

## A Study on Some Alkaloid Producing Plants in Hinthada Township

Ni Ni Lwin<sup>1</sup>, Mya Mya Than<sup>2</sup> and Khin Khin Sann<sup>3</sup>

### Abstract

In the present work, some alkaloid-containing flowering plants growing in Hinthada Township, Ayeyarwady Division, are studied from taxonomy, chemical constituents and medicinal uses. In this study, 5 families belonging to 6 species such as *Nelumbo nucifera* Gaertn., *Crataeva magna* (Lour.) DC., *Mimosa pudica* L., *Crotalaria spectabilis* Roth., *Erythrina variegata* L., and *Phyllanthus urinaria* L., were recorded. The samples were collected in all the seasons from December, 2006 to December, 2007. Natural habit and inflorescence have been photographed. Detailed taxonomic descriptions of collected species were thoroughly studied and fully described. Scale drawings were made from the actual specimens and herbarium sheets were also prepared for documentation. A comparative study of alkaloid producing plants were done.

**Key words:** Some alkaloid plants, taxonomy, Hinthada Township

### Introduction

Alkaloid-containing flowering plants constitute an extremely varied group both taxonomically and chemically, a basic nitrogen being the only unifying factor for the various classes. Alkaloids mostly contain a nitrogen-bearing molecule (-NH<sub>2</sub>) that makes them particularly pharmacologically active. The term alkaloid means alkali-like. Typical alkaloids derived from plant sources are basic, and they contain one or more nitrogen atoms (usually in heterocyclic ring) and usually have a marked physiological actions on men or other animals. At present more than 4,500 alkaloids have been known to occur in about 15 percent of all vascular plants. They rarely occur in Cryptogams, Gymnosperms and Angiosperms. The study of correlation between the plants and its neighbouring people is one aspect of the ethnobotany. Today the alternative medicine has become popular, so the correct identification and real resource of plants may be required.

In the present research a study on alkaloid producing plants in Hinthada Township has been undertaken. These plants were collected, identified and their taxonomic status were also verified. Colour photographic plates were presented to show the habit and inflorescences.

### Materials and Method

The six specimens of alkaloid producing plants were collected from the environment of Hinthada Township. The study period was from December, 2006 to December, 2007. Six alkaloid producing plants were photographed digitally in colour photo to record their actual habit, nature of inflorescences, distinctive floral patterns and colour. The plants were classified according to classification of Cronquist (1981). The identification was done by using the keys given by Backer, *et al.* (1963, 1965); Hooker (1872), Kubitzki (1993), Faridah *et al.* (1997), Bunyapraphatare *et al.* (1999), Valkenburg & Bunyapraphatare (2002). Taxonomic description of genera and species were accompanied by the one line drawing of habit, longitudinal sections of flowers, detailed floral parts, fruits and seed types. Colour photographic plates were presented to show the habit and inflorescences. Myanmar medicinal uses were described according to Mya Bwin & Sein Gwan (1967), Nagathein (1971),

<sup>1</sup> Lecturer, Department of Botany, Hinthada University

<sup>2</sup> Professor (Retired), Dr., Department of Botany, Hinthada University

<sup>3</sup> Professor and Head, Dr., Department of Botany, Hinthada University

Ministry of Health (2001, 2003). The uses in the other regions were followed after Swain (1963), Dassanayake & Fosberg (1981), Chopra (1982), Radcliffe-Smith (1986), Chevailler (1996), Devaraj (2001), Kapoor (2001), Trease & Evans (2002), Kress *et al.* (2003).

### **Classification of flowering plants by Arthur Cronquist System (1981)**

Division Magnoliophyta

Class - 1 Magnoliopsida

Sub-class I. Magnoliidae

Order - Nymphaeales

Family - Nelumbonaceae

Genus- 1 - *Nelumbo*

Species 1.1 *N. nucifera* Gaertn.

Sub-class II. Dilleniidae

Order - Capparales

Family - Capparaceae

Genus - 2 *Crateva*

Species 2.1 *Crateva magna* (Lour.) DC.

Sub-class III. Rosidae

Order - Fabales

Family – Mimosaceae

Genus - 3 *Mimosa*

Species 3.1 *Mimosa pudica* L.

Family – Fabaceae

Genus - 4 *Crotalaria*

Species 4.1 *Crotalaria spectabilis* Roth.

Genus - 5 *Erythrina*

Species 5.1 *Erythrina variegata* L.

Order – Euphorbiales

Family - Euphorbiaceae

Genus - 6 *Phyllanthus*

Species 6.1 *Phyllanthus urinaria* L.

