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Botany

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Contents

Botany

Study on Algal Flora of Lashio Hot Spring from Lashio Township in Northern Shan State

Khaing Wai Wai Nyunt*

Abstract

The algal flora of Lashio Hot spring from Lashio Township in Northern Shan State have been studied. The study area is located between N' 22°56' and E' 97°45'. All the specimens were collected from Lashio hot spring from October, 2020 to March, 2021. The 14 species of 5 genera belonging to 4 families and 2 orders were collected, classified, identified and described. The genera *Pseudanabaena*, *Phormidium*, *Oscillatoria* and Diatoms were abundantly found. Physico-chemical parameters of water were measured. An artificial key to the species was constructed.

Keywords: Taxonomic study, hot spring algae, Physico-chemical parameters, an artificial key

Introduction

Phycology or algology is the study of algae. The word phycology is derived from the Greek word phykos, which means ‘seaweed’. The term algology, described in Webster’s dictionary as the study of the algae (Lee 2008).

Lee (2008) suggested that the algae are thallophytes (plants lacking roots, stems and leaves) that have chlorophyll a as their primary photosynthetic pigment and lack a sterile covering of cells around the reproductive cells. Algae most commonly occur in water, be it freshwater, marine, or brackish.

Cryophilic algae occur in snow and ice; thermophilic algae live in hot springs; edaphic algae live on or in soil; epizoic algae grow on animals, such as turtles and sloths; epiphytic algae grow on fungi, land plants, or other algae; corticolous algae grow on the bark of trees; epilithic algae live on rocks; endolithic algae live in porous rocks; and chasmolithic algae grow in rock fissures (Rogers 2011). Samples from waters of Everglades National Park also contained several species of blue-green capable of growth at 45 and 50ºC. Thermophilic blue-green algae that have a growth temperature optimum of over 45ºC have a high fidelity to hot spring habitats in temperate or colder climates, but maintenance populations of some species may become established elsewhere in warmer areas (Jackson and

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Castenholz 1975). In the tropics, water temperature variation is governed by climatic conditions. Rainfall and solar radiations are the major climatic factors that influence most physico-chemical hydrology of water bodies (Odum 1992 and Kadiri 2000a).

In Myanmar, there are more than 92 hot springs have been located (ESCAP 1997). Distribution of hot springs in Myanmar was appeared to align within five major zones. Among these five zones, the second zone was observed in this research work.

The taxonomy of algae is subject to rapid change because new information is constantly being discovered. Algae provide much of Earth's oxygen, they are the food base for almost all aquatic life, they are a source of crude oil, and they provide foods and pharmaceutical and industrial products for humans. In addition to making organic molecules, algae produce oxygen as a byproduct of photosynthesis. Algae produce an estimated 30 to 50 percent of the net global oxygen available to humans and other terrestrial animals for respiration that the algae have many types of life cycles (Rogers 2011).

Hot springs were selected in Myanmar because there have few researchers who varieties of algae were interested. The aim of the present study is to analyze parameter of hot springs water in Lashio Township, to observe the various kinds of algae growing in hot springs and to study their relationships between the algal flora and physico-chemical parameters of hot springs.

Materials and Methods

Algae samples were collected from Lashio hot spring in Lashio Township, Northern Shan State. Lashio hot spring is situated in Lashio area at 22°56' North Latitude and 97°45' East Longitude, which is generally trending in the north – east directions.

The position of sampling site was measured by Global Position System (GPS), temperatures and pH of water samples were recorded in the field. Algae specimens were collected from the upper surface, the edge, the central area and the drains of hot springs.

Algae samples were studied by using compound microscope. The size of algae was measured by using micrometer. All species were presented by photomicrographs. The morphological characters of thermophilic algae were identified. After that, the samples were identified based on thallus

shape, size, colour, chloroplast, pyrenoid and sinus. Artificial key to the species were also constructed. The taxonomic description have been done by the references on Cupp (1943), Skuja (1949), Smith (1950), Desikachary (1959), Prescott (1962), Vinyard (1979), Round *et al.* (1990), Dillard and Gary (1991), John *et al.* (2002) and Komarek and Anagnostidis (1999, 2005). Physico-chemical parameters such as dissolved oxygen, total hardness, total solids, total alkalinity and sulphate were measured.

Results

Fourteen species of 5 genera belonging to 4 families and 2 orders were collected from Lashio Hot Spring in Lashio Township, Northern Shan State. The morphological characters of those species were classified and identified. The lists of collected species were presented in Table 1. Physico-Chemical Analysis of Hot Spring Water from Sampling Site were measured in Table 2.

Table 1. Classification of Thermophilic Algae from Lashio Hot Spring in Lashio Township

Division	Class	Order	Family	No	Scientific Name
Cyanophyta (Cyano-bacteria)	Cyano-phyceae	Oscillatoriales	Pseudanabaenaceae	1.	*Pseudanabaena catenata* Lauterborn
				2.	*Pseudanabaena galeata* Böcher
			Phormidiaceae	3.	*Phormidium animale* (Agardh ex Gomont) Anagnostidis et Komárek
				4.	*Phormidium articulatum* (Gardner) Anagnostidis et Komárek
				5.	*Phormidium formosum* (Bory ex Gomont) Anagnostidis et Komárek
				6.	*Phormidium terebriforme* (Agardh ex Gomont) Anagnostidis et Komárek

Division	Class	Order	Family	No	Scientific Name
				7.	*Phormidium tergestinum* (Kützing) Anagnostidis et Komárek
Division	Class	Order	Family	No	Scientific Name
			Oscillatoriaceae	8.	*Oscillatoria chlorina* Kützing ex Gomont
				9.	*Oscillatoria curviceps* Agardh ex Gomont
				10	*Oscillatoria limosa* Agardh ex Gomont
				11.	*Oscillatoria rupicola* Hansgirg
				12.	*Oscillatoria tenuis* Agardh ex Gomont
Chrysophyta	Bacillario-phyceae	Naviculales	Pleurosigmataceae	13.	*Pleurosigma normanii* Ralfs
				14.	*Gryosigma spenceri* (Quekett) Cleve

Table 2. Physico-Chemical Analysis of Hot Spring Water from Sampling Sites in Lashio Township

Parameter	Lashio Hot Spring (mg/L)
pH value	6.8
Water Temperature	52°C
Total Dissolved Solids	840
Total Hardness	280
Total Alkalinity	520
Calcilum as Ca	48
Magnesium as Mg	19
Chloride as CL	20
Sulphate as SO_4	137

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***Pseudanabaena catenata* Lauterborn (Figure 1. A)**

Trichomes solitary or aggregated, motile without oscillation and rotation, straight, rarely variously bent, flexible, strongly constricted at the thickened, hyaline, translucent and ungranulated cross-walls, not attenuated at the ends; cells cylindrical, truncate-rounded at both ends; apical cell rounded or slightly conical-truncate, without aerotopes; blue-green, pale grayish, olive-green to grayish-blue, 2 µm wide, 2.5 µm long.

***Pseudanabaena galeata* Böcher (Figure 1. B)**

Trichomes solitary or prostrate colonies, straight or variously curved and entangled, sometimes parallel arranged, deeply constricted at cross-walls, not attenuated at the ends; cell content sometimes with scarce but prominent granules, apical cells flat-rounded, rarely slightly conical-rounded, motility forwards without waving and rotation; bright blue-green or emerald-green to olive-green clusters, 1.25 µm wide, 2.5 µm long.

***Phormidium animale* (Agardh ex Gomont) Anagnostidis et Komárek (Figure 1. C)**

Trichomes solitary or clusters, straight, not constricted at the mostly ungranulated cross-walls, attenuated and slightly bent at the ends, rapidly motile, with clockwise rotation and strong oscillation; sheaths very rare, fine, diffluent; apical cells acute-conical, without calyptras or thickened outer cell wall; blue-green, 3.75 µm wide, 5.5 µm long.

***Phormidium articulatum* (Gardner) Anagnostidis et Komárek (Figure 1. D)**

Trichomes solitary among other algae, long and straight or short and circinate, unconstructed or slightly constricted at the thick cross-walls, not attenuated at the ends; sheaths thin, visible, usually indistinct or lacking ; apical cells rounded, without thickened outer cell wall; blue-green, 5 µm wide, 2.5 µm long.

