

## STUDY ON MORPHOLOGICAL, SENSORY CHARACTERS, PHYTOCHEMICAL TEST AND ELEMENTAL ANALYSIS OF *SOLANUM TORVUM* LINN.

Win Win Nu<sup>1</sup>, SawWin<sup>2</sup>, Khin Hla Win<sup>3</sup>

### Abstract

*Solanum torvum* Linn., belonging to the family, Solanaceae, is a pharmaceutically valuable, edible plant and distributed in tropical regions. It was collected from East Yangon University Campus, Thanlyin Township, Yangon Region. It is known as khay-an-kazaw. The morphological characters, sensory characters and phytochemical test of this plant were studied and identified in the Department of Botany East Yangon University. The collected plant samples were washed and then dried in room temperature. After drying completely, the samples were ground to get powder and stored in an air-tight container for chemical and pharmacological studies. The powdered fruits were tested for the phytochemical investigation. Results from the phytochemical study flavonoids, glycosides, alkaloids, phenolic compound, steroids, reducing sugar,  $\alpha$ -amino acids, carbohydrates, saponin and tannin were present and starch and cyanogenic glycoside were absent. The presence of elements in fruits were observed by using Energy Dispersive X-ray Fluorescence (EDXRF) spectrophotometer. From the observation of elemental analysis, it was found that the elements necessary for health such as potassium, calcium, iron and phosphorus were present in the fruits.

**Key words:** *Solanum torvum* Linn., Morphological characters, sensory characters, phytochemical test and elemental analysis

### Introduction

The Solanaceae are also the third most important taxon economically and the most valuable in terms of vegetable crops and are the most variable of crop species in terms of agricultural utility, as they include the tuber-bearing potato, a number of fruit-bearing vegetables (Tomato, Eggplant, Peppers), ornamental plants with edible leaves and medicinal plants (Jagatheeswari, 2014).

A large family of 85 genera and more than 2200 species are growing chiefly in central and South America. The largest genus *Solanum* with about 1500 species occurs over most parts of the world. (Bhattacharyya, 1998).

*Solanum torvum* Linn. perennial shrub, is often cultivated but sometimes wild. Mesophyte; Stem: woody, erect and much branched, few prickles are present. Leaves: alternate, ovate, lobed, acute, often cordate at base, softly tomentose. Inflorescence: A branched helicoid cyme. Flowers: pedicellate, bisexual, hypogynous, white, actinomorphic. Calyx: 5, gamosepalous, persistent, entire. Corolla: 5, gamopetalous, rotate, white, 0.75 cm in diameter, stellate. Androecium: 5 anthers, epipetalous, opening with terminal pore, filaments short. Gynoecium: Bicarpellary, syncarpous, superior ovary with obliquely axile placentation. Fruit: A globose berry with many seeds (Jagatheeswari, 2014) In this work, a morphological study of the vegetative organs of *Solanum torvum* Linn. has been carried out with the objective of providing a macroscopical morphodiagnosis for its characterization which forms a part of a project of pharmacognostic studies of *Solanum* species used as medicinal plants in Brazil (Basilio *et al.*, 2007).

---

<sup>1</sup> Dr. Associate Professor, Department of Botany, Myeik University.

<sup>2</sup> Dr. Associate Professor, Department of Engineering Chemistry, West Yangon Technological University.

<sup>3</sup> Dr. Professor (Head), Department of Botany, Myeik University.

Leaves have been reported to contain the steroidal gluco-alkaloid, solasonine. In addition, they contain steroidal sapogenins, neochlorogenin, neosolaspigean and soaspigenine. They have also been found to contain triacontanol, tetratriacontanic acid, z-tritriacontanone, sitosterol, stigmasterol and campesterol. Fruits also contain the gluco-alkaloid, solasonine, sterolin, protein, fat and minerals (Yuanyuan *et al.*, 2009).