## Results

### Description 1

- Botanical name - *Nelumbo nucifera* Gaertn. Fruct. I.73 & 19.f.2.1788. (Figure 1)  
 Myanmar name - Padon-mar-kya, kya-kyaung-laung.  
 English name - Sacred lotus; Chinese water lily; Egyptian Bean; Indian lotus; Pythagorean Bean.  
 Family - Nelumbonaceae

A large aquatic perennial herbs, rhizomes short, thick and erect, milky latex present. Leaves alternate, simple; the petioles long and rigid with sharp warts, raise high above the water, lamina large in size, orbicular, concave or cupped peltate, 55.0 cm long and 52.0 cm wide, the margin entire, multicostate, reticulate, glaucous; exstipulate. Inflorescences 1-flowered scapose, the pedicels long and stout, flexible with prickly. Flowers showy, fragrant, 8.0 - 10.0 cm long and 21.0cm wide, white or pink, the pedicel 1.0 - 3.0 cm long, hypogynous; sepal 3, oblanceolate to obovate, saccate, 8.5 - 9.5 cm long and 3.0 - 4.5 cm wide, caducous, greenish; petals numerous, free, oblanceolate, obtuse, pink; stamen numerous, polyandrous, the filaments flattened, 1.0 - 1.5 cm long, creamy white, the anthers ditheous, with clavate appendages at the top, basifixed, longitudinal dehiscence; ovary superior, apocarpous, oblongoid, about 7.0 mm long and 2.5 mm wide, sunk in the flat top of the obconic spongy torus, the placentation pendulous, the ovules 1, the style obsolete, the stigma discoid. Fruits nullet (Achene) 4.0 - 6.0 cm long and 6.0 - 9.0 cm wide, with a large spongy tours indehiscent. Seeds filling the carpel, testa spongy, non-endospermic.

These plants grow wild in warmer parts of Myanmar and are commonly found in lakes and ponds.

**Flowering and fruiting period** - November to February.

### Description 2

- Botanical name - *Crateva magna* (Lour.) DC. Prodr. 1: 243. 1824. (Figure 2)  
*C. nurvala* Buch. - Ham.  
 Myanmar name - Kon - kadet, kadet  
 English name - Garlic tree or Three-leaved caper  
 Family - Capparaceae

A deciduous tree with grey bark, 13.3 - 15m high, stems erect, woody, branched. Leaves alternate, trifoliolated palmately compound; the petioles long, about 5.5 - 11.0 cm long, the central leaflet ovate-lanceolated to obovate, the bases obtuse, the margins entire, the tips acuminate to mucronulated, 9.5cm - 19.5cm long and 2.5 - 8.7 cm wide, the two lateral leaflets oblique at the base, reticulate venation, the veins 7 pairs; exstipulate. Inflorescences terminal corymbs, 8.0 - 17.5 cm long. Flowers 4.5 - 6.5 cm long and 5.0 - 6.5 cm wide, hypogynous; sepals 4, free, ovate, about 5.0 mm long and about 1.0 mm wide, inserted on the edge of a large lobed disc; petals 4, free, ovate or spatulate with long claw, the limbs 1.5 - 2.5 cm long and 1.3 - 1.8 cm wide, the claws 0.7 - 1.0 cm long, greenish white to greenish yellow when old; stamens numerous, polyandrous, the filaments filiform, about 5.0 cm long, purplish above and yellowish green below, longer than the petals, adnate

to the base of the gynophore, the anthers ditheous, introrse, glabrous, basifixed, longitudinal dehiscense; ovary superior, ellipsoid, seated on a long gynophore, about 6.0 cm long, bicarpellary, syncarpous, unilocular, the placentation parietal, the styles sessile, the stigma discoid. Fruits a berry, ovoid, 7.0 - 8.5 cm long and 5.5 - 6.5 cm wide, whitish grey. Seeds numerous and densely packed, reniform or horse-shoe shaped, 1.5 - 2.0 cm long and 1.0 - 1.5 cm wide, brown, imbedded in pulp, non-endospermic.

The plant commonly grows wild or is cultivated throughout Myanmar.