***Phormidium formosum* (Bory ex Gomont) Anagnostidis et Komárek (Figure 1. E)**

Trichomes solitary or clusters, straight, long, intensely motile with oscillation constricted at the usually finely granulated cross walls, slightly attenuated at the ends and bent; sheaths thin, rarely developed, usually missing; cell content finely granulated, apical cells obtuse-conical, rounded-conical or acutely-rounded, not capitates, without calyptra or thickened outer cell wall; olive-green, 6.25 µm wide, 5 µm long.

***Phormidium terebriforme* (Agardh ex Gomont) Anagnostidis et Komárek (Figure 1. F)**

Trichomes solitary or clusters, long, straight or flexuous, rapidly motile, not constricted at the mostly finely granulated cross-walls, mostly slightly and gradually attenuated at the ends and hooked; cell content usually finely granular, very rarely with large prominent granules, especially at the cross-walls; apical cells rounded-hemispherical or slightly depressed and almost truncate, sometimes obtuse-conical or nearly capitates, without calyptras or thickened outer cell wall; bright blue-green, sometimes olive-green, 5 µm wide, 3.75 µm long.

***Phormidium tergestinum* (Kützing) Anagnostidis et Komárek (Figure 1. G)**

Trichomes solitary or clusters, varying length, usually straight, sometimes slightly and irregularly curved, rarely spirally-coiled, motile, inconspicuously to clearly or not constricted at the sometimes translucent and granulated cross-walls, not attenuated and bent at the ends; sheaths occur very facultatively; cells usually shorter; apical cells rounded or hemispherical, with or without thickened cell; pale to dark blue-green, 10 µm wide, 5 µm long.

***Oscillatoria chlorina* Kützing ex Gomont (Figure 1. H)**

Trichomes straight or curved, unconstricted or slightly constricted at the cross-walls; gas-vacuoles absent; cells cross-walls not granulated; calyptra absent; yellowish green, 5 µm wide, 7.5 µm long.

***Oscillatoria curviceps* Agardh ex Gomont (Figure 1. I)**

Trichomes mats, straight, long, motile, with left-handed rotation, not constricted at the sometimes granulated cross-walls, hooked or loosely spirally-coiled at the ends, not or very slightly attenuated; apical cells flat-rounded, not capitates, sometimes with slightly thickened cell wall; blue-green, 10 µm wide, 2.5 µm long.

***Oscillatoria limosa* Agardh ex Gomont (Figure 1. J)**

Trichomes solitary or clusters, usually very long, straight, colourless sheaths, not constricted at the frequently granulated cross-walls, not attenuated at the ends or very shortly, slightly attenuated, not capitates, motile, slowly gliding and oscillating, with left-handed rotation; cell content mostly finely granular; apical cells flat-rounded or obtuse-rounded, convex,

mostly with slightly thickened outer cell wall, without calyptras; dark to bright blue-green or olive-green, 12.5 µm wide, 5 µm long.

***Oscillatoria rupicola* Hansgirg (Figure 1. K)**

Trichomes small clusters, mats, or sometimes only solitary, straight or slightly curved, with straight ends, not attenuated, not constricted at cross-walls; rarely with very fine sheaths, not visible; apical cells widely-rounded without calyptras and without or only with slightly thickened outer cell wall, olive-green or blue-green; 5 µm wide, 2.5 µm long.

***Oscillatoria tenuis* Agardh ex Gomont (Figure 1. L)**

Trichomes mats or clusters, straight, not constricted at cross-walls, usually without granulation at cross-walls, cylindrical, not attenuated, but very rarely slightly curved at the ends; apical cells rounded, not capitates; blue-green or grayish-violet, 10 µm wide, 5 µm long.

***Pleurosigma normanii* Ralfs (Figure 1. M)**

Cells solitary; valves broadly lanceolate, slightly sigmoid, with subacute ends; raphe nearly central, sigmoid; oblique striae 17-19in 10µm near the middle, slightly closer at the ends; transverse striae 15µm, 95 µm long.

***Gryosigma spenceri* (Quekett) Cleve (Figure 1. N)**

Cells solitary; valves lanceolate, sigmoid with obtuse ends; raphe central, central nodule elliptical; 10 µm wide, 107.5 µm long.

An Artificial Key to the Studied Species

1. Cell solitary ---------- 2
1. Trichomes ----------3
   2. Cells subacute ends ---------- *Pleurosigma normanii*
   2. Cells obtuse ends ---------- *Gryosigma spenceri*
3. Cells less than 3 µm long ---------- 4
3 Cells more than 5 µm long ---------- 8
   4. Trichomes constricted ---------- 5
   4. Trichomes not constricted ---------- 6
5. Cells 2 µm wide ---------- *Pseudanabaena catenata*

5. Cells less than 1.5 µm wide ---------- *Pseudanabaena galeata*
   6. Trichomes long ---------- *Oscillatoria curviceps*
   6. Trichomes curved ---------- 7
7. Sheaths visible ---------- *Phormidium articulatum*
7. Sheaths not visible ---------- *Oscillatoria rupicola*
   8 Trichomes ungranulated cross-walls ---------- 9
   8. Trichomes granulated cross-walls ---------- 11
9. Trichomes yellowish green ---------- *Oscillatoria chlorina*
9. Trichomes blue-green ----------10
   10. Apical cells acute-conical ---------- *Phormidium animale*
   10. Apical cells rounded ---------- *Oscillatoria tenuis*
11. Trichomes attenuated at the ends ---------- 12
11. Trichomes not attenuated at the ends ---------- 13
   12. Apical cells not capitate ---------- *Phormidium formosum*
   12. Apical cells capitate ---------- *Phormidium terebriforme*
13. Cells 10 µm wide ---------- *Phormidium tergestinum*
13. Cells more than 11 µm wide ---------- *Oscillatoria limosa*

