

## QUALITATIVE AND QUANTITATIVE PHYTOCHEMICAL ANALYSIS OF *CORDIA DICHOTOMA* G. FORST.

Khin Than Oo<sup>1</sup>, Swe Swe Aye<sup>2</sup>

### Abstract

There is a very few scientific information on *Cordia dichotoma* G.Forst., so the qualitative and quantitative analysis of leaves, barks, fruits, seeds and roots was performed by using the methods given in WHO (1998) and Trease and Evans (2002). The plant specimens were collected from Loilem Township, Southern Shan State. Identification of the plant was done by standard procedure. In preliminary phytochemical study, the three different extracts such as petroleum ether, chloroform, and ethanol extracts of leaves, barks, fruits, seeds and roots were found to contain tannins, flavonoids, steroids and terpenoids whereas alkaloids were present in 1% hydrochloric acid extract of leaves, barks and roots. However, reducing sugar, glycoside and cyanogenic glycoside were absent in the whole plant parts. Moreover, the watery extract of leaves, barks, fruits and roots contain amino acids, carbohydrates, starch, saponins, and phenolic compounds where as the seeds has no starch, saponins, phenolic compounds and flavonoids. The extractive values with different solvents and ash values were also analyzed and recorded. The Energy Dispersive X-Rays Fluorescence Spectrophotometer (EDXRF) analysis was used to investigate the elements present in different plants parts. According to the results, the barks of *Cordia dichotoma* G.Forst. has more calcium element (73.109 %) than other parts of the plants whereas potassium in fruits was (76.266 %) and iron in seeds was (44.082 %). The Atomic Absorption Spectrometer (AAS) analysis was performed to investigate the heavy metal contents in powdered of different parts of the plants. In nutritional study, it was significantly found that 40.25 % of carbohydrates in barks, 30.78 % of crude fat in fruits and 48.71 % of crude fibers in seeds. The obtain data from this research could be use for crude development.

**Keywords:** Phytochemical, Physicochemical, *Cordia dichotoma* G.Forst.

### Introduction

*Cordia* is a genus of flowering plants, belong to the family Boraginaceae, subfamily Cordioideae. The family Boraginaceae composed of about 130 genera and six subfamilies: Boraginoideae, Cordioideae, Ehretioideae, Heliotropioideae, Hydrophyloideae and Lennooideae. The subfamily Cordioideae contains the genus *Cordia*, which is comprised of evergreen trees and shrubs (Thirupathi *et al.*, 2008); about 300 species of *Cordia* have been identified worldwide. *Cordia dichotoma* G. Forst., is a perennial trees, growing mostly in tropical and sub-tropical region in India. In Myanmar, it is mostly found in Loilem Township in the Southern Shan State. The leaves have been used for wrap cheroot.

The chemical screening of both leaves and fruits revealed the presence of pyrrolizidine alkaloids, coumarins, flavonoids, saponins, terpenes and sterols. (Alarcon, 1994). Aalkaloid, saponin, quercetin and coumarin are present in stem bark of *Cordia dichotoma* (Moheboob *et al.*, 2018). The seeds of this plant reported to contain fatty acids and flavonoids (Awadi, 2001). *Cordia dichotoma* G.Forst. are used as anti-ulcer (Parmar, 1998; Nazim & Kakoti, 2013) anti-inflammatory (Rapisarda *et al.*, 1992; Ficarra *et al.*, 1995; Kuppast & Nayak, 2006) analgesic

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(Rapisarda *et al.*, 1992; Ficarra *et al.*, 1995) anticancer (Rahman, 2015) antimicrobial (Nariya *et al.*, 2011), hepatoprotective and diuretic purposes (Parmar, 1998; Nazim, 2013).

Even though many medicinal uses are granted with documented research, there is no pharmacognosy research in Myanmar. Therefore, the aims of the present research is to investigate so the qualitative and quantitative analysis on *Cordia dichotoma* G. Forst.

## Materials and Methods

### Collection and preparation of samples

The sample plant *Cordia dichotoma* G. Forst. was collected from Loilem Township, Southern Shan State during the months of April to July, 2018. The leaves, barks, fruits, seeds and roots were washed and cut into small pieces and air dried in room temperature for several days. After being completely dried, they were pulverized by grinder machine to get powder and stored in airtight containers to prevent it from moisture and air-borne contamination.

### Preliminary phytochemical test of leaves, barks, fruits, seeds and roots

Preliminary phytochemical test were carried out according to British Pharmacopoeia, 1968; Central Council for Research in Unani Medicine, 1987; Harbone, 1984 and Trease and Evans, 2002.

### Physicochemical properties of leaves, barks, fruits, seeds and roots

Physicochemical properties were carried out according to quality control method of WHO, 1998 at the Department of Botany, University of Yangon.

### Determination of elemental analysis of leaves, barks, fruits, seeds and roots

The concentrations of elements in *Cordia dichotoma* G. Forst. powdered leaves, barks, fruits, seeds and roots were analyzed by using Energy Dispersive X-ray Florescence (EDXRF) spectrometer at University of Research Center in Yangon University. The elements in leaves, barks, fruits, seeds and roots were analyzed by Atomic Absorption Spectroscopy (AAS) at University of Research Center in Yangon University.