**Flowering and fruiting period** - March to August.

### Description 3

Botanical name	- <i>Mimosa pudica</i> L., Sp. Pl. 518, 1753. (Figure 3)
Myanmar name	- Htikayon
English name	- Sensitive plant
Family	- Mimosaceae

A spreading undershrub. Stems cylindrical with deflexed curved prickles and velutinous. Leaves alternate, bipinnately compound, paripinnate; the petioles sensitive to touch and show sleep movement when touch and usually base of the petiole provided with pulvinus, the leaflets small and sensitive to touch, 10 - 20 pairs, obliquely narrow, oblong, acute, appressed, bristly beneath; the stipules modified into spines, persistent. Inflorescences axillary globose head, pinkish, about 1.5 cm long and about 1.5 cm wide, the peduncles about 2.2 cm long. Flowers about 8.0 mm long and wide, bracteate, sessile, hypogynous, pink; sepals minute shortly toothed; petals 5, fused, campanulate, pinkish; stamens 4, polyandrous, the filaments long and exerted, pink, versatile, longitudinal dehiscence; ovary superior, oblongoid, monocarpellary, unilocular, the placentation marginal, the ovules 3 - 5, the styles long and slender. Fruits lomentum, flat, about 1.0 cm long and 0.3 cm wide, covered with bristles. Seeds 3 - 5, non-endospermic.

This plant is found growing along the roadsides and on waste dry land.

**Flowering and fruiting period** - July to January

### Description 4

Botanical name	- <i>Crotalaria spetabilis</i> Roth. Nov.pl.sp:341.1821. <i>C.sericea</i> Retz. (Figure 4)
Myanmar name	- Taw-paik-san
English name	- Showy rattlebox
Family name	- Fabaceae

Erect, much branched annual herbs, up to 4.0 m high. Stems and branches angular, grooved, subglabrous. Leaves alternate, simple; the petioles 6.0 - 8.0 mm long, pubescent, the lamina oblanceolate to obovate, about 15.2 cm long and 6.5 - 7.5 cm wide, the bases cuneate, the tips mucronulate, the stipules persistent, obliquely-ovate, the tips acuminate, about 11.0 mm long and about 5.0 mm wide. Inflorescences many-flowered racemes, 30.0 - 36.0 cm long. Flowers papilionaceous, 1.8 - 2.0 cm long and about 0.8 cm wide, acute or acuminate; the pedicels about 1.0 cm long, hypogynous; sepals 5, fused, campanulate, 13.0 - 15.0 mm long and wide, glabrous; petals-5, free, the standard orbicular, 2.0 - 2.5 cm long and

2.5 - 3.0 cm wide, the wings obovate-oblong, 1.8 - 2.0 cm long and 1.0 - 1.2 cm wide, the keels about 1.2 - 1.5 cm long and 1.0 - 1.3 cm wide (twisted beak), bright yellow; stamens 10, monadelphous, the staminal tube about 8.0 mm long and about 3.0 mm wide, the anthers diamorphic, 5 long filaments bear dorsifixed with small anthers, 5 short filaments bear basifixed with large anthers; ovary superior, oblongoid, 5.0 - 7.0 mm long, glabrous, 1 carpelled, 1 loculed, the placentation marginal, the ovules many, the styles curved, the stigmas simple with woolly hairs at the top, the gynophore present. Fruits pod, oblongoid, swollen, brown to dark-brown when mature, 4.0 - 4.5 cm long and 1.0 - 1.3 cm wide, persistent calyx. Seeds numerous, 16 - 24 seeded, about 6.0 mm long and 5.0 mm wide, brown.

It grows in open dry locations along roadsides and as a weed in cultivated fields.

**Flowering and fruiting period-** October to April.

### Description 5

Botanical name	-	<i>Erythrina variegata</i> L., Sp. Pl. 2. 706. 1753. <i>E. indica</i> Lamk. (Figure 5)
Myanmar name	-	Kathit
English name	-	Coral tree
Family	-	Fabaceae