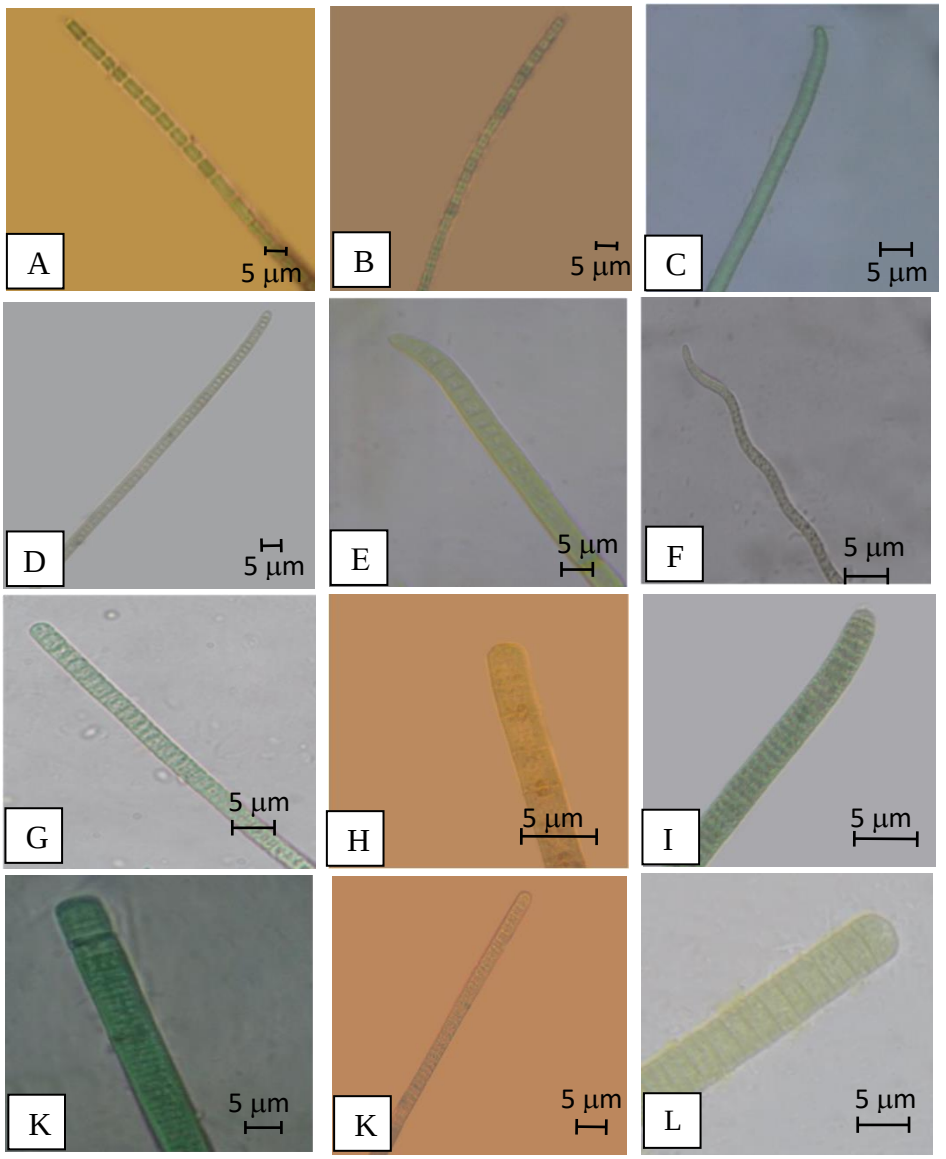

Figure 1.
A. *Pseudanabaena catenata* Lauterborn
B. *Pseudanabaena galeata* Böcher
C. *Phormidium animale* (Agardh ex Gomont) Anagnostidis et Komárek
D. *Phormidium articulatum* (Gardner) Anagnostidis et Komárek
E. *Phormidium formosum* (Bory ex Gomont) Anagnostidis et Komárek
F. *Phormidium terebriforme* (Agardh ex Gomont) Anagnostidis et Komárek
G. *Phormidium tergestinum* (Kützing) Anagnostidis et Komárek
H. *Oscillatoria chlorina* Kützing ex Gomont
I. *Oscillatoria curviceps* Agardh ex Gomont
J. *Oscillatoria limosa* Agardh ex Gomont
K. *Oscillatoria rupicola* Hansgirg
L. *Oscillatoria tenuis* Agardh ex Gomont

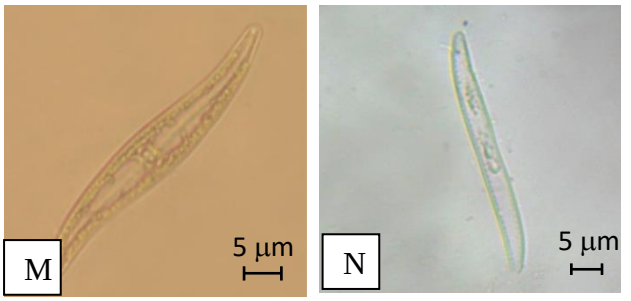

Figure 1. M. *Pleurosigma normanii* Ralfs
N. *Gryosigma spenceri* (Quekett) Cleve

Discussion and Conclusion

In the present study, algae samples were collected from Lashio hot spring which are situated Northern Shan State. Total of 14 thermophilic species can be observed in these sampling site. They were included belong to Cyanophyta and Chrysophyta. In the present study, one class, one order and three families of Cyanophyta were described; one class, one order and one family of Chrysophyta were observed. 12 species belong to 3 genera of Cyanophyceae and 2 species belong to 2 genera of Bacillariophyceae were classified, described and recorded. The algal flora of Lashio hot spring in Myanmar were studied by Khin Myat Soe (2011) which contained 4 species of 2 genera of belonging to 2 families of Cyanophyta in Lashio sampling sites. *Pseudanabaena catenata*, *Pseudanabaena thermalis*, *Pseudanabaena frigida* and *Mastigocladus laminosus* are found in Khin Myat Soe (2011). In the present study, *Pseudanabaena catenata* was found, so the algal species are the same Khin Myat Soe (2011)**.** In the present study, *Phormidium* and *Oscillatoria* were abundantly occurred in Lashio hot spring.

Hot springs water was tested water chemical analysis, differences were observed. Thermophilic algae (Heat-loving); - applied especially to microorganisms such as certain bacteria, fungi and algae, which are grown best at temperatures above 40˚C (e.g. between 50˚C and 60˚C). They are found in naturally hot locations, such as at hot springs or the thermal vents at the ocean bottom (Webster's 1913). In the present study, the water temperature of Lashio hot spring was found at temperatures 52°C, so the algal species can be resisted**.**

A measure of the hydrogen ion concentration; pH of 7.0 indicates a neutral solution, pH values smaller than 7.0 indicate acidity, pH values larger than 7.0 indicate alkalinity. The drill hole water had a pH of 5.5 and

smelled heavily of sulfide, whereas the geyser nearby had a pH of around 8.5 and had almost no sulfide (Brock 1971). In the present study, pH 6.8 was found in Lashio hot spring, so pH values smaller than 7.0 indicate acidity and smelled heavily of sulfide. Thus, these observations agreed with Brock 1971. *Pseudanabaena, Phormidium, Oscillatoria* and Diatoms were observed in the present study, therefore these species were resisted the acidity.

The range of magnesium was 14.4 to 35 mg/l (WHO 2004). The minimum value 56.0 mg/L of chloride and the maximum value 138.0 mg/L were noted Mostafa *et al.* 2013. The concentrations of calcium ranged from 50 mg/l - 58.0 mg/l (Vardhan *et al*., 2015). In the present study, the range of magnesium was 19 mg/l in agreement with WHO 2004. Chloride was ranged 20 mg/l and Calcium ranged 48 mg/l are not agreed with Mostafa *et al.* 2013 and Vardhan *et al*., 2015.

The observations of water is commonly classified in terms of the degree of hardness as 0-75 mg/L consider to be soft, 75-150 mg/l is moderately hard, and 150-300 mg/l is hard and above 300 mg/l is very hard water (WHO 2004). In the present study, the total hardness was 280 mg/l in Lashio hot spring, therefore the total hardness was considered hard of water. The total dissolved solid levels ranged from 341.88 to 556 mg/L. All total dissolved solid results were within the permissible limits (< 1000 mg/L) (Mostafa *et al.* 2013). In this study, the concentration of total dissolved solid was found from 840 mg/l in Lashio hot spring. These sampling sites were considered the permissible limits.

The sulphate values were found to be less in all groundwater samples. The minimum value 25.7 mg/L, whereas the maximum value 38.6 mg/L was observed. All sulphate concentrations in the groundwater samples were within the permissible limits (< 250 mgL-1) (Mostafa *et al.* 2013). According to this research, the concentration of sulphate of 137 mg/l was found in Lashio hot spring, thus, this sampling site was the permissible limits. These species are tolerated the highest hardness, total dissolved solid and sulphate in the present research. Thus, these observations are in agreement with WHO 2004 and Mostafa *et al.* 2013.

In the previous studied, many researchers have been observed in the fresh water algal flora, in contrast, very few researches were observed the algal flora of hot springs in Myanmar. This research attempts to investigate the morphological characters and water analysis of algal flora in Lashio hot spring. This research is the study on algal flora of Lashio hot spring from

Lashio Township in Northern Shan State. In future, the researchers can do the research on the comparison of the hot spring algae and fresh water algae.

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Evaluation of Antioxidant Activities, Elemental Compositions and Nutritional Values of Roots of *Houttuynia cordata* Thunb.

Htay Htay Myint[1], Kathy Myint[2] & Phyo Phyo Win[3]

Abstract

The medicinal plant *Houttuynia cordata* Thunb. belongs to the family Saururaceae. The plant samples were collected from Banmaw Township, Kachin State. The plant was identified by standard procedures. DPPH radical scavenging assay was used for antioxidant activity with ascorbic acid as positive control showed the watery extract possessed excellent antioxidant property. The Energy Dispersive X-Rays Fluorescence Spectrophotometer (EDXRF) analysis was used to investigate the elements present in roots. According to the results, potassium was found more than other elements in roots. In a nutritional study, it was significantly found that 74.1 % of carbohydrate in roots.

Keywords: *Houttuynia cordata* Thunb., antioxidant, nutritional values

Introduction

Most natural products used as drugs come from plants. Many modern drugs are obtained from plants and natural products constitute a major source of drug development in the pharmaceutical industry. Some plants were found to have very dramatic effects on the body and some were found to cure certain diseases.

