as *chanterelles*. They are mycorrhizal fungi. Despite this, chanterelles are one of the most recognized and harvested groups of edible mushrooms. They also contain significant amounts of vitamin D. <https://en.wikipedia.org/wiki/Cantharellus>. *Cantharellus* spp. on ground (Vernacular = hmo-thin-gun = monk's robe mushroom) in woodland, M. M. Thaug (2007). *Chanterelle* mushrooms in raw nutritional value per 100 g (3.5 oz) are Protein (1.49g), Fat (0.53g), Vita B₂ (0.215mg), Ca (15mg), Mg (13mg), Na (9mg). <https://en.wikipedia.org/wiki/Chanterelle>.

Nutritional composition % dry weight of some wild mushroom in *Cantharellus cibarius* contained Protein (15) and Fat (5). *Lactarius deliciosus* had Protein (from 23 to 27) and Fat (7). Protein (from 33 to 49) and Fat (from 5 to 10) were found in *Termitomyces microcarpus*, *Tricholoma populinum* had Protein (13) and Fat (9). (Anthony B. Cunningham and Xuefei Yang. 2011. Mushrooms in Forests and woodlands).

Lactarius is a genus of mushroom-producing, ectomycorrhizal fungi, containing several edible species. The species of the genus, commonly known as milk-caps, are characterized by the milky fluid ("latex") they exude when cut or damaged. Like the closely related genus *Russula*, their flesh has a distinctive brittle consistency. <https://en.wikipedia.org/wiki/Lactarius>. Proximate chemical composition (g/100g of fresh weight) *Lactarius* are Fat (from 0.00 to 0.22), Moisture (from 0.53 to 90.05), Crude protein (from 0.04 to 2.96). <https://www.researchgate.net>.

Lentinus has 40 species in the genus, which have a widespread distribution, especially in subtropical regions. <https://en.wikipedia.org/wiki/Lentinus>. *Lentinus tigrinus* was richest in dry matter (94%), and is also rich in carbohydrate (62%), magnesium (11 g/kg). <http://www.academicjournals.org>. M. M. Thaung (2007) showed that *Lentinus squarrosulus* (Vernacular name = wah-yon- hmo = bamboo stool mushroom) on dead wood, Lower Burma; in the vicinity/inside of a bamboo clump.

Russula delica is a mushroom that goes by the common name of milk-white brittlegill, and is mostly white, with ochraceous or brownish cap markings, and a short robust stem. It is edible, but poor in taste, and grows in coniferous, broadleaved, or mixed woods. It can be confused with other white *Russula* species and certain white *Lactarius* species. https://en.wikipedia.org/wiki/Russula_Russuladelica contains 90.67 % moisture, 3.70 % protein, 0.43 % fat, 4.1 mg. sodium and 10 mg calcium. <http://agris.fao.org/agris-search/search>. The moisture content was highest in the *Russula sp.* (90.2%) and on the average the crude protein was 41.7%, 30.3%. <http://www.eajournals.org/journals/european-journal-of-food-science-and-technology>.

Termitomyces mushrooms are edible for most people, and the larger species are a popular wild food where they occur. There are about 30 species in the genus. They include the largest mushroom in the world. These fungi grow on 'combs' which are formed from the termites' excreta, dominated by tough woody fragments. <https://en.wikipedia.org/wiki/Termitomyces>. Proximate chemical composition (g/100g of fresh weight) Crude Protein (37%), Ca(216g/kg) and Manganese (136mg/kg). <http://www.academicjournals.org>. M. M. Thaung (2007) mentioned that *Termitomyces*

schimperi (Vernacular name = toung-bho-hmo or Naga-hmo) on termite hills, jungle east of Yezin Campus.

Tricholoma is a genus of fungus that contains a large number of fairly fleshy white-spored gilled mushrooms which are found worldwide generally growing in woodlands. These are ectomycorrhizal fungi. <https://en.wikipedia.org/wiki/Tricholoma>. Proximate and mineral compositions of *Tricholoma matsutake* (per 100 g sample, n = 3) had Protein (from 0.02 to 20.30), Fat (from 0.01 to 5.04), Ca (from 0.04 to 41), Fe (from 0.03 to 36.9) and Manganese (from 0.02 to 8.31). <https://www.researchgate.net>.

