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EVALUATION AND COMPARISON OF PHYTOCHEMICAL, GCMS AND FTIR ANALYSIS OF WILD AND MICROPROPAGATED *CADABA FRUTICOSA* (L.)

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ABSTRACT

Cadaba fruticosa an important endemic medicinal plant which is known for its wide variety of medicinal value in indigenous traditional medicine. In this study we reported phytochemical, FTIR and GCMS analysis of ethanol and methanol extracts of wild *Cadaba fruticosa* (WCF) and micropropagated *Cadaba fruticosa* (MCF). Among the two extracts, WCFE, WCFM, MCFE, MCFM, WCFW and MCFW showed positive results for alkaloids, WCFE, WCFM, MCFE and MCFM extracts established positive results for flavonoids. Steroids and glyceroids are positive in WCFPE, WCFC, WCFEA, MCFPE, MCFC and MCFEA extracts. FTIR spectrum of wild and micropropagated plant extracts showed 9 and 4 peaks in the reports between 800-3500 cm^{-1}. GCMS analysis of WCFE and WCFM extracts exhibited 83 and 165 compounds with 18 and 11 bioactive compounds and MCIE and MCFM extracts showed33 and 90 compounds with two bioactive compounds each.

KEYWORDS: Wild *Cadaba fruticosa*(WCF) and micropropagated *Cadaba fruticosa*(MCF).

INDROTUCTION

Cadaba fruticosa (L.) or the Indian *Cadaba* is a medicinally important, which belongs to Capparidaceae family commonly known as ‘vizhuthi’ in Tamil and ‘Capper bush’ in English. This species is endemic on Indian Subcontinent such as Bangladesh, India, Pakistan, Sri Lanka and Indo-China (Myanmar) (https://en.wikipedia.org/wiki/*Cadabafruticosa*). *Cadaba fruticosa* is commonly used plant in indigenous traditional medicinal systems. The leaf juice is internally used in the case of general weakness, energetic during dysentery, diarrhoea, also

to relieve general body pain, antidote against poisoning, stimulant, and antiscorbutic (Provitamin, 2001;Sandhya *et al*., 2006). Indian *Cadaba*, the Indian medicinal plant finds usage in various chronic ailments, known to be effective for prolonged periods. The leaves and roots are considered deobstruent, anthelmintic and emmenagogue and are prescribed in the form of a decoction for treating uterine obstructions. The leaves of Indian *Cadaba* are also used as a poultice to promote healing of sores. It has been reported to possess hypoglycaemic activity (Arokiyaraj *et al*., 2008) and the leaf juice is used internally to treat diarrhoea, dysentery and general weakness (Sankaranarayanan *et al*., 2010; Arokiyaraj *et al*., 2008). It is also used as an anti- allergic, antidote, antiscorbutic and anti-helminthic herbal drug (Arokiyaraj *et al*., 2008; Sankaranarayanan *et al*., 2010). The leaf extracts also possesses antimicrobial activity (Chatterjee, 1993) and is used in traditional medicine to treat syphilis and gonorrhoea (Rao and Sreeramulu, 1985), antipyretic activity (Mythreyi *et al*., 2008), antidiabetic activity (Arokiyaraj *et al*., 2008). In Sidha, the leaf and fruit are used to treat worm infestation, swellings, eczema and constipation. The leaves are used to treat eczema (Arokiyaraj *et al*., 2008) and also to treat leucoderma (Chatterjee, 1993). Moreover it was reported to have the active constituents, i.e, cadabicine, cadabicine diaceate (Viqar Uddin *et al*., 1990), Capparisine and α – B –dihydroferulic acid (Aziz-Ur-Rehman, 1990). Hence in this content, the present study was designed to study phytochemical, FTIR and GCMS analysis of wild and micropropagated *Cadaba fruticosa*.

MATERIALS AND METHODS

Preliminary phytochemical studies

To determine the group of secondary metabolites present in wild and micropropagated plants extracts (WCFPE, WCFC, WCFEA, WCFE, WCFM, WCFW, MCFPE, MCFC, MCFEA, MCFE, MCFM and MCFW) were exposed to preliminary phytochemical tests. The major secondary metabolites like alkaloids (Ciulci, 1994), flavonoids (Sofowora, 1993), tannins (Ciulci, 1994), steroids (Ciulci, 1994), terpenoids (Finar, 1986), saponins (Kokate, 1999), glycosides (Camporese *et al*., 2003), gum & mucilage (Whistler and BeMiller, 1993), fixed oil (Kolate, 1999) and anthraquinones (Sanker and Nahar, 2007) were screened with their respective tests.