### Determination of nutritional value of leaves, barks, fruits, seeds and roots

Nutritional values of the leaves were determined by Association of Official Analytical Chemist (AOAC) method, (AOAC, 2002).

## Results

Scientific Name - *Cordia dichotoma* G. Forst.

Local Name - Thanatphet or Thanat

Family - Boraginaceae

### Outstanding characters

Perennial trees. Leaves simple, alternate. Inflorescence terminal and axillary cymes. Flowers white coloured, pentamerous, hypogynous. Stamen 5, petalostemonous, base of filament hairy anther dithecous, dorsifixed. Ovary monocarpellary, tetralocular, style twice bifid. Fruits drupe, pink. Seeds 1, globose, pale brown, wrinkled (Figure 1)



A . A plant in natural habit.      B. Inflorescence.      C. A bunch of ripen fruit

**Figure 1** Habit of *Cordia dichotoma* G.Forst.

**Preliminary phytochemical investigation**

In preliminary phytochemical test, the present or absence of alkaloid, α amino acid, carbohydrate, starch, reducing sugar, cyanogenic glycoside, glycoside, saponin, phenolic compound, tannin, flavonoid, steroid and terpenoid were observed in leaves, barks, fruits, seeds and roots. The results were shown in Table (1) and Figures ( 4-14 ).

**Table 1** Preliminary phytochemical results of *Cordia dichotoma* G.Forst.

No.	Test	Extract	Test Reagents	Observation	Results				
					leave	bark	fruit	seed	root
1	Alkaloid	1% HCl	Wagner’s reagent	Deep purple ppt	+	+	-	-	+
			Dradendroff’s reagent	Deep purple ppt	+	+	-	-	+
2	α –amino acid	H <sub>2</sub> O	Ninhydrin solution	purple color	+	+	+	+	+
3	Carbohydrate	H <sub>2</sub> O	10% α Naphthol+ H <sub>2</sub> SO <sub>4</sub>	Red ring	+	+	+	+	+
4	Starch	H <sub>2</sub> O	Iodine	Blue color	+	+	+	-	+
5	Reducing sugar	H <sub>2</sub> O	Benedict solution	No change in color	-	-	-	-	-
6	Cyanogenic glycoside	H <sub>2</sub> O	conc: H <sub>2</sub> SO <sub>4</sub> + sodium picrate solution	No change in color	-	-	-	-	-
7	Glycoside	H <sub>2</sub> O	10% Lead acetate solution	No change in color	-	-	-	-	-
8	Saponin	H <sub>2</sub> O	Distilled water	Forthing	+	+	+	-	+
9	Phenolic compound	H <sub>2</sub> O	1% Ferric chloride	Bluewish green	+	+	+	-	+
10	Tannin	EtOH	3 Drop of 1% gelatin solution	White ppt	+	+	+	+	+
11	Flavonoid	EtOH	Mg & conc: HCl	Brown colour	+	+	+	-	+
12	Steroid	P.E	Acetic anhydride & H <sub>2</sub> SO <sub>4</sub>	Blue color	+	+	+	+	+
13	Terpenoid	CHCl <sub>3</sub>	Acetic anhydride & H <sub>2</sub> SO <sub>4</sub>	Green color	+	+	+	+	+