Different parts of the plants are used as sedative, diuretic and digestive. They are also used in the treatment of coughs and colds. Leaves are used as haemostatic. Extract of the fruits and leaves are said to be useful in case of liver and spleen enlargement and in the treatment of cough. Paste of root is used to cure cracks in feet. The fume of burning seeds is inhaled for toothache (Bhakuni *et al.*, 1962 & 1969).

### **Material and Methods**

#### **Botanical studies**

##### **Collection of plant materials and used for classification and identification of plants**

In this research, the plants samples were collected from East Yangon University Campus, Thanlyin Township, Yangon Region from August to November, 2018. The morphological characters were studied of the plants undertaken with the help of available literatures.

The collected plants were washed with water and then air dried at room temperature. When constant weight was obtained, the dried samples were pulverized by grinding machine and stored air tight bottles for further use.

##### **Methods used for sensory character examination of different plant parts and powders**

The fresh specimens were examined under dissecting microscope. The sensory characters studies of *Solanum torvum* Linn. were performed according to the methods of Trease and Evens, 2002; Metcalf and Chalk, 1950; Backer, 1965; Pandey, 1999; at the Department of Botany, East Yangon University.

The following reagents were used to examine the section cutting and powdered samples. Chloral hydrate solution B.P as clearing reagents. Sodium hypochlorite solution was used as clearing and bleaching reagent.

#### **Chemical studies**

##### **Preliminary phytochemical tests**

The preliminary phytochemical investigation of the plants samples were determined the presence or absence of alkaloid, glycoside,  $\alpha$ - amino acid, reducing sugar, phenolic compound, starch, tannin, carbohydrate, saponin, steroids and terpenoids, flavonoid, cyanogenic glycoside.

The tests have been performed according to Trease and Evans (1987); central council for research in Unani medicine (1987), Marini, (1981).

##### **Energy Dispersive X-ray Fluorescence (EDXRF)**

For relative quantitative elemental determination, EDXRF spectrometry was used. About 2.5 g of ash sample was fabricated into pellet. The elements present in the samples were measured. Basically, energy dispersive X-ray spectrometry is especially qualified for surveying analysis because a spectrum of all involved elements is usually generated (Ertel, 1991).

## Results

### Morphological characters of *Solanum torvum* Linn.

Scientific Name -*Solanum torvum* Linn.

Family - Solanaceae

Myanmar Name - Khayan- kazaw

English Name - Turkey berry

Perennial shrub, prickly erect, 1.5 – 4.0 m high, Stem: woody, erect and much branched, few prickles are present on young branches. Stems and branches terete, sparsely covered with stellate hairs; **Leaves:** simple, alternate, ovate, lobed, acute, cordate at base, softly tomentose. exstipulate, petioles 1.5- 5.0 cm long, tomentose, blades oval-ovate- elliptic-oblong, 3.1 – 13.2 cm length, 2.5- 8.3 cm wide, cuneate or cordate at the base, entire pinnatilobed along the margin, acute at the apex, stellately tomentose on both surfaces, often prickly beneath on the nerves, shallowly lobed or pinnatifid; **Inflorescences:** axillary, a branched helicoids cyme, 1.0 cm – 8.0 cm long, dense scorpioid racemes, many-flowered; peduncles densely tomentose; **Flowers:** bracteates, ebracteolate, actinomorphic, bisexual, white, 1.2- 2.0 cm in diameter; pedicels 0.6 cm long, stellately pubescent; hypogynous; **Calyx:** (5), synsepalous, campanulate with 5 lobes, persistent, entire, tube 0.17 – 0.18 cm long; glabrous; lobes acuminate, 1.0 cm long, white with yellow center, inferior; **Corolla:** (5), synpetalous, rotate, white with a light yellow centre, 1.25 - 2.0 cm in long, lobes acuminate, inferior; **Androecium:** anthers 5, epipetalous, free, anther 0.6 - 0.7 cm opening with terminal pore, exserted, adnate to the throat of the corolla-tube; filament short, glabrous, greenish yellow; anthers ditheous, oblong, inferior; **Gynoecium:** Bicarpellary, syncarpous, ovary globose 0.03 – 0.05 cm in diameter, glabrous, usually bilocular, often tetralocular with obliquely axile placentation, many ovule, style 1.0 cm long, filiform, stigma 0.2 cm in diameter, sub-globose, superior; **Fruit:** a globose berry with many seeds. berry globoid, 1.0 - 1.5 cm in diameter, many seeded, orange - yellow when ripe, glabrous; **Seeds:** numerous, compressed, rounded, 0.2 – .03 cm in diameter, smooth, white.