Fourier-Transform Infrared Spectroscopy analysis (FTIR)

All the spectra were recorded with using BRUKER ALPHA 8400S FTIR spectrophotometer. Translucent sample discs were prepared by using dry powder of wild and micropropagated plants samples encapsulated with KBr pellet,. Small amount of each sample was placed

directly on the germanium piece of the infrared spectrometer with constant pressure applied. Data of infrared absorbance were collected over the wave number ranged from 3500/cm to 500/cm. The FTIR spectrum of all samples was analysed on the basis of peak values in the region of infrared radiation.

Gas Chromatography Mass Spectrometry analysis (GC-MS)

The Clarus 680 GC (Perkin Elmer) was used in the analysis employed a fused silica column, packed with Elite-5MS (5% biphenyl 95% dimethylpoly siloxane, 30 m × 0.25 mm ID × 250 μm df) and the components were separated using helium as carrier gas at a constant flow of 1 ml/min. The injector temperature was set at 260 °C during the chromatographic run. The 1μL of extract samples (WCFE, MCFE, WCFM and MCFM) injected into the instrument the oven temperature was as follows: 60 °C (2 min); followed by 300 °C at the rate of 10 °C min^{-1}; and 300 °C, where it was held for 6 min.The mass detector conditions were: transfer line temperature 240 °C; ion source temperature 240 °C; and ionization mode electron impact at 70 eV, a scan time 0.2 sec and scan interval of 0.1 sec. The fragments from 40 to 600 Da. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS NIST (2008) library.

RESULTS

Phytochemical analysis

Preliminary phytochemical screening of *Cadaba fruticosa*

Phytochemical screening of various polar solvent extracts like wild plant petroleum ether (WCFPE), chloroform (WCFC), ethyl acetate (WCFEA), ethanol (WCFE), methanol (WCFM), water (WCFW) and micropropagated plant petroleum ether (MCFPE), chloroform (MCFC), ethyl acetate (MCFEA), ethanol (MCFE), methanol (MCFM), water (MCFW) extracts of *Cadaba fruticosa* was carried out using various methods in order to identify either the presence or absence of secondary metabolites such as alkaloids, flavonoids, tannins, steroids, terpenoids, saponins, glycosides, gum and mucilage, fixed oils and anthraquinones and presented in table 1 . WCFE, WCFM, MCFE and MCFM extracts showed positive result to Dragendorff test of alkaloids observing an orange precipitate and also WCFW, MCFW have positive for Dragendorff and Hagers's test but negative result in Mayer and Wager's test. WCFE, WCFM, MCFE and MCFM extracts exhibited positive result for flavonoids compare to other extracts of *C. fruticosa* wild and micropropagated plants. Positive results were observed for terpenoids important secondary metabolites from wild and micropropagated samples.

Tannins and saponins are not present in all the extracts except WCFW and MCFW. The other two secondary metabolite such as steroids, glycosides are positive in WCFPE, WCFC, WCFEA, MCFPE, MCFC and MCFEA extracts and which are negative in other extracts of wild and micropropagated sample. Gum and mucilage compounds are positive in all the extracts of wild sample of *C. fruticosa* except WCFEA and those compounds negative in all the extracts of micropropagated sample. Finally anthroquinones is negative in all extracts of wild and micropropagated plants of *C. fruticosa*.

Table 1: Preliminary phytochemical screening of various polar solvent extracts of *Cadaba fruticosa* wild and micropropagated plants.

Compounds	Tests	Wild plant extracts (WCF)						Micropropagated plant extracts (MCF)					
		WCFPE	WCFEA	WCFC	WCFE	WCFM	WCFW	MCFPE	MCFEA	MCFC	MCFE	MCFM	MCFW
Alkaloids	Dragendroff's test	-	-	-	+	+	+	-	-	-	+	+	+
	Mayer's test	-	-	-	+	+	-	-	-	-	+	+	-
	Wagner's test	-	-	-	+	+	-	-	-	-	+	+	-
	Hager's test	-	-	-	+	+	+	-	-	-	+	+	+
Flavonoids	10% HCl& 5% NaOH test	-	-	-	+	+	-	-	-	-	+	+	-
	Alkaline test	-	-	-	+	+	-	-	-	-	+	+	-
Tannins	5% $FeCl_3$ test	-	-	-	-	-	+	-	-	-	-	-	+
Steroids	Libermann - Burchard's test	+	+	+	-	-	-	+	+	+	-	-	-
Triterpenoids	Libermann - Burchard's test	+	+	+	+	+	+	+	+	+	+	+	+
	Salkowski's test	+	+	+	+	+	+	+	+	+	+	+	+
Saponins	Foam test	-	-	-	-	-	+	-	-	-	-	-	+
Glycosides	Killer &Kilian test	+	+	+	-	-	-	+	+	+	-	-	-
Gum &Mucilages	Whistler &BeMiller test	+	-	+	+	+	+	+	-	-	-	-	-
Fixed oils	Spot test	+	+	+	+	+	+	-	-	-	-	-	-
Anthraquinones	NH_4OH test	-	-	-	-	-	-	-	-	-	-	-	-