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

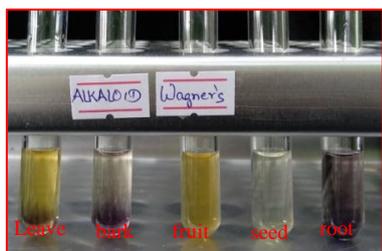


Figure 2 Alkaloid test

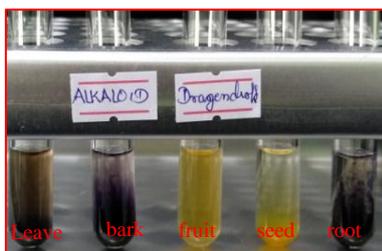


Figure 3 Alkaloid test



Figure 4 Amino acid test



Figure 5 Carbohydrate test

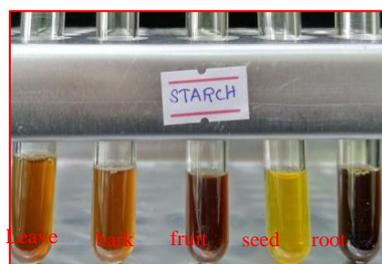


Figure 6 Starch test

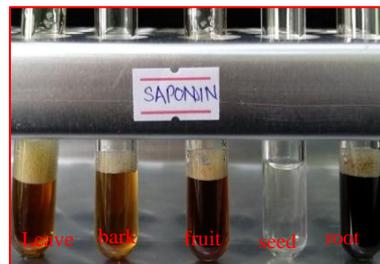


Figure 7 Saponin test

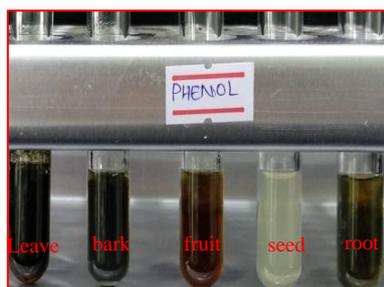


Figure 8 Phenol test

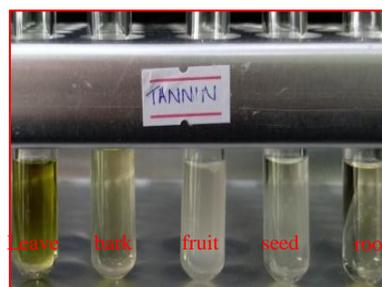


Figure 9 Tannin test



Figure 10 Flavonoid test



Figure 11 Steroid test

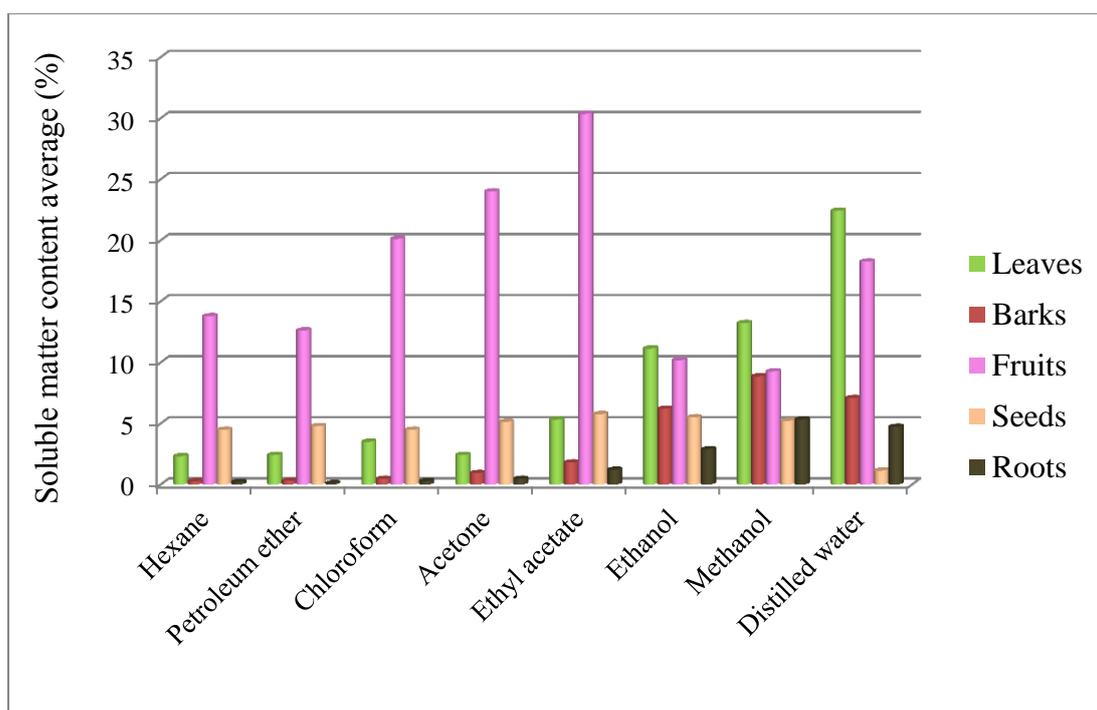


Figure 12 Terpenoid test

**Physico-chemical investigation**

**Table 2 Physico-chemical examination of *Cordia dichotoma* G. Forst.**

No	Physico-chemical Character	Leaves average (%)	Barks average (%)	Fruits Average (%)	Seeds Average (%)	Roots Average (%)
1.	Moisture content	11.45	8.18	13.87	10.42	10.46
2.	Total ash content	8.38	7.81	13.12	7.04	4.36
3.	Acid insoluble ash content	10.78	17.11	11.97	8.04	17.33
4.	Water soluble ash content	37.77	24.76	35.00	35.60	22.24
5.	Hexane soluble content	2.32	0.26	13.78	4.48	0.2
6.	Petroleum ether soluble content	2.42	0.3	12.62	4.78	0.1
7.	Chloroform soluble content	3.5	0.46	20.12	4.48	0.28
8.	Acetone soluble content	2.42	0.94	24.00	5.14	0.46
9.	Ethyl acetate soluble content	5.32	1.8	30.36	5.76	1.2
10.	Ethanol soluble content	11.14	6.2	10.18	5.5	2.88
11.	Methanol soluble content	13.22	8.86	9.26	5.22	5.32
12.	Distilled water soluble content	22.42	7.08	18.26	1.14	4.72