Flowering Period - Throughout all year around

Fruiting Period -Throughout all year around

Location - East Yangon University Campus

Part used - Leaves, Fruits and roots

Uses - Fever, wounds, tooth decay, traditional medicine

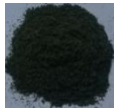


### Microscopical Characters of Leaves, Stems and Fruits of *Solanum torvum* Linn.

In powdered sample of leaves were observed fiber, unicellular trichome, stellate trichome, spiral and pitted vessel, fragment of epidermal cell, group of tracheid, epidermal cell with unicellular trichome and idioblast of sand crystal.

In powdered sample of stems were observed fiber, fiber tracheid, tracheid, stellate trichome, spiral and scalariform vessel, and calcium oxalate crystal.

In powdered sample of fruits were observed fiber, fiber tracheid, tracheid, stellate trichome, pitted vessel, fragment of epidermal cell and group of vessels.

Table 1 Sensory Characters of Powdered Leaves, Stems and Fruits of *Solanum torvum* Linn.

Sample	Leaves	Stems	Fruits
Sensory characters			
Colour	Black green	Pale yellow	Brown yellow
Odour	Aromatic	Aromatic	Aromatic
Taste	Slightly bitter	Tasteless	Slightly sweet
Texture	Fibrous	Fibrous	Fibrous

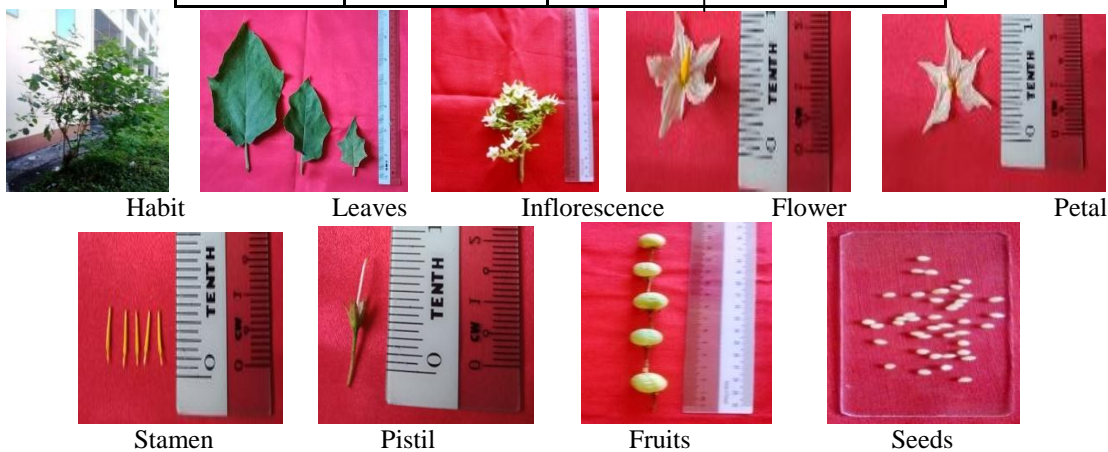


Figure 1 Morphological characters of *Solanum torvum* Linn.