A medium-sized deciduous trees. Stems 5.0 - 13.0 m high with thin gray bark and prickles minute, flowering branches often leafless. Leaves alternate, the younger spirally arranged, trifoliolate palmately compound; the petioles 8.0 - 16.0 cm long, younger petiole tomentose, 0.8 mm – 1.0 cm long and wide, the rachis 8.0 – 10.0 cm, pulvinus present, the lateral leaflets asymmetrical, ovate to broadly rhomboid, 3.0 - 3.5 cm - 11.3 - 11.7 cm long and 2.5 - 11.0 cm wide, the terminals 5.5 – 12.0 cm long and 4.5 - 14.5 cm wide, the bases rounded to truncate, the margins entire, the tips acuminate; the stipules caducous, the stipules gland shaped. Inflorescences 10.0 - 21.0 cm long, ferruginous tomentose, the peduncles stout, about 8.0 cm long. Flowers papilionaceous, 5.0 - 5.7 cm long and 5.0 - 5.5 cm wide, bracteate, the pedicels 0.5 - 1.0 cm long, bracteolate, hypogynous; sepals 5, spathe like, 2.5 - 3.0 cm long, red, cleft on one side, glabrescent; petals 5, free, the standard ovate- elliptical with shortly clawed, 5.5 - 6.0 cm long and 1.0 - 1.2 cm wide, the wings and the keels usually much smaller than the standard, 2.0 - 2.3 cm long and 0.8 - 1.0 cm wide, bright red; stamens 10, monadelphous, basally connate with a tube, the staminal tubes 1.3 - 1.5 cm long, the anthers ditheous, longitudinal dehiscence; ovary superior, linear-oblongoid, 5.0 - 5.5 cm long, monocarpellary, unilocular, the placentation marginal, the ovules many, the styles 1, incurved, the stigmas capitate, the gynophore distinct. Fruits long and curved, cylindrical pod, often constricted between the seeds, 18.0 - 40.0 cm long and 2.0 - 3.0 cm wide. Seeds 5 - 13, ellipsoid to reniform, glabrescent, about 1.5 - 1.6 cm long and about 1.0 cm wide, reddish brown.

It is found growing in open area and sometimes cultivated in garden for ornamental plants.

**Flowering and fruiting period -** February to June.

**Description 6**

Botanical name	-	<i>Phyllanthus urinaria</i> L., Sp. Pl. 982.1753. (Figure 6)
Myanmar name	-	Mye-zibyu, Taung-zibyu
English name	-	Not found
Family	-	Euphorbiaceae

Monoecious annual herbs, 7.0 - 30.0 cm high, stems and branches often strongly suffused with red, usually glabrous. Leaves also often 2 types, the scale-like cataphyll on the long or short shoots and foliage-leaves, cataphyll about 1.0 - 2.0 mm long, triangular-lanceolate, acute, cataphyll borne above their stipules, usually scaly, foliage-leaves alternate; the petioles 0.5 - 1.0 mm long, the lamina 1.0 - 2.0 cm long and 5.0 - 8.0 mm wide, dark green above, the bases obtuse to suboblique, the margins entire with minute hairs, the tips mucronate, both surfaces pubescent; stipulate, about 1.0 mm long. Male flowers 1 - 2, borne in higher part of the plants axile, about 1.0 mm long and wide, the pedicels about 0.3 mm long, the perianth lobes 6, polyphyllous, ovate, about 0.3 mm long and wide, yellowish-white; stamens 3, the filaments united to form a short staminal column, the anthers dithecal, extrorse, longitudinal dehiscence; female flowers solitary in lower axile, about 1.0 mm long and about 1.0 mm wide, subsessile, the perianth 6, polyphyllous, ovate, slightly saccate, 0.5 - 1.0 mm long, pale-yellow, outer surfaces pubescent; ovary superior, sub-globose, trilocular, syncarpous, trilobular, the placentation axile, two ovules in each locule, the styles 3, very short, closely appressed to the top of the ovary, the stigmas bifid, segment recurved, 6 discs present at the base of the staminal column. Fruits dry dehiscent capsule, depressed, subglobose, about 1.5 mm long and about 2.0 mm wide. Seeds 6, about 1.0 mm long and about 0.8 mm wide 12 - 15 transversely ridges on back sides of the seeds, yellowish-brown.

The plant is found growing in gardens, fields, road sides and waste places.