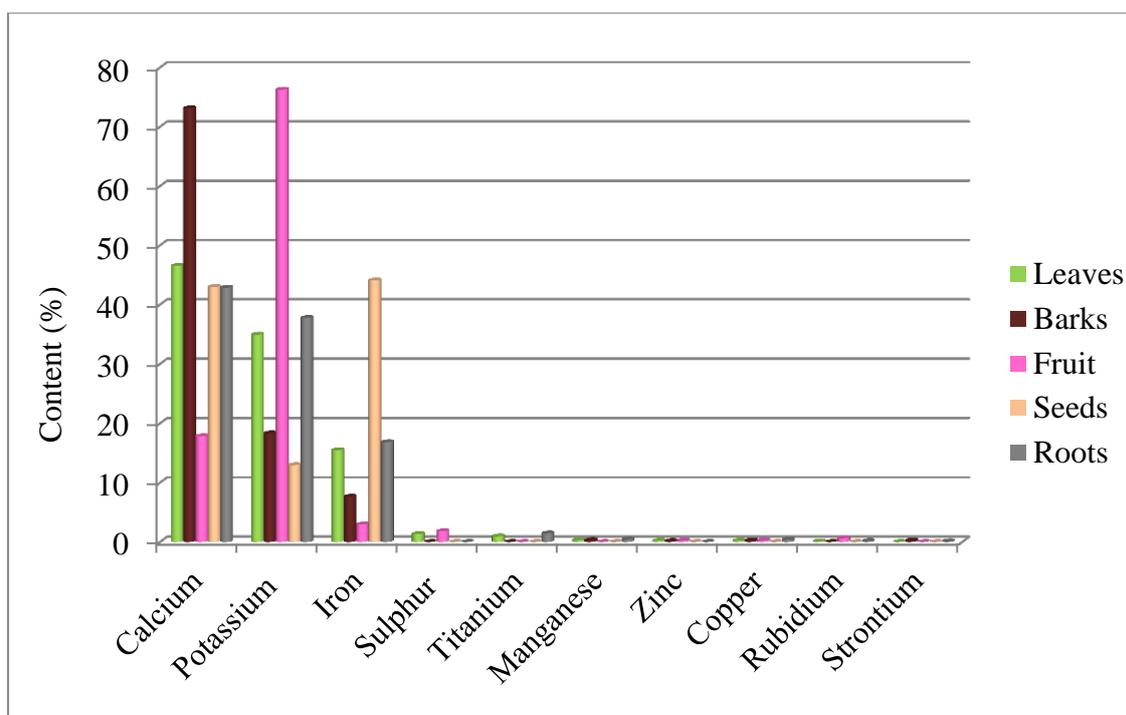
**Figure 13** Solubility tests from the leaves, barks, fruits, seeds and roots of *Cordia dichotoma* G.Forst.

### Determination of some elements (EDXRF)

The content of elements in leaves, barks, fruits, seeds and roots of *Cordia dichotoma* were determined by using EDXRF analysis. It was found that calcium and potassium, iron were significantly present in barks, fruits and seeds. The spectrum and spectral data were shown in Table (3) and Figures. (14-19).

**Table 3** Elemental analysis of *Cordia dichotoma* G. Forst. by using EDXRF

No.	Elements	Leaves Content (%)	Barks Content (%)	Fruits Content (%)	Seeds Content (%)	Roots Content (%)
1	Calcium (Ca)	46.521	73.109	17.814	42.97	42.854
2	Potassium (K)	34.934	18.297	76.266	12.948	37.75
3	Iron (Fe)	15.466	7.625	2.942	44.082	16.812
4	Sulphur (S)	1.346	-	1.821		-
5	Titanium (Ti)	0.955	-	-		1.449
6	Manganese (Mn)	0.301	0.312	-		0.447
7	Zinc (Zn)	0.189	0.156	0.248	-	-
8	Copper (Cu)	0.185	0.26	0.279	-	0.393
9	Rubidium (Rb)	0.103	-	0.63	-	0.168
10	Strontium (Sr)	-	0.241	-	-	0.127