**Diagnostic characters of powdered leaves**

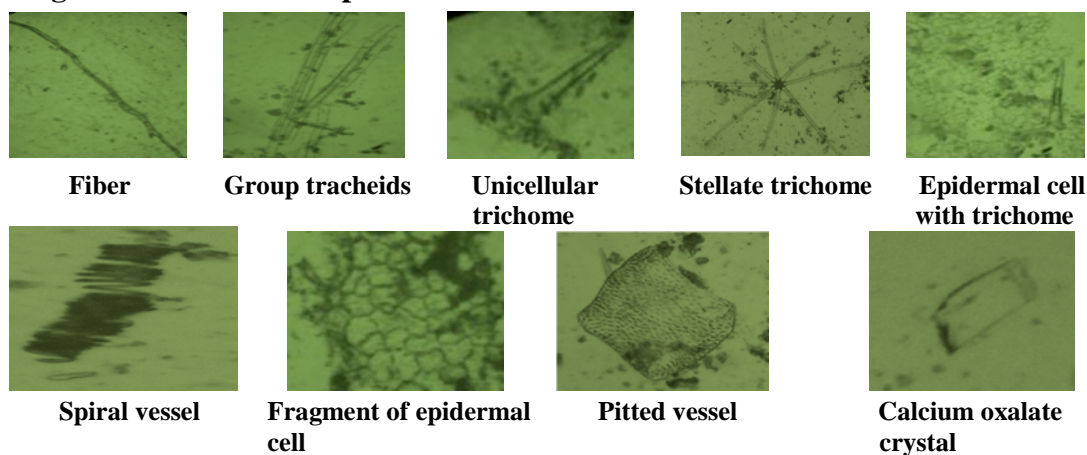
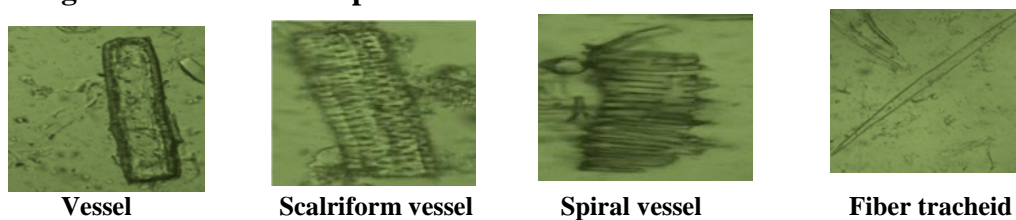


Figure 2 Diagnostic characters of powdered leaves

**Diagnostic characters of powdered stems**



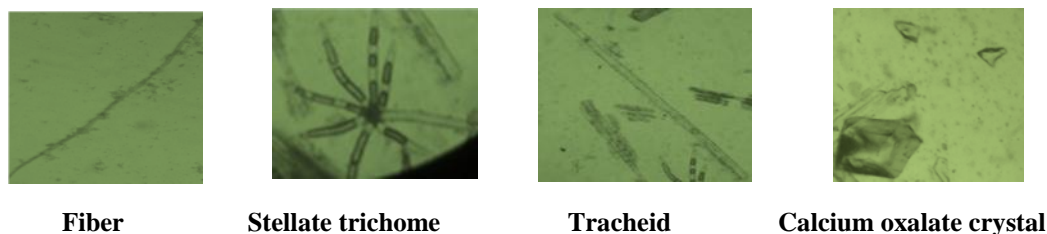


Figure 3 Diagnostic characters of powdered stems

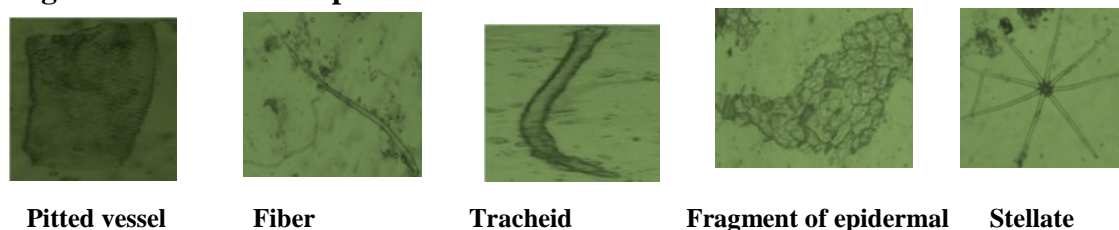
**Diagnostic characters of powdered fruits**