+ indicate present; - indicate absent

FTIR analysis

Functional groups of compounds were examined through Fourier Transfer Infrared (FTIR) spectroscopic studies by their peak values. Functional groups like alkanes, alkyl helides, amines, amides, carboxylic acid and aliphatic amines were identified. Nine main peaks observed through the spectrum of wild plant sample were 3349, 2934, 1627, 1338, 1097, 599, 483, 451 and 424 cm^{-1} in the region between 500-3500 cm^{-1}. The corresponding functional group are amines, amides (3349 cm^{-1}), alkanes (2934 cm^{-1}), amines (1627 cm^{-1}), aliphatic amines (1091 cm^{-1}) and alkyl halides (599 cm^{-1}) respectively (Table 2; Fig. 1).

Whereas the micropropagated plant sample FTIR spectrum shows 4 peaks in the region between 500-3500 cm^{-1}. The peaks are 2881 (alkanes with C-H stretch), 1646 (amines with N-H bend) and 1016 (aliphatic amines with C-N stretch) (Table 2; Fig. 2).

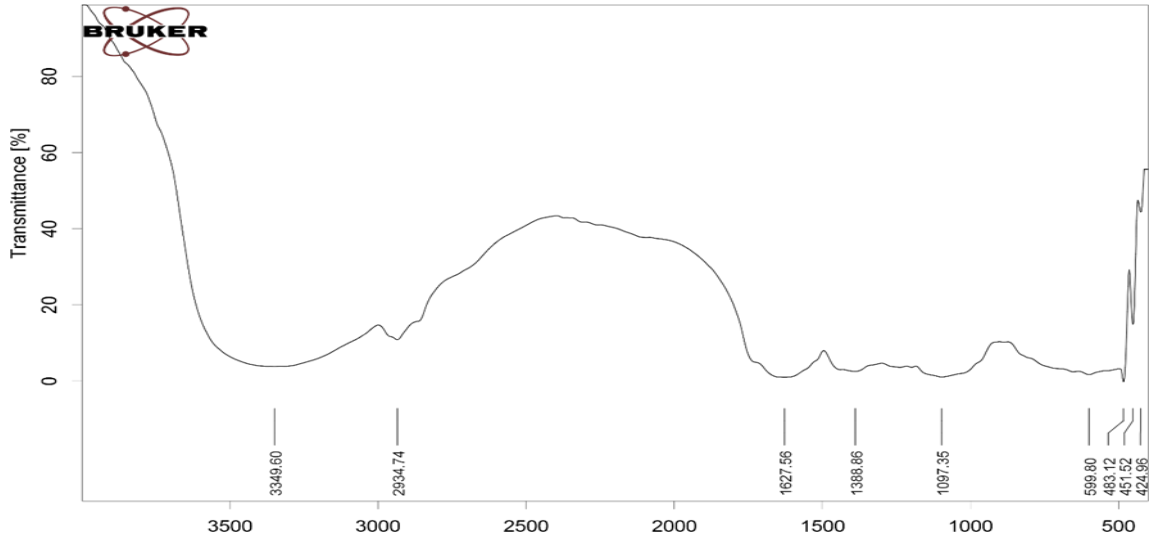

Figure 1: FTIR spectrum of wild plant of *Cadaba fruticosa.*

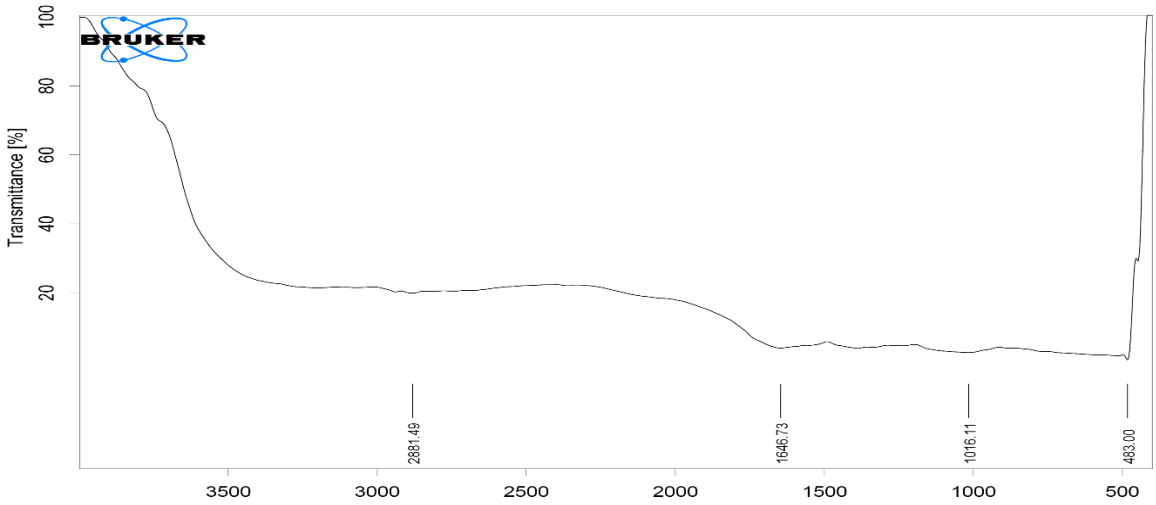

Figure 2: FTIR spectrum of micropropagated plant of *Cadaba fruticosa.*

Table 2: FTIR analysis of wild and micropropagated plant samples of *Cadaba fruticosa.*

S. No	Samples	Frequency (cm^{-1})	Bond	Functional group name
1	Wild plant	3349 (m)	N-H stretch	1°, 2° amines, amides