Houttuynia cordata Thunb. was also known as fish mint, fish leaf, rainbow plant, chameleon plant, heart leaf, fish wort or Chinese lizard tail. It is one of two species in the genus *Houttuynia*. It is native to North America and Southeast Asia. The plants generally inhabit wet areas. The natural distribution of the Saururaceae, with six species in four genera is restricted to North America and Southeast Asia (Brach, *et al*., 2005). *Houttuynia cordata* Thunb. is a sciophilous, hygrophytic herb native to Japan, North and South Korea, China, Nepal, Taiwan, Vietnam, India,

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Myanmar, Indonesia, Thailand and Bhutan (Brach, *et al*., 2005; Kress, *et al*., 2003).

Houttuynia cordata Thunb. consists of chemical constituents such as alkaloids, essential oils, phenolic acids and flavonoids.*Houttuynia cordata* Thunb. is used against several health problems such as colds, coughs, fevers, pneumonia, mumps and tumors, anti-inflammatory, anti-bacterial, anti-viral, anti-oxidant and anti-tumor effects. *Houttuynia cordata* Thunb. regulates immunity by enhancing the immune barriers of the oral cavity, vagina and gastrointestinal tract and shows broad-spectrum activity against liver, lung, breast and colon tumors (Rafiq, *et al*., 2022).

In Myanmar, *Houttuynia cordata* Thunb. has been eaten and used as medicine by the locals. The plant decoction is used for the treatment of colds, coughs, and fevers. The leaves and roots of *Houttuynia cordata* Thunb. are used as vegetables, condiments and spices, either cooked or raw. The leaves and roots are also consumed as fresh herbal garnishes in salads, soups, fish stews, etc. The root stocks are powdered with fried meat and it can be eaten as Kachin traditional curry.

Thus, the present investigation showed the usefulness of *Houttuynia cordata* Thunb. in the human health-care system and promote natural products research. The aim and objectives of the present research were to know beneficial or detrimental effects of Myanmar's medicinal plant, to investigate morphological characters of this plant and to provide for teaching, local requirements and research works.

Materials and Methods

Collection and preparation of samples

The plant specimens were collected from Banmaw Township, Kachin State during 2022-2023. After collection, vegetative and reproductive parts of the plants were identified by using the literatures. The roots were thoroughly washed with water and air-dried at room temperature for several days. The dry roots were powdered by a grinder machine and stored in air tight containers for further studies.

Screening of *In Vitro* Antioxidant Activity

(a) Preparation of DPPH and sample solutions

DPPH (4.732 mg) was thoroughly dissolved in EtOH (100 mL). This solution was freshly prepared in the brown colour reagent bottle and stored in the fridge for no longer than 24 hours. Each tested samples (4 mg) and 10 mL of EtOH were thoroughly mixed by shaker. The mixture solution was filtered and the stock solution was obtained. By adding with EtOH, the tested sample solutions with different concentrations of 400, 200, 100,50,25 and12.5 µg /mL were prepared from the stock solution.

(b) Determination of *in vitro* antioxidant activity

The effect on DPPH radical was determined using the method by Marinova and Batchvarov (2011). 1.5 mL of 120 µM DPPH solution and 1.5 mL of EtOH were thoroughly mixed for the preparation of control solution by using shaker. The tested sample solution was also prepared by mixing thoroughly 1.5 mL of 120 µM DPPH solution and 1.5 mL of each sample solution. The mixture solutions were allowed to stand at room temperature for 30 min. Then, the absorbance of these solutions was measured at 517 nm on a UV-7504 UV-visible spectrophotometer. Absorbance measurements were done in triplicate for each concentration and then mean values obtained were used to calculate percent inhibition of oxidation.

$$\% \text{ Inhibition} = \frac{A_{\text{Control}} - A_{\text{Sample}}}{A_{\text{Control}}} \times 100$$

where, A_{Control} = absorbance of control solution

A_{Sample} = absorbance of tested sample solution.

Linear regressive excel programme used for the determination of 50 % antioxidant inhibition concentration (IC_{50}) of tested samples and positive control.

Determination of elemental analysis of roots

The concentrations of elements in powdered roots of *Houttuynia cordata* Thunb. were analyzed using an Energy Dispersive X-ray Florescence (EDXRF) spectrometer at the University of Research Center in University of Yangon.

Determination of nutritional values of roots

The nutritional values of roots of *Houttuynia cordata* Thunb. were analyzed at the Small Scale Industries Department, Ministry of Cooperatives and Rural Development, Nay Pyi Taw. The nutritional values were determined by Pearson (1976).

Results

Morphological Characters of *Houttuynia cordata* Thunb.

Scientific name	-	*Houttuynia cordata* Thunb.
Myanmar name	-	Htin-kwe
English name	-	Fishmint, Chameleon, Heartleaf
Family	-	Saururaceae
Local name	-	Htin-ke
Flowering period	-	June to September
Parts used	-	Leaves, Roots

Perennial aromatic herbs with creeping rootstock. Leaves simple, alternate; petioles sheathing at the base; stipules adnate; leaf blade cordate, the apex acute to acuminate, the margin entire, the base cordate, both surfaces pubescent. Inflorescences terminal, involucrate spike; involucral bracts 4, white, oblong, rounded at the apex. Flower bisexual, regular, actinomorphic, hypogynous, sessile; bract elliptic, petal-like. Stamens 3, free, anther dithecous, minute. Ovary globoid, trilocular, 2 ovules in each locule on axile placenta; style 3; stigma simple. Fruit berries.

Morphological characters

Figure 1. Habit

Figure 2. Inflorescences

Figure 3. Roots of *Houttuynia cordata* Thunb.

Figure 4. Air dried of roots

In vitro antioxidant activity by DPPH free radical scavenging assay

The antioxidant activities of ethanolic and watery extracts of roots were measured as DPPH free radical scavenging activity and exhibited significant variations (Table 1-2 and Figure 2-4). The antioxidant (radical scavenging) activity of the watery extract (IC_{50} = 117.99 µg/mL) was significantly higher than that of the ethanolic extract (IC_{50} = 172.37 µg/mL) of roots compared with the standard ascorbic acid (IC_{50} = 3.34 µg/mL).

Table 1. Radical Scavenging Activity (% RSA) and IC_{50} Values of Ethanol and Watery

Sample	% RSA ± SD at Different Concentrations (μg/mL)						
	12.5	25	50	100	200	400	IC_{50} (μg/mL)
Ethanol	20.65 ± 0.065	21.33 ± 0.019	27.48 ± 0.025	31.79 ± 0.036	56.95 ± 0.084	61.89 ± 0.005	172.37
Watery	18.98 ± 0.04	22.25 ± 0.05	31.40 ± 0.01	44.18 ± 0.01	76.52 ± 0.01	82.28 ± 0.03	117.99

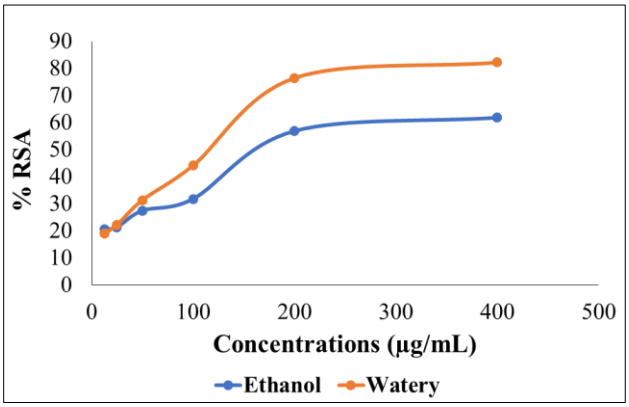

Figure 5. A plot of % RSA *vs* concentrations of Ethanol and Watery

Table 2. Radical Scavenging Activity (% RSA) of Ascorbic acid

Sample	% RSA ± SD at Different Concentrations (μg/mL)						
	1.25	2.5	5	10	20	40	IC_{50} (μg/mL)
Ascorbic acid	18.91 ± 0.05	38.70 ± 0.04	72.32 ± 0.01	98.76 ± 0.06	97.60 ± 0.005	96.31 ± 0.001	3.34