In Spain, the *Lactarius* was cash mushroom between € 5600 and 8400 € a season around 40% of the average family annual income for the region. In northwest Yunnan people built houses and occasionally bought cars with the proceeds from selling matsutake (*Tricholoma matsutake*). In Oaxaca, the poorest state of Mexico and could earn between \$20 and \$30 a day collecting (*Tricholoma magnivelare*) (Arora, 2008).

Larvae and pupae (and rarely adults) of honeybees are roasted/grilled over a fire and cooked in Japan, China and Java. They are boiled with porridge or rice, stir-fried or drunk together with honey. In India, eating of honey bee comb with the brood (eggs and larvae) is common practice in certain areas (Partha et.al, 2014)

Silkworm *Bombyx mori* L. (Saturniidae) are consumed by locals in many Asian countries (Partha et.al, 2014). It is a popular dish in Korea, these are known as Bon Daegi, and are an edible by product of the silk-harvesting process. (<https://edibug.wordpress.com/list-of-edible-insects/>)

Cricket is eaten fried, sauteed, boiled, and roasted, these are amongst the most common edible insects in Mexico, and Southeast Asia (<https://edibug.wordpress.com/List-of-edible-insects/>). Popular food insect in Burma is the large cricket, *Brachytrupes portentosus*, which breeds underground and emerges during the end of the rainy season, around September- October. (Jeffrey Hays, 2008) (<http://factsanddetails.com/>)

Cicadas have soft, juicy bodies, and are very tender and delicious. Cicada are also eaten in many Asian countries, such as Japan, Thailand, and Malaysia. (<https://edibug.wordpress.com/list-of-edible-insects/>)

Delphin says that a very popular insect is the larva of *Eretes sticticus*, Twin Poo which breeds in prodigious numbers in a lake in the crater of an extinct volcano at Twin-daung in central Myanmar. The larvae are sundried, then fried and eaten as a snack

typically Burmese preparation consisting of fermented tea leaves at Burmese social gatherings. (Jeffrey Hays, 2008) (<http://factsanddetails.com/>)

Dung beetles are found worldwide, on all continents except Antarctica, and eaten fried, quite tasty(Partha et.al, 2014).

Weaver ants are very popular and consumer demand is higher than the natural supply. They were first used for biological control of citrus pests in China, and are used in mango and cashew plantations in Australia (Partha et.al, 2014).

Bamboo worms are eaten fried in Thailand, felled bamboo can be used as fuel and garden materials and in the manufacture of handicrafts after collection of bamboo worms (Partha et.al, 2014).

Red palm weevils (*Rhynchophorus ferrugineus*) from the Sago palm (Metroxylon sagu) larvae is a specialty in Malaysia and Indonesia, the taste somewhat like bacon, and are an essential source of fat (Partha et.al, 2014).

Wasps are eaten in both adult and larval stages. Boiled, sautéed, and fried, Japan favored boiled wasps with rice. (<https://edibug.wordpress.com/list-of-edible-insects/>)

5 RESULTS

Part-I

Fungi Species: - *Astraeus hygrometricus*
Common Name - Dipterocarpus Ball
Local Name - In Auu

Characters: – Length had- 0.5 to 1 in, Breadth:-0.3to 0.5 inches, Stalk: -no. Fruit-body has layers, outer cover layer and inner spore layer, young is white and old is black, spore mass, white and creamy color in young, change sooty and black when mature. It can be found in the rainy season under the tree of *Dipterocarpus tuberculatus*.

Table 1. Nutrients composition of *Astraeus hygrometricus*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
1.	<i>Astraeus hygrometricus</i>	12.8404	89.54	87.72	15.78	1.33	354.5	151.8	29.3	152.9

Fig: 1. *Astraeus hygrometricus*



Fungi Species: - *Calvatia sp.*
Common Name - Puff ball
Local Name - Mho Auu

Characters: – Length had- 3 in, Breadth:- 2.5 inches, Stalk: - 0.3 to 0.5 inches. Young Puffball is white and old, yellowish and brown, no gill and short stalk. Can be found in the rainy season on the grass land, grows singly or scattered in areas with decay debris and soil. Peoples can be able to eat while new fresh Puffball (young stage white color) but can’t eat when mature. Color is whitish in fresh and change to brownish in mature stage.