		2934 (m)	C-H stretch	Alkanes
		1627 (m)	N-H bend	1° amines
		1338 (m)	N-O symmetric stretch	Nitro compounds
		1097 (m)	C-N stretch	Aliphatic amines
		599 (m)	C-Br stretch	Alkyl halides
2	Micropropagated plant	2881 (m)	C-H stretch	Alkanes
		1648.73 (m)	-C=C stretch	Alkanes
		1018.11 (m)	C-N stretch	Aliphatic amines

m = medium

Gas chromatogram mass spectrometer (GCMS)

GCMS analysis of wild *C. fruticosa* ethanol, methanol (WCFE, WCFM) and micropropagated ethanol, methanol (MCFE, MCFM) extracts exhibited the presence of 83, 165, 33 and 90 bioactive compounds respectively with many bioactive principles. The results obtained through mass spectrum with compound names, formula, weight and bioactive uses were tabulated in the table 3, 4, 5and 6.

The WCFE extract GCMS spectrum exhibited 83 peaks. Among these 18 known bioactive compounds are N-Hexadecanoic acid, Eicosanoic acid, Octadecanoic acid, Pentadecanoic acid, Tetradecanoic acid, Dodecanoic acid, Oleic acid, Erucic acid, Cis-11-eicosenoic acid, Cis-10-nonadecenoic acid, 6-octadecenoic acid, (z), 9-Eicosene, (E), Cis-vaccenic acid, Cis-9-hexadecenoic acid, Trans-13-octadecenoic acid, Lupeol and 1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-e) (Fig. 3; Table 3). The main properties of bioactive compounds are antioxidant, anti-inflammatory, anticancer, antimicrobial, antiandrogenic and antitumor activities.