Figure 4 Diagnostic characters of powdered fruits

**The preliminary phytochemical tests of powdered of fruits in *Solanum torvum* Linn.**

The preliminary phytochemical investigation was carried out on the powdered of fruits. This test indicated that the fruits contained alkaloid, Carbohydrate, glycoside, phenolic compound,  $\alpha$ -amino acid, saponin, tannin, flavonoid and steroid. The absence of starch and cyanogenic glycoside were recorded in table 2.

**The procedure for phytochemical tests of powdered fruits from *Solanum torvum* L.**

$\Delta$  boil (15')

Dried powder + distilled water  $\longrightarrow$  filter aqueous extract  
 7g                      45 ml

**(1) Test for Alkaloid**

Powder + 1% HCl acid  $\longrightarrow$  filtrate  $\longrightarrow$  divided four portions  
 1.5 g                      10 ml

- (a) acidic extract + Mayer's reagent  $\longrightarrow$  white ppt  
 (b) acidic extract + Wagner's reagent  $\longrightarrow$  brown ppt  
 (c) acidic extract + Dragendroff 's reagent  $\longrightarrow$  orange ppt  
 (d) acidic extract + Hager's reagent  $\longrightarrow$  yellow ppt

$\therefore$  Alkaloid (+)

**(2) Test for Carbohydrate**

aqueous extract + 10% alcoholic naphthol (1 drop)  $\xrightarrow{\text{shake}}$  sulphuric acid (conc:)1ml  $\longrightarrow$  red ring between two layers

$\therefore$  Carbohydrate (+)

**(3) Test for Glycoside**

aqueous extract + 10% lead acetate solution  $\longrightarrow$  white ppt  
 (5 drops)

$\therefore$  Glycoside (+)

**(4) Test for Phenolic compound**

aqueous extract + 10% FeCl<sub>3</sub> solution  $\longrightarrow$  brownish green ppt  
 (5 drops)

$\therefore$  Phenolic compound (+)

**(5) Test for  $\alpha$  - Amino acid**

aqueous extract  $\xrightarrow{\Delta \text{ dry}}$  spotted on spray ninhydrin reagent (few)  $\xrightarrow{\text{dry } \Delta \text{ oven}}$  pink color  
filter paper

∴ Amino acid (+)

**(6) Test for Saponin**

aqueous extract  $\xrightarrow{\text{shake}}$  stand  $\xrightarrow{(15)}$  present foam

∴ Saponin (+)

**(7) Test for Tannin**

aqueous extract + 10% NaCl solution + 1% Gelatin solution  $\longrightarrow$  ppt

∴ Tannin (+)

**(8) Test for Flavonoid**

Powder 1g + ethyl alcohol 7ml  $\xrightarrow{70\% \Delta \text{boil}}$  filter  $\rightarrow$  filtrate + Mg ribbon + HCl acid  $\xrightarrow{\Delta}$  pink color ppt

∴ Flavonoid (+)

**(9) Test for Steroid and Terpenoid**

Powder 1g + petroleum ether 15 ml  $\xrightarrow{\Delta \text{water bath}}$  till 1/2 volume  $\xrightarrow{\text{filter}}$  evaporation till dry  $\longrightarrow$  dissolve in acetic anhydride

drops)

sulphuric acid (conc.) (2)