Table 2. Nutrients composition of *Calvatia sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
2.	<i>Calvatia sp.</i>	16.4998	91.88	87.23	18.52	1.68	171.1	82.1	11	75.8

Fig: 2. *Calvatia sp.*



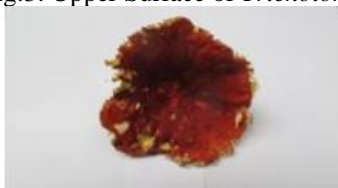
Fungi Species: - *Tricholoma sp.*
Common Name - Ectomycorrhizal fungi
Local Name: - Inn Tine Ni

Characters: – Cap: - 1.4 to 3.5 inches. Stalk: - 1.2 to 3 inches. Cap mostly shining brick-red and depress center, stalk usually longer than cap, gill broad and distant, adnate, finally cream color. It grows scattered in areas with decay debris and soil.

Table3. Nutrients composition of *Tricholoma sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
3.	<i>Tricholoma sp.</i>	15.3577	92.36	84.16	24.19	3.92	101.1	73.3	17.8	172.6

Fig:3. Upper Surface of *Tricholoma sp.*



Under Surface of *Tricholoma sp.*



Fungi Species: - *Tricholoma sp.*
Common Name - Ectomycorrhizal fungi
Local Name: - Inn Tine War

Characters: – Cap: - 1.5 to 4 inches Stalk - 1 to 3.5 inches. Cap is yellow and reddish color, stalk is pale pink color, has large gill. It grows scattered in areas with decay debris and soil.

Table 4. Nutrients composition of *Tricholoma sp.*

No.	Scientific Name	Mois-ture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
4.	<i>Tricholoma sp.</i>	14.0632	93.74	82.42	26.37	3.20	119.8	75.1	10.3	236.9

Fig. 4. Upper Surface of *Tricholoma sp.*



Under Surface of *Tricholoma sp.*



Fungi Species: - *Tricholoma sp.*
Common Name - Ectomycorrhizal fungi
Local Name: - Inn Tine Sein

Characters: – Cap: - 1.5 to 4 inches Stalk: - 1 to 2.5 inches. Cap is green and slightly flattened, has scale and gill, and is broad. It grows scattered in areas with decay debris and soil.

Table5. Nutrients composition of *Tricholoma sp.*

No.	Scientific Name	Mois-ture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
5.	<i>Tricholoma sp.</i>	12.2742	92.87	82.72	26.53	1.94	223.6	82.9	15	135.6

Fig. 5. Upper Surface of *Tricholoma sp.*



Under Surface of *Tricholoma sp.*



Fungi Species: - *Cantharellus sp.*
Common Name - Chanterelles
Local Name: - Hmo War Tar

Characters: - Cap: - 0.5 to 4 inches Stalk: - 0.7 to 1.5 inches, wholly yellow, irregular funnel-shape, and margin incurved, has gill shallow, it is delicious.

Table 6. Nutrients composition of *Cantharellus sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
6.	<i>Cantharellus sp.</i>	12.0702	91.99	83.78	18.99	5.97	131.7	103.8	13.1	284.9

Fig. 6. Upper side of *Cantharellus sp.*



Under side of *Cantharellus sp.*



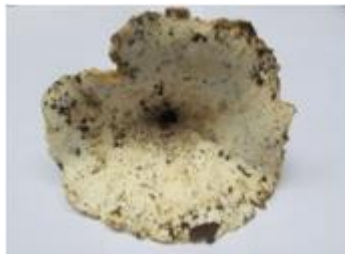
Fungi Species - *Russula sp.*
Common Name - Milk-white brittle gill
Local Name - Hmo Bee Kyae

Characters: – Cap: - 1.8 to 4.5 inches Stalk: -1 to 2 inches. Cap is large, white and convex, funnel shaped, finally depress, gill is decurrent.

Table7. Nutrients composition of *Russula sp.*

No.	Scientific Name	Mois-ture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
7.	<i>Russula sp.</i>	8.2746	93.02/	85.48	18.43	7.46	131.1	94.4	14.4	47.19

Fig. 7. Cap of *Russula sp.*



Fungi Species - *Termitomyces sp.*
Common Name - Termite mounds mushrooms
Local Name -Taun Poet Hmo

Characters: – It can be found on termite’s nests (Termite mound) on damp, black soil, stipe>15 inches long, central, hollow, stipe ring and volva; is more longer than cap, slender, striate. Spore print pale cinnamon. Pileus shape conic to flat, 0.5 to 1 inches, white and dark grayish color,. When young broadly conical to convex finally expended, gill is narrow.