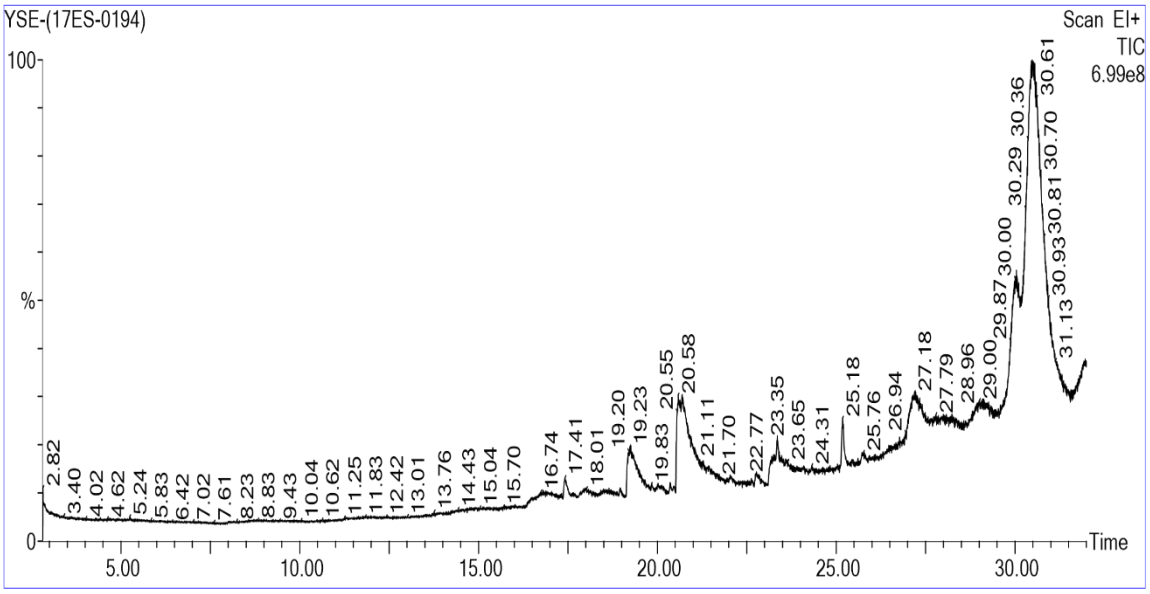

Figure 3: Gas chromatograph of WCFE extract of *Cadaba fruticosa.*

Table 3: GCMS analysis of WCFE extract of *Cadaba fruticosa.*

S. No	Compound name	Formula	Weight	Uses
1	N-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	Hypocholesterolemic nematicide, antioxidant, pesticide, antiandrogenic flavor, (Kumar *et al*., 2010), anti-inflammatory (Aparna *et al*., 2012),
2	Octadecanoic acid	$C_{18}H_{36}O_2$	284	Anti-inflammatory (Othman *et al*., 2015)
3	Pentadecanoic acid	$C_{15}H_{30}O_2$	242	Antioxidant activity (Vijisaral Elezabeth and Arumugam, 2014)
4	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	Antioxidant, cancer preventive, cosmetic, Hypercholesterolemic, nematicide, lubricant (Amutha Iswarya Devi and Kottai Muthu, 2014)
5	Dodecanoicacid	$C_{12}H_{24}O_2$	200	Antimicrobial, anti-inflammatory (Dinesh Kumar and Rajakumar, 2016)
6	Oleic acid	$C_{18}H_{34}O_2$	282	Anemiagenic, insectifuge, antiandrogenic, cancer preventive, dermatitigenic (Vijisaral Elezabeth and Arumugam, 2014), antibacterial (Chen *et al*., 2005).

S. No	Compound name	Formula	Weight	Uses
7	Erucic acid	$C_{22}H_{42}O_2$	338	Antimicrobial activity (Arumugham Suresh *et al.*, 2014)
8	Cis-11-eicosenoic acid	$C_{20}H_{38}O_2$	310	Antimicrobial activity (Arumugham Suresh *et al.*, 2014)
9	Cis-10-nonadecenoic acid	$C_{19}H_{36}O_2$	296	Antitumor (Fukuzawa *et al.*, 2008)
10	6-octadecenoic acid, (z)-	$C_{18}H_{34}O_2$	282	Cancer preventive, insectifuge (Vijisaral Elezabeth and Arumugam, 2014)
11	9-Eicosene, (E)-	$C_{20}H_{40}$	280	Anti-microbial and cytotoxic properties (Dalli *et al.*, 2007; Noryawati Mulyono *et al.*, 2013)
12	3-Eicosene, (E)-	$C_{20}H_{40}$	280	Antibacterial properties (Vinay Kumar *et al.*, 2011)
13	Cis-vaccenic acid	$C_{18}H_{34}O_2$	282	Cosmetics (Santhosh *et al.*, 2014)
14	Cis-9-hexadecenoic acid	$C_{16}H_{30}O_2$	254	Flavoring agent (Santhosh *et al.*, 2014)
15	Trans-13-octadecenoic acid	$C_{18}H_{34}O_2$	282	Anti-inflammatory and cancer preventive characters (Karthika Krishnamoorthy and Paulsamy Subramaniam, 2014)
16	Cis-9-hexadecenal	$C_{16}H_{30}O$	238	Antimicrobial (Dinesh Kumar and Rajakumar, 2016)
17	Lupeol	$C_{30}H_{50}O$	426	Anti-inflammatory (Geetha and Varalakshmi, 2001)
18	1,6,10,14,18,22-Tetracosahexaen-3-OL, 2,6,10,15,19,23-hexamethyl-, (all-e)-	$C_{30}H_{50}O$	426	Antimicrobial, anti-inflammatory activities (Sivakumar and Gayathri, 2015).

The GCMS spectrum of WCFM extract revealed the presence of 165 compounds (Table 4; Fig. 4). The WCFM extract have 12 known bioactive compounds. They are N-Hexadecanoic acid, Dodecanoic acid, Octadecanoic acid, N-Decanoic acid, Pentadecanoic acid, Tetradecanoic acid, Nonanoic acid, Oleic acid, 1,2-15,16-Diepoxyhexadecane, Heptacosane, Pentatriacontane and Lupeol. The other compounds may also have activities but not known or not studied.