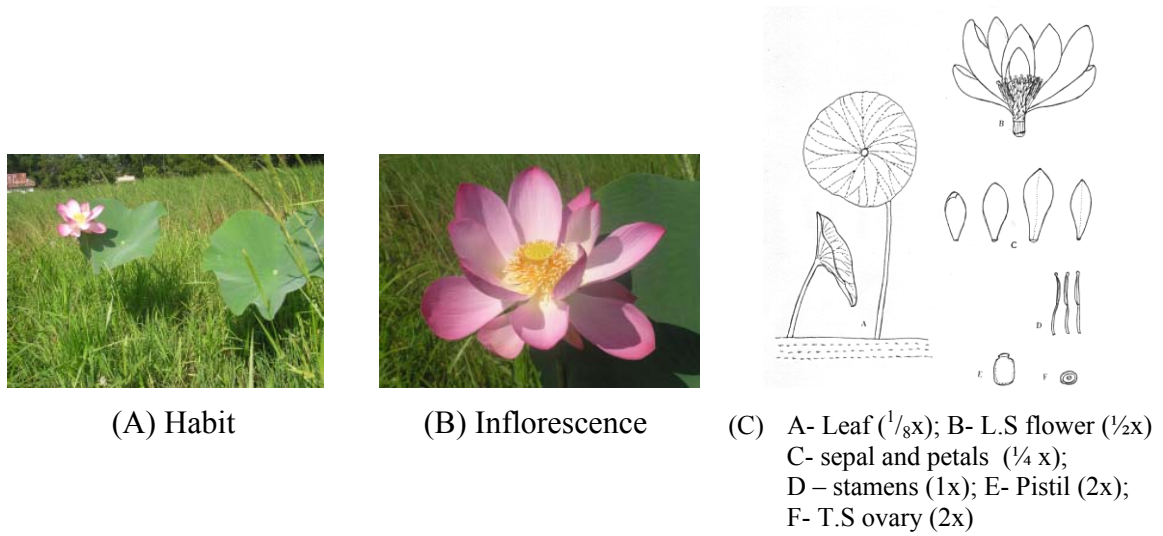
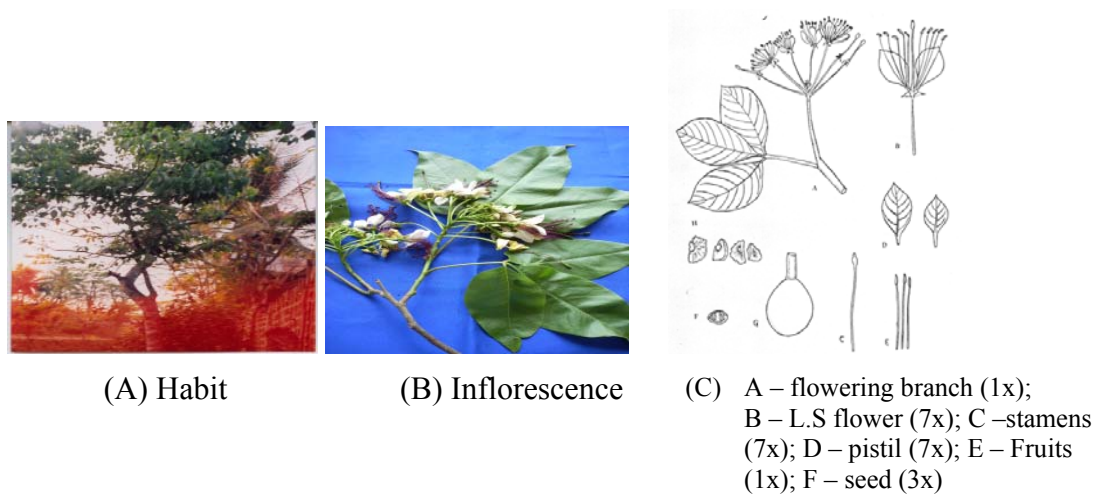
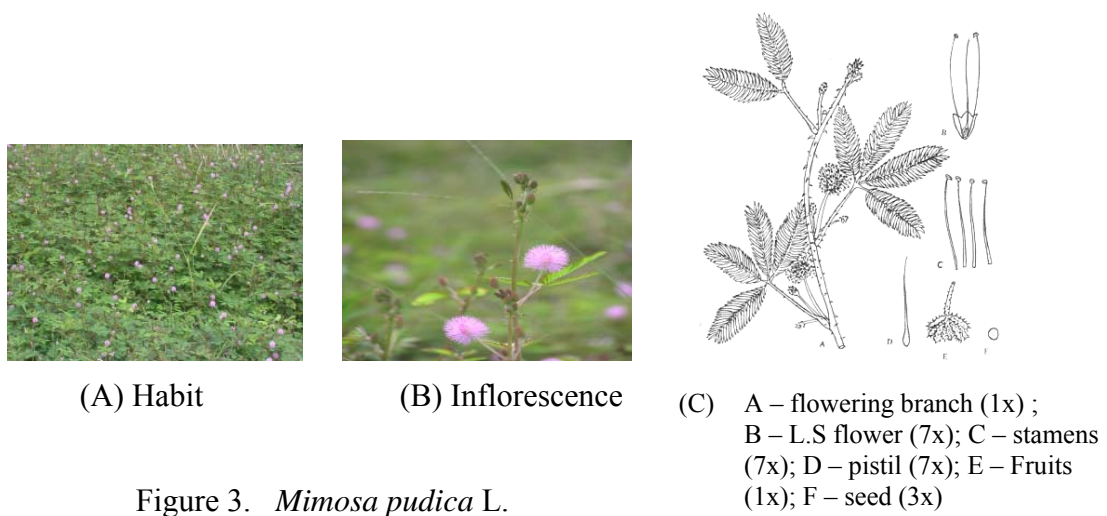
**Flowering and fruiting period** - Throughout the year.