Table 8. Nutrients composition of *Termitomyces sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
8.	<i>Termitomyces sp.</i>	12.0447	91.98	93.41	27.93	1.83	209.3	96.9	11.5	66.2

Fig:8. *Termitomyces sp.*



Transverse section of *Termitomyces sp.*



Fungi Species - *Auricularia auricula*
Common Name - Jew’s ear fungi
Local Name - Kwet Na Ywet Hmo

Characters: – Cap: - length: 0.8 to 3.8 inches, breadth 0.4to 0.8 inches. Various colour yellowish, brown and black, ear-shaped. Like leather and, rubbery, when dries become tough and hard, grows in groups on logs, appears in early summer and rainy.

Table 9. Nutrients composition of *Auricularia auricula*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
9.	<i>Auricularia auricula</i>	10.4950	93.01	94.49	7.88	0.65	471.9	130.1	35.2	36.6

Fig: 9. Cap of *Auricularia auricular*



Underside of *Auricularia auricular*



Fungi Species - *Canthrellus sp.*
Common Name - monk’s robe mushroom
Local Name - HmoThin Gan

Characters: – Cap: - 1 to 2.5 inches stalk: -2 to3 inches. Cap and stalk -yellow brown, thick, cap is funnel shaped, gill, stalk-short and big, can be found in Pine Plantation.

Table 10. Nutrients composition of *Canthrellus sp.*

No.	Scientific Name	Mois-ture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
10.	<i>Cantharellus sp.</i>	8.1350	92.70	85.15	21.52	4.28	84.3	46.2	33.6	114.8

Fig: 10. Cap of *Canthrellus sp.*



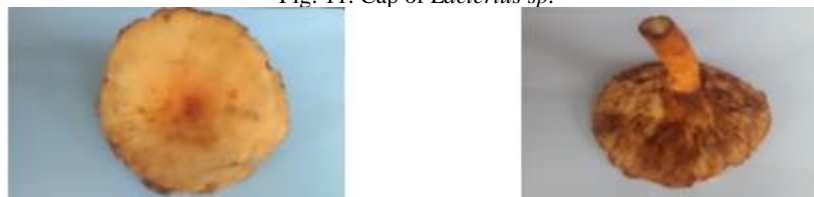
Fungi Species - *Lactarius sp.*
Common Name - Milk-caps
Local Name - Hmo Seinn Sarr

Characters: – White cap length: 0.8 in to 3.5 inches, breadth : 0.5 in to 2.0 inches, stalk: 1.0 in to 3.0 inches. In rainy season grows singly or scattered in areas with conifers. Gill release milky latex if it is broken or tease when it fresh. Mychorrhizal mushroom in the pine plantation.

Table 11. Nutrients composition of *Lactarius sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
11.	<i>Lactarius sp.</i>	16.8	93.1	94.5	19.2	2.8	447.5	453.0	82.8	4538.0

Fig: 11. Cap of *Lacterius sp.*



Fungi Species - *Lentinus squarrosulus*
Common Name -Bamboo stool mushroom
Local Name - Wah Yon Hmo

Characters: – Cap: - 1.1 to 2.5 inches, stalk: - 0.5 to 2.5 inches. Host- Bamboo, whitish or creamy color, pileus funnel shape, irregular margin. Leathery after drying.

Table 12. Nutrients composition of *Lentinus squarrosulus*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
12.	<i>Lentinus squarrosulus</i>	17.4	92.9	95.7	19.8	3.2	333.4	613.0	84.8	253.6

Fig: 12. Cap of *Lentinus squarrosulus*



Under side of *Lentinus squarrosulus*



Fungi Species - *Termitomyces cartilagineus*
Common Name - Termite mounds mushrooms
Local Name - Hmo-Ohn-Net

Characters: – Cap: - 2 inches, growing single or in tufts, color is drab to pale ochre; top of cap is blackish, stipe -1.5 inches, central, fibrous, spongy, it is hard after drying, gill decurrently and black color.