**Figure 14** The elemental analysis of leaves barks, fruits, seeds and roots of *Cordia dichotoma* G. Forst.

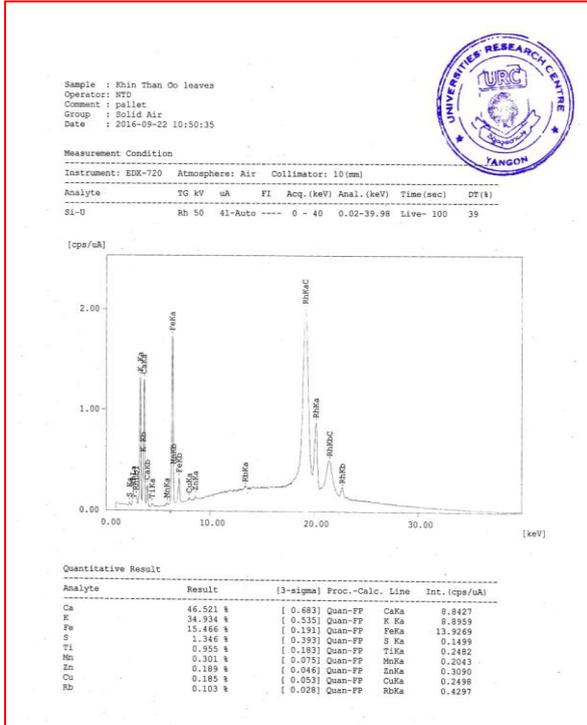


Figure 15 EDXRF spectrum of Leaves

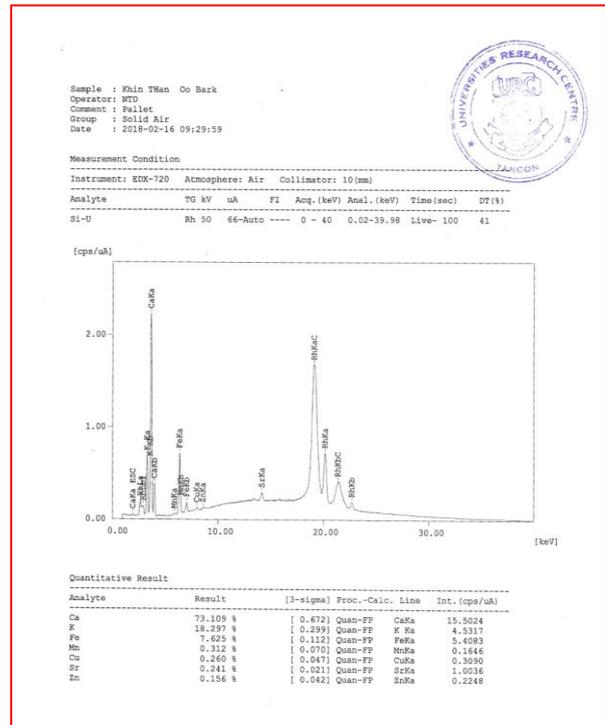


Figure 16 EDXRF spectrum of Barks

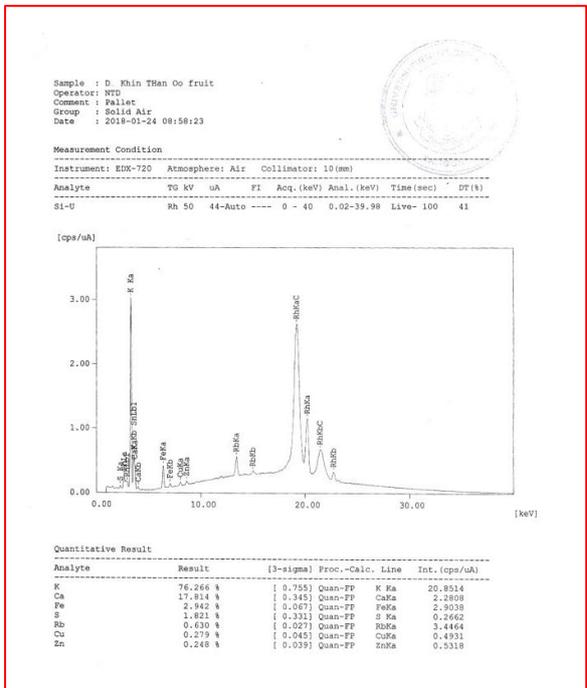


Figure 17 EDXRF spectrum of Fruits

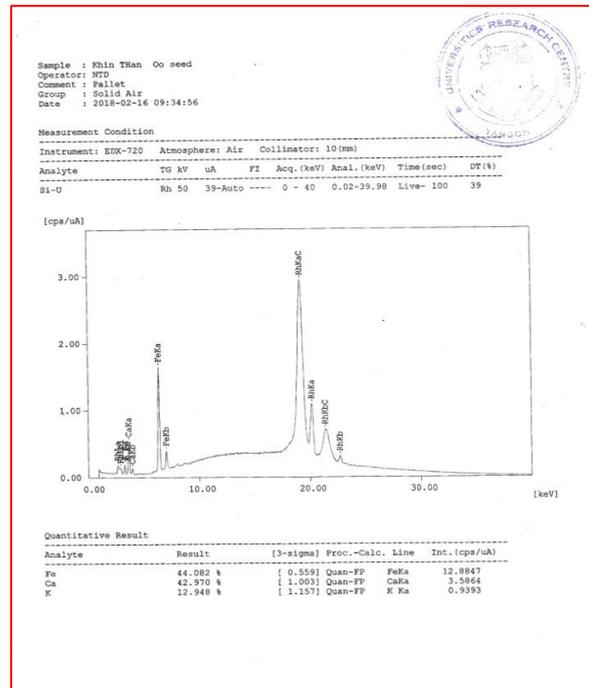


Figure 18 EDXRF spectrum of Seeds.

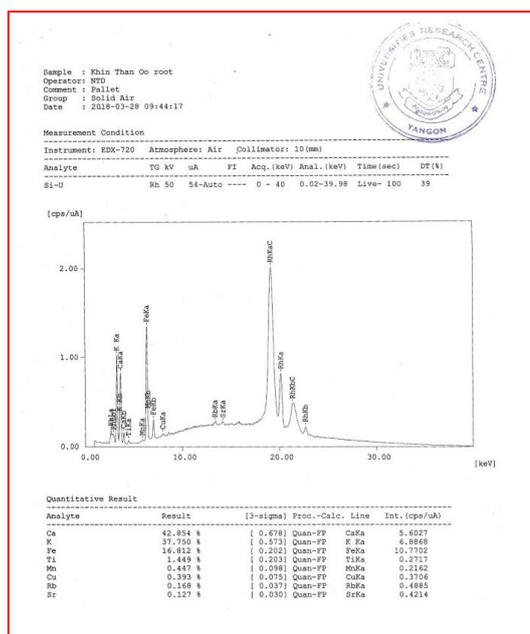


Figure 19 EDXRF spectrum of Roots

### Quantitative determination of some elements (AAS)

The heavy metals such as Arsenic (As), Lead (Pb) and Cadmium (Cd) contents in different plant parts were detected. According to the results, the roots of *Cordia dichotoma* G.Forst. has more lead elements than other parts of the plants. The results were shown in table (4) figure (20).