↓  
bluish green (steroid) and  
↓  
deep pink color (terpenoid)

∴ Steroid (+), ∴ Terpenoid (+)

**(10) Test for Reducing sugar**

aqueous extract + Fehling's solution  $\longrightarrow$  orange ppt

I (7 drops) + II (7 drops)

∴ Reducing sugar (+)

**(11) Test for Starch**

aqueous extract + I<sub>2</sub> solution (2 drops)  $\longrightarrow$  brown ppt

∴ Starch (-)

**(12) Test for Cyanogenic glycoside**

Powder 1g + moistened distilled water (few) + sulphuric acid (conc.) 3 drops  $\longrightarrow$  sodium picrate paper  $\xrightarrow{\Delta \text{ water-bath } (40^\circ\text{C}) \text{ 3 hrs}}$  no color change

∴ Cyanogenic glycoside (-)

**Table 2 Preliminary Phytochemical Tests on the Fruits of *Solanum torvum* Linn. (Khayan - Kazaw)**

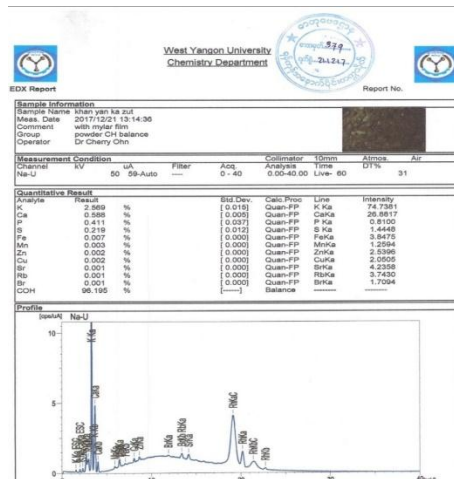
No	Type of compound	Extract	Reagent used	Observation	Results
1.	Alkaloid	1% HCL	Mayer's reagent	Cream colour ppt.	+
			Wagner's reagent	Deep brown ppt.	
			Dragendorff's reagent	Reddish brown ppt.	
			Hager's reagent	Yellow ppt.	
2.	Carbohydrate	H <sub>2</sub> O	10% α-naphthol & H <sub>2</sub> SO <sub>4</sub> (Conc:)	red ring	+
3.	Glycoside	H <sub>2</sub> O	10% Lead acetate solution	White ppt.	+
4.	Phenolic compound	H <sub>2</sub> O	5% FeCl <sub>3</sub> solution	Brownish green ppt.	+
5.	α-amino acid	H <sub>2</sub> O	Ninhydrin reagent	Pink colour	+
6.	Saponin	H <sub>2</sub> O	H <sub>2</sub> O	Persistent foam	+
7.	Tannin	H <sub>2</sub> O	1% Gelatin & 10% NaCl solution	ppt.	+
8.	Flavonoid	70% EtOH	Mg ribbon & Conc; HCL	Pink colour ppt.	+
9.	Steroid	petroleum ether	Acetic anhydrite & Conc; H <sub>2</sub> SO <sub>4</sub>	Bluish green	+
10.	Terpenoid	Petroleum ether	Acetic anhydrite & Conc; H <sub>2</sub> SO <sub>4</sub>	Deep pink	trace
11.	Reducing sugar	H <sub>2</sub> O	Fehling's solution	Brick red ppt.	Orange
12.	Starch	H <sub>2</sub> O	Iodine solution	Brown ppt	-
13.	Cyanogenic glycoside	powder	H <sub>2</sub> O, Conc; H <sub>2</sub> SO <sub>4</sub> , sodium picrate paper	No colour change	-

(+) = present, (-) = absent, ppt = precipitate

### Elemental analysis on the fruits of *Solanum torvum* Linn. (Khayan -Kazaw)

The elements present in powdered fruits were quantitatively determined by EDXRF. It was found that Potassium (K), Calcium (Ca), Phosphorus (P), Sulphur (S), Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Strontium (Sr), Rubidium (Rb), Bromine (Br) and Carbon, Oxygen and Hydrogen (COH) were found as trace elements. The results are shown in Figure (7) and Table (3).