Table 13. Nutrients composition of *Termitomyces cartilagineus*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
13.	<i>Termitomyces cartilagineus</i>	10.2	93.75	92.22	34.17	2.25	640	130	20	220

Fig: 13. Upper side of *Termitomyces cartilagineus*



Underside of *T. cartilagineus*



Part II

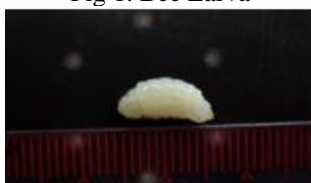
Insect Species - *Apis sp.* Linneaus
Common Name - Bee Larva
Local Name - Pyar

Characters: The larva is headless, whitish and cream color, size is about 1-1.5 cm and has segments. It is soft and easy to spoil. The larvae are collected from comb cells. It can be fried, pounded after broil, delicious and can be collected in a round year. Bee comb with the brood (eggs and larvae) is common edible among the rural people.

Table 1. Nutrients composition of *Apis sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
1.	<i>Apis sp.</i>	13.0991	83.77	94.39	43.42	14.50	121.1	66.7	152.2	4.6

Fig 1. Bee Larva



Bee Comb



Insect Species - *Bombax mori* Linneaus, 1758
Common Name - Silk Worm
Local Name - Poe Chi Poe

Characters: The larvae of *Bombax mori* are caterpillars that are about 2-3 cm long, reddish brown, segments about 7 including their horned tail. They are buff-coloured with brown thoracic markings. *Bombax mori* spend 2 weeks as pupae in the safety of their cocoons before emerging as adults.

Table 2. Nutrients composition of *Bombax mori*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
2.	<i>Bombax mori</i>	8.32	93.5	92	45	4.92	70	270	10	10

Fig 2. Cocoons



Pupa of Silk Worm



Insect Species - *Brachytrupe portentosus* Lichtentosus, 1796
Common Name - Cricket
Local Name - Pa Yit

Characters: The short tail cricket is the largest field cricket known in Asia. It has a large head and body and light-brown in color. Body length is about 5 cm, and is broadest at the prothorax where it is about 1.5 cm wide. The males bear the sound producing organs, which are files and scrapers on both sides of the fore-wings. Nocturnal insects and collected from their hole, can be found all parts of Myanmar and common edible insects by Myanmar people. Females have an ovipositor. On females, the cerci are also more prominent.

Table 3. Nutrients composition of *Brachytrupe portentosus*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
3.	<i>Brachytrupe portentosus</i>	8.2162	92.94	93.29	58.87	16.56	275.3	74.8	184.7	118.4

Fig 3. Cricket



Insect Species - *Tibicen purinosus*
Common Name - Cicada
Local Name - Puzin Yin kwe

Characters: The adult 2 to 5 centimeters, color dark grey, and its wingspan is 18 to 20 centimeters. Cicadas have compound eyes set wide apart on the sides of the head. Short antennae have three small ocelli located on the top of the head in a triangle between the two large eyes. The mouthparts form a long sharp rostrum which they insert into the plant to feed. The post-clypeus is a large, wings are brown and black markings, The males bear the sound producing organs. These noisy cicadas are an unmistakable sign of the season.

Table 4. Nutrients composition of *Tibicen purinosus*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
4.	<i>Tibicen purinosus</i>	15.0	93.9	97.9	23.6	4.7	617.5	618.5	118.4	126.9

Fig 4. Dorsal side of Cicada



Ventral side of Cicada



Insect Species - *Erectes sticticus*
Common Name - Diving Beetle
Local Name - Twin Po

Characters: The body is oblong and ochraceous, narrower interiorly, moderately shining; length 1.5 to 2 cm. Head large, rectangular, yellowish in color and darkly. Antenna filiform long; eye large; mouths well developed; ocelli absent. Prothoracic process with a spine at the end; elytra a pale yellow usually with black punctures, broadened posterior; legs long and flattened; Abdomen is eight segmented, without hairs and spines. Larvae come up to the shore and burrow into the soil where they pupate, mainly found in rainy season. In Myanmar, it is popular edible with green tea leaf salad and product from Twin Taung, Monywa.