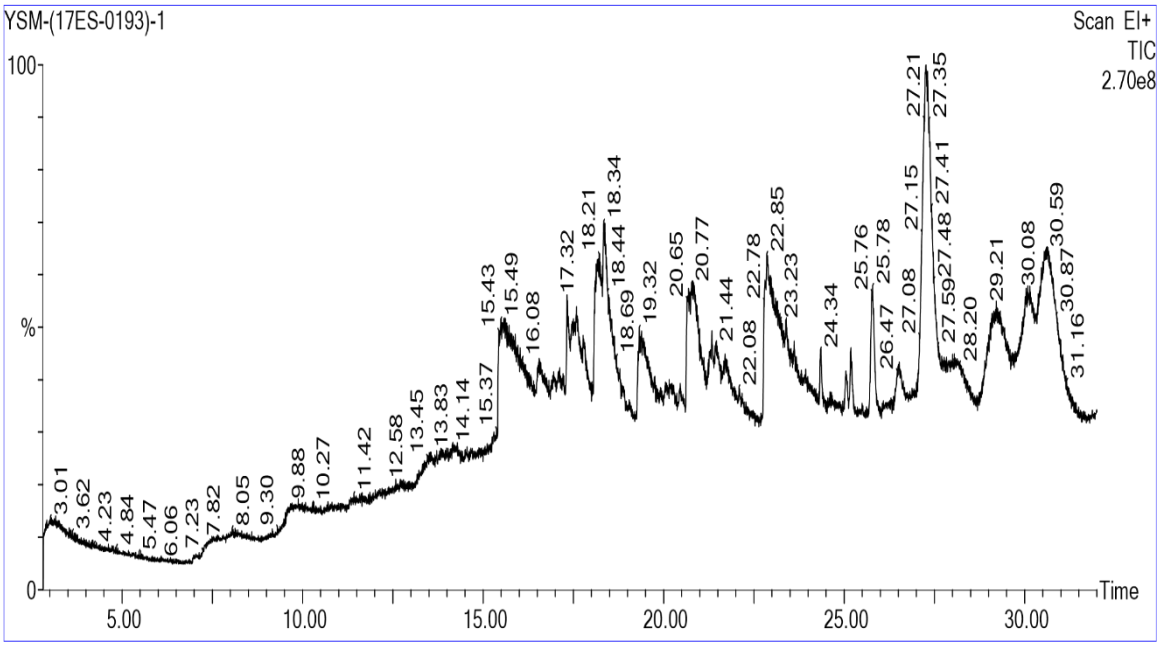

Figure 4: Gas chromatograph of WCFM extract of *Cadaba fruticosa.*

Table 4: GCMS analysis of WCFM extract of *Cadaba fruticosa.*

S. No	Compound name	Formula	Weight	Uses
1	N-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	Hypocholesterolemic, nematicide, antioxidant, pesticide, antiandrogenic flavor, (Kumar *et al*., 2010), anti-inflammatory (Aparna *et al*., 2012),
2	Dodecanoic acid	$C_{12}H_{24}O_2$	200	Antimicrobial, anti-inflammatory (Dinesh Kumar and Rajakumar, 2016)
3	Octadecanoic acid	$C_{18}H_{36}O_2$	284	Anti-inflammatory (Othman *et al*., 2015)
4	N-Decanoic acid	$C_{10}H_{20}O_2$	172	
5	Pentadecanoic acid	$C_{15}H_{30}O_2$	242	Antioxidant activity (Vijisaral Elezabeth and Arumugam, 2014)
6	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	Antioxidant, Cancer preventive, cosmetic, Hypercholesterolemic, nematicide, lubricant (Amutha Iswarya Devi and Kottai Muthu, 2014)
7	Nonanoic acid	$C_9H_{18}O_2$	158	Anti-seizures (Dinesh Kumar and Rajakumar, 2016)
8	Oleic acid	$C_{18}H_{34}O_2$	282	Anemiagenic, insectifuge, antiandrogenic, cancer preventive, dermatitigenic (Vijisaral Elezabeth and Arumugam, 2014), antibacterial (Chen *et al*., 2005).

S. No	Compound name	Formula	Weight	Uses
9	1,2-15,16-Diepoxyhexadecane	$C_{16}H_{30}O_2$	254	Cytotoxicity (Murugesan Amudha and Shanmugam Rani,2014)
10	Heptacosane	$C_{27}H_{56}$	380	Antibacterial (Mihailovi *et al.*, 2011)
11	Pentatriacontane	$C_{35}H_{72}$	492	Antibacterial, antiviral (Soosairaj and Dons, 2016).
12	Lupeol	$C_{30}H_{50}O$	426	Anti-inflammatory (Geetha and Varalakshmi, 2001)

Around 33 compounds were identified in the MCFE extract GCMS analysis and 90 compounds from MCFM extract. Both the extracts had common bioactive compounds cyclotrisiloxane, hexamethyl with antioxidant activity and silicic acid, diethyl bis (trimethylsilyl) ester with antibacterial activity (Table 5, 6; Fig. 5, 6).