Table 4 Results of heavy metals analysis of *Cordia dichotoma* G. Forst.

No.	Type of Element	Leaves (mg/L)	Barks (mg/L)	Fruits (mg/L)	Seeds (mg/L)	Roots (mg/L)
1.	Lead (Pb)	0.814	0.627	0.415	0.198	4.499
2.	Cadmium (Cd)	0.047	0.041	0.092	0.098	0.042
3.	Arsenic (As)	0.002	0.002	0.001	0.001	0.121

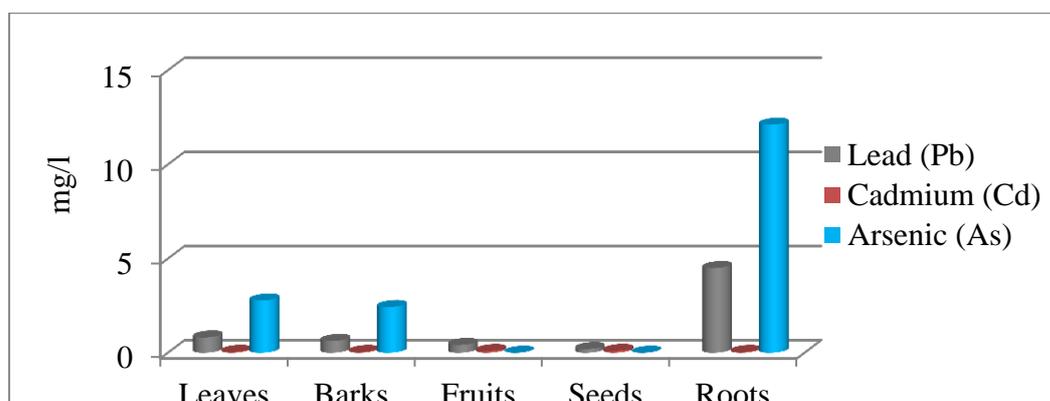


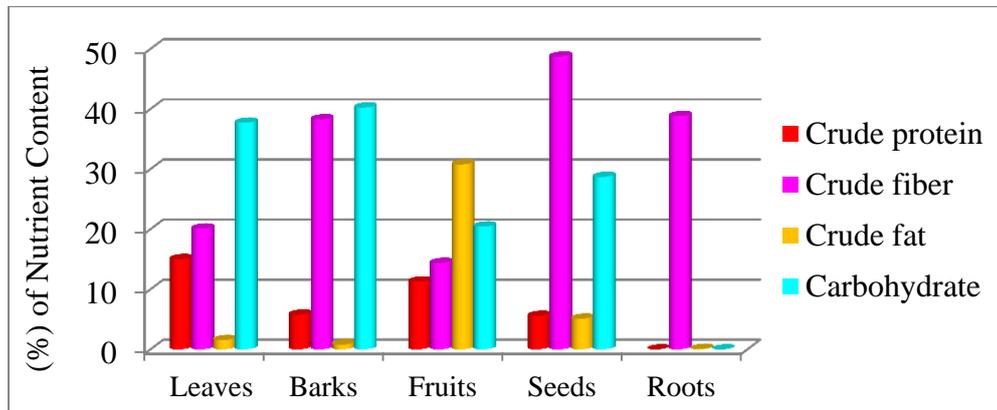
Figure 20 Heavy metals analysis of leaves, barks, fruits, seeds and roots of *Cordia dichotoma* G. Forst.

**Nutritional values of *Cordia dichotoma* G. Forst.**

The nutritional value such as crude fiber, crude protein, crude fat and carbohydrate values of the leaves, barks, fruits, seeds and roots of *Cordia dichotoma* G.Forst. were observed. The result were shown in Table ( 5 ) and Figure (21).

**Table 5 Nutritional values of *Cordia dichotoma* G. Forst.**

No	Type of Nutrients	Leaves content %	Barks content %	Fruits content %	Seeds content %	Roots content %
1	Ash	10.4	8.98	12.78	1.07	3.13
2	Crude protein	15.03	5.8	11.29	5.59	-
3	Crude fiber	20.11	38.29	14.4	48.71	38.83
4	Crude fat	1.55	0.8	30.78	5.11	0.09
5	Carbohydrate	37.73	40.25	20.44	28.71	-
6	Energy value(Kcal/100g)	230	197	403	185	-



**Figure 21** The nutritional values of leaves barks, fruits, seeds and roots of *Cordia dichotoma* G. Forst

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 Lanmadaw Township, Yangon, Myanmar

**LABORATORY ANALYSIS REPORT**

FIDSL - 06-2771/16  
Page 1/1

1. Company's Name : Daw Khin Than Oo  
 2. Address : Mawlamyaing University  
 3. Phone No. : 09-5058854  
 4. Date Received : 17.10.2018  
 5. Sample Number : 2398/16  
 6. Product Name : *Cordia dichotoma* G. Forst Leaf  
 7. Type of Test : Nutrition Package  
 8. Date of Issue : 28.10.2018  
 9. Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(930.04)	15.18%
2	Ash	AOAC-2000(930.05)	10.40%
3	Crude Protein	AOAC-2000(920.152) (Kjeldahl Method)	15.03%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	20.11%
5	Crude Fat (Ether Extract)	AOAC(Buchi Soxhlet Method)	1.55%
6	Carbohydrate	By Difference	37.73%
7	Energy Value ( Kcal / 100 g )		230