Table 3 Relative Concentration of Elements in the Sample Powdered Fruits of *Solanum torvum* Linn.



No.	Element	Relative Abundance (%)
1.	K (Potassium)	2.569
2.	Ca (Calcium)	0.588
3.	P (Phosphorus)	0.411
4.	S (Sulphur)	0.219
5.	Fe (Iron)	0.007
6.	Mn (Manganese)	0.003
7.	Zn (Zinc)	0.002
8.	Cu (Copper)	0.002
9.	Sr (Strontium)	0.001
10.	Rb (Rubidium)	0.001
11.	Br (Bromine)	0.001
12.	COH (Carbon, Oxygen and Hydrogen)	96.195

Figure 7 Elemental analysis on the fruits of *Solanum torvum* Linn.

## Discussion and Conclusion

*Solanum torvum* Linn. (kayan- kazaw) originated from Central and South America, found from Mexico to Brazil and Peru and is widely spreading in the Caribbean. In West and Central Africa it is locally a kitchen garden crop and occurs in other regions of Africa as well. It is cultivated as a small-scale vegetable in southern and eastern Asia, and is especially popular in Thailand (Schippers, 2004).

In this research, morphological characters, sensory characters, preliminary phytochemical test of powdered samples of fruits of *Solanum torvum* Linn., belonging to the family Solanaceae were presented.

In the present result, the plant is spreading slender shrubs, up to 3m tall, pubescent with stellate hairs, stem and branches usually with scattered prickles long, slightly hooked. Leaves are alternate, solitary, simple, stipules absent, petiole long, blade ovate, usually coarsely and sinuously 7 lobed with triangular, acute to obtuse lobes, somewhat sagittate to auriculate at base. Inflorescences are a compact, branched, corymb, at first terminal, later becoming lateral, peduncle long. Flowers are bisexual, regular, 5 merous, pedicellate, calyx, persistent corolla stellate, white, lobes lanceolate, stamens inserted on corollathrost, filaments very short, anthers connivent, opening by terminal pores ovary superior, globose, pubescent style long, stigma capitate, fruit a globose berry yellowish, many-seeded. Seeds are discoid, brownish seedling with epigeal germination. The character is in agreement with those described by (Schippers, 2004).

Sensory characters of *Solanum torvum* Linn. powders of leaves, stems fruits and roots show fiber, tracheid, fiber tracheid, unicellular trichome, stellate trichome, fragment of epidermal cells, scalariform vessel, spiral vessel, pitted vessel, calcium oxalate crystal. These characters are in accordance with those stated by Esau (1953).

The preliminary phytochemical test of powdered samples of fruits, alkaloid, carbohydrate, glycoside, phenolic compound,  $\alpha$ -amino acid, saponin, tannin, flavonoid, reducing sugar, steroid and terpenoid are present, starch and cyanogenic glycoside are absent in *Solanum torvum* Linn. (Marini, 1981).

Elemental analysis of the fruits were investigated by using EDXRF; Potassium (K), Calcium (Ca), Phosphorus (P) and Sulphur were trace elements and iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Strontium (Sr), Rubidium (Rb) and Bromine (Br) were microelements. Among them, calcium and potassium were important of health (Norman *et al.*, 1988).

Extract of the fruits and leaves are said to be useful in case of liver and spleen enlargement and in the treatment of cough. Fruits contain sterolin and 0.1% gluco-alkaloid solasonine (Chopra, 1956). The drug is used in treatment of coughs and as sedative, diuretic and digestive tonic, active principle either a glycoside or solamine alkaloid. Paste of root is used to cure cracks in feet. The fume of burning seeds is inhaled for toothache (Bhakuni *et al.*, 1969).