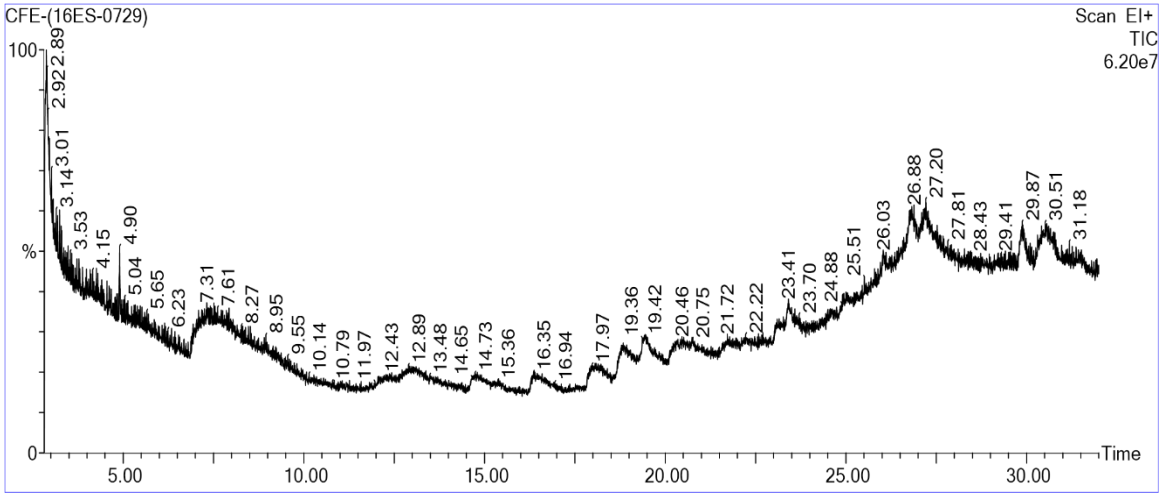

Figure 5: Gas chromatograph of MCFE extract of *Cadaba fruticosa.*

Table 5: GCMS analysis of MCFE extract of *Cadaba fruticosa.*

S. No	Compound name	Formula	Weight	Uses
1	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	222	Antioxidant activity (Alok Prakash and Suneetha, 2014)
2	Silicic acid, diethyl Bis(Trimethylsilyl) ester	$C_{10}H_{28}O_4Si_3$	296	Antibacterial activity (Hema *et al.*, 2011).

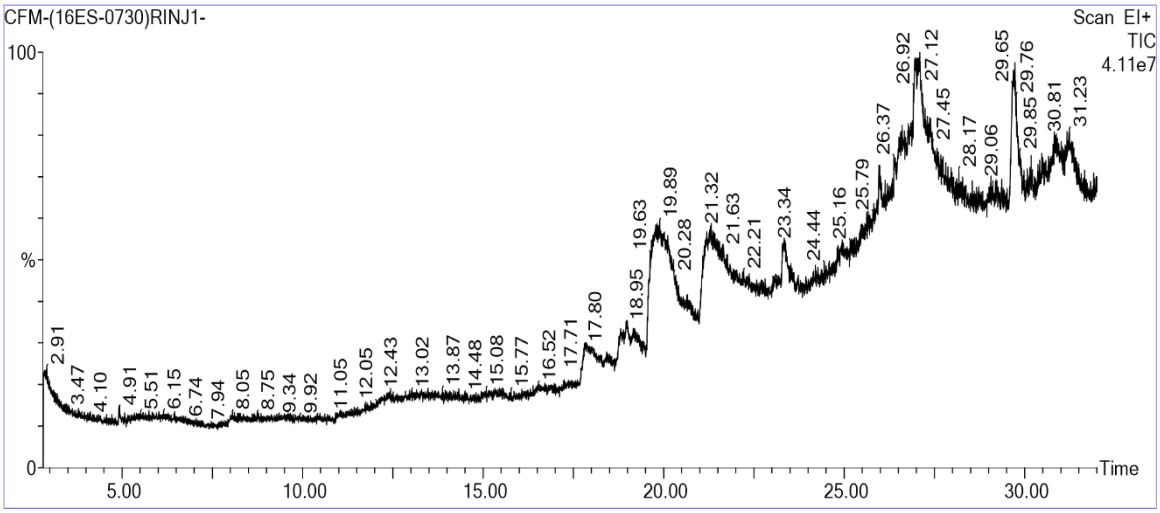

Figure 6: Gas chromatograph of MCFM extract of *Cadaba fruticosa.*

Table 6: GCMS analysis of MCFM extract of *Cadaba fruticosa.*

S. No	Compound name	Formula	Weight	Uses
1	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	222	Antioxidant activity (Alok Prakash and Suneetha, 2014)
2	Silicic acid, diethyl bis(trimethylsilyl) ester	$C_{10}H_{28}O_4Si_3$	296	Antibacterial activity (Hema *et al.*, 2011).