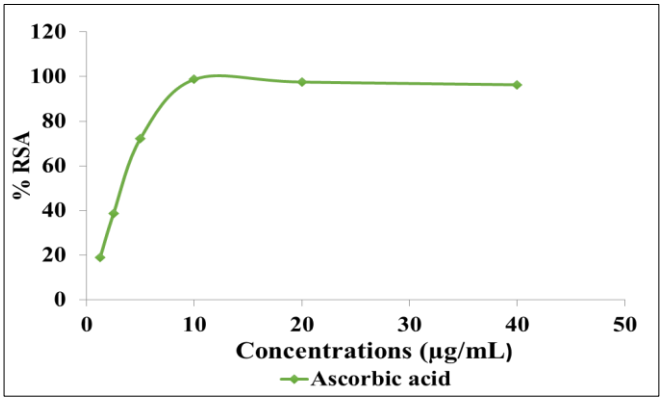

Figure 6. A plot of % RSA *vs* concentrations of Ascorbic acid

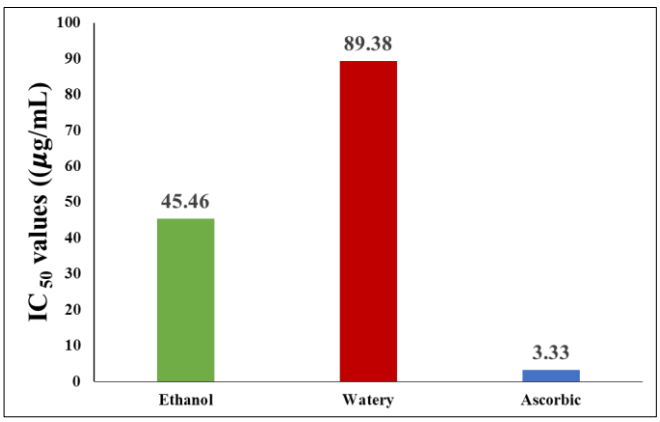

Figure 7. Comparison of IC $_{50}$ Values of Ethanol and Watery and Ascorbic acid

Determination of elemental analysis of roots of *Houttuynia cordata* Thunb.

The content of elements in the roots of *Houttuynia cordata* Thunb. was analyzed using Energy Dispersive X-ray Florescence (EDXRF) spectrometer analysis. It was found that potassium was significantly present than other elements in roots. CH was 99.1 in the roots. The spectrum and spectral data were shown in Tables (3) and Figures (8).

Table 3. Elemental analysis of *Houttuynia cordata* Thunb. (roots) by using EDXRF

	Analyte	Result
1	K	0.837
2	Ca	0.074
3	Fe	0.008
4	Tb	0.003
5	Mn	0.001
6	Zn	0.001
7	Cu	0.001
8	Sr	0.001
9	Rb	0.001
10	CH	99.072

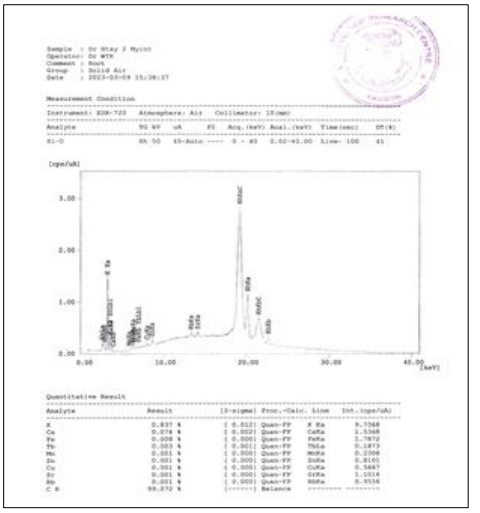

Figure 8. EDXRF spectrum of roots

Nutritional values of roots of *Houttuynia cordata* Thunb.

In the nutritional values, protein, fat, fiber, ash, and carbohydrate were observed in the roots of *Houttuynia cordata* Thunb..These results were shown in Table (4).

Table 4. Nutritional values of the roots of *Houttuynia cordata* Thunb.

Sr.	Experiment	Present Chemical Analysis Result
		Roots
1	Moisture (%)	0.1080
2	Proteins (%)	9.0251
3	Fats (%)	4.2236
4	Fibers (%)	8.1133
5	Ash (%)	4.4278
6	Carbohydrate (%)	74.1022

Discussion and Conclusion

Plants have always served as rich sources of pharmaceuticals and offer better advantages than synthetic compounds. According to WHO (2011) 70-95 % population of most developing countries depended on traditional medicines for their primary health and out of these 85 % of people used plants or their extracts as the active substance. New biologically active compounds were obtained from plants.

Houttuynia cordata Thunb. was a traditional medicinal plant that is widely distributed in East Asia. It is used to relieve lung conditions such as lung abscess, phlegm, cough, and dyspnoea (Jiechao, *et al*., 2011). *Houttuynia cordata* Thunb. has been used for treating pneumonia, infectious disease, refractory haemoptysis and malignant pleural effusion (Zeng, *et al*., 1998). Biologically, *Houttuynia cordata* Thunb. may be used for antimicrobial, immunostimulatory, diuretic, anticancer, sedative, anti-inflammatory, anti-allergic and antitussive effects (Li, *et al*., 2005; Park, *et al*., 2005; Kim, *et al*., 2007; Chiang, *et al*., 2003). *Houttuynia cordata* Thunb. has antiviral activities against herpes simplex virus, type 1, influenza virus and human immunodeficiency virus (Hayashi, *et al*., 1995).

Houttuynia cordata Thunb. had anti-severe acute respiratory syndrome-associated coronavirus activities (Haywood, 1978). A root extract is diuretic. The roots used in medicinal preparations for certain diseases in women (Duke and Ayensu, 1985**).** A decoction of this plant is used internally in the treatment of many ailments, including cancer, coughs,

dysentery, enteritis, and fever. Externally, it was used in the treatment of snake bites and skin disorders. The leaf juice used as antidote and astringent (Chopra, *et al*., 1986).

In the present study, the morphological characters of *Houttuynia cordata* Thunb. were perennial aromatic medicinal herbs with creeping rootstock. Leaves were broad, ovate-cordate. Stipular sheath was as long as petiole. Leaf blades were broadly ovate or ovate-cordate. Involucral bracts were oblong or obovate, apex rounded. Flowers are spike, subtended by four white and petaloid bracts, involucres. Stamens were 3. These data were in agreement with Kumar *et al.,* (2014).

In vitro antioxidant activity by DPPH free radical scavenging assay, the watery extract (IC_{50} = 117.99 μg/mL) was significantly higher than that of the ethanolic extract (IC_{50} = 172.37 μg/mL) of roots compared with the standard ascorbic acid (IC_{50} = 3.34μg/mL).

According to the EDXRF results, potassium was significantly present than other elements in roots. Potassium takes part in the ionic balance of the human body and maintains tissue excitability. Potassium is important for its diuretic nature (WHO, 2006).

Results of the quantitative determination of nutritional value showed moisture 5.9197 %, protein 9.6407 %, fat 5.0159 %, fiber 9.9021 %, ash 13.8219 %, and carbohydrate 55.6997 % in the leaves, and moisture 0.1080 %, protein 9.0251%, fat 4.2236%, fiber 8.1133 %, ash 4.4278 %, and carbohydrate 74.1022 % in roots. Calcium: low; iron: high; protein: 2.4 - 3.2 % were presented by Lin *et al*., (2009).

The present research was showed the significant properties of elemental analysis, nutritional values of the healthy roots of *Houttuynia cordata* Thunb.. Thus, *Houttuynia cordata* Thunb. was beneficial for the people and will promote researches concerning with natural plants.

Acknowledgement

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Taxonomic Study on Eight Species of Subfamily Mimosoideae in East Dagon Township

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& Naw Win Thawdar Oo[4]

Abstract

The taxonomic descriptions of 8 species that belong to 6 genera of subfamily Mimosoideae were recorded. All the taxa were collected from East Dagon Myothit township and have been classified and identified. This collection records 6 genera such as *Acacia*, *Albizia*, *Calliandra*, *Leucaena*, *Mimosa* and *Neptunia*. All the specimens are both wild and cultivated plants. In this paper, the morphological characters of the subfamily, description of the individual species with relevant photographs were presented.