Table 1. Comparative study of alkaloid producing plants in Hinthada Township

Scientific name and Myanmar name	Part used	Medicinal uses	Alkaloids	other
1 <i>Nelumbo nucifera</i> Gaertn. (Padon - ma - kya) - Nelumbonaceae	The whole plant The seed  The whole plant  Flower  Root	<b>Myanmar:</b> heart diseases calm (anxiolytic) dizziness, high fever, strangury, pile, cutaneous, eyediseases, tonic to uterus.  <b>Foreign:</b> fever, bleeding, biliousness, vomiting, diarrhoea, cholera, diseases of liver.  <b>Foreign:</b> cardiac tonic, brain, refrigerant, cutaneous diseases, leprosy antidote for poisons, diuretic.  <b>Foreign:</b> throat troubles, chest pain, leucoderma, small pox.	Carmepavine, nuciferine, roemerine, isoliensinine, liensinine, lotusinine, neferine, pronuciferine, nomuciferine, Numphar-alkaloids, bisbenzyltetrahydroisoquinolinebenzylisoquinoline benzyltetrahydroisoquinoline apporphin, proaporphin	ether, quercetin luteolin, isoquercetin glucoluteolin leukocyanidin 637 oil: myristic, palmatic oleic, linoleic, Linoleic acid 638, Resin, glucose, metabrin, tannin, flat, nelumbine, polyphenol, flavonols, flavones, proanthocyanidins
2 <i>Crateva magna</i> (Lour.) DC. (Kadet) - Capparaaceae	Leaves    Root bark	<b>Myanmar:</b> antipyretic, antiurolithiatic, head-ache, stomach-ache, rheumatism.  <b>Foreign:</b> tonic, skin irritant high fever, a paste for swelling of the feet, rheumatism, dysentery, head-ache, stomach-ache, irregular menstruation.  <b>Foreign:</b> rubefacient, antiinflammatory, antiurolithiatic, urinary tract infection.	Cadabicine, Cadabicine diacetate	Several triterpenes fatty acid ceryl alcohol triacontanol, methyl glucosinolate, saponins, flavonoids, plant sterol, glucosilicates
3 <i>Mimosa pudica</i> L., (Tikayon) - Mimosaceae	Root, seeds  The whole plant  Leaves	<b>Myanmar:</b> haematemensis, turgid, cough, piles, dysentery, diarrhoea, asthma  <b>Foreign:</b> haematuria, diuretic,  <b>Foreign:</b> dysmenorrhoea, dermatitis, wounds and ulcers, sedative, antiinflammatory, antiimplantation, antiarthritic, a synchronous human breast cancer cell.	Mimosine (N-3-alanyl), 3-hydroxyl-4-pyridone	amino acid, two C-glycosyl flavones and 2'- O - rhamnosyl-isoorientin, tannin.
4 <i>Crotalaria spetabilis</i> Roth. (Taw-paik-san) - Fabaceae	The whole plant	<b>Myanmar:</b>  <b>Foreign :</b> lower blood pressure and is toxic to farm animals and probably also to root-knot nematodes. Beneficial effect of crops result not only from increased N2 content of the soil but also from its effect in Nematodes and antitumour compounds from these plant	Pyrrrolizidine - monocrotaline	