DISCUSSION

Plant derived natural products such as flavonoids, terpenes, alkaloids, etc., have received considerable attention in recent years because of their eco-friendly method of curing ailments (Osawa *et al.*, 1990; Keith *et al.*, 1990). Most of the secondary metabolites like alkaloids, tannins, steroids, triterpenes, saponins and anthraquinones are known due to the important biological activity attributed to this class of compounds. The wild plant extracts WCFPE, WCFC, WCFEA, WCFE, WCFM and WCFW as well as micropropagated plant extracts MCFPE, MCFC, MCFEA, MCFE, MCFM and MCFW were revealed the presence of secondary metabolites in amounts ranging from abundant to poor or absence. Some important secondary metabolites such as alkaloids, flavonoids, and terpenoids were present in wild and micropropagated plant ethanol and methanol extracts (WCFE, WCFM, MCFE and MCFM). Tannins and saponins are not present in all the extracts except WCFW and MCFW. The other two secondary metabolite such as steroids, glycosides are positive in WCFPE, WCFC, WCFEA, MCFPE, MCFC and MCFEA extracts and which are negative in other extracts of wild and micropropagated sample. Finally anthroquinones is negative in all extracts of wild

and micropropagated plants of *C. fruticosa* (Murugesan Amutha and Shanmugam Rani, 2014; Arokiyaraj *et al*., 2008).

FTIR spectrum is generally used tool in plant biological studies (Berthomieu and Hienerwadel, 2009). The FTIR analysis provides an accurate tool to distinguish the wild and micropropagated plants analysed. In the present study wild and micropropagated plant samples of FTIR spectrum shows nine and four peaks respectively. The less number of peaks in micropropagated plant samples may be due to the nature, environmental condition and age of the plant. The peaks of both the samples confirmed the presence of amines, amides, alkanes, amines, aliphatic amines and alkyl halides. Generally alkyl halides and alkanes prevalent in FTIR studies of plant samples which were found more significant against microbes (Janakiranman *et al*., 2011).

Medicinal plants play a major role and source in discovery of new compounds for drug development (Bnouham*et al*., 2006; Wadkar*et al*., 2008; Tundis*et al*., 2010;Shori, 2015). GC-MS is one of the most widely used methods to separate phytocompounds within the test sample. Also a powerful technique for identification of secondary metabolites from nature and biological system (Sharma and Vijayvergia, 2015; Robertson, 2005; Kell*et al*., 2005). In the present study the extracts WCFE, MCFE, WCFM and MCFM were subjected to GCMS analysis. The spectrum confirmed the presence of various bioactive compounds in all the extracts. WCFE and WCFM extracts exhibited 83 and 165 compounds whereas the MCFE and MCFM extracts showed 33 and 90 compounds. When compared to wild plant extracts the micropropagated extracts having less number of compounds. Among the two solvent ethanol and methanol used, the methanol extract revealed more number of compounds than ethanol. Similar results were reported in *Baccharoides anthelmintica* leaf and leaf callus extracts (Kalimuthu *et al*., 2016a). Among the 83 peaks observed in GC-MS analysis chromatogram of WCFE, eighteen bioactive compounds were observed but in MCFE extract among 33 compounds only 2 are known bioactive compounds whereas in WCFM and MCFM extracts 165 and 90 compounds with 11 and 2 known bioactive principles respectively. The results shows that the wild plant extracts have more number of compounds than micropropagated plant extracts. Similar results were obtained in *Baccharoides anthelmintica* (Kalimuthu *et al*., 2016a) and (Vanitha *et al.*, 2018).

GCMS analysis of WCFM revealed the presence of 11 known bioactive compounds. In this 7 compounds N-hexadecanoic acid, dodecanoic acid, octadecanoic acid, pentadecanoic acid,

tetradecanoic acid, oleic acid and Lupeol were present in WCFE also. The remaining 4 compounds are nonanoic acid with anti-seizures agent (Dinesh Kumar and Rajakumar, 2016); 1, 2-15, 16-Diepoxyhexadecane was known to have cytotoxicity (Murugesan Amudha, Shanmugam Rani, 2014); heptacosane and pentatriacontane was proven to be an antibacterial and antiviral activity (Vladimir Mihailovi *et al*., 2011; Soosairaj and Dons, 2016).

Whereas GCMS analysis of MCFE and MCFM extracts exhibited two common bioactive compounds namely cyclotrisiloxane, hexamethyl was reported to have antioxidant activity (Alok Prakash and Suneetha, 2014) and Silicic acid, diethyl Bis (Trimethylsilyl) ester proven to have antibacterial activity (Hema *et al*., 2011). However, no reports are available or not studied on the activities of other identified compounds. The variation in the chemical compounds of the wild and micropropagated plants may be due to age, season, time duration and nature of the hormones used.

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