Keywords: Mimosoideae, Taxonomic description

Introduction

The present research deals with the taxonomic studies of subfamily Mimosoideae growing in East Dagon Myo Thit Township. The Fabaceae family is usually divided into three sub-families: Mimosoideae, Caesalpinioideae and Faboideae (Papilionoideae)(WU De-lin, 2008).

The majority of the Mimosoideae are tropical and subtropical trees and shrubs. The Mimosoideae are characterized by their small, regular (actinomorphic) flowers crowed together, generally into spikes or heads which resemble a pom-pom. The stamens have become the most attractive part of the flower, the five petals inconspicuous. The leaves are predominatedly bipinnate (WU De- lin, 2008).

The aim of the study is to provide the taxonomic knowledge on some species of the subfamily Mimosoideae from Dagon Myothit (East) Township. It is sincerely hoped that, this study will contribute valuable information for the further studies of the subfamily Mimosoideae and to contribute necessary information towards compiling the Flora of Myanmar.

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Materials and Methods

Eight species of the subfamily Mimosaceae were collected from East Dagon Township. Specimens collections were made from October, 2020 to March, 2021. Specimens were properly collected during the flowering and fruiting time. Specimens were recorded with photographs and were stored immediately in plastic bags.

Identification of specimens were accomplished in accordance with taxonomic procedures. The specimens were firstly identified key to the family written by Hutchison (1967). The next step was to determine its generic name, then the species names, by referring to Hooker (1885), Backer (1965), Dassanayake (1983) and Gilbert (1994). Local Names were received from local inhabitants and records of Hundley *et al*., (1987) and Kress *et al*., (2003).

Result

In morphology, 8 species belonging to 6 genera of subfamily Mimosoideae have been studied. The species were listed according to alphabetical order.

Subfamily-Mimosoideae

Trees or shrubs, sometimes lianas, rarely herbs. Leaves alternate, usually bipinnate; pinnae usually opposite; leaf rachis or petiole usually with glands; petioles with pulvinus; stipules present or absent, sometimes spinelike. Inflorescences spicate or capitate, rarely racemose or paniculate. Flowers small, bisexual, sometimes unisexual, actinomorphic. Sepals united into a single tubular calyx, divided usually into (3-4-) 5 (-6-7) teeth, rarely entirely distinct. Petals as many as calyx-teeth, valvate in bud, free or united into a tube at the base. Stamens as many as or twice as the number of petals, or sometimes indefinite, free or united below into a tube, free part of filaments usually exserted, anthers small, 2-celled, opening by longitudinal slits. Ovary superior 1-locular: ovules mostly numerous: style slender; stigma small. Pods dehiscent or indehiscent, sometimes breaking into 1-seeded segment, straight or contorted. Seeds compressed (WU De-lin, 2008).

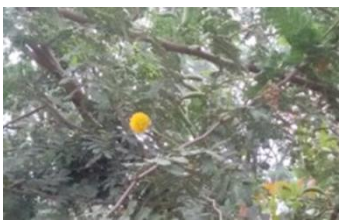
1. ***Acacia farnesiana* (L.) Willd. Sp. Pl. 4: 1083. 1806.**

Myanmar name : Non-lon-kyaing

Flowering of fruiting period : September to December

Uses : Flowers used for perfume; the bark has medicinal properties.

Perennial armed shrubs or small trees, up to 3 m tall. Stems cylindrical, woody. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 8-16 pairs, opposite, linear-oblong, the lower leaflets 0.3-0.4 x 0.08-0.10 cm, the upper leaflets 0.3-0.4 x 0.06-0.10 cm, membranous, oblique at the base, entire at the margin, acute-rounded at the apex, dark green, glabrous on both surfaces. Inflorescences axillary globose heads. Flowers golden yellow, about 0.3 cm in diameter at anthesis, fragrant, bracteate, ebracteolate, sessile, complete, bisexual, regular, actinomorphic, 5-merous, cyclic, hypogynous; Stamens numerous (about 50), free, exserted; filaments filiform, unequal, 0.3-0.5 cm long, bright yellow, glabrous; anthers oblongoid, about 0.04 cm long, yellow, dithecous, extrorse, dorsifixed, with longitudinal dehiscence. Ovary superior, ellipsoid, 0.10 x 0.06 cm, monocarpellary, unilocular with many ovule in the locule on marginal placenta, green, glabrous, subsessile; style filiform, about 0.25 cm long, yellowish white, glabrous; stigma simple. Pods turgid, 3.0-7.0 x 0.4-0.6 cm, 4-10 seeded, dark green, glabrous, scarcely dehiscent.



Habit

Inflorescence

Fruit

Figure 1. *Acacia farnesiana* (L.) Wild

2. *Albizia procera* (Roxb) Benth., Lond. J. Bot. 3: 89. 1844.

Myanmar name : Sit-pin; Kokko-sit

Flowering of fruiting period : September to October

Uses : Cultivated as timber and is a medicinal plant.

Perennial inermous deciduous large trees, about 25 m in height. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 6-12 pairs, opposite, oval-oblong, the lower leaflets 1.5-1.9 x 0.9-1.1 cm, the upper leaflets 2.5-3.8 x 1.5-1.7 cm, coriaceous, oblique at the base, entire at the margin, retuse at the apex, dark green above and pale green beneath, glabrous on both surfaces. Inflorescences axillary and terminal globose heads, many-flowered. Flowers greenish yellow or white, about 0.2 cm in diameter at anthesis, bracteate, ebracteolate, pedicellate, complete, bisexual, regular, actinomorphic, 5-merous, cyclic, hypogynous; Stamens numerous (about 30), monadelphous, much exserted; filaments filiform, unequal, 0.35-0.40 cm long, greenish white, glabrous; staminal tube about 0.4 cm long, yellowish green, glabrous; anthers ovate, small, yellow when young and brown with age, dithecous, introrse, dorsifixed, with longitudinal dehiscence. Ovary superior, linear, 0.10 x 0.05 cm, monocarpellary, unilocular with many ovules in the locule on marginal placenta, green, glabrous, stipitate; style filiform, about 0.1 cm long, white, glabrous; stigma simple. Pods oblong, 10.5-13.5 x 0.2-3.0 cm, 8-12 seeded, flattened, straight, beak ed, green or reddish brown, glabrous, dehiscent.

Habit

Inflorescences

Flowers

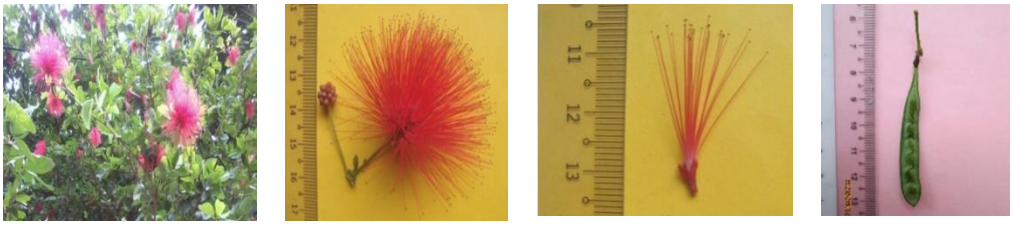
Fruits

Figure 2. *Albizia procera* (Roxb) Benth.

3. *Calliandra emarginata* (Humb. & Bonpl. ex Willd.) Benth. London. J. Bot. 3: 95. 1844.

Myanmar name : Japan-kokko
Flowering and fruiting period : all year round
Uses : Ornamental.