Kha yan kazaw thee *Solanum torvum* Linn. has been used as traditional medicine due to the presence of elements necessary for health. Fruits of Kahayan kazaw plant can be used to control a range of microbial activities because fruits contain potassium, calcium, phosphorus and iron. The fruit decoction has been used as cough, sore throat and stomachache medicine for children. This research papers are evaluated and indicate the production of scientific efficacy as systematically medicine. So suggestion for further studies, the bioactive compounds should be isolated from the *Solanum torvum* Linn. and pharmacological activities should be done for human being.



### Acknowledgements

The authors are thankful to Rector and Professor (Head), Department of Botany, Myeik University for their helpful suggestions and advice. Special thanks are extended to Department of Botany, East Yangon University for their valuable advice and for providing the research facilities. The authors also would like to express their profound gratitude to the Rector and Professor (Head), Department of Botany, Dagon University, Ministry of Education, Yangon, Myanmar for offering us this opportunity to do this research.

### References

- Backer, C.a., 1965.**Flora of Java**, Vol. II, Wolters Noordhoff N.V. Groningen, The Netherlands.
- Basilio, I., 2007.**Estudofarmacobotanico das folhas de *Solanum paludosum* Moric.** BrasBioci, **5**: 651-653.
- Bhattacharyya and B. M. Johri., 1998.**Flowering Plants Taxonomy and Phylogeny**, Narosa Publishing House, New Delhi Madras Bombay Calcutta London.
- Bhakuni, D. S., M. L. Dhar, *et al*, 1969.**Screening of Indian Plants for Biological Activity: Part II.** *Indian J. Exp. Biol.*, **7**:250-262.
- Chopra, I. C., 1956. **GLOSSARY OF INDIAN MEDICINAL PLANTS**, Drug Research Laboratory, Jammu- Kashmir. COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH NEW DELHI
- Easau, K., 1953. **Plant Anatomy**, John Wiley and Sons, Inc. New York, London.
- Ertle, D. 1991. **X-ray Fluorescence Analysis**, Nuclear Research Centre, Karlsruhe, Germany.
- Evans, 1978, 2002.**Pharmacognosy**, 11<sup>th</sup>, 13<sup>th</sup>ed.BilliereTindall London.
- Hundley, H. G and U Chit KoKo, 1987.**List of Trees, Shrubs, Herbs and Principle Climbers**, Third Revised and Enlarge Edition, SUPDT, GOVT. Printing and STATY., Union of Burma, Rangon.
- Jagatheeswari, D., 2014.**Morphological studied on flowering plants (Solanaceae)** Department of Botany, Annamalai Nagar, Childambaram, Tamil Nadu, India.
- Marini-Bettolo, 1981.**Plant screening by chemical and chromatographic procedure conditions**, J Chromatograph.
- Metcalf, C. R and Chalk, 1950.**Anatomy of the dicotyledons**, vol.II, Oxford, At the Claredo Press.
- Norman. C., M. Runswick., R. Pollock. and R. Treismon-cell, (1988). Isolation and properties of cDNA clones encoding SRF, a transcription factor that binds to the c-fos serum response element, **55**(6), 989-1003.
- Pandey, S. N and A. Chadha, 1999.**Plant Anatomy and Embryology**, Vikas Publishing House Pvt, Ltd., New Delhi. Trease and
- Schippers, R. R., 2004.***Solanum torvum***Sw. Internet Record from PROTA4U.Grubben, G.J.H. & Denton, o.a. (Editors). PROTA (Plant Resources of Tropical Africa/ Resources vegetables de l' Africque tropical) Wageningen, Netherlands.
- Yuanyuan, L. U., L. Jianguang, H. Xuefeng and K. Lingyi, 2009.**Four steroidal glycosides From *Solanum torvum* and their cytotoxic activities.** *Steroids*, **74**: 95-101.