Scientific name and Myanmar name	Part used	Medicinal uses	Alkaloids	other
5 <i>Erythrina variegata L.</i> (kathit) - Fabaceae	Spines, leaves Barks  The whole plant   Leaves  Barks, leaves	<p><b>Myanmar:</b> pimple, olalgia, dentalgia, epiphora, glactagogues,</p> <p><b>Myanmar:</b> germicides.</p> <p><b>Foreign:</b> antibilious, expectorant febrifuge and anthelmintic, dysentery.</p> <p><b>Foreign:</b> worms, ophthalmia, vermifuge.</p> <p><b>Foreign:</b> cathartic, rheumatic joints, liver troubles, diabetes, dysmennorrhoea, sterility, lactation, antidote, anti-bacterial activity, mensural disorder, rheumatism, asthma, cough, cancer, abcesses, snake bites, inhibiting and cytotoxic activity</p>	erythrine, erysodine C10H21NO3, erysovine C18H21NO3, erysonine C17H19NO3, hypaphorine C14H18N2O3, Crystorine C19H23NO3, isoquinoline, Erythraline, lectine	β - sitosterol γ - sitosterol δ - sitosterol , Hydrocyanic acid, amino acid, histidine, cyclitol, ononitol, L- bornesitol.
6 <i>Phyllanthus urinaria L.</i> , (me-zi-byu, Taung-zi-byu) - Euphorbiaceae	The whole plant	<p><b>Myanmar:</b> jaundice, ascite, hepatitis, gonorrhoea diuretic, demulcent for children.</p> <p><b>Foreign:</b> febrifuge, emmenagogue abortifacient, dysentery, small pox, pain in the chest, diuretic, inhibit DNA polymerase of hepatitis-B, Wookchuck hepatitis (WHV), hypoglycemic activity in diabetic rats, antibiotic activity against <i>Staphylococcus, E, coli, Salmonella typhi, Vibrio, Cholerae and Shigella dysenteriae.</i></p>	quinolizidine alkaloids phyllantine (methoxy-securinine)	β - amyri β - sitosterol triacontanol quercetin, kaempferol rutin, phyllanthin, hypophyllathin, triterpenoid triacontanol, (phyllanthine, phyllochrysine) lignans, ethyl gallate, methyl gallate phenolic acid, tannin flavonoid, Essential oil linoleic acid.



Figure 1. *Nelumbo nucifera* Gaertn.Figure 2. *Crataeva magna* (Lour.) DC.Figure 3. *Mimosa pudica* L.



(A) Habit



(B) Inflorescence



(C) A – flowering branch (x) ; B – L.S flower (2x); – sepals (1x) ; D – petals (1x) ; E- side view of standard 1x; F – stamens (3x); G – pistil (3x); H – fruit (1x); I – seed (1x) ; J – T.S ovary (5x)

Figure 4. *Crotalaria spectabilis* Roth.



(A) Habit



(B) Inflorescence



(C) A – flowering branch (1x); B – L.S flower (1x); C – sepals with stamens (1x) ; D – petals (1x); E – pistil (1x); F – T.S ovary (5x) ; G- Fruit (1/4x); H – seed (1x) ; I – Leaf (1x)

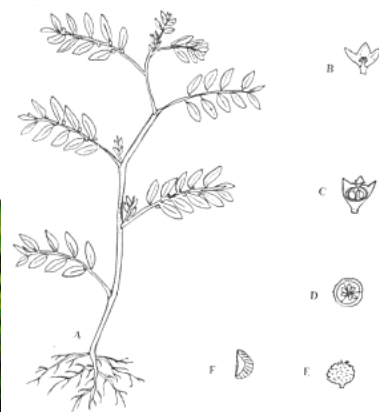
Figure 5. *Erythrina variegata* L.



(A) Habit



(B) Inflorescence



(C) A – Habit (1x) ; B – staminate flower (10x); C – Pistillate flower (10x) ; D – T.S ovary (10x); E – Fruit (5x) ; F – seed (10x)

Figure 6. *Phyllanthus urinaria* L.

### Discussion and Conclusion

Alkaloids often occur in plants in association with characteristic acids. In this research, six alkaloid producing plants were mentioned. The study also carried out the comparative study of some alkaloid producing plants in Hinthada Township. As seen in Table 1, the whole plant of *Nelumbo nucifera* Gaertn. contains benzyltetrahydroisoquinoline, aporphin, proaporphin and bisbenzyltetrahydroisoquinoline bases. In Capparaceae family, *Crateva magna* (Lour.) DC. contains cadabicine and cadabicine diacetate which was isolated from stem bark. In Mimosaceae family, the whole plant of *Mimosa pudica* L. consists of mimosine alkaloids. In Fabaceae family, *Crotalaria spectabilis* Roth. contains pyrrolizidine monocrotaline alkaloid from the whole plant and in *Erythrina variegata* L., erytherine, erysodine, erysovine, erysonine, hypaphorine, crystorine, isoquinoline, erythrinine, lectine alkaloids are present. In Euphorbiaceae, *Phyllanthus urinaria* L., contains quinolizidine alkaloids. Alkaloids in plants are believed to be waste products and a nitrogen source. They are thought to play a role in plant protection and germination, and to be plant growth stimulants. Alkaloids are more common in dicotyledons than in monocotyledons families. The characteristic nature of alkaloids and their pharmacological effects when administered to animals naturally led scientists to speculate their biological role in the plants in which they occurred. The present work will widen the knowledge concerning the sustainable conservation and utilization of these plants. Moreover, it will be of help to the study of real source plants for local people and further study of investigation.