Perennial small trees, up to 2.5 m tall. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 3 per pinnae, opposite, elliptic, the lower leaflets 1.2-4.0 x 0.5-2.2 cm, the upper leaflets 1.7-6.5 x 0.9-3.2 cm, coriaceous, oblique at the base, entire at the margin, obtuse-acute at the apex, green above and pale green beneath, pubescent. Inflorescences axillary globose heads, many-flowered. Flowers crimson, about 0.6 cm in diameter at anthesis, bracteate, ebracteolate, sessile, complete, bisexual, actinomorphic, 6-merous, cyclic, hypogynous. Stamens numerous (about 23), monadelphous, much exserted; filaments filiform, unequal, 1.1-1.7 cm long, red, glabrous; staminal tube about 0.6 cm long, reddish white, glabrous; anthers oblong, about 0.03 cm long, black, dithecous, introrse, dorsifixed, with longitudinal dehiscence. Ovary superior, oblongoid, 0.15 x 0.06 cm, monocarpellary, unilocular with many ovules in the locule on marginal placenta, green, glabrous, stipitate; style filiform, about 2.2 cm long, red, glabrous; stigma simple. Pods flattened, 5.0 x 0.6 cm, 6-seeded, green, glabrous, dehiscent.



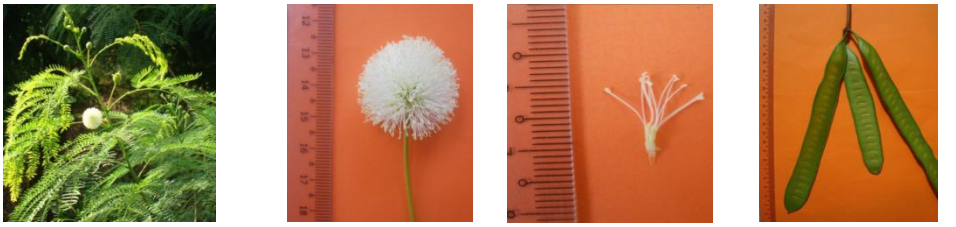
Habit Inflorescences Flower Fruit

Figure 3. *Calliandra emarginata* (Humb. & Bonpl. ex Willd.) Benth.

***4. Leucaena leucocephala* (Lam.) de Wit. Taxon 10(2): 53. 1961.**

Myanmar name : Baw-za-gaing; A-wai-ya
Flowering and fruiting period : June to January
Uses : Young leaves, flowers and fruits are used in cooking.

Perennial unarmed shrubs or small trees, 2-5 m tall. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 9-16 pairs, opposite, linear-oblong, the lower leaflets 0.6-0.9 x 0.2-0.4 cm, the upper leaflets 1.1-1.3 x 0.4-0.6 cm, membraneous, oblique or rounded at the base, entire at the margin, acute at the apex with a short mucronulate, dark green above and pale green beneath, glabrous on both surfaces. Inflorescences axillary or terminal globose heads, many-flowered. Flowers white or greenish white, about 0.4 cm in diameter at anthesis, bracteate, ebracteolate, sessile, complete, bisexual, regular, actinomorphic, 5-merous, cyclic, hypogynous. Stamens 10, free, far-exserted; filaments filiform, unequal, 0.65-0.70 cm long, white, glabrous; anthers oblong, about 0.08 cm long, yellow, dithecous, introrse, dorsifixed, with longitudinal dehiscence, pubescent. Ovary superior, oblongoid, 0.20 x 0.08 cm, monocarpellary, unilocular with many ovules in the locule on marginal placenta, yellowish green, velutinous, stipitate; style filiform, about 0.5 cm long, creamy white, glabrous; stigma simple. Pods strap-shaped, 12.5-15.5 x 1.7-2.0 cm, 18-21 seeded, flattened, straight, 2-valved, sutures thick, beaked, green when young and reddish brown when mature, glabrous, dehiscent.



Habit Inflorescences Flower Fruit

Figure 4. *Leucaena leucocephala* (Lam.) de Wit.

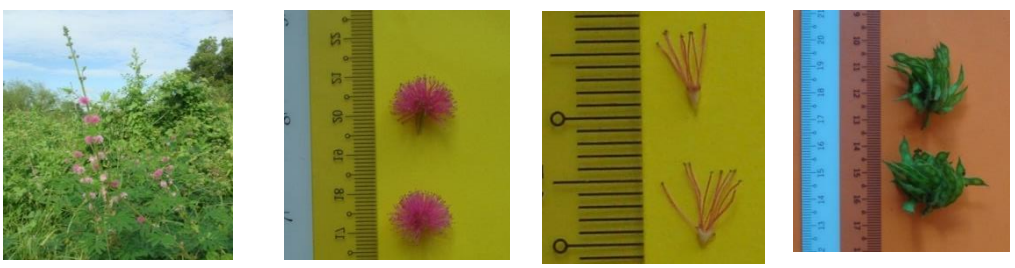
5. *Mimosa diplotricha* C. Wright ex Sauvalle, Anal.Real Acad. Ci. Habana. 5: 405.1868.

Myanmar nam : Japan-hti-ka-yon

Flowering and fruiting period : April to November

Uses : Originally used as a cover-crop in the fields.

Perennial decumbent shrubs or a straggling or scrambling woody shrubs. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 12-26 pairs, opposite, linear oblong, the lower leaflets 0.25-0.30 x 0.03-0.09 cm, the upper leaflets 0.25-0.30 x 0.03-0.10 cm, sub-membranous, oblique-rounded at the base, entire and ciliate at the margin, acute at the apex, dark green, scattered hairs on both surfaces, sensitive to the touch. Inflorescences terminal and axillary globose heads, many-flowered. Flowers pinkish purple, about 0.2 cm in diameter at anthesis, bracteate, ebracteolate, sessile, complete, bisexual, regular, actinomorphic, 4-merous, cyclic, hypogynous. Stamens 8, free, exserted; filaments filiform, unequal, 0.5-0.7 cm long, pinkish purple, glabrous; anthers oblong, small, about 0.03 cm long, black, dithecous, introrse, dorsifixed, longitudinal dehiscence. Ovary superior, oblongoid, about 0.05 x 0.02 cm, monocarpellary, unilocular with 3-8 ovules in the locule on marginal placenta, green, puberulous, subsessile; style filiform, about 0.35 cm long, pinkish-purple, glabrous; stigma simple. Pods oblong, 1.6-3.0 x 0.4-0.5 cm, 3-8 seeded, flattened, borne in umbelliform, slightly curved, green, prickly bristles on margin and surface of the valves, indehiscent.



Habit Inflorescences Flowers Fruits

Figure 5. *Mimosa diplotricha* C. Wright ex Sauvalle

6. *Mimosa pigra* L. Cent. I. Pl. 1: 13. 1755.

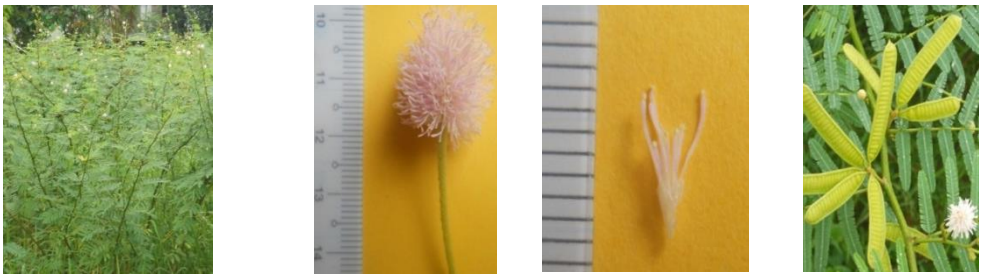
Myanmar name : Yae-hit-ka-yon

Flowering and fruiting period : August to December

Uses : Cultivated as timber.

Perennial widely branched shrubs, about 2 m tall. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 30-45 pairs, opposite, linear-oblong, the lower leaflets 0.25-0.40 x about 0.08 cm,

the upper leaflets 0.15-0.35 x 0.06-0.09 cm, coriaceous, oblique at the base, entire and bristly along the margin, acute at the apex, sensitive to the touch, yellowish green when young and dark green with age, glabrous within and finely pubescent without. Inflorescences axillary and terminal globose heads, many-flowered. Flowers pink, about 0.4 cm in diameter at anthesis, bracteate, ebracteolate, sessile, complete, bisexual, regular, acitnomorphic, 4-merous, cyclic, hypogynous. Stamens 8, 4 in each whorl, free, exserted; filaments filiform, unequal, the outer short about 0.4 cm long, the inner long about 0.8 cm long, white but pink at the upper half, glabrous; anthers oblongoid, about 0.02 cm long, pale yellow, dithecous, extrorse, dorsifixed, with longitudinal dehiscence. Ovary superior, obovate, flat, 0.20 x 0.08 cm, monocarpellary, unilocular with many ovules in the locule on marginal placenta, yellowish green, pilose, stipitate; style filiform, about 0.45 cm long, pale pink, glabrous; stigma simple. Pods oblong, 3.5-7.5 x 1.0-1.1 cm, 10-25 seeded, compressed, clustered, beaked, greenish-yellow when young and black when mature, closely beset with long bristles, with persistent calyx.