Table 5. Nutrients composition of *Erectes sticticus*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
5.	<i>Erectes sticticus</i>	11.5583	92.73	92.02	54.74	15.54	232.5	89.6	272.3	30.8

Fig 5. *Erectes sticticus*



Insect Species - *Helicoprís bucephalus* F.
Common Name - Dung Beetle
Local Name - Cow Dung Beetle

Characters: Dung ball diameter is 18.5 cm - 25 cm, larva can be found in dung ball, the ball color is match with soil. Larva grub like, usually curved, the head well developed, the larva is cream color, Larva length is 4.5cm to 6cm. Body stout and swollen, segments 11-13 tapering. The dung beetles are found beneath cow dung, buffalo dung, horse

manure, found in mainly March to May. The insects made dung balls and oviposited eggs inside. The balls were placed in tunnels below fresh dung, each tunnel contained six to ten balls. It is popular edible within group of tribes.

Table 6. Nutrients composition of *Heliocoprís bucephalus*

No.	Scientific Name	Moisture %	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
6.	<i>Heliocoprís bucephalus</i>	4.51	92	89	39	5.49	50	140	140	70

Fig 6. Dung ball



Larva in Dung ball



Larva of Dung Beetle



Insect Species - *Oecophylla smaragdina*
Common Name - Weaver ant
Local Name - Kha Gyin

Characters: *Oecophylla* weaver ants vary in color from reddish to yellowish brown. Length: - 0.9 to 1.0cm. The ants nest is in rolling leaf of trees. Ants protect themselves by biting or stinging, or by spraying formic acid, therefore its taste is sour. In Myanmar, it is used as an ingredient in a called locally Yet-sar for cough and digestion, not only as a traditional medicine but also pounded as a Myanmar dish. Larvae are white, grub-like, and fried edible in some locations.

Table 7. Nutrients composition of *Oecophylla smaragdina*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
7.	<i>Oecophylla smaragdina</i>	11.20	85.71	95.54	69.65	11.5	202.6	71.8	183.9	24.9

Fig 7. Nest of Weaver ant



Insect Species - *Omphisa fuscidentalis*
Common Name - Bamboo Worm
Local Name - Wah Poe

Characters: It has an annual life cycle. The bodies of the worms are white, 3 to 4 centimeters long and inhabit bamboo culms. Larvae bore a hole in the bamboo stem, destroying the inner pulp. Then the larvae bore through the internodes moving upwards within the stem. External evidence of their presence includes holes in the stem, shortened internodes and stiffened sheaths. The larval stage is 280 to 304 days. When almost mature, larvae migrate back down the stem into the old segment where they initially bored in.

Table 8. Nutrients composition of *Omphisa fuscidentalis*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
8.	<i>Omphisa fuscidentalis</i>	10.8	94.4	98.7	26.8	5.6	461.8	529.0	70.7	43.6

Fig 8. Larva of Bamboo Worm



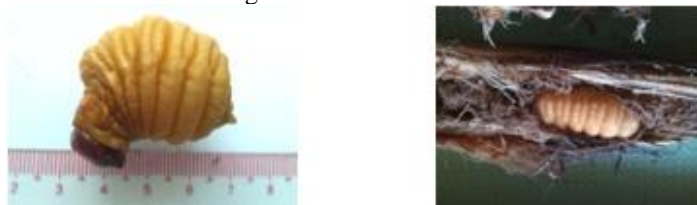
Insect Species - *Rhynchophorus sp.*
Common Name - Palm Weevil larva (Sago Larva)
Local Name - Thin Paung Poe

Characters: The larvae are creamy-white in color, without legs, segmented and are normally found in wounds of live palm tree in March. Length- 5cm to 6cm, upon completion of larval development, the larva will sometimes emerge from the trunk of the tree, and build a pupal case of fiber extracted from the galleries inside the palm.

Table 9. Nutrients composition of *Rhynchophorus sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
9.	<i>Rhynchophorus sp.</i>	4.55	91.1	94.6	59.3	7.64	270.2	52.2	50.7	5.6

Fig 9. Palm Weevil larva



Insect Species - *Vespa sp.*
Common Name - Hornet grubs
Local Name - Padu Larva

Characters: The larva color is yellowish white, has segments, like a wavy shuttle, Length has about- 2.3 cm, it can be collected from the cells of comb. The comb can be found in the bush and or on the roof of buildings.