People all over the world cannot survive without plants. All green plants are capable of transforming the solar energy into chemical energy, which are vital to the very existence to animal life. The oxygen we breathe is produced by green plants. The main point is that people are much dependent upon the plants around them. Alkaloids are an extremely heterogeneous group of so-called secondary metabolites containing one or more nitrogen atoms, usually in a heterocyclic ring. Alkaloidal plants are scattered almost in every group of plants, except probably the algae. They are especially common in families of Angiosperms. They are toxic and correct dosage is very important as in all cases.

### Acknowledgements

We are greatly indebted to Dr. Tin Tun Myint, Acting Rector and Dr. Si Si Hla Bu, Pro-Rector of Hinthada University, for their permission to carry out this research. We would also like to express our deep gratitude to Dr. San Aye, Professor and Head, Department of Botany, University of East Yangon, for her invaluable suggestions and encouragement. We are also grateful to Dr. Moe Moe Khine, Professor, Department of Botany, University of Panlong for her guidance, generous help and valuable advice.

### References

- Backer, C.A, Bakhuizen, R.C. and Van Der Bruggen J. (1963) *Flora of Java*, I, N.V.P Noord Half. Gorningen. The Netherlands.
- Backer, C.A, Bakhuizen, R.C. and Van Der Bruggen J. (1965) *Flora of Java*, II, N.V.P Noord Half. Gorningen. The Netherlands.
- Bunyapraphatsara, L.S. de Padua, N. and Lemmens, R.H.M.J. (1999) Plant resources of Southeast Asia. *Medicinal and Poisonous Plants*, **12**(1) Printed in Indonesia.
- Chevallier, A. (1996). *The Encyclopedia of Medicinal Plants*. Dorling kindersley, London. New York.
- Chopra, I.C. (1982). *Indigenous Drugs of India*. Academic publishers: Calcutta. New Delhi.
- Cronquist, A. (1981) *An Intergrated System of Classification of Flowering Plants*, New York.
- Dassanayake, M.D. and Fosberg, F.R. (1981). *A Revised Hand Book to the Flora of Ceylon*, **IV**.

- Devaraj, T. L. (2001) *Speaking of Ayurvedic Herbal Cures*. Laserset by Surya Computer Services, New Delhi.
- Faridah, H.I. and Maesen Van der, L. J. G. (1997) *Plant Resources of Southeast Asia*. **11**. Auxillary Plants. Printed in Netherlands.
- Hooker, J.D. (1872) *Flora of British India*, **I** Reeve & Co., Ltd London.
- Kapoor, L.D. (2001) *Handbook of Ayurvedic Medicinal Plants*. CRC Press. Boca Raton London, New York Washington D.C.
- Kress, W. J., Defilipps, R. A., Farr, E. and Yin Yin Kyi (2003). *A Checklist of the Trees, Shrubs, Herbs, and Climbers of Myanmar*. National Museum of Natural Histroy, Smithsonian Institution, Washington D.C, U.S.A.
- Kubitzki, K. (1993) *The Families and Genera of Vascular Plants*. Printed in Germany.
- Lawrence, G.H.M. (1964) *Taxonomy of Vascular Plants*. Printed in the United States of America.
- Ministry of Health (2001) *Resources of Myanmar Traditional Medicine*, Department of Traditional Medicine, Myanmar.
- Ministry of Health (2003) *Collection of Commonly Used Herbal Plants*, Department of Traditional Medicine, Myanmar.
- Mya Bwin and Sein Gwan (1967) *Burmese Indigenous Medicinal Plants*. **1** Plants with reputed hypoglycemic action. Department of pharmacology, Burma Medicinal Research Institute, Rangoon.
- Nagathein, Ashin (1971) *Pon- pya- say- abidan*. **I**, Printed in Union of Burma.
- Radcliffe-Smith, A. (1986) *Flora of Pakistan*, No.172. Euphorbiaceae, Royal Botanic Gardens, Kew.
- Swain, T. (1963) *Chemical Plant Taxonomy*. Academic Press. London and New York.
- Trease and Evans (2002) *Pharmacognosy*. Fifteenth edition, W.B. Saunders. Edinburgh, Landon, New York.
- Valkenburg, J.L., Van C. H. and Bunyaphaphatare, N. (2002) *Plant Resources of Southeast Asia*. **12(2)** Medicinal and Poisonous Plants. Printed in Indonesia.