Habit Inflorescences Flower Fruits

Figure 6. *mimosa pigra* L.

7. *Mimosa pudica* L. Sp. Pl. 518. 1753.

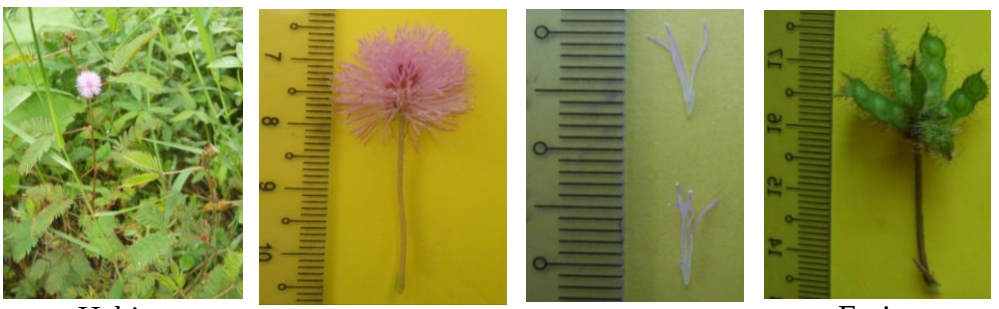
Myanmar name : Hti-ka-yon

Flowering and fruiting period : March to November

Uses : Cover-crop at roadside; roots used medicinal.

Perennial diffuse shrubby herbs. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 10-20 pairs, opposite,

linear-oblong, the lower leaflets 0.5-1.1 x 0.1-0.2 cm, the upper leaflets 0.3-0.8 x 0.1-0.2 cm, sub-coriaceous, oblique-rounded at the base, entire and ciliate at the margin, obtuse at the apex, yellowish green when young and dark green with age, glabrous within and pubescent without, sensitive to the touch. Inflorescences axillary globose heads, many-flowered. Flowers pink or purple, about 0.2 cm in diameter at anthesis, bracteate, ebracteolate, sessile, complete, bisexual, regular, actinomorphic, 4-merous, cyclic, hypogynous; Stamens 4, free, exserted; filaments filiform, about 0.5 cm long, pale pink or pale purple, glabrous; anthers oblongoid, about 0.04 cm long, pale yellow, dithecous, introrse, dorsifixed, with longitudinal dehiscence. Ovary superior, oblongoid, 0.08-0.10 x about 0.04 cm, monocarpellary, unilocular with 1-4 ovules in the locule on marginal placenta, yellowish green, pubescent, subsessile; style filiform, 0.3-0.6 cm long, pinkish purple, glabrous; stigma simple. Pods oblong, 0.5-1.3 x 0.2-0.3 cm, 1-4 seeded, flattened, slightly recurved, swollen, beaked, yellowish green when young and dark brown or brownish black with age, densely brown with soft bristles on both sutures, indehiscent.



Habit Inflorescences Flowers Fruit

Figure 7. *Mimosa pudica* L

8. *Neptunia oleracea* Lour., Fl. Cochinch. 564. 1790.

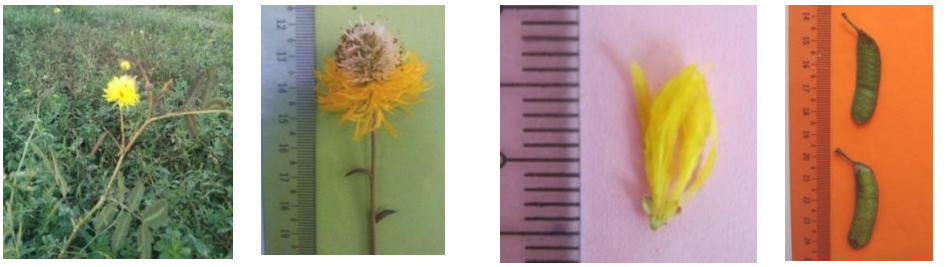
Myanmar name : Ye-sue-boke or Yae-hti-ka-yon

Flowering and fruiting period : November to August

Uses : Young stems are used as a vegetables

Perennial floating aquatic herbs or prostrate near water's edge herbs, up to 1.5 m long. Leaves alternate, bipinnately (paripinnate) compound, petiolate, stipulate; leaflets 15-23 pairs, opposite, oblong, the lower leaflets 0.20-0.40 x 0.08-0.10 cm, the upper leaflets 0.4-0.6 x 0.1-0.2 cm,

membranous, obliquely at the base, entire at the margin, rounded or often tipped by a small cusp at the apex, dark green but purple at the margin, pubescent. Inflorescences axillary oblong heads, many-flowered. Flowers greenish-yellow, about 0.2 cm in diameter at anthesis, bracteate, ebracteolate, sessile, the lower flowers of the heads barren or male with protruding flattened staminodes and the upper flowers bisexual, regular, actinomorphic, 5-merous, cyclic, hypogynous. Neutral flowers (lower flowers): calyx 5-toothed, campanulate. Petals 5, apopetalous, narrowly oblanceolate, about 0.35 cm long, white but green at the upper half, glabrous. Staminodes 10, free, about 1.4 cm long, petal-like, yellow, glabrous. Bisexual flowers (upper flowers): calyx 5-toothed, campanulate. Petals 5, free, narrowly oblanceolate, about 0.4 cm long, white but purplish green at the upper half, glabrous. Stamens 10, free, exserted; filaments filiform, about 0.8 cm long, greehish-white, glabrous; anthers oblongoid, about 0.1 cm long, yellow, dithecous, introrse, dorsifixed, with longitudinal dehiscence.



Habit Inflorescence Flower Fruits

Figure 8. *Neptunia oleracea* Lou.

Ovary superior, oblong, 0.20 x 0.05 cm, monocarpellary, unilocular with many ovules in the locule on marginal placenta, yellowish green, glabrous, stipitate; style filiform, about 0.6 cm long, curved, white, glabrous; stigma simple. Pods broadly oblong, 2.7-4.7 x 0.9-1.0 cm, 6-13 seeded, beaked, curved, green when young and brown with age, pubescent, upper suture early dehiscent.

Discussion and Conclusion

Family Fabaceae were placed in the order Fabales according to most taxonomic systems, including the APG IV system (2016). This Family includes three subfamilies: Mimosoideae, Caesalpinioideae and Faboideae. These three subfamilies have been alternatively treated at the family level, as in Cronquist system (1981). However, this choice has not been supported by late 20^{th} and early 21^{st} century evidence, which has shown the Caesalpinioideae to be paraphyletic, while the Mimosoideae and the Faboideae are largely monophyletic.

According to the collected data, the life span of the studied species were perennial. Habit of the studied species, *Mimosa pudica* L., was herbs and *Neptunia oleracea* Lour. was an aquatic herbs; *Albizia procera* (Roxb) Benth., was a large tree and the rest species were shrubs or small trees. The type of leaves were bipinnately compounds. Inflorescences types were oblong heads as in *Neptunia oleracea* Lour., while the rest of the species of Mimosoideae were globose heads. The color of flowers were variable and pretty, actinomorphic flowers were found in Mimosaceous plants. Stamens are 4 to 8 as in *Mimosa* species; 10 stamens as in *Leucaena* and *Neptunia* species; and the rest species were numerous. Ovaries are superior, monocarpellary, unilocular with many ovules in the locule, marginal placentas and stipitate. The type of fruits were commonly pods. These characters agreed with Backer (1963), Dassanayake (1991) and WU De-lin *et al*., (2008).

In conclusion, the present research deals with the scientific studies especially the identification and classification of various legumes. The survey of plant specimens which were widely distributed in the study area has been undertaken. Therefore, it is hoped that the present research work can give valuable information and wide knowledge for the students, local people and researchers in various ways.

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