Table 10. Nutrients composition of *Vespa sp.*

No.	Scientific Name	Moisture%	DM %	OM %	CP %	EE %	Total % (oven dry basic)			
							Ca (mg)	Mg (mg)	Na (mg)	Fe (mg)
10.	<i>Vespa sp.</i>	11.0235	87.74	92.98	60.81	13.94	46.6	150.7	93.6	26.6

Fig 10. Larva of *Vespa sp.*



DM = Dry Matter
 OM = Organic Matter
 EE = Ether Extract (Crude Fat)
 CP = Crude Protein

6 DISCUSSIONS

The results showed that mineral elements were some low and some more than other research findings. Edible insects had highly nutritious than fungi. CP of fungi 8-28 % existing were compared to insects had over 60 %. Protein of fungi and insect were greater than livestock except Jew’s Ear examined 7.88 percentage. Both are as good as other food.

Nutrient value of this paper was compared to Anthony et al. (2007), the specimen *Tricholoma* was different value in finding, however the nutrient value of *Russula* sp., *Cantharellus* sp. and *Termitomyces* sp. were very similar to their results.

Cricket is commonly, more consumed and popular among the Myanmar people. Weaver Ants is consumed local people as digestion powder mixed with salt and black cumin.

Edible larva were collected and analyzed their nutrients in this study, the larva cannot be identified their kind of species. Adult for identification is necessary, however, it is difficult to breed getting adult in the laboratory according to a limited situation./ lack of facility. Some mushrooms were easily to full of maggots although sundry in the field trips that need urgently send to lab in a short period.

Myanmar people collect on a small scale for personal consumption or local trade. In the Thailand, Cambodia, Lao, Vietnam and China have big farming and exporting that income is getting from them. Myanmar should be learning the farming technologies and, processing that earned may be made a personal finance.

FAO presents insects as a viable replacement for meat in the event of a food shortage over the next century because of their high nutritional value. Many other natural resources, damage to habitat, such as deforestation, forest degradation and pollution (e.g. through insecticides), has placed further stress on edible insect populations (Morris, 2004; Ramos et.al, 2006; Schabel, 2006). Host trees are often cut down to increase and facilitate the collection of insects.

Forest pest can be as a biological control by consuming of insects. However, large harvesting can be negative for food chain, ecology stable, and some collector do tree felling for larva and pupa inside of tree. The importance is should be avoid threats the tree and should be considered how to catch skillfully and effective collection.

7 CONCLUSIONS

The number of edible fungi 13 species and insects 10 species were scientifically recorded; indentified and tested the nutrient composition. This research is preliminary investigation of edible fungi and insect of Myanmar as first documentation, identification, and nutrition value that can generate more details contribution in the future.

Protein of edible insects contained as much as more than meat. The nutritional resources were assumed to be provided human physiology and health. Due to their nutrients content as a food source with long-term supporting that can be recommended to

FAO prospects. These prospects can be enhanced through promotion and adoption of modern food technology standards to ensure that the fungi, mushroom and insects are safe and attractive for human consumption. Commercial processing and marketing are essential in Myanmar for safety and supplementary food.

Arora, 2008 mentioned that in Spain, the *Lactarius* was cash mushroom between € 5600 and 8400 € a season around 40% of the average family annual income for the region. In northwest Yunnan people built houses and occasionally bought cars with the proceeds from selling matsutake (*Tricholoma matsutake*). In Oaxaca, the poorest state of Mexico and could earn between \$20 and \$30 a day collecting (*Tricholoma magnivelare*). In Myanmar, local people collect on a small scale for personal consumption or local trade. Nevertheless, the consumption and local trade can be provided as a supplementary food, partially income for the rural people.

RECOMMENDATIONS

Further survey with more nutrition analysis (carbohydrate, amino acids, vitamins etc.); marketing would be necessary that can be attracted and have a potential for all level of Myanmar people.

Identification was confusing according to different species are in the different literatures. Regional academic group should discuss together to identify definitely with standard key confirmed.

Commercial processing and conservation of the population must be played as a dual role in Myanmar.

ACKNOWLEDGEMENTS

This paper could not have submitted without supporting of Forest Department, Forest Research Institute and assistance of local people. Very grateful must be expressed to DAR and Veterinary Science University of Yezin for a testing of some nutrient values of edible fungi and insects. Thanks the staff of Forest Protection for their helps of drying, powdering the specimen and etc.