Remarks

Nutrition Facts (100 gm)	
Energy	230 kcal
Protein	15 gm
Fat	2 gm
Carbohydrate	38 gm

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Manager  
FIDSL

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**LABORATORY ANALYSIS REPORT**

FIDSL-Ad-06-01- 04338 /18

1. Company's Name : Daw Khin Than Oo  
 2. Address : Botany Department, Mawlamyaing University  
 3. Phone No. : 09-796277837  
 4. Date Received : 17.10.2018  
 5. Sample Number : 3121/18  
 6. Product Name : *Cordia dichotoma* G.Forst (Bark)  
 7. Test Performed date : 12.11.2018  
 8. Type of Test : Nutrition Package  
 9. Date of Issue : 28.11.2018  
 10. Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(930.04)	5.61%
2	Ash	AOAC-2000(930.05)	8.98%
3	Crude Protein	AOAC-2000(920.152) (Kjeldahl Method)	5.80%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	38.29%
5	Crude Fat (Ether Extract)	AOAC(Buchi Soxhlet Method)	0.80%
6	Carbohydrate	By Difference	40.52%
7	Energy Value ( kcal / 100 g )		197

Remarks

Nutrition Facts ( 100 g )	
Energy	197 kcal
Protein	6 g
Fat	1 g
Carbohydrate	41 g

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LABORATORY ANALYSIS REPORT

FIDSL-Ad-06-01- 04340 /18

- Company's Name : Daw Khin Than Oo
- Address : Botany Department, Mawlamyaing University
- Phone No. : 09-796277837
- Date Received : 9.11.2018
- Sample Number : 3249/18
- Product Name : *Cordia dichotoma* G.Forst (Fruit)
- Test Performed date : 12.11.2018
- Type of Test : Nutrition Package
- Date of Issue : 28.11.2018
- Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.06)	10.34%
2	Ash	AOAC-2000(930.05)	12.78%
3	Crude Protein	AOAC-2000(920.152) (Kjeldahl Method)	11.29%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	14.40%
5	Crude Fat (Ether Extract)	AOAC(Buchi Soxhlet Method)	30.75%
6	Carbohydrate	By Difference	20.44%
7	Energy Value ( kcal / 100 g )		403

Nutrition Facts	
1 package ( 100 g )	
Energy	403 kcal
Protein	11 g
Fat	31 g
Carbohydrate	20 g

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LABORATORY ANALYSIS REPORT

FIDSL-Ad-06-01- 04339 /18

- Company's Name : Daw Khin Than Oo
- Address : Botany Department, Mawlamyaing University
- Phone No. : 09-796277837
- Date Received : 17.10.2018
- Sample Number : 3122/18
- Product Name : *Cordia dichotoma* G.Forst (Seeds)
- Test Performed date : 12.11.2018
- Type of Test : Nutrition Package
- Date of Issue : 28.11.2018
- Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(930.04)	10.81%
2	Ash	AOAC-2000(930.05)	1.07%
3	Crude Protein	AOAC-2000(920.152) (Kjeldahl Method)	5.59%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	48.71%
5	Crude Fat (Ether Extract)	AOAC(Buchi Soxhlet Method)	5.11%
6	Carbohydrate	By Difference	28.71%
7	Energy Value ( kcal / 100 g )		185

Nutrition Facts	
1 package ( 100 g )	
Energy	185 kcal
Protein	6 g
Fat	5 g
Carbohydrate	29 g

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LABORATORY ANALYSIS REPORT

FIDSL-Ad-06-01- 04341 /18

- Company's Name : Daw Khin Than Oo
- Address : Botany Department, Mawlamyaing University
- Phone No. : 09-796277837
- Date Received : 9.11.2018
- Sample Number : 3250/18
- Product Name : *Cordia dichotoma* G.Forst (Root)
- Test Performed date : 12.11.2018
- Type of Test : Nutrition Package
- Date of Issue : 28.11.2018
- Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	12.30%
2	Ash	AOAC-2000(930.05)	3.13%
3	Total Nitrogen	AOAC-2000(920.152) (Kjeldahl Method)	0.50%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	38.83%
5	Crude Fat (Ether Extract)	AOAC(Buchi Soxhlet Method)	0.09%

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## Discussion and Conclusion

In this investigation, the preliminary phytochemical tests, physico-chemical properties, elemental analysis and nutritional values of *Cordia dichotoma* G Forst. had been studied.

In preliminary phytochemical study, alkaloids, saponins, phenolic compounds, tannins, steroids and terpenoids were present in leaves, barks, fruits, seeds and roots of *Cordia dichotoma* G.Forst. but reducing sugar, glycoside and cyanogenic glycoside were absent. The physico-chemical properties the most significantly soluble matter content of leave *Cordia dichotoma* G.Forst. sample was in water, followed by methanol, ethanol and ethyl acetate at least soluble in hexane. Powdered of barks and roots were the most soluble in methanol whereas the powdered fruits and seeds were the most soluble in ethyl acetate solvent. These results were agreement with those described by Parmar, 1998; Mahour 2008; Jamkhande *et al.*, 2013; Nazim *α* Kakoti, 2013.