REFERENCES

- Anthony B. Cunnighan and Xuefei Yang. 2011. Mushrooms in Forests and woodlands. Resource Management, Values and Local Livelihoods. People and plants International Conservation series.earthscan.
- Arora, D. (2008). The Houses That Matsutake Built, *Economic Botany* 62.
- C.J. Alexopoulos and C.W. Mims. 1979. *Introductory Mycology*. John Wiley and Sons.
- FAO, 2010. *Forest Insects as Food: humans bite back*. Proceedings of a workshop on Asia-Pacific resources and their potential for development. Chiang Mai , Thailand.
- Frank M. Dugan. 2012. *The Identification of fungi. An Illustrated Introduction with Keys, Glossary, and Guide to literature*. APS
- Jeffrey Hays, 2008. *Strange Foods and Recipes for Popular Dishes of Myanmar's Ethnic Groups*. ([http://factsanddetails.com/southeast-asia/Myanmar/ sub5_5c/entry-3069.html](http://factsanddetails.com/southeast-asia/Myanmar/sub5_5c/entry-3069.html)).
- M. M. Thaug (2007). A preliminary survey of macromycetes in Burma. *Australasian Mycologist* 26(1): 16-36.
- Miguel Ulloa and Richard T. Handlin. 2012. *Illustrated Dictionary of Mycology*. The American Phytopathological Society.
- Morris, B. 2004. *Insects and human life*. Oxford, UK, Berg.
- Morten Lange and F. Bayard Hora. 1975. *Collins Guide to Mushrooms and Toadstools*. Collins, London.
- Partha Pal, Spandita Roy, 2014. *Edible insects: Future of Human food. -A review*. Department of Zoology, Kolkata-700006, India.
- Ramos Elorduy, J. & Pino, J.M. 2006. Algunos ejemplos de aprovechamiento comercial de varios insectos comestibles y medicinales. *Entomología Mexicana*, 1: 524–533.
- Rattanapan, R. 2000. *Edible insect diversity and cytogenetic studies on short-tail crickets (Genus Brachytrupes) in northeastern Thailand*. Khon Kaen University, Thailand. M.Sc. thesis.
- Schabel, H. 2006. Forest-based insect industries. In H. Schabel, ed. *Forest entomology in East Africa: forest insects of Tanzania*, pp. 247–294.
- Yupa & Durst. 2014. *Edible Insects in Lao PDR. Building on tradition to enhance food security*. FAO. Bangkok.

Websites:

1. www.academia.edu/http://9417975/Nutritive_value_of_popular_wild_edible_mushrooms_from_northern_Thailand
2. <https://en.wikipedia.org/wiki/Auricularia>
3. https://www.researchgate.net/publication/282701493_Chemical_Composition_and_Nutritional_Value_of_the_Mushroom_Auricularia_auricula-judae
4. <https://en.wikipedia.org/wiki/Calvatia>
5. <https://en.wikipedia.org/wiki/Cantharellus>
6. <https://en.wikipedia.org/wiki/Chanterelle>
7. <https://en.wikipedia.org/wiki/Lactarius>
8. https://www.researchgate.net/publication/222686809_Fatty_acid_and_sugar_compositions_and_nutritional_value_of_five_edible_mushrooms_from_Northeast_Portugal
9. <https://en.wikipedia.org/wiki/Termitomyces>
10. <http://www.academicjournals.org/journal/AJB/article-full-text-pdf/751BD0111330>
11. <https://en.wikipedia.org/wiki/Tricholoma>
12. https://www.researchgate.net/publication/222686809_Fatty_acid_and_sugar_compositions_and_nutritional_value_of_five_edible_mushrooms_from_Northeast_Portugal
13. <http://agris.fao.org/agris-search/search.do?recordID=TH9121537>
14. <https://en.wikipedia.org/wiki/Russula>
15. <http://www.eajournals.org/journals/european-journal-of-food-science-and-technology-ejfst/vol-3issue-2may-2015/nutritional-composition-and-some-anti-nutritional-factors-of-three-edible-mushroom-species-in-south-eastern-nigeria/>
16. <http://www.dl.begellhouse.com/journals/708ae68d64b17c52,3b344c674f08ce4b,205d85bd007b8e63.html>
17. <http://www.academicjournals.org/journal/AJB/article-full-text-pdf/8963E1F42826>
18. <https://en.wikipedia.org/wiki/Lentinus>
19. <http://www.academicjournals.org/journal/AJB/article-full-text-pdf/751BD0111330>
20. www. Encarta 1998.
21. http://factsanddetails.com/southeast-asia/Myanmar/sub5_5c/entry-3069.html
22. <https://edibug.wordpress.com/list-of-edible-insects/>