According to the EDXRF results, Calcium (Ca), Potassium (K) and Iron were found as principal elements in leaves, barks, fruits, seeds and roots. Among them, the bark of *Cordia dichotoma* G.Forst. was found to contain the highest amount of Calcium 73.10%. Calcium is an essential element that plays a vital role in metabolic function (WHO guide line, 2013). The iron in the selected plant ranges from 7.62% - 76.26%. Among them, the seeds of *Cordia dichotoma* G. Forst. was found to contain the highest amount of iron 44.082% (WHO guide line, 2006).

According to the results of (AAS), the heavy metals such as lead (Pb), Cadmium (Cd) and Arsenic (As) in this plant are found to be below permissible levels of WHO, 2005.

In quantitative determination of nutritional value, the result of present study showed that 15.03% crude protein, 20.11% of crude fibers, 37.73% of carbohydrate are present in leaves. Hussain, 2013 documented that the leaves contain 12.15% of crude protein, 16-27% crude fibres.

Thus, it can be concluded that the results obtained from the present study will be useful for the potential drugs investigations.

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### References

- Alarcon, D. L., M. J. Martin, and V. Motilva., (1994), "Antiulcerogenic activity of flavonoids and gastric protection". *Journal of Ethnopharmacol.* 42, p.161-170
- Awadi, Al. FM, TS. Srikumar, JT. Anim and I.Khan, (2001), "Antiinflammatory Effects of *Cordia myxa* Fruit on experimentally induced colitis in rats". *Nutrition*, 17 (5), p.391-396
- AOAC (2000), *Official Method of Analysis of the association of Official Analytical Chemists*.17<sup>th</sup> ed., Washington D.C.
- Ayurvedic Pharmacopoeia of India, (2016), Government of India Ministry of AYUSH.
- British Pharmacopoeia, (1968), Published Under the direction of the General Medicinal Council. Medicinal Act: London. Willian Clowes and Sons Limited.
- Central Council for Research in Unani Medicine, (1987), *Phytochemical standards of Unani formulation*, New Delhi.
- Ficarra, R., P. Ficarra, S. Tommasini, M.L. Calabro, S. Ragusa, R. Barbera and A. Rapisarda, (1995), "Leaf extracts of some *Cordia* species: analgesis and anti-inflammatory activities as well as their chromatographic analysis". *Farmaco* 50(4): 245-256
- Harbone, J.D. (1984), *Phytochemical Methods*. A Guide to Modern Techniques of Plant Analysis. Chapman and Hall Ltd., New York
- Kuppast, I J & V P Nayak (2005), "Wound healing activity of *Cordia dichotoma* Forst. f. fruit". *National collages of Pharmacy, Karnataka, India*.
- Maheboob, Shaikh & Dhotre. Revansiddha (2018), " Phytochemical analysis of stem bark of some medicinal plants". *International Journal Research in Pharmacy and Pharmaceutical Sciences*, vol.3, p.86-89
- Nariya PB, NR Bhalodia, VJ Shukla, RN Acharya, (2011), "Antimicrobial and antifungal activities of *Cordia dichotoma* (Forester F.) bark extracts". *Ayu.* ; 32: p.585-589.
- Nazim, H & BB Kakoti, (2013),"Review on ethno botany and psychopharmacology of *Cordia dichotoma*". *Journal of drug delivery and therapeutics*; 3(1), 110-113

- Parmar NS & Shikha parmar, (1998), "Anti-ulcer potential of flavonoids". Indian J. Physiol.Pharmacol. 48, p.343-351
- Rahman Azizur Md & Arshad Hussain, (2015), "Phytochemical and analytical evaluation of *Cordia dichotoma* Linn. leaves" Pharmacognosy Journal, Vol 7.
- Rapisarda A., R Berbera, A De Pasquale, P Ficarra, S.Tommasin, ML Caldbro, and S. Hungsa (1992), "*Cordia francisci*, *C. martinicensis*, *C. myxa*, *C. serratifolia* and *Culmifolia* leaves as new source of routine; Analgesis and anti-inflammatory activity". Plant Medica; 58(S 1), p. 643-649
- Trease G.E. & W.C. Evans., (2002), *Pharmacognosy*. 15<sup>th</sup> ed. Edinburgh London, New York.
- Thirupathi K, SS Kumar, VS Raju, B Ravikumar, DR Krishna and GK Mohan. (2008), "A review of medicinal plants of the genus *Cordia*; their chemistry and Pharmacological uses". J Natn Rem; 8 (1): p.1-10
- WHO (1998), *Quality control Methods for medicinal plant materials*, World Health Organization, Geneva.
- WHO (2005), WHO Quality Control Methods for Medicinal nonessential trace element having function neither in Plant Materials, Geneva.
- WHO Guidelines (2006), Guidelines on food fortification with micronutrients, World health Organization, Geneva, p. 57-131
- WHO Guidelines (2013), Calcium supplementation in pregnant woman, World health Organization, Geneva, p.31